

**SOCIAL MEDIA USAGE AND ITS EFFECT ON VIRTUAL  
TEAM DYNAMICS:  
A TRANSACTIVE MEMORY SYSTEM APPROACH**

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BY

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## **Abstract**

Virtual teams (VTs) comprise knowledge workers who are geographically dispersed, may be constrained by different time zones, and primarily co-ordinate their work through suitable communication tools. Virtual teams are increasingly being used by corporate organisations due to their benefits such as access to international markets where there is an abundance of talent and cheaper expertise as well as provision of a flexible workforce.

The communication tool is an important component of a virtual team and VTs heavily rely on the communication tool for meeting their task specific and other needs. Existing literature on virtual team communication tools specifies email, videoconferencing, telephone, fax and social media tools such as blogs and wikis. Email, videoconferencing, telephone and fax are regarded as core virtual team communication tools. Corporate organisations are actively engaging with social media tools to meet their VTs' day to day work needs such as communication, collaboration and knowledge sharing. In addition, social media tools also provide other benefits such as an ability to create groups and initiate conversations, information broadcast and good social networking characteristics to name a few.

Virtual team dynamics such as trust, team cohesion, satisfaction, conflicts, communication effectiveness and leadership are key to how well virtual teams function. Previous research has attempted to explain the relationship between the communication tool and virtual team dynamics however the relevance of this relationship in the context of social media tools remains unanswered. To this end, this research contributes by empirically examining the effect of social media tools on virtual team dynamics; trust, team cohesion, satisfaction, conflicts, communication effectiveness and leadership are investigated in this research.

This research builds upon the existing literature and explores the relationship between virtual team dynamics and the transactive memory system (TMS). Transactive memory system refers to the development of a shared internal system for encoding, storing and retrieval of information among the team members. A conceptual research model is developed and it posits that TMS mediates the relationship between social media tools and virtual team

dynamics, a phenomenon which has not been investigated by any of the previous research studies.

The primary data is collected in form of a 6-point Likert questionnaire and semi-structured interviews. In following a mixed method research design, the research model is empirically tested and validated by performing a partial least squares structural equation modelling on the Likert questionnaire data during the quantitative phase. A nested modelling approach is used to understand TMS mediation. The qualitative phase provides a deeper insight into the phenomenon represented by the research model and contributes by providing a rich understanding of the factors that contribute to the results achieved in the quantitative phase.

The research findings are novel and fill the gaps in knowledge. First, the hypotheses testing showed a strong support for the research model which answered the research questions and helped achieve the research goals. Second, the qualitative findings provide an understanding of the underlying reasons which affected virtual team dynamics through the use of social media tools. Overall, the research findings indicate that TMS mediates the relationship between social media tools and each of the six virtual team dynamics under consideration: trust, team cohesion, satisfaction, conflicts, communication effectiveness, and leadership.

This research makes a number of contributions to theory and practice. First, underpinning the effect of social media tools on virtual team dynamics, this research contributes literature demonstrating this effect. Second, in examining the effect of social media tools on virtual team dynamics through a TMS lens, this research contributes a novel research model towards the literature on Information Systems, Psychology, Management and Organisational Studies. Third, this research extends the existing knowledge on virtual teams, social media tools, computer-mediated communication, group decision support systems, group support systems, electronic meeting systems and collaborative technologies. Finally, this research contributes to the transactive memory system theory through an application of this theory in the context of social media tools and also investigates the relationship between TMS and virtual team dynamics.

The practical relevance of this research lies in the guidelines for practitioners who work in virtual teams and use social media tools. It provides a reference for managers who are looking into the use of social media tools within their virtual teams. This research has

implications for the ‘strategic’ internal use of social media tools within organisations to support work processes as well as the provisioning of a platform for nurturing the social aspects of the organisation.

*Keywords: Social media, team dynamics, transactive memory system, virtual teams.*

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## **Abbreviations**

AVE- Average variance extracted  
CB-SEM- Covariance based structural equation modelling  
CMC- Computer-mediated communication  
CR- Composite reliability  
CSCW- Computer-supported cooperative work  
GDSS- Group decision support systems  
GSS- Group support systems  
EMS- Electronic meeting system  
HR- Human resource  
ICT- Information and communications technology  
IS- Information systems  
IT- Information technology  
NS- Not significant  
PLS- Partial least squares  
QA- Quality assurance  
RSQ- R-squared  
RSS- Rich site summary  
SEM- Structural equation modelling  
SME- Small and medium-sized enterprise  
TMS- Transactive memory system  
UK- United Kingdom  
US- United States  
VT- Virtual team

# **Chapter 1. Introduction**

## **1.1 Chapter overview**

The aim of this chapter is to introduce the topic of this research. In doing so, firstly this chapter discusses the background to the research followed by the motivation for this research. Subsequently, the research problem and the research questions are presented. In the next section, the contribution of this research is highlighted and the structure of this dissertation is outlined in the following section. The chapter summary is presented in the last section.

## **1.2 Background to the research**

A virtual team (VT) is defined as “small temporary groups of geographically, organisationally and/or time dispersed knowledge workers who coordinate their work predominantly with electronic information and communication technologies in order to accomplish one or more organisation tasks” (Ale Ebrahim et al., 2009, p. 1578 cited in Bastida, Gupta & Wingreen, 2013). Some previous studies suggest that a virtual team is strictly ‘virtual’, and the team members never meet each other face-to-face while other studies suggest that virtual team members meet each other (Caney-Davison & Ward, 1999; Jarvenpaa & Leidner, 1998). In either case, virtual team members coordinate with each other by means of suitable information and communication technologies (ICTs) (Melymuka, 1997b; Townsend, DeMarie, & Hendrickson, 1996). In this research, virtual teams refer to teams that are geographically dispersed and the team members primarily communicate by means of suitable communication tools and may or may not have met face-to-face.

Virtual teams are an increasingly adopted trend by organisations across the globe (Horwitz, Bravington, & Silvis, 2006), and in many organisations, they have become an important part of day to day work practices. Virtual team members are knowledgeable in their respective areas and hold individual roles and responsibilities, but are also inter-dependant on their team members at the same time. Virtual team members have to regularly communicate with each other to perform their tasks, and seek each other’s expertise when needed. Virtual team members are used when organisations need access to work processes and expertise that are not confined to a particular geographic area. This gives organisations a wide range of choices and helps them allocate the best expertise to the projects. This kind of methodology proves

beneficial and often irresistible to organisations due to constraints in terms of expertise, availability of the right skills, and cost.

Virtual teams are increasingly being used by organisations due to the fact that more and more organisations are going multinational. Previous research indicates that the number of multinational firms across the globe has undergone a tremendous increase within a span of 13 years; from 3000 in the year 1990 to roughly 63000 in the year 2003 (Gabel & Bruner, 2003). The significant increase in the number of virtual teams may be seen as a consequence of the advancement in information and communication technologies that enable team members to carry out the tasks despite their geographic differences. Caney-Davison & Ward (1999) suggest that the concept of a VT gained attention in the last decade and has become vital to organisational decision making and implementing actions across the firm, globally. Organisations are becoming global and aim to serve global customers, and hence, in many cases, they need local, country-specific expertise to grow their business. Virtual teams are seen as a key to success in such situations.

Virtual teams have reinvented the organisational landscape and have made it possible to replace traditional teams, and this has allowed organisations to undertake complex and dynamic projects (Peters & Manz, 2007). A virtual team is geographically diverse and may be comprised of team members with different roles and jobs, and hence in a way is more 'dynamic' than traditional organisational teams (Daim, Reutiman, Hughes, Pathak, Bynum, & Bhatla, 2012; Peters & Manz, 2007). The importance of virtual teams can be attributed to their advantages in terms of increased productivity, reduced operational costs and access to global markets.

Kirkman and Mathieu (2005, p.1) define team virtuality as "the extent to which team members use virtual tools to coordinate and execute team processes, the amount of informational value provided by such tools, and the synchronicity of team member virtual interaction". They put forth an important point that co-located organisational teams may also have a high degree of virtuality and so extend the previous studies which suggest that virtual teams have geographic diversity and dispersion as a key criterion.



### ***1.2.1 Transition from co-located to virtual teams***

Co-located teams have been used by organisations for years. Co-located teams have challenges to cope with, such as productivity issues and costs. Organisations then took measures to overcome the challenges posed by co-located teams. The communication tools were also developing at a similar pace, and hence, the organisations began to tap expertise by means of virtual teams. In these new types of teams where the team members were distributed across different locations, the team members reported to the project manager and also to the manager of their functional group (Daim et al., 2012; Nunamaker, Romano, & Briggs, 2003). The project manager had added responsibilities during a virtual team project, as he had to communicate with a team which was geographically dispersed, and this often made things complicated for him. Achieving success greatly relied on the project manager, who had to master the art of managing geographically distributed projects. Project managers maintained flexibility as the teams worked 24 hours a day, 7 days a week, and hence, they needed to know every aspect of the team in order to effectively communicate with their team, and meet with project success (Daim et al., 2012; Nunamaker, Romano, & Briggs, 2003). As an example, multinational organisations such as Intel have a wide range of products and numerous teams working on product design and other activities. Such teams are generally scattered all over the globe, and in most cases, are also virtual. Keeping track of such projects and teams is a tedious task for organisations such as Intel, who have hundreds of each. Despite this, the company has managed its operations across the borders well and has met with success in opening new offices around the world (Daim et al., 2012).

According to Katzenbach and Smith (2004), organisational teams encounter four phases during their life cycle: forming, norming, reforming and performing. In order to achieve VT success, leadership, trust, and interpersonal relationships are regarded as the major pillars which must exist in the team. When teams are virtual, the team members meet each other less often, and in many cases, do not meet each other at all. In such teams, leadership is crucial to motivate the team members, and the leader must be a person who can give direction to the team and handle all the troubles.

### ***1.2.2 Virtual team dynamics and transactive memory system***

Prior literature has identified certain team dynamics that come into play when a team is working on a project, and they are the key determinants of team effectiveness (Maznevski,

Davison, & Jonsen, 2006). Trust, communication effectiveness, conflicts and leadership are the key determinants of team effectiveness as suggested by prior literature (Maznevski et al., 2006). Apart from these factors, team cohesion (Sivunen & Valo, 2006) and satisfaction (Shachaf, 2008) also contribute to team effectiveness. All of these dynamics manifest themselves in virtual teams in a manner similar to the co-located teams.

Trust is important to a virtual team since it binds the team together while working on a task (Greenberg, Greenberg, & Antonucci, 2007). Trust also accounts for relationship building in the virtual team, which is desirable (Horwitz et al., 2006). Team cohesion ensures that team members work together and share their expertise and knowledge while working on a task (Bastida et al., 2013; Malhotra, Majchrzak, & Rosen, 2007; Sivunen & Valo, 2006). Satisfaction is crucial for a VT since previous literature has linked satisfaction with team performance (Lin, Standing, & Liu, 2008). Accordingly, satisfied team members have a more organised approach and perform better on the task.

Conflicts may happen in a VT and they have a tendency to lower the efficiency of the VT (Griffith, Mannix, & Neale, 2003). Conflicts may deteriorate the relations between team members and may affect the functioning of the VT (Kankanhalli, Tan & Wei, 2006). Hence, it is important to avoid conflicts and resolve them as soon as possible if they happen (Maznevski, 1994a). VTs face communication challenges at times and hence communication effectiveness is vital to a VT. Communication effectiveness resolves some communication problems that may occur in VTs (Daim et al., 2012; Malhotra et al., 2007). Finally, leadership is important to a VT since it guides the VT by giving it a direction and a set of goals to be achieved (Schmidt & Bannon, 1992). Effective leadership ensures that the team stays motivated and works together in a coordinated manner (Leinonen, Jarvela, & Hakkinen, 2005).

Hence, all of these virtual team dynamics are important factors that may affect the functioning of a VT and also work on its effectiveness.

Prior literature has also mentioned about the theory of group mind (McDougall, 1973) and the transactive memory system (TMS) theory (Wegner, 1987; Wegner, Giuliano, & Hertel, 1985). TMS theory was originally proposed by Wegner et al. (1985) as an extension to various theories of group mind. TMS theory refers to a team as a group of individual memory

systems which reside with individual team members. These individual memory systems turn into a ‘transactive memory’ by the interconnection of individual memory systems when a team is working on a specific task (Wegner, 1987). Transactive memory includes knowledge about team member-expertise associations as well as team members’ expertise (Lewis, 2003; Lewis 2004). TMS has three components: specialization, coordination and credibility which explain how team members share and retrieve knowledge and pool their expertise while working on a project (Choi, Lee, & Yoo, 2010; Lewis, 2003). TMS affects team performance in VT projects and is therefore an important component of a virtual team.

Interest in virtual teams amongst academics and industry practitioners across the globe has also become more pronounced. This can be attributed to their increased success and rising numbers; virtual teams are now an essential part of the day to day activities of organisations across the globe.

### ***1.2.3 Developments in information and communication technologies***

Email has long been used for communication, and is now a universally accepted communication tool (Bastida et al., 2013). VTs have been quick to adopt email for communication and information sharing purposes. Apart from email, videoconferencing and telephone are also used for communication in VTs. The rise of email and other communication technologies is attributed to the growth of the internet. Internet and email initially provided the capability of exchanging data and information both within and outside an organisation (Bastida et al., 2013).

Communication tools classified as ‘groupware tools’ were also developed in parallel and aimed to support group work. Group decision support systems (GDSS) and group support systems (GSS) provided capabilities of supporting team work (Dennis, 1996). Group support systems are defined as “information technology designed to enhance the productivity of group meetings and group decision making” (De Vreede, 1997, p. 146). However, it cannot be ignored that GSS suffered from poor information processing (Dennis, 1996) and information overload (Grise & Gallupe, 1999/2000) and were not a commonly used tool in corporate organisations. Previous literature indicates that social media tools (social media) such as blogs are better than traditional group support systems (Bastida et al., 2013) in terms of information organisation capabilities.

The internet motivated the growth of interactive web, which is better known as Web 2.0. Web 2.0, the enhanced form of web, provides features that include creation of user generated content and internet interactivity, where the users can exchange information and communicate among themselves. Web 2.0 gave birth to social media tools such as blogs, wikis and discussion forums. These are essentially a modified form of the information and communication technologies that have features of supporting user generated content and communication which collectively support the formation of a network of users. Social media tools support a network of online users who are interconnected and share information. Due to the increased hype around social media tools many organisations started using social media tools internally. For example, some organisations use social media tools for knowledge management (Case & King, 2011). Social media tools, in today's organisational landscape, can be regarded as an important aspect of an organisation's day to day business activities (Kaplan & Haenlein, 2010).

Communication tools can be classified on the basis of their media richness and the power to clarify the information that the tool is presenting (Daft & Lengel, 1986). In terms of media richness, different social media tools vary in the extent of information transfer. Some social media tools have the ability to present more detailed information than others on account of their media richness (Daft & Lengel, 1986; Kaplan & Haenlein, 2010). Yet another classification of social media tools is done on the basis of their media richness and self-presentation (Kaplan & Haenlein, 2010). Accordingly, blogs are considered to have a high self-presentation and low media richness (Kaplan & Haenlein, 2010).

#### ***1.2.4 Internal use of social media tools in organisations***

There is currently much interest in the internal use of social media tools (inside organisational boundaries) among corporate organisations and more and more organisations are using social media tools to support their business processes and tasks. Social media tools used internally within organisations are known as 'Enterprise Social Media' and are designed to meet communication and other needs of organisations (Cook, 2008; Leonardi, Huysman, & Steinfield, 2013; McAfee, 2006). Internal blogs (Goodwin-Jones, 2003), wikis (Grace, 2009), internal discussion forums (Lipsman et al., 2012), enterprise social software (Cook, 2008; McAfee, 2006; McAfee, 2009) (e.g. Yammer, blueKiwi etc.) and internal portals are some

commonly used enterprise social media tools. As an example, organisations such as IBM, Microsoft, SAP, Deloitte and American Express are using social media tools internally (Leonardi et al., 2013). Internal social media tools can be hosted on an organisation's internal servers or can be implemented privately as a 'software as a service' platform. Internal wikis are adopted by organisations for meeting organisation's needs such as collaboration, knowledge management and improving existing work processes (Majchrzak et al., 2006 cited in Leonardi et al., 2013). The internal use of social media tools is associated with social benefits (e.g. social networking) as well as advantages in terms of information access (e.g. communication and knowledge sharing). For example, in the case of a large Information Technology (IT) organisation the internal use of social media tools led to social networking and a sense of community among the team members, and employees also knew more about the organisation (Jackson et al., 2007 cited in Leonardi et al., 2013). The employees also gained from assistance and valuable feedback received from their co-workers.

Another example of the internal use of social media tools is at IBM Corporation who has an internal community named 'BlogCentral', which is supported by the use of blogs and enables employees to access tacit knowledge of other experts within the organisation and also encourages collaboration (Huh et al., 2007 cited in Leonardi et al., 2013). The pharmaceutical organisation AstraZeneca uses an internal discussion forum for knowledge sharing purposes, where the employees could gain sufficient amount of knowledge before having a face-to-face meeting and hence save time and increase productivity (Adelmann & Jashapara, 2003).

External use of social media tools has been investigated in detail by prior studies (Case & King, 2011; Culnan, McHugh, & Zubillaga, 2010; Gupta, Nicholson and Newman, 2012; Kaplan & Haenlein, 2010), but the internal use of social media tools has not been studied in much detail. The interest of the research community into social media tools is great, and to this end, this research aims to contribute by studying the internal use of social media tools, i.e. within organisational virtual teams.

### **1.3 Motivation for research**

Virtual teams are used in organisations across the globe. Researchers and practitioners are interested in investigating the use and effectiveness of virtual teams and also improvising measures to improve the effectiveness of these teams. A body of literature has accumulated

along these lines, and the interest in virtual teams is growing. The communication in a virtual team environment has been studied in the context of email (Brown, Huettner, & James-Tanny, 2007; Jarvenpaa & Leidner, 1998), videoconferencing (Brown et al., 2007; Duarte & Snyder, 2011) and telephone (Brown et al., 2007; Duarte & Snyder, 2011). Similarly, there is abundance of literature on group decision support systems (Dennis, 1996), group support systems (Dennis, 1996) and computer-mediated communication (Luo, Shen, Fan, & Xue, 2011; Ou, Sia, & Hui, 2013; Riemer, Scifleet, & Reddig, 2012) and their use in facilitating team work. External use of social media tools (except within organisational teams) is thoroughly researched by prior studies (Case & King, 2011; Culnan et al., 2010; Gupta et al., 2012; Kaplan & Haenlein, 2010). To the best of researcher's knowledge, the use of social media tools within organisational virtual teams has not been investigated in much detail by any prior study, although the literature mentions about the internal use of social media tools (Cook, 2008; Leonardi et al., 2013; McAfee, 2006), and blog and wiki use for virtual team communication (Bastida et al., 2013; Brown et al., 2007).

There are visible gaps in the literature with regard to making sense of the use of social media tools for organisational VT communication and its effect on virtual team dynamics. This research examines the current patterns of the use of social media tools for organisational virtual team communication and other activities across multiple organisations. Drawing upon these usage patterns, this research goes further and explores the effect of social media tools on virtual team dynamics and TMS, which are discussed in detail in chapter 2. Finally, this research is of value to academics, researchers and practitioners as it provides a reference to understand and evaluate the effectiveness of social media tools for co-ordinating virtual team work.

#### **1.4 Research problem**

Communication tools lie at the heart of a virtual team and most of the aspects of project work are co-ordinated by electronic communications. Email (Brown et al., 2007; Jarvenpaa & Leidner, 1998), videoconferencing (Brown et al., 2007; Duarte & Snyder, 2011), fax and telephone (Brown et al., 2007; Duarte & Snyder, 2011) are well known virtual team communication tools. Amongst these tools, videoconferencing is classified as a richer media (Daft & Lengel, 1986), since it gives a feeling of co-presence to the VT members. Email is the universally accepted and adopted virtual team communication tool. However, there are

certain downsides of using email for VT communication such as information clutter, loss of project information among chains of emails, and poor information organisation and social networking capabilities (Bastida et al., 2013; Darisipudi & Sharma, 2008; Gupta & Wingreen, 2014). Similarly, email, videoconferencing and telephone have some common problems associated with their use, such as none of these tools provides a central repository for all project communications and neither do they encourage a collaborative effort between the VT members. Social media tools (social media) are essentially computer-mediated communication and collaboration tools (Luo et al., 2011; Ou et al., 2013; Riemer et al., 2012) that are used by organisations for team communication, collaboration and other project related activities (Ou et al., 2013; Riemer et al., 2012) and may solve the problems associated with email and other communication tools.

Social media tools such as blogs offer a highly collaborative environment (Gupta et al., 2012; Turban, Liang, & Wu, 2011), may function as a central repository for team communications and may also be well suited to distribute information among virtual team members (Brown et al., 2007). The use of social media tools is regarded as relatively easier than sending out emails (Nardi, Schiano, & Gumbrecht, 2004). Social media tools such as enterprise social media (Leonardi et al., 2013; McAfee, 2006; Riemer et al., 2012) are some other examples of communication tools that are used by organisations for VT work. Social media tools also help improve the work processes of an organisation and team members gain valuable feedback on their work from other team members (Leonardi et al., 2013). Enterprise social media tools improve knowledge sharing and encourage collaboration and discussions among the team members and may function towards accelerating the development of the TMS of the virtual team, and also have a positive effect on the virtual team dynamics (Choi et al., 2010; Leonardi et al., 2013). This research seeks to empirically investigate how social media tools improve work processes, and encourage collaboration, effective communication and information organisation in virtual teams.

Previous literature (Bastida et al., 2013; Ou et al., 2013) mentions instant messaging and blog use in a virtual team environment, but does not explain how social media tools can affect the TMS and virtual team dynamics. There is a gap in literature in terms of quantifying the effect of social media tools on TMS and virtual team dynamics. To the best of researcher's knowledge, there is no prior study that models and evaluates the effect of social media tools

on TMS development and virtual team dynamics in organisational virtual teams. This gap in knowledge forms the starting point for this research.

### **1.5 Research questions**

The research questions for this study are:

RQ 1: How does the use of social media tools affect virtual team dynamics?

RQ 2: Can the use of social media tools encourage TMS development in organisational virtual teams?

### **1.6 Research contribution**

Social media tools are being used internally by organisations to meet their work and non-work related needs. As organisations continue to adopt and use social media tools to meet their communication and project related needs, quantifying the effect of social media tools on the TMS and virtual team dynamics remains a challenge.

This research contributes theoretically as well as practically, and advances our existing knowledge on social media tools and the use of social media tools within organisational boundaries. There is a plethora of research on the use of social media tools for external communication (Case & King, 2011; Gupta et al., 2012; Kaplan & Haenlein, 2010). However, the internal use of social media tools within organisational virtual teams has not been investigated in much detail by prior research (Leonardi et al., 2013; McAfee, 2006; Riemer et al., 2012). To this end, this research contributes by studying the internal use of social media tools within organisational virtual teams.

Theoretically, TMS has not been investigated by prior research in the context of internal use of social media tools. While there are a few studies that investigate TMS in the context of communication tools (Choi et al., 2010; Kanawattanachai & Yoo, 2007), none of them explains the effect of social media tools on the TMS of a virtual team. Similarly, Ou et al. (2013) studied the effect of email and instant messenger on virtual team work but did not study social media tools in the context of virtual teams. Bastida et al. (2013) studied TMS under experimental conditions and not in the context of organisational virtual teams. This research contributes by studying the effect of social media tools on virtual team dynamics through a TMS lens.



This research therefore provides a platform to connect the concepts of social media tools, virtual team dynamics and TMS. In doing so, this research attempts to explain the effect of social media tools on virtual team dynamics and the TMS of a virtual team, and in particular, how the use of social media tools leads to the development of virtual team dynamics. This research puts forward a TMS lens for assessing the effect of social media tools on virtual team dynamics, which is a key theoretical and empirical contribution of this research. There was a lack of suitable measurement scale to study the effect of social media tools on virtual team dynamics. Hence, going beyond the theoretical contribution, this research also provides a measurement scale for studying virtual team dynamics which can be replicated by future studies for studying the effect of social media tools on virtual team dynamics.

Practically, this research contributes to an improved understanding of how social media tools can impact virtual team work and work processes and improve collaboration and communication among team members. This research calls for a greater understanding of the effect of social media tools within an organisational context, which was hitherto unknown. Further, organisations that are already using social media tools may use this research as a reference for quantifying the benefits of social media and other tools to their organisational virtual teams.

## **1.7 Structure of the dissertation**

This dissertation is structured into six chapters as discussed below.

Chapter 1 - *Introduction*, provides an overview of this dissertation, and outlines the background and motivation for conducting this research. This chapter discusses the area of investigation and context of this research, and the issues that are being investigated. This chapter outlines the research questions which this research seeks to answer, by conducting an empirical investigation. The chapter also identifies the contribution of this research to theory and practice.

Chapter 2 - *Literature Review*, discusses the research subject in detail, and provides an overview of the relevant literature on the use of virtual teams in organisations, virtual team dynamics, communication tools such as email, videoconferencing and social media and the benefits that social media tools can offer to virtual teams. This chapter discusses the

transactive memory system (TMS) theory, and investigates the relationship between TMS and the virtual team dynamics. Using a TMS lens, this chapter discusses the development of a research framework and a set of hypotheses for examining the effect of social media tools on TMS and virtual team dynamics.

Chapter 3 - *Research Methodology*, outlines the research method adopted for this research. This chapter discusses the mixed method research (quantitative phase followed by a qualitative phase) and its relevance to this research. This chapter outlines the instrument development and discusses the results of the expert panel review and the pilot testing phase. Following this, the chapter highlights the data collection and analysis techniques used for the quantitative and qualitative phase of this research.

Chapter 4 - *Research Findings*, presents the findings of this research. The findings are grouped under quantitative findings, which were reached through an analysis of the quantitative data, and the qualitative findings which were reached by an analysis of the qualitative interview data. Quantitative findings section reports the findings of the partial least squares structural equation modelling which was conducted using SmartPLS software. Quantitative findings are used to test the hypotheses and validate the research model. Qualitative findings section presents the findings from the follow-up semi-structured interviews which were conducted with the participants.

Chapter 5 - *Discussion*, explains the findings of this research and answers the research questions. The qualitative findings are used to enrich the discussion and provide additional evidence in support of the arguments.

Chapter 6 - *Conclusion*, is the last chapter of this research. This chapter summarises the findings of this research and highlights the contribution of this research to both theory and practice. This chapter acknowledges the limitations of this research and proposes a set of recommendations and a research direction for future research in the area of social media tools, virtual teams and TMS.

## **1.8 Chapter summary**

The purpose of this chapter was to introduce the research topic and highlight the motives behind undertaking this research. The aim of this research is to provide an understanding of the effect of social media tools on virtual team dynamics by using TMS as a theoretical lens. This chapter provided a background to this research by discussing transition from co-located to virtual teams, virtual team dynamics, TMS, the developments in information and communication technologies and the internal use of social media tools in organisations. The first section presented an understanding of virtual teams and how virtual teams operate. The key differences between virtual and co-located teams were highlighted and a snapshot of virtual team dynamics and transactive memory system was provided. This chapter then drew attention towards the developments in communication tools and how these developments affected an increase in the number and popularity of virtual teams. The commonly used communication tools were listed and a description of the internal use of social media tools in organisations was presented.

The motivation for this research was laid out followed by a description of the research problem, which led to an identification of the research goals. In order to realise these research goals two research questions were proposed. The research questions were consistent with the aim of this research. The significance of this research was highlighted in terms of its contribution to both theory and practice. Finally, an overview of the structure of this dissertation was presented.

The next chapter presents a review of the relevant literature on each of the six virtual team dynamics viz trust, team cohesion, satisfaction, conflicts, communication effectiveness and leadership, social media tools, and other topics relevant to this research. It is theorised that the use of social media tools contributes towards TMS development in virtual teams which affects virtual team dynamics. Finally, a theoretical framework and research model are developed and discussed in detail.

## **Chapter 2. Literature Review**

### **2.1 Chapter overview**

The purpose of this chapter is to present a comprehensive literature review of the topics and themes that form the foundation of this research. The literature review is a thematic summary of the studies drawn from Information Systems, Psychology, Management, Organisational Studies and other disciplines. This chapter defines the specific objectives of this research and provides an initial structure which assists with the development of a research methodology in Chapter 3, and also provides a reference for analysis (Chapter 4) and discussion (Chapter 5).

This chapter is organised into a number of sections. In the first section the rise of organisational use of virtual teams is discussed followed by an overview of virtual team usage by corporate organisations in the second section. Virtual team dynamics are introduced in the next section and the existing literature is discussed. The section ends with a summary of key themes extracted from the virtual team dynamics literature. To follow, the role of communication tool in virtual teams is highlighted with some examples of communication tools that are used in virtual teams.

The internal use of social media tools in organisations is discussed in the next section which sets a research direction for this study. In the next section, the concept of feature richness is explained which provides a basis for studying social media tools in organisational virtual teams. In this research the transactive memory system theory provides a conceptual framework and shapes the development of the research model; a description of which is presented in the next section. The chapter ends with a summary of the key points discussed in this chapter.

### **2.2 Rise of organisational use of virtual teams**

The rise in the number of virtual teams and their ever increasing popularity is a great success story in itself. Virtual teams may be comprised of people who never meet face-to-face (Jarvenpaa & Leidner, 1998) and even people who rarely meet each other in person (Chudoba, Wynn, Lu, & Watson-Manheim, 2005). The common characteristic is that the VT members use communication tools for communication within and outside the team. The rise

of the internet, email and other communication tools has greatly increased the pace of team interactions, and has thus given new means of collaborating in different types of work environments. The VT trend has seen a dramatic increase over the last decade, and there are a number of factors that have greatly supported it. These factors include globalisation, better communication bandwidth, a number of reliable internet-enabled services and devices available in the market, availability of better software for communication and information exchange, and flexible job agreements between an employer and the worker (Kirkman, Rosen, Gibson, Tesluk, & McPherson, 2002; Walvoord, Redden, Elliott, & Coover, 2008).

Virtual team members endeavour to collaborate and carry out the task productively while remaining geographically dispersed. The project may be carried out continuously and may benefit from efficient expertise and cheaper foreign resources. Virtual teams may have the best people work together on projects and help organisations achieve excellent outputs without having to worry about the location constraints (Horwitz et al., 2006; Maznevski, Steger, & Amann, 2007). Another advantage of virtual teams is that they may be quickly formed when desired, and after the project, may be disbanded or put into another project.

There are two different categories of virtual teams: Teams who have met face-to-face at least once and the teams who have not met each other ever (Maznevski & Chuboda, 2000). In the first category of virtual teams, it is considered that face-to-face meetings are essential in the early stages of the virtual team setup. Some other studies (Mortensen & O'Leary, 2012) suggest that having some sort of communication before a face-to-face meeting can sometimes be better as it gives the VT members a chance to understand each other's abilities and skills.

Task accomplishment in virtual teams is highly dependent upon how well the VT members are socialised from an organisational perspective, and how well they understand and respond to each other's actions (Weick, 1993). Accordingly, the success of the team is dependent upon the efficiency of the communication tool used in the virtual team environment. Any improvement in the performance of virtual teams can certainly impact the project due to the increased reliance on such teams. This may benefit the organisation in a number of ways, such as, increased productivity and profits. The downside to selection of virtual teams can be that the team members are susceptible to clashes among themselves owing to the differences in trust levels and experiences. Even their individual outlook and personality can create conflict. All these factors may be a serious cause of concern for organisations deploying

virtual teams, as these factors hold a strong potential to undermine the overall team effort and functioning, and lower the efficiency of the VT and the project as a whole (Horwitz et al., 2006).

### **2.3 Virtual team usage by corporate organisations**

Virtual teams are important to organisations across the globe (Horwitz et al., 2006) and have produced positive results where they were deployed. The advantages of having virtual teams have contributed to their increased adoption rates over the past two decades. Virtual teams are widely used across organisations from various industry sectors such as IT, consulting, law, and accounting, to name a few. Virtual teams are important to both large organisations and SMEs (small and medium-sized enterprises). VTs allow large organisations and SMEs to take advantage of low-cost and skilled expertise in cheaper labour markets overseas, get quality outputs and save on costs. By setting up VTs across different national and international locations, organisations may benefit by acquiring the best expertise depending on the needs of the project, and may even dissolve the team upon project completion. There are numerous organisations around the globe that are utilizing the benefits of virtual teams and enjoying benefits such as increased throughput, cost savings and higher work quality (Accountingweb, 2010). Some examples of the use of virtual teams and their deployment scenarios are mentioned in the literature:

#### ***2.3.1 Virtual teams in IT organisations***

Virtual teams are used by the IT sector organisations because software and services can be easily offshored to other destinations. A number of North American and European IT organisations have established offices across different global locations. Virtual teams are used for software development and other activities across geographic boundaries and they work collectively to achieve the task. As an example, Shirani (2000) studied virtual teams in the case of global software development, and suggested that virtual teams work together to achieve their collective goal. The project manager of the software project plays the major role of communicating with the team members and ensuring that the team output meets the client's requirements (Shirani, 2000). Software development is understood as a 'collaborative activity' between the members of globally distributed teams. In the case of distributed software development, virtual teams communicate and collaborate by means of information sharing, acquiring new knowledge and integrating well with the task (Andreas, 2002). Virtual

teams created for global software development use different communication technologies to co-ordinate the tasks across national boundaries throughout the software development project life cycle (Edwards & Sridhar, 2003). Offshore information systems development is yet another task for which VTs are used, and the offshore team's members work closely with the team members onshore (Vlaar, 2008). Therefore, it can be concluded that virtual teams are important to IT organisations (Edwards & Sridhar, 2003; Vlaar, 2008).

### ***2.3.2 Virtual teams in consulting organisations***

Consulting organisations need to tap global expertise and skills to serve global clients. Virtual team use by consulting firms in New Zealand was studied by Paulene (2004). Major consulting organisations such as Bain and Company, Ernst and Young and McKinsey and Company have teams in different global locations (Alavi & Tiwana, 2002; Hansen, Nohria, & Tierney, 1999). As an example, the consulting organisation, McKinsey and Company, serves global clients including businesses, institutions, and governments and has teams working across more than 50 countries (McKinsey & Company, 2013). Knowledge management is crucial to the success of any consulting business (Alavi & Tiwana, 2002; Hansen et al., 1999), in order to help make client businesses better. McKinsey and Company is based in the United States (US) but, its largest global knowledge centre is operated by a dedicated team in India (McKinsey & Company, 2013). The teams based in the US and India co-ordinate by means of suitable communication tools. Hence, it can be concluded that virtual teams are important to consulting organisations (Alavi & Tiwana, 2002; Hansen et al., 1999; Paulene, 2004).

### ***2.3.3 Virtual teams in law organisations***

Legal sector organisations, like other service sector organisations, send their work to offshore destinations where expertise is often cheaper and in abundance, and they can even get their work done much faster. In today's global economy, many of the global law organisations have a significant number of lawyers in overseas destinations (Terry, 2008), sometimes more than the number of lawyers in the home country. Law firms are knowledge intensive organisations and they rely heavily on knowledge management for the success of their business. The global law firms have utilized the potential of IT enabled knowledge management to support their business (Gottschalk, 2000). The largest law organisation in the world, Baker and McKenzie, is increasingly global with over 4000 lawyers working across

45 different countries (Baker & McKenzie, 2013). It repeatedly uses the local knowledge and expertise of its lawyers to have a greater understanding of the global market and offer a global perspective to its global clients. Similarly, the largest European law firm Clifford Chance LLP is a global organisation with over 3200 lawyers in 24 countries, and it serves clients across different business sectors (Clifford Chance, 2013). These numbers demonstrate the need to have VTs performing functions such as knowledge management and IT support for these organisations (Khandelwal & Gottschalk, 2003).

### ***2.3.4 Virtual teams in accounting organisations***

The use of virtual teams for co-ordinating project work is exploited by many accounting organisations. Virtual teams are used for various tasks ranging from taxation to advisory. Many organisations use suitable communication technologies for managing virtual teams (Harwell, 2012).

## **2.4 Virtual team dynamics**

Virtual team dynamics are defined as “unconscious, psychological forces that influence the direction of a team’s behaviour and performance” (Myers, 2013). Virtual team dynamics reflect interactions between team members and are important factors that determine the effectiveness of the project (task), and may also determine the performance of the virtual team. If the virtual team dynamics are effective, the project outcomes could be improved. Prior literature (Dion, 2000; Maznevski & Chudoba, 2000; Maznevski et al., 2006; Shachaf, 2008; Sivunen & Valo, 2006) suggests six major factors associated with a virtual team that can lead to its success or failure. They are trust, team cohesion, satisfaction, conflicts, communication effectiveness and leadership. All of these are crucial factors that contribute to the success of VT projects. Since the communication tools are the primary means of contact within a virtual team, all of these factors are heavily dependent upon the communication tool. A communication tool is much more effective if it accelerates the development of virtual team dynamics apart from providing a means for communication. Virtual team dynamics and their impact on a virtual team are discussed in the following sub-sections.



### ***2.4.1 Trust in virtual teams***

Trust is defined as “a state involving confident positive expectations about another’s motives with respect to one’s self in situations entailing risk” (Boon & Holmes, 1991, p. 194). Trust is a critical component of a successful virtual team. Trust exists at many levels such as interpersonal, organisational and team management. In this research, the trust between the virtual team members is under consideration. Trust develops automatically in teams after face-to-face communication and gradually increases with repeated communication (Jarvenpaa et al., 1998 cited in Henttonen & Blomqvist, 2005; Kirkman et al., 2002). In a VT environment, face-to-face communication is minimal or may not exist at all, and the team members might not find sufficient time to understand each other and build relationships. This may pose challenges to trust building in VTs. Virtual teams develop trust when the sharing of project information and resources is carried out in a timely fashion, and the team members communicate frequently through the communication tool (Henttonen & Blomqvist, 2005; Kirkman et al., 2002). Greenberg et al. (2007) suggests that trust is the most vital component of a virtual team. Trust itself has three vital components: ability, integrity and benevolence (Cummings & Bromiley, 1996; Greenberg et al., 2007; McAllister, 1995). These three components of trust affect the lifecycle of the virtual team starting from establishment of the team, through to its inception, team organisation and task completion.

Trust works like a glue and encourages a sense of co-operative behaviour among the team members, so that they can concentrate on the project with much ease. In a VT environment a team member would trust others when he feels that others are performing well and possess a certain degree of integrity (Greenberg et al., 2007; McAllister, 1995). Initially, a greater exchange of communication leads to a greater level of trust in the team (Henttonen & Blomqvist, 2005; Kirkman et al., 2002; Peters & Manz, 2007). In the longer term (single project or multiple), trust serves as a strong antecedent for effective virtual team collaboration and the higher the level of trust in a virtual team the greater the level of team collaboration (Peters & Manz, 2007). Trust leads to a better understanding among team members in a VT environment, and helps develop a sense of shared understanding, where the team members are able to judge what to expect from their counterparts (Peters & Manz, 2007). Shared understanding gives a strategic direction to the team as a whole, and also provides a chance to know each other and their skills well, and so get an idea about how they should collaborate with others (Peters & Manz, 2007). Finally, trust building also accounts for relationship

building in the team, which is highly essential and desirable for achieving project success in a virtual team environment (Horwitz et al., 2006; Peters & Manz, 2007). Relationship building is an important component that adds to VT effectiveness (Horwitz et al., 2006), because if team members enjoy good relations then they can get along well and help each other.

There are different forms of trust as suggested by Paul and McDaniel (2004): calculative, competence, relational and integrated. The first one, calculative trust, is based upon reliability and the second, competence, is based upon the expertise of the team members. Both of them pertain to the task that the VT is performing. Relational trust is based on similarities in society, culture and race. The last one, integrative, is a combination of the first three types. The first two forms of trust are relatively transparent, and can be built easily using internet-enabled tools. Integrative trust is the highest level of trust that often creates the strongest bonding and collaboration between the team members. In this research, integrative trust is referred to as 'trust'. In a virtual team environment, the role of trust becomes far greater and challenging than in co-located teams (Canney Davison & Ekelund, 2004). A virtual team environment is highly complex and is marked by uncertainty, hence in order to co-ordinate, the team members must have mutual trust and understanding (Canney Davison & Ekelund, 2004; Peters & Manz, 2007). Trust enables virtual teams to co-operate and co-ordinate. This instils confidence in the virtual team, and the team members can perform better and deliver better results (Peters & Manz, 2007). Peters and Karren (2009) found out that the overall performance of the project team is directly dependent upon trust and increases with an increase in team trust. They also point out that there is also a lack of control in a VT environment, hence trust is an important determining factor and leads to a greater expectation of the project being completed.

Team members who do not trust each other are less likely to share knowledge and ideas, and this may negatively affect the overall team performance (Brown, Poole, & Rodgers, 2004; Peters & Karren, 2009). Further, the team members may develop a tendency to exhibit an opportunistic behaviour, which may give rise to conflicts in a VT and lead to a much lower efficiency (Brown et al., 2004). Trust is regarded as a major element that determines the success or failure of a virtual team (Kanawattanachai & Yoo, 2002). Effective relationship building is quite difficult in virtual teams due to the fact that the team members rarely meet each other face-to-face but are still required to work collaboratively and efficiently (Horwitz et al., 2006).

Virtual teams are marred by certain constraints such as language, culture and time zone barriers, which can affect overall team performance. Miscommunication is another major challenge that undermines the feeling of trust in a virtual team. Miscommunication has a potential to reduce team performance, and also leads to deteriorated relations among the team members (Shachaf, 2008). Thus, trust building is an important part of virtual teams. Owing to the challenges that virtual teams face, many organisations have realised that sharing of knowledge, use of skills and development of relations are the key to developing virtual team effectiveness. Keeping in mind these factors, many firms have designed specific training programs for VTs, which help develop a broader understanding of team formation, mutual understanding, a strong sense of the goals and objectives, and good team co-ordination (Smits, 2005). These team programs are essential for team formation and later for the development of trust, which is highly desired in a VT.

Hence, it can be concluded that trust is an important virtual team dynamic that may affect team performance in virtual team projects.

#### ***2.4.2 Team cohesion in virtual teams***

Team cohesion is defined as “a dynamic process that is reflected in the tendency for a group to stick together and remain united in the pursuit of its instrumental objectives and/or for the satisfaction of member affective needs” (Carron et al., 1998, p. 213 cited in Carron and Brawley, 2012). Trust building in a virtual team environment ensures that the independent knowledge workers (members) of the team are aware of each other’s abilities and expertise, and can respond to any situation well by pooling their expertise (Bastida et al., 2013; Lewis, 2003). This leads to the development of a cohesive team, which is often advantageous. Previous research (Sivunen & Valo, 2006) suggests that team cohesion is highly desirable and has a major role to play in teams that are culturally diverse, as is often the case of VTs, owing to the team members being located in different locations (Maznevski & Chudoba, 2000).

Team cohesion has capability to create better teams, as it creates more knowledgeable workers once they start pooling their skills and expertise, and work collectively throughout the project. Malhotra et al., (2007) suggests that proper member-task pairing strengthens team

ties and increases team cohesion. A cohesive virtual team has an ability to handle different situations well and in a timely fashion, and has a greater control of the project (Bastida et al., 2013). This in turn increases the likelihood of achieving success and excellent project outcomes. In summary, team cohesion is an important virtual team dynamic, which may affect team work and project outcomes.

#### ***2.4.3 Satisfaction in virtual teams***

Satisfaction in teams working towards a group task is defined as “the group’s shared attitude towards its task and the associated work environment” (Mason & Griffin, 2002, p. 284). Satisfaction is another vital element that comes with trust and ensures team member satisfaction in a VT environment (Jarvenpaa, Shaw, & Staples, 2004). Team satisfaction is essential in a VT environment since satisfied team members perform better, and this makes the team productive in the longer term (Lin et al., 2008). Satisfaction is achieved by proper skill matching. Skill matching can be viewed as the right kind of mapping between the project tasks and the team members’ skills. A good match between the skills and the task raises team performance, and makes the team members more satisfied because they well understand what to do, and how to achieve it. Team members stay more organised and deliver well.

Team satisfaction is a critical element and directly impacts team performance (Curseu, Shalk, & Wessel, 2008; Shachaf, 2008). Satisfied team members are well aware of each other’s skills and know which tasks others can handle well (Lema, 2012). All these factors are thus inter-related and work towards raising team performance and lead to team success. Hence, it can be concluded that satisfaction is an important virtual team dynamic that may affect team performance.

#### ***2.4.4 Conflicts in virtual teams***

Conflict is defined as “an interactive process manifested in incompatibility, disagreement or dissonance within or between social entities” (Rahim, 2010, p. 16). Virtual teams are often marred by conflicts which may reduce the efficiency and lower the morale of the team members, thereby badly reflecting on productivity measures of the team (Griffith et al., 2003; Montoya-Weiss, Massey, & Song, 2001). When two colleagues working in a common office have an argument, the manager can sort that out by talking things out face-to-face. However,

in a virtual team environment this is not possible and conflicts can often intensify. In a VT environment, the team members are not aware of their co-workers' daily life problems and also their assumptions about their team mates can be wrong and misleading (Brown et al., 2007). There are often more conflicts in virtual teams than in co-located teams due to the nature of communication and the diversity of the team (Baan, 2004).

Cultural diversity often leads to conflicts that hinder carrying out the task by the virtual team (Kankanhalli et al., 2006). This could take any form, and in the end, lower the productivity of the team and even the project quality. Cultural diversity may cause conflicts where the relations of the team members are destroyed. The relational conflicts can intensify quickly and have a potential to breakdown the team trust and cohesion.

Another kind of diversity is functional diversity which leads to task related conflicts in the virtual team (Kankanhalli et al., 2006). Hence, an effective conflict management approach must be put in place to stop the conflict from happening. The conflict management approach used must be tailored according to the nature of conflict and its effectiveness to counter the situation. Empirical research (Maznevski, 1994a; Watson, Kumar, & Michaelsen, 1993) has shown that when culturally diverse teams engage in processes such as communication and conflict management, they perform equivalent to homogenous teams and sometimes, even better. Hence, conflicts can effectively be resolved using a best-fit approach.

On similar lines, Maznevski et al., (2006) suggested that conflicts can be categorised into relationship and task conflicts. The former leads to deteriorated relationships and differences between the team members while, the latter leads to a divided viewpoint on the overall team strategy and effort. A virtual team has a significant challenge due to the team members not knowing what their co-workers are good at, and even about their co-workers' working styles (Leinonen et al., 2005; Maznevski et al., 2006). In such cases, to resolve task conflicts, the VT members are best to have a sense of 'collaboration awareness'. It means that the success of the VT project depends on how well virtual team members remember critical information (Leinonen et al., 2005). A reduction in VT conflicts may improve team performance. Virtual teams rely heavily on the communication tool and it can then help prevent conflicts by reducing certain factors such as miscommunication and communication breakdowns which may cause conflicts. Also, when conflict happens, the communication tool would be the

primary means for the manager to resolve conflicts in VTs. In summary, conflicts are an important virtual team dynamic that may affect team performance and task success.

#### ***2.4.5 Communication effectiveness in virtual teams***

The communication tool is regarded as the engine of a VT as it would have ceased to exist in the absence of a proper communication tool. The reliance of a virtual team on the communication tool is significant, and any problems in the tool pose serious challenges to the VT and its operations (Bjorn & Ngwenyama, 2009). The main barriers to effective communication in a VT project are: language barriers, different perceptions about the given information, and lack of a proper communication plan in the virtual team (Carvalho, 2008). All these factors are important and determine the overall efficiency of the project communications. Daim et al. (2012) suggests that virtual teams are marred by communication problems at times. Virtual teams suffer from communication breakdowns at times, and this tends to lower the efficiency of the team. The five major factors that are attributed to communication breakdowns are trust, cultural diversity, inter-member relationships, leadership and technology (Daim et al., 2012). Each of these factors is important to the team, and failing these, communication breakdowns become more likely. Communication breakdowns are a common problem in virtual teams (Bjorn & Ngwenyama, 2009).

There is an abundance of literature which suggests that a virtual team environment is highly susceptible to communication failures and has to deal with it quite often (Malhotra et al., 2007; Rosen, Furst, & Blackburn, 2007). Newer virtual teams need to be more aware and capable of tackling communication breakdowns as they are highly susceptible to these kinds of failures, when compared with experienced virtual teams (Hinds & Mortensen, 2005). Thus, effective communication is one of the foremost challenges for a virtual team. VT managers often have to send out positive and supportive messages to the team so that the morale of the team stays high (Howitz et al., 2006). The literature advocates that better communication can lead to an effective VT.

Virtual team members deliver best if they develop a ‘shared meaning’ among themselves (Bjorn & Ngwenyama, 2009). Shared meaning ensures that the team members are able to adjudge others’ thoughts and perceptions in case of a communication failure, so that the task in hand can be achieved even from the bits of information that can be found in the

communication tool (Bjorn & Ngwenyama, 2009). This kind of a terminology takes much more time and effort to develop in virtual teams than in co-located teams. In the context of virtual team workspace, communication breakdowns can lead to serious questions about the work practices and routines of the virtual team (Bjorn & Ngwenyama, 2009; Daim et al., 2012). A possible solution to this problem is a comprehensive re-assessment and reframing of the team policies (Bjorn & Ngwenyama, 2009). Communication breakdowns are damaging for the organisation as they carry severe risks such as the project delivery being delayed or even greater setbacks. Communication planning (Daim et al., 2012) refers to the analysis and planning of the project information. Good communication planning keeps in mind all the VT members and ascertains who will require what information.

Moving ahead of the communication failures, communication within the virtual team itself can be a real challenge as the team members are geographically distributed and may be time dispersed (Horwitz et al., 2006). Horwitz et al. (2006) suggest that communication can be difficult in a VT environment where team members working across different time zones and across different working environments and locations interact with each other in order to achieve a common goal. In a virtual team environment, the team members have to rely heavily on the communication tool and sometimes the team members can face difficulties of not getting responses from their colleagues. In some cases, team members working on an essential part of the project may not be able to proceed with their work unless they get a confirmation from their colleague. This can delay the overall work process and can slow down the performance of the VT. Hence, in the case of a VT, the team members have to work harder in the absence of any face-to-face communication.

Hence, it can be established that communication effectiveness is an important virtual team dynamic which may build effective virtual teams and improve VT performance.

#### ***2.4.6 Leadership in virtual teams***

Leadership is defined as “the process of influencing others to understand and agree about what needs to be done and how to do it, and the process of facilitating individual and collective efforts to accomplish shared objectives” (Yukl, 2006, p. 8). Leadership is crucial for a virtual team as it gives the team a clear set of goals and objectives to be achieved. Virtual team management is often very challenging as it involves the task of assembling,

scheduling, monitoring and co-ordinating individual team activities, as well as interdependent tasks, between geographically distributed team members (Bjorn & Ngwenyama, 2009; Schmidt & Bannon, 1992). The first major challenge for virtual team leadership is selecting and retaining the right team members for their virtual team. Members should have a balance of technical and interpersonal skills (Horwitz et al., 2006). Previous literature (Davidson, Hambrick, Snell, & Snow, 1996) suggests that the role of leadership changes to that of a catalyst as the team evolves and later, it acts as an integrator of the team. Effective leadership is one of the most important constituent of VT effectiveness.

Virtual teams are very different from co-located teams and hence there is a need for different management techniques in a virtual team environment (Kimball, 1997 cited in Schlenkrich & Upfold, 2008). The leaders of co-located teams have an advantage over virtual team leaders in terms of their use of tested management methods that they have used in the past. Further, the leaders of co-located teams can directly meet and have face-to-face conversations with the team members, and can get a complete overview of the team's situation (Carmel, 2002; Joinson, 2002). VT leadership can assess goals and policies of the organisation, but is constrained in terms of having a complete picture of the VT in front of them (Carmel, 2002; Joinson, 2002). In a virtual team, there are concerns about less frequent interaction among the virtual team members and the inability to support forms of visual feedback to the team members. The management factor helps in the improvement of team dynamics, but in VTs, this factor cannot be exploited fully (Gaudes, Hamilton-Bogart, Marsh, & Robinson, 2007). The management has to be more vigilant in a VT environment to guard the team against forthcoming troubles.

Leadership issues are vital to the success of a virtual team and a good leadership creates better and productive VTs. Previous research (Ayoko, Konrad, & Boyle, 2012; Shachaf, 2008) suggests that the early stages of a virtual team creation are very important for the team leadership as during these phases, the team trust is built up. More effort needs to be put in during the early phases of team formation to create a sound and reliable team. It reflects in the later phase when the team is put into a project. Team management activities are to an extent similar in VTs to those in co-located teams, but require additional care and effort as there is an absence of visual feedback in a VT environment (Daim et al., 2012). In co-located teams, trouble can be easily mitigated by means of face-to-face communication or visual feedback.



Virtual team leadership must have a great deal of involvement and commitment in taking each step for the virtual team. VT leadership must actively promote the building of team's strengths, and also provide timely feedback to the members. By doing so, a team spirit can be developed (Furst, Reeves, Rosen, & Blackburn, 2004). Effective leadership ensures that there is no loss of motivation in the team, even if the members are not able to deliver their best during projects. Secondly, it ensures that there is no loss of co-ordination among the virtual team members, and helps avoid a situation where the team members do not effectively coordinate and contribute to the task in hand (Leinonen et al., 2005).

Virtual team leadership has an additional role to play apart from managing the team, since the role of leadership in a distributed project development (e.g. case of offshore software development) is highly important. In such projects the burden of leadership and communication across boundaries is borne by the project leaders, who assume the responsibility of effectively communicating between the client and vendor organisations Shirani (2000). The work of team leadership is thus not only limited to managing the virtual team, but also acting as a bridge between the team and the client.

Meindl (1993) suggested that leadership may assume two roles: assigned leadership and emergent leadership. Assigned leaders are team leaders or managers who have actually assumed the responsibility of the team. However, in virtual teams there may be some emergent leaders who can lead the team as a team manager, because the team members trust them, take guidance from and act according to them. In effective teams there exist one or two highly conscientious team members who spend a significant time prodding their team mates and boosting their morale (Piccoli, Powell, & Ives, 2004). This has the ability to keep the team spirit high, and ensures that the team members deliver their best. Emergent leadership is therefore as important as assigned leadership in the case of distributed projects, and can in some cases be more effective than assigned leadership (Misiolek & Heckman, 2005).

Leadership is thus, crucial for the success of virtual team projects because leaders motivate and direct the team members to work towards the task (Tuffley, 2012). Effective leadership ensures that the team members stay focussed, and binds the team members together. A great leader manages the virtual team's relationships with its external members (Druskat & Wolff, 2001) and understands how a leader's role extends the team manager's role.

The role of the communication tool becomes mainstream in ensuring effective leadership and team management in a VT (Hambley, O'Neill, & Kline, 2007). Leadership in virtual teams holds little relevance in the absence of a communication tool. The communication tool plays an important role in determining the effectiveness of leadership in a VT. A communication tool can ensure effective leadership in a virtual team, since it facilitates immediate communication between the leadership and the team members, and also acts as the primary point of contact between the team and its leadership (Kayworth & Leidner, 2001). Different communication tools can affect team leadership in different ways (Pauleen & Yoong, 2001). Accordingly, social media tools, when used for VT communication, can affect leadership in a virtual team in a different manner than some other tools such as email.

It can now be established that the performance of a virtual team is directly dependent upon the six VT dynamics, which have the power to make VTs effective, if addressed properly. It can be understood that the communication tool has a major role to play and it affects each of these six dynamics in certain ways. An effective VT communication tool can make the project outcomes better by affecting the overall team communication, work ethic and team dynamics. Social media tools can be an effective and suitable communication tool for various reasons discussed in the next three sections. Once used, social media tools can impact the team dynamics and the TMS development in a virtual team.

<b>Virtual team dynamic</b>	<b>Main themes from virtual team dynamics literature</b>
Trust	<ol style="list-style-type: none"> <li>1. Develops after repeated and frequent communication (Jarvenpaa et al., 1998 cited in Henttonen &amp; Blomqvist, 2005).</li> <li>2. Knowledge and information sharing increases trust and vice-versa (Henttonen &amp; Blomqvist, 2005).</li> <li>3. Trust has three components (Greenberg et al., 2007): <ol style="list-style-type: none"> <li>3a. Ability: A VT member trusts his co-worker when he believes that his co-worker is performing well (Greenberg et al., 2007; McAllister, 1995).</li> <li>3b. Integrity: VT member trusts his co-worker when he believes that his co-worker possesses integrity (Cummings &amp; Bromiley, 1996; Greenberg et al., 2007).</li> <li>3c. Benevolence: VT member trusts his co-worker when he believes that his co-worker is working hard on the project</li> </ol> </li> </ol>

	<p>(Greenberg et al., 2007; McAllister, 1995).</p> <p>4. Trust forms an antecedent to collaboration (Peters &amp; Manz, 2007).</p> <p>5. Over time, the team members develop expectations from trusted co-workers (Horwitz et al., 2006).</p> <p>6. Trust building leads to relationship building in a VT (Horwitz et al., 2006).</p> <p>7. Relational trust is based on similarities in society, culture and race (Paul &amp; McDaniel, 2004).</p> <p>8. Trust leads to co-ordination in VTs (Peters &amp; Manz, 2007).</p> <p>9. Miscommunication reduces trust (Shachaf, 2008).</p>
Team cohesion	<p>1. Team members are aware of each other's expertise (Sivunen &amp; Valo, 2006).</p> <p>2. Team members pool their expertise (work on a problem jointly) (Bastida et al., 2013; Lewis, 2003).</p> <p>3. Team members ask each other for help when needed (Sivunen &amp; Valo, 2006).</p> <p>4. Cohesive team has members that are knowledgeable in all aspects of the project collectively (Malhotra et al., 2007).</p> <p>5. Cohesive team has a greater control over the project (Bastida et al., 2013).</p>
Satisfaction	<p>1. Satisfaction comes with trust (Jarvenpaa et al., 2004).</p> <p>2. Satisfaction comes with appropriate member-task matching (Lin et al., 2008)</p> <p>3. Team members know what to do (Curseu et al., 2008; Shachaf, 2008).</p> <p>4. Satisfied team members know what others do well (Lema, 2012).</p>
Conflicts	<p>1. Conflicts lower the morale of team members (Griffith et al., 2003; Montoya-Weiss et al., 2001).</p> <p>2. Conflicts can arise on account of team member's perceptions or assumptions about others (Brown et al., 2007).</p> <p>3. Team members might not be aware of their co-workers' daily life problems which may cause conflicts (Brown et al., 2007).</p> <p>4. Conflicts can arise due to the nature of communication (Baan,</p>

	<p>2004).</p> <p>5. Task and relationship conflicts can arise due to the cultural diversity (Kankanhalli et al., 2006).</p> <p>6. Relationship conflicts destroy team members' relations (Maznevski et al., 2006).</p> <p>7. Task conflicts leave a VT divided in their approach towards the project (Maznevski et al., 2006).</p> <p>8. Conflict management approach reduces conflicts (Maznevski, 1994a; Watson et al., 1993).</p> <p>9. Collaboration awareness: How well the VTs remember information may reduce task conflicts (Leinonen et al., 2005).</p> <p>10. In online tools the problems can be resolved before they are sparked (Ferrazzi, 2012).</p> <p>11. Online tools save all discussions to refer back to when resolving conflicts (Ferrazzi, 2012).</p> <p>12. Team members can mutually resolve conflicts through comments in online tools (Ferrazzi, 2012).</p>
Communication effectiveness	<p>1. VTs are heavily reliant on the communication tool (Daim et al., 2012).</p> <p>2. Problems related to the communication tool reflect badly on the VT project (Daim et al., 2012).</p> <p>3. Communication tool can lead towards communication breakdowns (Daim et al., 2012).</p> <p>4. Barriers to effective communication in a VT are language barriers and different perceptions about given information (Carvalho, 2008).</p> <p>5. Lack of a proper communication plan poses challenges in VTs (Carvalho, 2008).</p> <p>6. Communication failure is a barrier to effective communication (Malhotra et al., 2007; Rosen et al., 2007).</p> <p>7. Communication breakdown can occur on account of a lack of trust, inter-member relationships and cultural diversity, and is often damaging for the team (Bjorn &amp; Ngwenyama, 2009; Daim et al., 2012).</p> <p>8. Newly created VTs are more susceptible to communication breakdowns (Hinds &amp; Mortensen, 2005).</p> <p>9. Shared meaning resolves communication breakdowns (Bjorn &amp;</p>

	<p>Ngwenyama, 2009).</p> <p>10. Communication breakdowns might trigger changing of team's communication policies and practices (Bjorn &amp; Ngwenyama, 2009).</p> <p>11. Geographic time zone differences lead to communication problems and breakdowns (Horwitz et al., 2006).</p>
Leadership	<p>1. Leadership gives VT a clear set of goals to be achieved (Schmidt &amp; Bannon, 1992).</p> <p>2. Feedback from leadership boosts team spirit (Furst et al., 2004).</p> <p>3. Leadership involves assembling, scheduling, monitoring and co-ordinating independent and inter-dependent duties (Bjorn &amp; Ngwenyama, 2009).</p> <p>4. Good leadership ensures proper member-task pairing (Horwitz et al., 2006).</p> <p>5. Good leadership ensures a balance of skills (interpersonal and task related) (Horwitz et al., 2006).</p> <p>6. Leadership acts as a catalyst, initially, and as an integrator, later (Davidson et al., 1996).</p> <p>7. Effective leadership leads to team effectiveness (Leinonen et al., 2005).</p> <p>8. VT leadership lacks in having a complete picture of the scenario in front of them (Carmel, 2002; Joinson, 2002).</p> <p>9. VT leadership cannot give visual feedback for early sign of trouble (Daim et al., 2012).</p> <p>10. Leadership factor might not be exploited fully in VTs to support other team dynamics (Gaudes et al., 2007).</p> <p>11. Vigilant leadership guards the VT against potential troubles (Gaudes et al., 2007).</p> <p>12. The leader needs to put in more effort while the VT is in the early stages of formation (Ayoko et al., 2012; Shachaf, 2008).</p> <p>13. Emergent leadership and assigned leadership are two types of leadership (Meindl, 1993; Misiolek &amp; Heckman, 2005).</p> <p>14. Effective leadership forms a bridge between the VT and the client's requirements (Shirani, 2000).</p> <p>15. Leaders try to know the root cause of the problems as opposed to managers who try to resolve it quickly (Zaleznik, 2004).</p> <p>16. Communication tool has an important role to play in VTs to</p>

	ensure effective team leadership (Hambley et al., 2007).
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Table 1. Summary of virtual team dynamics literature

## 2.5 Role of the communication tools in virtual teams

Communication tools are the key to team interactions and decision making process in global virtual teams due to minimal face-to-face interaction (Maznevski & Chudoba, 2000). Technology has significantly improved in the past few decades, and has eventually led to the development of communication tools that are now commonly used across globally dispersed teams. Technology and virtuality can be seen as two interrelated terms, since the rise of virtuality in organisational teams can be attributed to the developments in technology. Sharing a common workplace despite being miles apart from colleagues is now possible due to the development and use of suitable communication tools. Without these communication tools, virtual teams would not exist, and it would be mere individuals who work from different locations with minimal levels of interaction and collaboration. Owing to the technological developments, groups of talented individuals who are dispersed geographically and have the desired talent and skills for a task can come together and complete tasks with accuracy. Communication tools have made it possible to bring together dispersed individual skills to contribute to the task in hand. This allows achievement of the best results in a short span of time (Peters & Manz, 2007). The role of communication tool is vital to the success of a virtual team.

Previous literature suggests that the richer the media used, the lesser is the feeling of being virtual (virtuality) among the team members (Kirkman & Mathieu, 2005). Communication technologies such as videoconferencing can give the VT members a sense of being co-located thereby reducing the ‘virtuality’ of the team. Richer communication technologies have many advanced features such as verbal and face-to-face communication as opposed to an exchange of text, which accounts for this difference. Kirkman and Mathieu (2005) also touch upon the terminologies of synchronous and asynchronous communication in VT exchanges (Lanubile, Ebert, Prickladnicki, & Vizcaino, 2010). Asynchronous tools make the VT members realise that they are a part of a virtual team when contrasted with synchronous communication tools. This is due to the fact that in the case of asynchronous tools, there might be considerable delays in replying to the messages from each other (Kirkman & Mathieu, 2005).

The role communication tool plays in facilitating communication in a virtual team setting is important. Collaboration is understood as a process in which there is a creation of significant values that cannot be achieved by simply communicating or by teamwork (Peters & Manz, 2007). Collaboration is hence much richer than communication or teamwork (Peters & Manz, 2007). The same concept can be extended to virtual teams, where collaboration can lead to fruitful results, as opposed to simply communicating to achieve a task. Team collaboration starts as soon as the team members want to get ideas or information from their co-workers. Over a period of time, the team members develop an influence over each other, and communicate effectively with minimal supervision. Team members also develop additional capabilities such as being mutually supportive, trustworthy, and listen to their co-workers during the course of the project. The depth of relationships, understanding and the trust factor determine the success of collaboration in a virtual team environment. Collaboration acts as an initiator of a meaningful dialogue between the team members, leads to numerous information exchanges and finally, forms the basis for an understanding within the team.

Virtual teams have to share knowledge through the communication tool and hence, knowledge sharing is heavily reliant on the communication tool. The same concept applies to knowledge management in virtual teams, because virtual teams have to create a knowledge repository for the project through the application of the communication tool. The knowledge exchange mechanism in virtual teams depends on the social and technological features of the knowledge management system used by the virtual team (Holthouse, 1998). This makes the role of the communication tool used in the VT important, since a communication tool with good repository-like features would be of great utility.

Similarly, participation would occur by means of the communication tool in the VT, and a tool that encourages participation from VT members would catalyse knowledge sharing and creation of a knowledge repository. Knowledge management is vital to achieving high performance in VT projects hence, knowledge management issues have to be resolved with care. A communication tool that hosts features of providing feedback on the previous posts by team members greatly enhances knowledge sharing and exchange in the virtual team. Accordingly, it is not always necessary to have synchronous communication, because asynchronous communication tools also ensure active participation from team members (Hayes & Walsham, 2000). This highlights the role of the communication tool in the case of VTs, since the communication tool must possess capabilities where, the VT members can

share and manage the critical project knowledge. The communication tool should also have excellent knowledge management capabilities.

The communication tool used in a virtual team environment greatly impacts the efficiency and satisfaction in the team (Edwards & Sridhar, 2003). Hence, the choice of communication tool has to be made with great care and deep thought. Mortensen & O’Leary (2012) suggest that the main criteria for selecting a VT communication tool are:

- **Simplicity:** The communication tool must be simple to grasp and easy to use. Meaningful interactions can be carried out on simple technologies, and depend little on the complexity of the tool.
- **Reliability:** The communication tool must be reliable and should possess minimal errors or interruptions. In other words, the tool must convey the message without fault.
- **Accessibility:** The communication tool must be accessible from potentially anywhere.

Social media tools may provide these capabilities since they are simple to use (Nardi et al., 2004), and may be reliable and accessible depending upon their usage patterns.

### ***2.5.1 Commonly used communication tools***

Email is the most widely used communication tool in organisations. Email is considered to be simple to use and reliable for organisational communication. However, it cannot be ignored that every communication tool comes with certain limitations, and email is no exception. Email communication has a lot of challenges that are often carried over to the VT communication when email is used for VT communication. Email does not have a capability to provide translucence in information, since there is no common place where the VT members can collect and share project data and items (Bjorn & Ngwenyama, 2009). Email communication makes monitoring of the team activities a bit difficult because most of the project communication is located on team members’ mailboxes (Bastida et al., 2013). This reduces the capability for data exchange which is a constituent of an efficient and collaborative work practice. The limitations of email can badly reflect on virtual team performance because, when the complexity of the task increases, so does the extent of information. Email is often associated with disorganisation of information and information



clutter (Darisipudi & Sharma, 2008). Lots of useful information is often lost in a chain of emails, and this may cause a loss of valuable project information at times. These disadvantages make email highly vulnerable to exhibiting lower communication effectiveness. Information disintegration may lead to a delay in communication because key project information might be difficult to trace and may cost the project in terms of time spent to trace it. It can eventually lead to a negative impact on the VT dynamics. The team members might feel dissatisfied and frustrated with their work. There are increased chances of miscommunication and communication breakdowns every now and then. Relationships between the team members may deteriorate due to not receiving the information on time since the information might get lost under some incorrect subject line of the email (Bastida et al., 2013). In the worst case, the team members may start distrusting each other. All this can have consequences that may lead to lowering of the project efficiency, increased costs for the organisation and even project failures.

Videoconferencing is another VT communication tool, with its use becoming widespread. It is regarded as a rich communication medium (Daft & Lengel, 1986) as it gives the VT members a feeling of being co-located and a means of face-to-face communication wherein the VT members can actually speak with each other and discuss the topics of interest. Very much in line with email communication, there are downsides of using videoconferencing as well. For instance, there may be no auto-generated record of communication done during a videoconference call unless the call is recorded and/or transcribed, and the team members, after a period of time, may not remember what was discussed in the meeting (Brown et al., 2007). Similarly, there is no central pool of communication or a repository that can be used for future reference.

Computer-based communication systems are used to support co-operative work since the 1970s (Bonczek, Holsapple, & Whinston, 1979; Huber, 1980; Kerr & Hiltz, 1982). These communication systems are known by different names on the basis of their usage. Collectively, these systems are known as 'group support systems' (GSS) (Bonner & Basavaraj, 1995). Examples, of GSS are electronic meeting systems (EMS), group decision support systems (GDSS), and computer-supported cooperative work (CSCW). Group support systems were information technologies designed to support group work and co-operative team working since they enhanced team's cognitive capabilities and also facilitated team learning (Bui & Jarke, 1986).

All of these systems, CSCW, GDSS and EMS, were developed to support communication and decision making processes. GSS were also adapted and used in academic environments such as in universities (Valacich, Dennis, & Nunamaker, 1991). Previous research on GSS suggests that they provided a different environment for information exchange between team members than non-GSS environments (Dennis, 1996). For example, GSS provided an alternative to face-to-face communication by providing a medium for electronic communication between team members (Dennis, 1996; DeSanctis & Gallupe, 1987). Face-to-face or verbal communication was considered to be an incomplete exchange of information, which negatively impacted decision making (Dennis, 1996). GSS communication provided a better alternative to verbal communication by an increased use of 'factual information' rather than the information that team members (users) preferred (Dennis, 1996). GSS also provided a communication tool where team members could refer to the previously communicated information and it also motivated team members to share more information, since the information was anonymised (Dennis, 1996). Different types of GSS could be distinguished mainly on the basis of the mode of their use (Bonner & Basavaraj, 1995).

EMS is defined as "an information technology-based environment that supports group meetings, which may be distributed geographically and temporally. The IT environment includes, but is not limited to, distributed facilities, computer hardware and software, audio and video technology, procedures, methodologies, facilitation, and applicable group data" (Dennis, George, Jessup, & Nunamaker, 1988, p. 593). EMS systems were specially designed to support group tasks, and enabled face-to-face meetings (Dennis, 1996). A good example of an EMS is the GroupSystems EMS (Dennis, 1996; Valacich et al., 1991).

Group decision support systems (GDSS) combined computer communication with decision making technologies to support problem solving and decision making in groups (Gallupe & McKeen, 1990). A major difference between GDSS and computer-mediated communication (CMC) was that GDSS not only provided computer-based communication between team members similar to CMC, but also included advanced decision making functions such as electronic brainstorming, voting support, and even decision modelling in case of advanced GDSS systems (DeSanctis & Gallupe, 1987; Gallupe & McKeen, 1990). The primary aim behind the design of GDSS was to reduce the cognitive effort that team members encountered during decision making processes in group meeting sessions. GDSS have been successful in supporting analysis during decision-making processes, but did not have much impact on the

quality of decisions that were made. Additionally, a considerable amount of time was spent in the entire decision making process (Gallupe & McKeen, 1990). Previous literature also suggests low decision satisfaction with the use of both GDSS and CMC (Gallupe & McKeen, 1990). In general, GSS also had disadvantages in terms of information overload (Grise & Gallupe, 1999/2000) and poor information processing power (Dennis, 1996).

CSCW systems support ‘co-operative’ work between team members. CSCW are also referred to as ‘Groupware’. Groupware is defined as “computer-based systems that support groups of people engaged in a common task (or goal) and that provide an interface to a shared environment” (Elli, Gibbs, & Rein, 1991, p. 40). Examples of CSCW systems are The Coordinator (Ellis et al., 1991) and Lotus Notes (Bonner & Basavaraj, 1995). Collaborative technologies are a form of CSCW (Yon, Shen, & James, 2013), and they play a greater role in improving the overall performance of the group (Bjorn & Ngwenyama, 2009). When contrasted with other technologies, collaborative technologies provide greater insight to the team members, makes them aware of the collaboration structure, and helps monitor what is going on in the team. This creates a sense of visibility in the task structure and can benefit the virtual team. A sense of visibility or translucence within a virtual team environment can be very effective in resolving communication breakdowns in the teams.

Social technologies are also used to establish frequent contact between virtual team members in order to keep their relationship intact (Meister & Willyerd, 2010). A mix of various tools such as blogs, discussion forums etc. are used for co-worker interaction, in a manner that organisations prefer (Brown et al., 2007). Social technologies have collaborative aspects, for example, social media tools such as blogs are used for social tasks such as networking and collaboration (Standing & Kiniti, 2011). Using online social tools in VTs have several advantages such as (Ferrazzi, 2012):

1. Problems can be tracked and prevented on online discussion boards much easily.
2. The problems can be easily resolved on online discussion boards since, the team members can study an issue, comment on it, and also comment further on others’ comments.
3. Online discussion boards ensure a level of transparency in any issue that comes up since, they encourage free-form discussions and hence, a fair solution can be reached. This also ensures trust building in the team.

4. The online discussion board saves the entire discussion and hence, the consensus that is reached can be retrieved at a later date without any hassle.

Such advantages may exist in the case of some other social media tools, since they have some features similar to those found in online discussion boards. For instance, the users comment on the posts under certain topics, and save the discussion for future reference (Brown et al., 2007). Social media tools may also help by providing an overview of the project communication, in case of a disagreement (Bastida et al., 2013).

## **2.6 ‘Enterprise social media’ - Social media tools in an organisational context**

Enterprise social media (social media) is defined as “Web-based platforms that allow workers to (1) communicate messages with specific co-workers or broadcast messages to everyone in the organisation; (2) explicitly indicate or implicitly reveal particular co-workers as communication partners; (3) post, edit, and sort text and files linked to themselves or others; and (4) view the messages, connections, text, and files communicated, posted, edited and sorted by anyone else in the organisation at any time of their choosing” (Leonardi et al., 2013, p. 2). Accordingly, most of these enterprise social media tools (social media) are used for internal communication (within organisational teams). Enterprise social media is distinct from publicly used social media (e.g. Twitter, YouTube or Facebook), which are primarily used for personal or other reasons. Another difference is that only people within the organisation have access to enterprise social media tools, and nobody outside the organisation can access these tools (with an exception of customers and clients if they are authorised by the organisation).

Enterprise social media tools are also different from GDSS tools (DeSanctis & Gallupe, 1987; Gallupe & McKeen, 1990) since GDSS tools were primarily used in the earliest days of the internet and did not possess any Web 2.0 features. Enterprise social media tools are an important component of the Enterprise 2.0 (McAfee, 2006). Enterprise 2.0 is understood as the use of emergent social software (enterprise social media) platforms within companies, in order to create visibility in the practices and outputs of the knowledge workers (McAfee, 2006, p. 23). Enterprise 2.0 extends from an organisation to its partners and even their customers. This research focuses on Enterprise 2.0 within an organisational context only.

Enterprise social media has four primary functions within an organisation, which are referred to as 4Cs (Cook, 2008): communication, co-operation, collaboration and connection. Communication allows the users (or people) in an organisation to have conversations with each other through tools such as blogs, discussion forums etc. Co-operation refers to software that allows users to share content with each other. Collaboration refers to tools such as wikis that enable users to collaborate with each other. Finally, connection refers to networking technologies that enable users to establish connections with and between the content and also other users of these tools (Cook, 2008). Within an organisational context, blogs, wikis, as well as document sharing features of social media may be integrated in one platform (Leonardi et al., 2013).

Hence, in this research, social media refers to a collective name for different enterprise social media tools (or platforms), since it makes little sense to distinguish between these individual platforms when they are integrated together within an organisation (Leonardi et al., 2013). Accordingly, internal blogs (Goodwin-Jones, 2003), wikis (Grace, 2009), internal discussion forums (Lipsman, Mudd, Rich, & Bruich, 2012), enterprise social software (Cook, 2008; McAfee, 2006; McAfee, 2009) (e.g. Yammer, blueKiwi etc.), internal portals (intranet portals) and WhatsApp are classified as social media tools for this research. Some of these enterprise social media tools are discussed below:

### ***2.6.1 Internal blogs (corporate blogs)***

Blogs have become an important constituent of organisational communication, and are widely known for their ‘collaborative environment’ where users jointly produce interactive content, which is accessible by all the users connected to the blog (Goodwin-Jones, 2003). Blogs are essentially a form of webpage that allows the blogger (user) to make entries (text) onto the blog and also provides an option to add Podcasts which can be downloaded as audio and/or video clips (Davidson, 2011). Blogs have a capability to categorise information and facilitate discussions, which makes them very useful (Gupta et al., 2012). Blogs typically function in a journal-like format and allow the users to share information personally and casually. The authors of the blog can add posts to specific categories, and the readers of the blog (team members in case of VTs) view only those posts that are relevant to the project. An added advantage of using a blog is that it can securely be installed on an organisation’s own server for the exclusive use by the organisation’s VTs. To enhance the appearance of the blog

and to give it a more professional touch, it may have options for changing the templates and themes according to the VT's preference (Brown et al., 2007). Rich site summary (RSS) feeds can be added to the blog to alert the users to any new updates, additions or deletions made to the blog.

Blogs are also used for knowledge sharing purposes inside organisations. As an example, Quora is a useful organisational knowledge sharing blog (Quora, 2014). The internal use of blogs in organisations (within organisational teams) is becoming widespread. Internal blogs are classified into knowledge and collaboration blogs based upon their usage patterns. Knowledge blogs are used for knowledge management purposes, and collaboration blogs provide a platform for organisational teams to collaborate effectively during projects (Juch & Stobbe, 2005). Blogs are regarded as a strong platform for sharing knowledge (Hutton & Fosdick, 2011).

### **2.6.2 Wikis (*corporate wikis*)**

The role of knowledge in an organisation is crucial and vital to an organisation's success (Drucker, 1993), and making it accessible is achieved by sharing it. Hence, knowledge sharing is an important aspect of a successful knowledge management project which leads to the creation of a knowledge repository (Davenport & Prusak, 1998; Wickert & Herschel, 2001). Knowledge sharing occurs across organisational hierarchies, and it benefits the organisation as a whole (Bartol & Srivastava, 2002). Knowledge management issues are critical for organisational gains in today's competitive markets, but it is well-known that many organisations are not able to fully exploit the potential of knowledge management (Evangelista, Esposito, Lauro, & Raffa, 2010). Every organisation needs to have the right strategic information at the right time to gain competitive advantage (Cook, 2008), and next generation tools such as Wikis can help organisations to achieve this. Wikis provide a platform for knowledge sharing and knowledge management and could be integrated into the organisation's agenda to allow the organisational teams to gain and share knowledge on the Wiki. Wikis encourage the creation of a knowledge repository, which can be useful in making important strategic decisions during a project (Grace, 2009).

Wikis are suited for knowledge sharing and management purposes in a VT environment, since the content can be accessed and modified by all the VT members in real time. Wikis

have security features such as user permissions and IP blocking which can make the information on the wiki secure and prevent its misuse (Brown et al., 2007). Very much like blogs, wikis can be customised and changed by the users in order to make the content appear more appealing and professional. A useful feature found in wikis is the revision history, where all the changes that have been made to the wiki are recorded and any unwanted changes can be rolled back easily. This has implications for effective information organisation and retrieval from a wiki, in a VT context. Alerts can be setup on the wiki, which make the administrators of the wiki aware of any changes. This feature can be exploited by VTs, since whenever any of the team member changes any information on the wiki, all other team members get to know about the change. This keeps the team up to date and prevents miscommunication. The locking feature of wikis can make it change-resistant once activated, and the crucial project information can then be kept safe from any unwanted changes. An example of wiki use for knowledge management is in the firm eBay, who started using a wiki internally to cope with the tremendous amount of knowledge generated by a customer base of 193 million. Wiki usage for team communication and knowledge management is on an increase in many organisations. As another example, a Taiwanese company uses a wiki collaboration system named 'MediaWiki' to enable faster and smooth communication amongst its staff (Kang, Chen, Ko, & Fang, 2010).

### ***2.6.3 Internal discussion forums***

Discussion forums are essentially online forums, which allow the users to post in their topic of interest, and also form relationships with others. Discussions forums have become an important component of team communication and knowledge management in many organisations (Gupta et al., 2012). Discussion forums facilitate an easy, bidirectional communication, and are really effective (Pitta & Fowler, 2005). An example of internal use of discussion forums is the pharmaceutical organisation AstraZeneca, who uses a discussion forum to facilitate knowledge sharing. AstraZeneca uses the potential of discussion forums to reduce the time and effort spent by its employees in gathering relevant information. The teams at AstraZeneca make use of the relevant knowledge found on the discussion forum threads (topics) to facilitate learning (Adelmann & Jashapara, 2003).

#### **2.6.4 Yammer**

Yammer is used by many organisations for supporting internal communication. Yammer is well known for its collaboration and social networking features that allow users to get in touch with other users within the same organisation, and also along the organisational hierarchy. Yammer usage encourages open flow of thoughts and ideas within an organisation which reduces the chances of miscommunication between the co-workers (Yammer, 2012). Yammer offers a highly collaborative environment across geographical boundaries and departments and ensures that an organisation's collaboration and communication needs are met across multiple projects. This potential of Yammer can be highly effective to virtual teams. Additionally, Yammer has the capability of file sharing and knowledge sharing which could be exploited by VTs for reaping benefits such as increased speed of collaboration and enhanced team efficiency. Yammer usage also encourages innovation in the organisation due to an open flow of thoughts on Yammer (Gupta et al., 2012).

Yammer can be used for effective virtual team collaboration since it allows users to share files and communicate during projects (Reynolds, 2012). As an example, a leading web solutions firm SpinWeb is using Yammer for team collaboration and communication purposes and is finding it a great tool to use. As another example, the potential of Yammer has been exploited by Suncorp Group, which is a large financial services provider in Australia and New Zealand. Yammer usage for internal company communications is practiced by many organisations across the globe, and has been beneficial for them (Yammer, 2012). Large organisations such as LG, Deloitte and Thomson Reuters are actively exploiting the potential of Yammer for internal communication. Yammer provides features that can allow VTs to interact with their clients while simultaneously working on projects and getting the highly valuable client perspective into the project alongside team communication (Yammer, 2012).

#### **2.6.5 Enterprise social software (*Enterprise social networks*)**

Enterprise social software is considered to be an important component of the Enterprise 2.0. A variety of tools classified as enterprise social software (Butler, Butler, & Chester, 2010; Cook, 2008; McAfee, 2006; McAfee, 2009) are increasingly being used by organisations to meet their work and non-work related needs. These tools enable efficient collaboration, participation, and content management in organisations, and provide a platform where



everyone can contribute to organisational decision making and innovations. These tools have been effective in promoting a more ‘conversational’ organisational communication as opposed to the traditional top-down management style in organisations (Durugbo, 2012; Groysberg & Slind, 2012). Many organisations have embraced the use of these tools with an assumption of creating a friendly work environment, and now these tools have become a norm in these organisations (Kreitzberg, 2009). In such workplaces, users are stimulated, enthusiastic, guided and convinced of the values of co-operation, and they invite others to participate rather than forcing others to work in a specified manner. Thus, Enterprise 2.0 assumes a bottom-up approach and is characterised by collaboration, interoperability and user-centric information sharing (De Hertogh, Viaene, & Dedene, 2011).

An organisation implementing the concept of Enterprise 2.0 is subject to ‘network effects’. A network effect is caused when more and more users join the existing users and the emergent structure becomes more fine grained, which increases the possibilities for ‘searchable, navigable and analysable’ and easier ways for the users to find what they are looking for (McAfee, 2006). Enterprise social software is used by organisations to support their communication, collaboration, knowledge management, social networking, and other project needs. Many of these tools are now commonly used by organisations alongside traditional tools such as email. Some examples of enterprise social software are:

*Jive* is an enterprise social collaboration software that provides a platform for communication, social networking and social collaboration within organisations (Jive, 2013).

*Socialcast (TheHub)*: Socialcast or commonly known as TheHub is another enterprise social software used by some organisations for work, collaboration and social networking purposes within the organisational boundaries. As an example, the leading multinational organisational SAS uses TheHub for various work related purposes (Socialcast, 2014).

*Slack* is a social platform designed to meet the communication and collaboration needs of an organisation. Slack provides messaging, document sharing, and effective work related communication and can also integrate with other enterprise social software (Slack, 2014).

*Confluence* is wiki-based enterprise social software developed by Atlassian. Confluence provides powerful collaboration, document sharing and networking capabilities (Confluence, 2014).

*Tibbr* is an enterprise social network. Tibbr has capabilities of social networking, discussion, collaboration, and document sharing (Tibbr, 2014).

*Chatter (by Salesforce)* is an enterprise social software developed by Salesforce Inc. Chatter provides capabilities of communication, collaboration, knowledge management and social networking inside organisations (Salesforce, 2014).

*Microsoft Sharepoint* (Sharepoint) is a commonly used tool in many organisations. Sharepoint integrates the capabilities of document and file management, social networks, collaboration, and an intranet portal. Sharepoint can be integrated with wikis and enterprise social networks such as Yammer (Sharepoint, 2014; Webb, 2007). Sharepoint also provides capabilities to host organisation-wide social networks, for example, Infosys Technologies, a multinational organisation, uses a Sharepoint based enterprise social network to facilitate sharing of work and personal information, and for networking purposes (Microsoft, 2014).

*SAP Jam* is cloud-based enterprise social and collaboration software developed by the organisation SAP. SAP integrates features that allow users to connect with their co-workers for work related and other purposes, and boosts employee engagement (SAP, 2014).

*Internal portals (Intranet portals)*: Many organisations have internal portals within their corporate intranets, which they use for work related and social networking purposes. For example, an intranet portal named ‘Sparsh’ is exclusively used by the employees of Infosys Technologies Limited, a leading multinational IT organisation (Infosys Technologies, 2014). Another example is ‘Pega Pulse’, a social collaboration tool used by Pegasystems Inc., an American multinational IT organisation, to facilitate work, collaboration and social networking among its employees globally (Pegasystems, 2014).

*Asana* is an enterprise social software that provides an alternative to email. Asana facilitates communication, posts and comments, document sharing, and collaboration. Asana can be

integrated with other enterprise social software to meet the needs of an organisation (Asana, 2014).

#### ***2.6.6 WhatsApp and instant messaging***

*WhatsApp* is classified as a social and instant messaging software, and has social media like capabilities such as creation of groups, sharing files, and provides a medium for instant communication (Church & de Oliveira, 2013; Johnston, King, Arora, Behar, Athanasiou, Sevdalis, & Darzi, 2014). WhatsApp is being exploited by various organisations for informal communication between team members. This can include work-related communication and even personal discussion outside of work hours. WhatsApp helps in building personal relationships between colleagues (O'Hara, Massimi, Harper, Rubens, & Morris, 2014; Wani, Rabah, AlFadil, Dewanjee, & Najmi, 2013) and gives a chance to meet and know new colleagues. As an example, WhatsApp usage is becoming popular in healthcare organisations (Johnston et al., 2014).

*Microsoft Lync* (Lync) provides capabilities of instant messaging, document sharing, status updates, desktop sharing and communication and is widely used in organisations (Lync, 2014). Lync is classified as an enterprise social software by previous research (Floesse, Gimpel, Caton, & Schaefer, 2014).

### **2.7 Feature richness of social media tools**

Previous research suggests that richer media (Daft & Lengel, 1986) such as videoconferencing gives team members a feeling of being co-located, and provides synchronous communication (Kirkman & Mathieu, 2005). Social media communication is not considered synchronous, because the team members may not receive the message in real time (Brown et al., 2007). Other research (Dennis & Valacich, 1999; Dennis, Fuller, & Valacich, 2008) focuses on choice of communication media into communication performance (Dennis & Kinney, 1998) and suggests that communication performance is dependent upon the match between media capabilities and the communication processes that are required to accomplish the task. Dennis et al., (2008) proposed that it is more appropriate to refer to the set of features offered by the communication tool in light of the development of newer communication tools. Social media possesses a 'feature richness', which is not found in some other VT communication tools such as email and videoconferencing. Feature richness is

defined as “the set of features that the communication medium offers to encourage participation, collaboration, transparency and information organisation” (Gupta & Wingreen, 2014, p. 4). Most of the social media tools possess features which encourage participation, collaboration, information organisation and transparency and distinguish them from some other tools such as videoconferencing and email.

Previous research (Nissen & Bergin, 2013) has suggested that different social media tools offer different capabilities, but feature richness is common to most of the social media tools. Operationally, feature richness comes into play when social media tools are used in a VT and it may support different processes involved in team work (van den Hooff & de Leeuw van Weenen, 2004; van den Hooff & de Ridder, 2004) such as participation and collaboration between team members. Feature richness may support information organisation and transparency in project communication and knowledge (Gupta & Wingreen, 2014).

### ***2.7.1 Participation***

Participation is an antecedent for effective virtual team collaboration, and is very important in a virtual team. Participation is achieved by the encouragement of a meaningful conversation between the team members, and sharing of information and resources (Henttonen & Blomqvist, 2005; Kirkman et al., 2002). Participation also leads to trust development in a team (Maznevski & Chudoba, 2000; Peters & Manz, 2007). Previous literature suggests that social media tools have capabilities to encourage participation on account of posts, comments and shares, which initiate conversations (Hoffman & Fodor, 2010).

### ***2.7.2 Collaboration***

Collaboration is understood as a rich process that creates values which could not be achieved through communication or teamwork alone (Peters & Manz, 2007). Accordingly, an effective virtual team collaboration may lead to a better team work and better outputs as opposed to those achieved with a mere communication between the team members. Once a virtual team is setup, the team members initiate conversations to seek information and ideas from their co-workers. This marks the beginning of collaboration in a team, and over time team members start developing an influence over each other, support each other, and work with minimal supervision (Peters & Karren, 2009). Previous literature suggests that social media tools provide a highly collaborative environment (Goodwin-Jones, 2003; Standing & Kiniti, 2011)

which increases interactions between the users. Collaboration features of a communication tool have advantages such as development of a ‘shared meaning’, where virtual team members are able to adjudge their co-workers’ perceptions, and they can make sense out of the minimal information which is found on the communication tool (Bjorn & Ngwenyama 2009).

### ***2.7.3 Information organisation and transparency***

Organisation of the project information is necessary, since unorganised information tends to lower the productivity of a team. Previous literature suggests that communication tools such as email may result in an information clutter, and a loss of critical project information in form of chains of emails (Bastida et al., 2013; Darisipudi & Sharma, 2008). In complex virtual team projects the amount of information is huge, and an information clutter and loss of information may downgrade the collaborative effort in the team, and may also lower performance of the team (Bjorn & Ngwenyama, 2009). Social media tools have good capabilities for information organisation, and make information retrieval easier. As an example, a blog organises information under suitable topics with relevant links to the information, which keeps the information organised and makes its retrieval easy (Juch & Stobbe, 2005).

Transparency ensures visibility of the project information and may encourage participation from virtual team members. Communication tools such as email provide little transparency due to a lack of a central place where project information can be saved, because most of the information resides on individual members’ mailboxes (Bastida et al., 2013; Bjorn & Ngwenyama, 2009). Previous research suggests that social media tools offer more transparency in communications and information sharing (Bertot, Jaeger, & Grimes, 2011; Kaplan & Haenlein, 2010). Transparency can be very useful to a virtual team in resolving any problems that arise within the VT (Ferrazzi, 2012). In a virtual team, the communication tool saves the project communication for future reference; hence ensuring transparency depends on the communication tool.

Together, information organisation and transparency make the project information and communication more organised and visible which may benefit the team.

In summary, social media tools are ‘feature rich’ communication tools and they may provide a different work environment to the virtual team members and affect virtual team dynamics in a manner which is different from some other tools. Feature richness also distinguishes social media tools from some other communication tools such as email, videoconferencing, GDSS, GSS and CMC tools. Hence, feature richness provides a new direction to study social media tools in organisational virtual teams.

## **2.8 Theoretical framework**

This section explains the theoretical development for this research. Transactive memory system theory was used to develop a framework for this research since it examined teams and could also be adapted to understand the role of communication tool in the context of virtual teams (Choi et al., 2010; Wegner, 1987). Another benefit of using transactive memory system theory was that it has previously been investigated by Information Systems literature (Bastida et al., 2013; Choi et al., 2010; Nevo & Wand, 2005). Other theories such as the theory of media richness (Daft & Lengel, 1986) and theory of media synchronicity (Dennis et al., 2008) primarily focused on communication tool, and the task technology fit theory (Goodhue & Thompson, 1995) focused on individual performance. Adaptive Structuration Theory (DeSanctis & Poole, 1994) has been used to study the complexity of technology-organisation relationship in the context of complex information technologies however it primarily focused on organisation change. Hence, none of these theories apart from TMS provided a framework to examine the effect of social media tools on virtual team dynamics.

Transactive memory system theory provided a good fit with the virtual team dynamics literature which was consistent with the research goals. Transactive memory system is explained and is described in the context of virtual teams and the feature richness of social media tools in rest of this section.

### ***2.8.1 Transactive memory system***

The term transactive memory system was originally proposed by Wegner (1987) to study the behaviour of couples in close personal relationships. Accordingly, partners in close personal relationships cultivated one another as ‘external’ memory aids. This led to the development of a shared system for encoding, storing and retrieval of the information among the partners (Wegne, Erber, & Raymond, 1991). Later, it was suggested that similar systems existed in

groups in the form of a ‘transactive memory’ of the group (Lewis, 2003). The transactive memory of the group (team) is comprised of a pool of transactive memories of the individual team members, together with an understanding of which team member possesses what knowledge (Lewis, 2003).

Great teams have a commonality: a well-developed transactive memory system (TMS) (Hsu, Shih, Chiang, & Liu, 2012). “A TMS refers to a specialized division of cognitive labor that develops within a team with respect to the encoding, storage, and retrieval of knowledge from different domains” (Wegner, 1987 cited in Choi et al., 2010, p. 856). By definition, a virtual team is a group of individual knowledge workers who communicate through a suitable communication tool, and turn into a team of experts to work towards project completion (Bastida et al., 2013). A virtual team may be viewed as a group of individual memory systems which reside with individual team members, and a common team memory system (Wegner, 1987). The individual memory systems turn into a ‘transactive memory’ by the interconnection of individual memories of the team members when a VT works together on a project (Wegner, 1987; Wegner et al., 1985). The VT transactive memory consists of the virtual team members’ expertise and knowledge about virtual team member-expertise associations (Lewis, 2003). Accordingly, the virtual team members make use of their expertise and the transactive memory to combine their knowledge with other team members’ knowledge to jointly achieve the task in hand (project) (Lewis, 2003). TMS ensures that team members know who knows what, and who knows who knows what (Jarvenpaa & Majchrzak, 2008). IS research has suggested that TMS is crucial to team performance as it relates to how teams store knowledge amongst themselves. TMS is also crucial as far as the retrieval of that stored knowledge and its application are concerned (Choi et al., 2010). A well-developed TMS can raise team performance under different and varying circumstances. A transactive memory system has three components (Choi et al., 2010; Lewis, 2003):

*Specialization:* Specialization refers to what team members know about who knows what. In other words, specialization refers to the extent of knowledge about the structure of expertise within the team in form of team member-expertise associations (Lewis, 2003). When a TMS is developed, team members also know what other team members need to know (Choi et al., 2010). Specialization may lead to appropriate task-expertise matching, since the team members would know whose skills can combine with their skills to accomplish the task in hand. Team members understand who possesses the skills needed for the task. Specialization

also allows team members to differentiate their knowledge from others since they are aware of the overlaps in knowledge within the team. This benefits the team in terms of gaining an understanding of what knowledge the team lacks (Lewis, 2003; Lewis, 2004).

*Credibility:* Credibility refers to the beliefs that team members have about the reliability of the knowledge possessed by other team members (Lewis, 2003). In other words, credibility refers to the cognitive trust that team members have in other team members' knowledge. Credibility ensures that the team members would believe in the knowledge that other team members provide them and they will not expend any effort in verifying that knowledge (Choi et al., 2010; Hsu et al., 2012). Accordingly, team members will actively seek knowledge from others if they believe in the credibility of knowledge they receive, and they would be more open to sharing knowledge, and vice-versa (Chen, 2014).

*Co-ordination:* Co-ordination refers to how well the team members co-ordinate knowledge according to the task structures and along the unevenly distributed knowledge in the team. In other words, co-ordination refers to effective knowledge processing within the team (Lewis, 2003). Co-ordination depends on how well team members understand each other's knowledge, and how that knowledge fits together (Lewis, 2003). Co-ordination can thus be viewed as a process that the team members use to combine their transactive knowledge.

Transactive memory system development is affected by the communication tool used in a VT environment since frequent communication between the team members has an ability to encourage the development of TMS (Kanawattanachai & Yoo, 2007). Information technology such as KMS creates a 'directory' of team members' expertise and facilitates who knows what synergy (Choi et al., 2010).

### ***2.8.2 Hypotheses development***

By drawing upon virtual team dynamics literature (Bjorn & Ngwenyama, 2009; Greenberg et al., 2007; Henttonen & Blomqvist, 2005; Horwitz et al., 2006; Hsu et al., 2012; Kraut & Streeter, 1995; Lin et al., 2008; Malhotra et al., 2007; Maznevski et al., 2006; Peters & Manz, 2007; Shachaf, 2008; Sivunen & Valo, 2006), the literature on social media tools (Bastida et al., 2013; Bertot et al., 2011; Curseu et al., 2008; Goodwin-Jones, 2003; Gupta et al., 2012; Gupta & Wingreen, 2014; Hoffmann & Fodor, 2010; Kaplan & Haenlein, 2010; McAfee,



2006; Ou et al., 2013; Standing & Kiniti, 2011), and the TMS theory (Choi et al., 2010; Lewis, 2003; Kanawattanachai & Yoo, 2007; Wegner et al., 1985; Wegner, 1987) a theoretical framework is established for this research. It is theorised that the use of social media tools can positively affect TMS development. TMS refers to ‘collectivism’, and translates to an effective team work in the case of virtual teams (Choi et al., 2010; Hsu et al., 2012; Lewis, 2003; Wegner, 1987).

Social media tools may help in the development of co-ordination, specialization and credibility in the virtual team since social media tools have a capability to make the team collaborate and work together (Goodwin-Jones, 2003; Standing & Kiniti, 2011), encourage participation in the team (Hoffman & Fodor, 2010), help in keeping the project information organised (Bastida et al., 2013; Darisipudi & Sharma, 2008), and create a task-expertise association in the team. Team members would know what project information resides with which team member. Social media tools also help ensure transparency in project information by keeping all information in a central place, and hence resolve any communication or co-ordination challenges (Bertot et al., 2011; Kaplan & Haenlein, 2010). Finally, it is expected that social media tools lead to TMS development in virtual teams. The repeated use of social media tools leads to more participation, collaboration, information organisation and transparency, which leads to more specialization, coordination and credibility, that is, a well-developed TMS. Hence, the following hypothesis is proposed:

**H1: Social media tools positively affect TMS development in virtual teams.**

A well-developed TMS ensures that team members get credible knowledge from other team members which accelerates trust building in the team (Lewis, 2003), and team members may actively seek information from each other (Chen, 2014). The use of social media tools ensures that team members get a chance to develop personal relationships with each other and this may form an antecedent to stronger team ties. Strong team ties can contribute to trust building in virtual teams (Meister & Willyerd, 2010). The communication tool used in a VT plays an important role in the development of team cohesion (Xu, Sankar, & Mbarika, 2004). Accordingly, social media tools can help in building team cohesion in virtual teams due to their ability to help create stronger team ties (Meister & Willyerd, 2010). A well-developed TMS ensures co-ordination among virtual team members. If team members co-ordinate well,

this may form a basis for team cohesion in the virtual team (Lewis, 2003; Sivunen & Valo, 2006). Hence, hypotheses 2 and 3 are proposed:

**H2: TMS mediates the positive effect of social media tools on virtual team trust.**

**H3: TMS mediates the positive effect of social media tools on virtual team cohesion.**

TMS may lead to team satisfaction since the team knows who knows what by using the task-member associations (Lewis, 2003, Lewis, 2004), and hence team members may be assigned tasks according to their expertise. Satisfied team members exhibit a greater degree of dedication and commitment towards the project, which may lead to achieving excellent project outcomes (Curseu et al., 2008; Lin et al., 2008; Shachaf, 2008). TMS creates increased team responsiveness because the team members can co-ordinate work among themselves, and each team member can contribute to the task with their expertise. Hence, hypothesis 4 is proposed:

**H4: TMS mediates the positive effect of social media tools on virtual team satisfaction.**

Conflicts are common to both co-located and virtual teams, but have a greater tendency of happening in a virtual team environment due to a lack of face-to-face communication, and even a lack of understanding between the team members (Baan, 2004; Brown et al., 2007). Conflicts can often intensify in a VT environment, and can take form of task related VT conflicts (Maznevski et al., 2006). Conflicts have a potential to reduce the efficiency of the VT, and can downgrade the project outcomes (Griffith et al., 2003; Montoya-Weiss et al., 2001). The role of the communication tool is important, since an effective communication tool can help prevent conflicts in virtual teams, and also help in resolving conflicts if they still happen. Even the project manager would primarily use the communication tool to communicate with the team to resolve the conflict. Social media tools such as online discussion boards ensure transparency of information (Ferrazzi, 2012) and help build stronger team ties which may reduce conflicts (Meister & Willyerd, 2010).

Communication effectiveness is a crucial factor determining VT project success (Wallace, 1999; Wallace & Keil, 2004) due to an increased reliance on the communication tool in VTs. Bits of useful information may be lost in messages. Inadequate communication poses a risk to the overall team performance and efficiency, and delayed communication can slow down the

virtual team work. A well-developed TMS ensures effective knowledge sharing among members in virtual teams (Chen, 2014; Oshri, van Fenema, & Kotlarsky, 2008) by locating the correct knowledge and transferring it to where it is needed (Alavi & Liedner, 2001; Choi et al., 2010). When a TMS is well-developed, the team members are able to pull out relevant knowledge based on the team member-expertise associations, and this may reduce any delays (communication breakdowns), lead to communication effectiveness and also reduce the likelihood of conflicts in the team (Lewis, 2003; Lewis, 2004). Credible knowledge adds to the communication effectiveness of the team since team members would believe in the information they receive and may not want to verify it from other team members thereby, reducing miscommunication arising out of getting inconsistent information from different sources (Choi et al., 2010). Hypotheses 5 and 6 are therefore proposed:

**H5: TMS mediates the positive effect of social media tools in reduction of virtual team conflicts.**

**H6: TMS mediates the positive effect of social media tools on communication effectiveness in virtual teams.**

Finally, TMS can mediate the effect of social media tools on leadership in virtual teams, since the team leadership is likely to get a better picture of the virtual team on account of team member-expertise associations in the team, and this may assist the leadership in creating a good task-skills match for the virtual team (Lewis, 2003; Lewis 2004). A well-developed TMS may also help the team leadership in co-ordinating and monitoring team activities well (Bjorn & Ngwenyama, 2009) which may boost team spirit (Furst et al., 2004). This can ensure that there is no loss of co-ordination in the virtual team while working on projects (Leinonen et al., 2005). Hence, hypothesis 7 is proposed:

**H7: TMS mediates the positive effect of social media tools on virtual team leadership.**

Based upon the theoretical framework, a research model is proposed (see figure 1). It is expected that social media tools can positively affect virtual team dynamics such as trust, team cohesion, satisfaction, conflicts, communication effectiveness and leadership, and TMS mediates (fully or partially) the effect of social media tools on virtual team dynamics. A well-developed TMS may form the basis for mutual understanding in the team, since team

members understand who knows what (Lewis, 2003; Lewis, 2004; Wegner, 1987), and this may boost team performance.

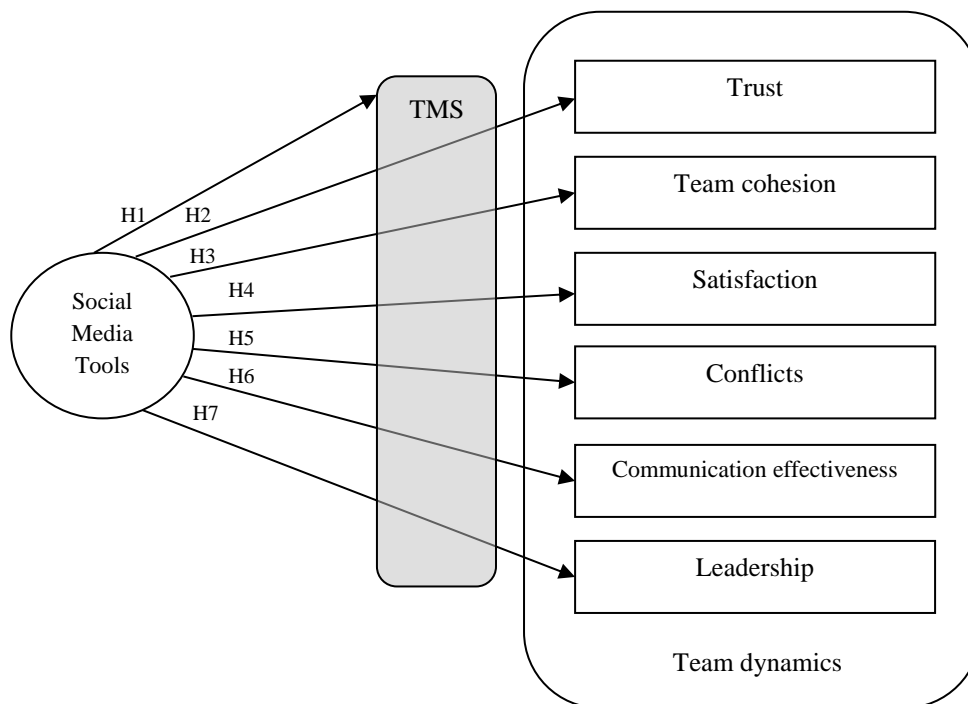


Figure 1. Research model

In summary, the repeated use of social media tools leads to more participation (Hoffman & Fodor, 2010), collaboration (Goodwin-Jones, 2003; Standing & Kiniti, 2011), information organisation (Bastida et al., 2013; Darisipudi & Sharma, 2008) and transparency (Bertot et al., 2011), which positively affects TMS (Choi et al., 2010; Wegner, 1987; Wegner et al., 1985) development in the virtual team. Finally, TMS mediates the effect of social media tools on virtual team dynamics.

## 2.9 Chapter summary

The objective of this chapter was to provide a summary of the key themes and topics in order to develop a foundation for this research as well as define the specific objectives of this research. In doing so, this chapter first introduced the rise of the organisational use of virtual teams, and then discussed VTs in the context of corporate organisations and their relevance to organisations from different industry sectors. The six virtual team dynamics under consideration; trust, team cohesion, satisfaction, conflicts, communication effectiveness and

leadership were explained and the role of the communication tool in virtual teams was highlighted. It paved way for a discussion of internal use of social media tools and introduction of the concept of feature richness of social media tools in the following two sections.

Later, the notion of transactive memory system was introduced and it was theorised to have an effect on virtual team dynamics. The existing literature on virtual team dynamics, social media tools and transactive memory system theory provided the basis for the development of a theoretical framework for this research. The proposed theoretical framework investigated the relationship between transactive memory system and the virtual team dynamics.

The anticipated role of transactive memory system of a virtual team on the relationship between social media tools and virtual team dynamics was thoroughly explained with support from the relevant literature. This led to the development of research hypotheses, each of which was aimed at providing insights into the research questions RQ1 and RQ2. Finally, a research model was proposed which provided a holistic view of the emerging themes from the relevant literature, transactive memory system and the research framework. The research model depicted the research objectives through relationships between the independent and dependent variables (or constructs).

The following chapter will discuss the research methodology used to conduct the literature review, investigate the hypotheses, validate and test the research model, and answer the research questions.

## **Chapter 3. Research Methodology**

### **3.1 Chapter overview**

The purpose of this chapter is to explain the research design and the method used to understand and investigate the effect of social media tools on virtual team dynamics. This chapter is driven by the theoretical foundation for this research which has already been established in Chapter 2. This chapter begins with a snapshot of the mixed method of research and a description of the research paradigm; meaning the epistemological and ontological beliefs which guide the development of research methodology. Next, a rich description of the research method followed in this research is provided which includes a description of the research approach, instrument development and pilot testing, the sampling strategy, and the research procedure followed while conducting this research. A description of the quantitative data analysis phase and the qualitative data analysis phase conducted as part of this research is also presented. This chapter ends with a concise summary of the key points discussed throughout this chapter.

### **3.2 Mixed method research and research design**

A mixed method of research is the third major research approach alongside quantitative and qualitative research approaches, which allows the researcher to collect and analyse both quantitative and qualitative data in order to understand the research problem and answer the research questions (Creswell & Clark, 2007; Creswell, 2014). The major assumption underlying the mixed method is that it provides a better understanding of the subject, the research problem, and research questions than either of the quantitative and qualitative approaches alone (Creswell & Clark, 2007).

Quantitative research comprises the collection of numerical data to deduce and provide evidence of the relationship between the theory and the research. Quantitative data provides numbers which can be analysed with appropriate statistical methods to assess the trends in a given population (Creswell & Clark, 2007; Creswell, 2014). Qualitative data, on the other hand, comprises data collected in form of words from the participants (Bryman & Bell, 2007). Methods such as interviewing facilitate the collection of qualitative data, which often

provides multiple perspectives into the phenomenon of interest (Creswell & Clark, 2007; Creswell, 2014).

The relationship between quantitative and qualitative data has been termed as both ‘enduring’ (Reichardt & Rallis, 1994) and ‘incompatible’ (Howe, 1988) by prior research. The advocates of mixed method research argue that both qualitative and quantitative data can be used and mixed together using various sets of combinations in order to draw some useful insights from the data (Teddlie & Tashakkori, 2010). The research into mixed method has pointed out a unique benefit of using this research paradigm which they term as ‘methodological eclecticism’. Methodological eclecticism is understood as the selection and integration of the most suitable techniques from a myriad of quantitative, qualitative and mixed methods of research, to undertake a thorough investigation of the phenomenon of interest (Teddlie & Tashakkori, 2010). Thus, mixed method approach rejects the notion of ‘incompatibility of methods’ among quantitative and qualitative approaches on account of the fundamental difference underlying both of these research approaches (Creswell & Clark, 2007; Teddlie & Tashakkori, 2010).

In view of the incompatibility between ontological and epistemological assumptions of the quantitative and qualitative research approaches, some of the literature suggests that combining both of these paradigms can be problematic (Creswell, 2010). However, the literature in support of mixed method emphasises that “we are free to combine methods and that we do so by choosing what we believe to be the best tools for answering our questions” (Teddlie & Tashakkori, 2010, p. 9). It is acknowledged by the previous literature that multiple methods provide a means to address the disadvantages of the quantitative and qualitative approaches when used alone (Creswell, Plano-Clark, Gutmann, & Hanson, 2003). Quantitative and qualitative approaches when combined provide a different type of ‘intelligence’ on the phenomenon of interest, which is far better than what can be achieved by a fusion of the outputs generated by both of these research approaches (Snape & Spencer, 2003). Pragmatism has been linked with the mixed method approach in the sense that, mixed method rejects the either/or choices associated with each of the individual paradigms (qualitative or quantitative), and acknowledges that “the values of the researcher play a large role in the interpretation of the results” (Teddlie & Tashakkori, 2003, p. 713). Further, by mixing different methods, a study can be strengthened and may become more capable of producing pragmatic solutions for valued ends (Creswell et al., 2003).

Mixed method of research thus provides an approach that stems from notions of multiple realism, pluralism, multiple epistemological viewpoints and multiple sources of evidence, and also incorporates the important aspects of different research methods (Johnson & Gray, 2010).

Mixed method research is often used interchangeably with multimethod research, although it is conceptually different from multimethod research. Mixed method research combines different worldviews to understand the phenomenon of interest. For example, different worldviews may be a combination of quantitative and qualitative research approaches to get a better understanding of the context (Teddlie & Tashakkori, 2003; Teddlie & Tashakkori, 2009; Venkatesh, Brown, & Bala, 2013). Hence, mixed method research necessarily entails a methodological combination. On the other hand, multimethod research may not use a combination of different worldviews. For example, only qualitative mode of inquiry such as participant observation and interviews or only quantitative mode of inquiry such as a field survey and experiment may be used. Hence, in multimethod research different methods within the same research approach (either qualitative or quantitative) are used. Mixed method may therefore be considered as a special case of multimethod research (Teddlie & Tashakkori, 2003; Teddlie & Tashakkori, 2009; Venkatesh et al., 2013).

A mixed method of research was deemed suitable for this research because it would provide the researcher with a “very powerful mix” (Miles & Huberman, 1994, p. 42) and a more clear picture and detailed overview of the research problem (Tashakkori & Teddlie, 1998). Further, mixed method of research, which uses a combination of quantitative and qualitative research methods, has been used by previous Information Systems (IS) research (Ang & Slaughter, 2001; Gupta et al., 2012; Kaplan & Duchon, 1988). The research findings are also expected to be more rigorous and accurate, since a mix of quantitative and qualitative methods would provide different perspectives on the same subject, which would inform the judgement made about the hypotheses and the research questions.

Hence, for collecting primary data a mixed method of research (Creswell, 2014) where a Likert-style questionnaire was succeeded by follow-up semi-structured interviews (Myers & Newman, 2007) was preferred. A mixed method (Creswell, 2014; Johnson, Onwuegbuzie, & Turner, 2007) allowed the collection of multiple views on the subject, and both the



quantitative and qualitative data could be used to investigate the subject and add richness to the research findings (Miller & Gatta, 2006). Similarly, different types of data can be collected simultaneously or one after the other. In a concurrent design qualitative data can be collected alongside quantitative data, and in a sequential design quantitative data collection can be succeeded by qualitative data collection or vice-versa (Small, 2011). In this research, a sequential design was followed where quantitative data collection was succeeded by the qualitative data collection. This was necessary since the quantitative phase was expected to identify the effect of social media tools on virtual team dynamics, and the qualitative phase was expected to provide much more details about the phenomenon and uncover possible reasons causing that effect. The quantitative phase allowed an examination of the constructs represented by the research model and determination of the relationship between them. This phase also facilitated hypotheses testing and the validation of the research model by the use of appropriate statistical methods. The qualitative phase facilitated the exploration of the adequacy of the research model more fully, leading to a detailed insight into the domain of this research. The qualitative phase provided a lens to view the results of the quantitative phase, in order to understand the effect of social media tools on virtual team dynamics more fully. This phase not only ensured that no important constructs are excluded from the domain of this research, but also added a level of richness by exploring how the relationships in the quantitative path model are enacted.

Hence, a mixed method of research consisting of measured scales and semi structured interviews was expected to shed light on the naturally-existing state of the domain of this research, and facilitate theory testing and validation. In order to make this study highly versatile with businesses of different sizes and locations across the globe, a global perspective was incorporated by means of gathering primary data across different nations. In this respect, a single case study approach (Scapens, 2006) was not intended to be followed since this research aimed to reach wider implications and not organisation specific outcomes. Finally, a sequential mixed method design was used to conduct this research.

### **3.3 Method**

This research focused on six virtual team dynamics that were expected to impact team performance in virtual team projects.

### ***3.3.1 Secondary research, theory development and research approach***

This research began as an exploratory study since there was a dearth of literature and theories that examined the effect of social media tools on VT dynamics. An exploratory research is preferred for situations where there is lack of an established theory to formulate a research design (Eisenhardt, 1989; Stebbins, 2001; Walsham, 1993; Yin, 2003). An exploratory research allows the researcher to gather sufficient data to formulate a theory and address the gap in literature. Collecting secondary data from multiple sources strengthens the reliability and credibility of the data and also helps address subjective bias (Chetty, 1996). Data supported by evidence from multiple sources is often more convincing to the readers and provides greater accuracy of information. Accordingly, a comprehensive review of the relevant literature on social media tools, virtual teams and each of the six virtual team dynamics (trust, team cohesion, satisfaction, communication effectiveness, conflicts and leadership) was undertaken in journals, publications, academic databases, industry whitepapers as well as keyword search on Google scholar, Google and Bing. This formed the starting point for this research. There was a need for gathering an extensive body of literature in light of the goals of this research that aimed at investigating social media tools in the context of virtual teams, an area that has received little attention from researchers and practitioners in the past.

Previous theories relating to teams and group behaviour were researched in journals. Finally, transactive memory system (TMS) was adopted to develop a theoretical framework for this research (Wegner, 1987, Wegner et al., 1985). The primary benefit of using the TMS theory was that it related to three different components that affect team work: specialization, coordination and credibility and it had been investigated by information systems research in the past (Choi et al., 2010; Kanawattanachai & Yoo, 2007). The literature on TMS was interrelated with the literature on the six team dynamics and both had significant overlaps between them. The commonalities between social media and virtual team dynamics literature and the TMS theory were identified and the relevant literature on social media, virtual teams and team dynamics was then coded in accordance with the TMS theory to form a strong theoretical framework. The collected secondary data provided a means to develop a theory, hypotheses and research questions which formed the basis for primary data collection. A grounded theory approach (Glaser & Strauss, 2009; Strauss & Corbin, 1998) involving primary data collection to develop a theory was not followed in this research since there was

an abundance of literature on virtual team dynamics, TMS and social media tools which facilitated theory building.

This research finally proceeded towards an empirical testing of the hypotheses and theory. The qualitative phase provided a rich interpretive discussion (Guba & Lincoln, 2005; Miles & Huberman, 1994; Miles, Huberman, & Saldana, 2013) of the results of hypotheses testing and the research model validation and captured the phenomenon of interest more fully.

### **3.3.2 Instrumentation**

A *Likert-style questionnaire* (Likert, 1932) was developed to validate the research hypotheses and to uncover facts about the research questions. A Likert-type scale “requires an individual to respond to a series of statements by indicating whether he or she strongly agrees (SA), agrees (A), is undecided (U), disagrees (D), or strongly disagrees (SD). Each response is assigned a point value, and an individual’s score is determined by adding the point values of all of the statements” (Gay, Mills, & Airasian, 2009, p. 150-151). A Likert-style questionnaire consists of Likert items, and the participants indicate their level of agreement or disagreement with each item on the Likert questionnaire. Likert questionnaires are designed to capture the participant’s intensity of feelings for a given time. A Likert-type scale is associated with a number of choices which the participants have to make for answering a particular item. The primary benefit of using a Likert scale was that it has been adopted and used previously in IS research (Agarwal & Prasad, 1998; Bajaj & Nidumolu, 1998). There is no shortage of research about the optimum number of items on the Likert-type scale. Some suggest using a scale with 7 items or an even number of response items (Cohen, Manion, Morrison, 2000). Other research suggests that a 7-point scale is optimally reliable, and by going beyond 7-point, the increase in reliability is minimal (Symonds, 1924). Prior research has also adopted and used 6-point Likert scales where the neutral response category is eliminated (Chang, 1994).

In this research, the purpose of the Likert-style questionnaire was to record the impressions and experience of the participants with social media tools in the context of team dynamics, while working in VTs. A 6-point scale ranging from ‘Strongly Agree’, ‘Agree’, ‘Slightly Agree’, ‘Slightly Disagree’, ‘Disagree’ and ‘Strongly Disagree’ was used. The neutral response category was eliminated in order to get a definite response from the participant and

to satisfy the assumptions of variance of a small sample (Brown, 2000; Edwards, 1946). The ‘Slightly Agree’ and ‘Slightly Disagree’ options allowed the participants to code responses to near-neutral category with a slight opinion about the items on the Likert questionnaire.

As suggested by Torgerson (1958), in measuring attitude, the participant responds to an item in a way that reflects the strength of the item in relation to his/her position with respect to the latent attribute that is being measured. The use of positively and negatively-worded items is encouraged to eliminate the response bias (Nunnally, 1978; Spector, 1992). Use of negatively worded items in order to minimise the response bias is based upon the assumption that items worded in the opposite way are measuring the same concept as the positively worded items (Nunnally, 1978; Spector, 1992).

The Likert questionnaire once developed was hosted on the Qualtrics survey software (see Appendix E). The Qualtrics survey software was selected due to its user-friendliness, ease of use and a simple interface to select responses. Appropriate validations were used to make sure that the participant answered all the required questions and there were no incomplete responses. The participants were required to complete the Likert questionnaire by indicating whether they ‘Strongly Agree’, ‘Agree’, ‘Slightly Agree’, ‘Slightly Disagree’, ‘Disagree’ and ‘Strongly Disagree’ with the statements. The Likert questionnaire was designed to record the impressions and experience of participants with their virtual team environment. The statements (questions) for the Likert questionnaire were adapted from previously published measures and the relevant literature for each of the team dynamics and TMS in light of the focus of this research i.e. virtual team communication via social media tools. The development of the measurement scale is discussed in detail in section 3.3.3. The participants were instructed to answer these questions while thinking about all their project related activities that are conducted through social media tools only (see Appendix D). It allowed the administration of a ‘control’ in the Likert instrument and ensured that the research captures all the important constructs which may be relevant to the domain of this research while the research progressed into a phase of theory testing.

A set of questions were designed to gather some additional information about the sample population and were included in the questionnaire, before and after the Likert-type items. The purpose of including these questions was to capture demographic and other relevant information from the participants; for instance what social media tools they were using and

for what purposes were they using social media tools (see Appendix D). A combination of closed-ended and open-ended questions (Dillman, Phelps, Tortora, Swift, Kohrell, Berck, & Messer, 2009) was included in order to capture all relevant information. The participants also used tools other than social media tools such as email, other project management tools and telephone, and hence a few questions were designed to understand what proportion of the time spent communicating is through social media tools (see Appendix D).

*Semi-structured interviews* were conducted to get additional insights from the interviewees and to extend the knowledge gained from the Likert questionnaire findings. Qualitative research methods “are designed to help us understand people and the social and cultural contexts within which they live” (Myers & Avison, 2002, p. 4). Interviews are considered to be a good source of qualitative data in IS research (Myers & Avison, 2002). Broadly, there are three different types of interviews: structured interview, unstructured or semi-structured interview, and group interview (Fontana & Frey, 2000). In a structured interview, a ‘complete’ interview script (or questions) is prepared beforehand with no room for improving upon it. In a semi-structured or unstructured interview, some of the interview script is prepared upfront, and there is scope for improvisation. Finally, a group interview comprises interviewing two or more people simultaneously. A group interview can either be structured or unstructured (Fontana & Frey, 2000; Myers & Newman, 2007).

A semi-structured interview is the most common type of interview that is used for conducting IS research alongside unstructured interview (Myers & Newman, 2007). An advantage of conducting semi-structured interviews is that it can accommodate open-ended as well as theoretically driven questions. Such a combination can be useful to elicit the data grounded in the experience of the participant as well as data guided by the existing constructs in the domain of the research (Galletta, 2013). The primary goal of the qualitative phase of this research was to uncover facts about the research questions in order to extend the existing knowledge that was gained from the quantitative phase of this research. Hence, in light of these goals, semi-structured interviews were selected for qualitative data collection.

A set of open-ended interview questions was designed to facilitate qualitative data collection. The interview questions were theoretically driven, extended the scope of the Likert questionnaire, and focused on participants’ thoughts on how the use of social media tools may affect each of the six VT dynamics. The interview questions were expected to function

as a ‘guideline’ when conducting the actual interviews, in order to gain valuable insights into the potential reasons that cause social media tools to affect VT dynamics and TMS, as revealed by the survey findings. The semi-structured interviews were expected to facilitate an in-depth study of the context.

The interviews were intended to uncover the facts about the research questions from the participant’s perspective and extend the findings of this research beyond the Likert questionnaire findings. The interviews would also inform the theory and research model and facilitate further investigation into the research area by researchers and practitioners who work with VTs.

### ***3.3.3 Measurement scale***

A measurement scale for each of the six virtual team dynamics and TMS was created to understand the context in light of previous research. Existing measurements (measures) for each of the six team dynamics, communication tool and TMS were researched within an organisational context. The existing measurements were also thoroughly studied for overlaps among them. Simultaneously, an investigation into the evolving extant literature was done and the key points from the literature on VT dynamics and TMS were summarised. The existing measurements were then compared with the literature on VT dynamics and TMS to find out the commonalities between them. This was done to make sure that the measures were appropriate to study the effect of social media tools on virtual team dynamics and TMS. Finally, after three iterations a set of measurement items from the existing published measurement items which best represented the literature were shortlisted. The shortlisted measurement items were then adapted accordingly and included in the instrument developed for this research. Some major themes that were identified during the literature review were also framed into measurement items where there was a lack of any concrete measurement items. This was done by summarising the key points identified from the literature and then shortlisting the ones that best represented the literature. After three iterations a set of refined measurement items which best represented the literature were created. The details about the measurement items for each of the six VT dynamics, communication tool and TMS are discussed in this section.

### 3.3.3.1 Trust

Measurement items (measures) for organisational team trust that were used and published in previous studies were researched. These items were then compared with the key literature on trust that was researched earlier. The ones that were in agreement with the relevant literature were then selected and adapted to form measures for studying the effect of social media tools on organisational virtual team trust. Accordingly, the measurement scale was developed to measure the three components of trust - ability/competence, integrity and benevolence as identified in the literature (Greenberg et al., 2007). Several studies on trust (Brockner, Siegel, Daly, Tyler, & Martin, 1997; Cummings & Bromiley, 1996; Gillespie, 2003; Mayer & Davis, 1999; McAllister, 1995; Robinson, 1996; Shockley-Zalabak, Ellis, & Winograd, 2000; Spreitzer & Mishra, 1999; Tzafrir & Dolan, 2004) were used to create measurement items for trust in this research; table 2 shows the source of the various measurement items for trust that were used in this study. Some studies on trust had certain common measurement items as shown in table 2.

<b>Trust component</b>	<b>Measurement item and source</b>
Ability/competence	T1. Team members work carefully (McAllister, 1995). T2. Team members meet their obligations (Cummings & Bromiley, 1996). T3. Team members contribute to team tasks/success (Spreitzer & Mishra, 1999; Tzafrir & Dolan, 2004). T4. Team members help resolve the problems in the team (Gillespie, 2003; Spreitzer & Mishra, 1999).
Integrity	T5. Team members share information even if it is unpleasant (Gillespie, 2003; Mayer & Davis, 1999). T6. Team members possess high integrity (Robinson, 1996). T7. Team members mislead me (Cummings & Bromiley, 1996). T8. Team members keep their promise (Spreitzer & Mishra, 1999; Tzafrir & Dolan, 2004).
Benevolence	T9. Team members freely share ideas and feelings (McAllister, 1995). T10. Team members share important project information with me (Brockner et al., 1997). T11. Team members avoid retaliation (Shockley-Zalabak et al., 2000). T12. My opinion is taken into account when important decisions are made (Huff & Kelley, 2003; Tyler, 2003).
General statement	T13. Team members trust me (McAllister, 1995; Robinson, 1996).

Table 2. Measurement scale for trust

The measurement items discussed in table 2 were keyed into the Likert questionnaire with a scale of Strongly Agree-Agree-Slightly Agree-Slightly Disagree-Disagree-Strongly Disagree.

### 3.3.3.2 Team cohesion

Existing measurement items for team cohesion that were published in academic studies were researched. These items were then compared with the key literature on team cohesion that was researched earlier. The ones that were in agreement with the relevant literature were then selected and adapted to create a measurement scale for studying the effect of social media tools on organisational virtual team cohesion. The items were categorized into task cohesion and social cohesion. To create measurement items for task cohesion component of team cohesion, three items (TC1-TC3) were derived from Widemeyer et al. (1985) cited in Carless & De Paola (2000). The other three items (TC4-TC6) were adapted from the literature on team cohesion (Carron & Brawley, 2012; Malhotra et al., 2007; Sivunen & Valo, 2006). These three items were carefully constructed according to the previous literature and the context of this study. Two measures for social cohesion (TC7 and TC8) were created in light of the previous literature on social media (Bastida et al., 2013) due to the lack of any concrete measure of social cohesion that could be used to understand the effect of social media tools on social cohesion in virtual teams. One measure under the general component of team cohesion (TC9) was derived from the previous literature on team cohesion (Carron & Brawley, 2012; Malhotra et al., 2007; Sivunen & Valo, 2006). This measure represented the key characteristics of a cohesive team.

Team cohesion component	Measurement item and source
Task cohesion	TC1. I am happy with the team's level of task commitment (Widemeyer et al., 1985 cited in Carless & De Paola, 2000). TC2. I have conflicting aspirations for team's performance (Widemeyer et al., 1985 cited in Carless & De Paola, 2000). TC3. The team gives me opportunities to improve my performance (Widemeyer et al., 1985) cited in Carless & De Paola, 2000). TC4. The team has a collective agreement on tasks. TC5. The team has expectations from individual members. TC6. Team members get to know of individuals' contribution to the team.
Social cohesion	TC7. Team members spend time socializing on the communication tool. TC8. Team members have fun on the communication tool apart from work.
General	TC9. The team is cohesive.

Table 3. Measurement scale for team cohesion



### 3.3.3.3 Satisfaction

Existing measurements for team satisfaction were researched in existing studies. Four items (S1-S4) from Gladstein (1984) and 3 items (S5-S7) from Smith and Barclay (1997) were adapted in light of the previous literature to create measurement items for satisfaction.

Satisfaction component	Measurement item and source
Team satisfaction	S1. I am satisfied with my team members (Gladstein, 1984). S2. I am pleased with the way me and other team members work together (Gladstein, 1984). S3. I am very satisfied with working in this team (Gladstein, 1984). S4. I am satisfied with team members' contribution to the team (Gladstein, 1984). S5. Some aspects of the team could be better (Smith & Barclay, 1997). S6. The team likes working with me (Smith & Barclay, 1997).
General	S7. The team members are satisfied with the team (Smith & Barclay, 1997).

Table 4. Measurement scale for satisfaction

### 3.3.3.4 Conflicts

Conflicts are categorised as task and relationship conflict and both affect different aspects of a virtual team. Existing measurement items published in academic studies were researched to find out suitable measurement items for task and relationship conflicts. These measurement items were then compared with the key literature points about conflicts which were identified earlier. The ones that were in agreement with the relevant literature were then adapted to form a measurement scale for studying the effect of social media tools on organisational virtual team conflicts. To measure task conflict, the first two measures CON1 and CON2 were adapted from the literature (Leinonen et al., 2005; Maznevski et al., 2006) since there was a dearth of measures for studying task conflict in the context of VTs and social media tools. The remaining two measures CON3 and CON4 for task conflict were adapted from Jehn (1995).

The first two measures for relationship conflict CON5 and CON6 were adapted from the literature (Joinson, 2002; Leinonen et al., 2005; Maznevski et al., 2006) and the remaining three (CON7-CON9) were adapted from Jehn (1995).

<b>Conflict component</b>	<b>Measurement item and source</b>
Task conflict	CON1. The team does not have a divided approach towards the project. CON2. Team members remember critical project information. CON3. Team members' ideas are often conflicting (Jehn, 1995). CON4. Team members often disagree on decisions (Jehn, 1995).
Relationship conflict	CON5. I have good relations with my team members. CON6. The communication tool helps my relationship with my team members work well. CON7. There is a lot of friction among the team members (Jehn, 1995). CON8. There are personality conflicts in the team (Jehn, 1995). CON9. There is a lot of tension among the team members (Jehn, 1995).

Table 5. Measurement scale for conflicts

#### 3.3.3.5 Communication effectiveness

The first five measures for communication effectiveness (CE1-CE5) were created to fit the context in light of the literature (Bjorn & Ngwenyama, 2009; Carvalho, 2008; Daim et al., 2012; Hinds & Mortensen, 2005; Malhotra et al., 2007; Rosen et al., 2007) due to a lack of reasonable measures for measuring communication effectiveness. Three measures (CE6, CE7 and CE8) were adapted from Sullivan and Feltz (1993). The last one (CE9) was adapted from Fussel, Kraut, Lerch, Scherlis, McNally, and Cadiz (1998).

<b>Communication effectiveness measurement item and source</b>
CE1. The team is able to respond to a communication breakdown well. CE2. There is little miscommunication in the team. CE3. The team was created over six months back. CE4. The team has a set communication plan. CE5. The team has clear communication policies. CE6. Team members communicate their feelings honestly (Sullivan & Feltz, 1993). CE7. Team members display mutual respect (Sullivan & Feltz, 1993). CE8. Team members communicate problems easily (Sullivan & Feltz, 1993). CE9. There is information overload (Fussel et al., 1998).

Table 6. Measurement scale for communication effectiveness

### 3.3.3.6 Communication tool

In order to measure the effectiveness of the communication tool the measurement items (CT1-CT9) were created from the literature (Bastida et al., 2013; Bjorn & Ngwenyama, 2009; Daim et al., 2012; Edwards & Sridhar, 2003; Ferrazzi, 2012; Gupta & Wingreen, 2014; Horwitz et al., 2006) to fit the need in the current study. This was done due to a lack of existing measurement items for measuring the effectiveness of social media as a communication tool. Some key points identified in the literature (Bastida et al., 2013; Bjorn & Ngwenyama, 2009; Daim et al., 2012; Edwards & Sridhar, 2003; Ferrazzi, 2012; Gupta & Wingreen, 2014; Horwitz et al., 2006) were summarised and refined to create measurement items for communication tool.

<b>Communication tool measurement item</b>
CT1. The team heavily relies on the communication technology.
CT2. The team experiences problems with the communication technology.
CT3. I prefer multiple communication channels.
CT4. The team experiences communication breakdowns.
CT5. The team experiences communication breakdowns frequently.
CT6. This communication channel is really good.
CT7. Communication tool ensures participation from all team members.
CT8. The communication tool ensures transparency.
CT9. The communication tool makes the team work together.

Table 7. Measurement scale for communication tool

### 3.3.3.7 Leadership

Existing measurement items for leadership were researched in the literature and some of them were adapted accordingly to create measurement items for understanding the effect of social media tools on VT leadership. 3 items (L2, L7 and L8) were derived from Rohs and Langone (1997). Six items (L1, L3-L6 and L9) were derived from the literature (Bjorn & Ngwenyama, 2009; Daim et al., 2012; Furst et al., 2004; Hambley et al., 2007; Schmidt & Bannon, 1992; Shachaf, 2008) in order to study the context.

<b>Leadership component</b>	<b>Measurement item and source</b>
Assigned leadership	L1. The team leader/manager establishes clear set of goals. L2. The manager spends time motivating and boosting team spirit (Rohs & Langone, 1997). L3. The manager gives good feedback to team members despite being geographically dispersed. L4. The manager integrates the team well. L5. The manager monitors the team and signals any trouble. L6. The manager is vigilant. L7. The manager makes informed decisions on team issues (Rohs & Langone, 1997). L8. The manager has an influence over the team (Rohs & Langone, 1997).
General	L9. This communication tool helps the manager to manage the team well.

Table 8. Measurement scale for leadership

#### 3.3.3.8 Transactive memory system

Existing measurement items for TMS (Lewis, 2003; Lewis, 2004) were researched and were compared with the literature on team dynamics (Clark & Payne, 1997; Fussel et al., 1998; Gladstein, 1984; Jehn, 1995; McAllister, 1995; Robinson, 1996; Rohs & Langone, 1997; Smith & Barclay, 1997; Spreitzer & Mishra, 1999; Sullivan & Feltz, 1993; Widemeyer et al., 1985 cited in Carless & De Paola, 2000) and TMS (Choi et al., 2010; Wegner, 1987). Following this process, measurement items were created for each of the three components of the TMS i.e. specialization, co-ordination and credibility.

<b>TMS Component</b>	<b>Measurement item</b>
Specialization	TMS1. I seek specialist team members' expertise when needed. TMS2. Team members seek my expertise when needed. TMS3. I know other team members' skills well. TMS4. The team members have the right skills for the project.
Co-ordination	TMS5. The team is united while working on the project. TMS6. Team members agree on most of the decisions. TMS7. I feel that the team is more knowledgeable than individual members. TMS8. The team is really effective.
Credibility	TMS9. Team members' motives are good for the team. TMS10. I can rely on other team members. TMS11. I trust other team members. TMS12. Team members respond constructively to my problems.

Table 9. Measurement scale for transactive memory system

#### *3.3.3.9 Interview protocol*

An interview protocol was developed for this research (see Appendix F). A set of open-ended interview questions was created to add a strong qualitative end to the Likert questionnaire findings. The interview questions were designed to more fully understand participants' views about their use of social media tools and its effect on virtual team dynamics. These questions were created in light of the relevant literature on the six virtual team dynamics. Open-ended follow-up questions were also created with some of these interview questions. The research model (figure 1) guided the development of the interview questions (Creswell, 2003). Each interview question was aligned with the corresponding component in the research model in order to investigate the adequacy of the research model e.g. the interview question on trust was aimed to capture participant's opinion on how social media tools led to the development of trust in their virtual team. The interview questions were kept open-ended in order to facilitate the collection of detailed insights into the research model and add richness to the quantitative findings.

The interview questions focused on gathering participant's generalised view about the effect of social media tools on their team's trust, team cohesion, satisfaction, communication effectiveness, conflicts, and leadership, in order to get more in-depth knowledge about the domain of this research.

#### *3.3.4 Instrument testing*

The research instruments (Likert questionnaire and interview questions) were peer-reviewed by an expert panel and were then pilot tested with a small number of participants to make sure that the instruments facilitated the collection of in-depth knowledge relating to the research questions and the domain of this research. The pilot test was necessary to ensure that the adaptations that were made to the existing measurement items to create the Likert instrument for this research work well and suit the needs of this research. Similarly, pilot testing of the interview protocol was necessary to make sure that it functions in a manner that is consistent with the goals of the qualitative phase of this research. The pilot test also ensured that the final instruments developed for this research could be replicated by any future studies.

#### *3.3.4.1 Expert panel*

An expert panel was recruited in order to thoroughly check the Likert instrument and the interview protocol before conducting a pilot test. The expert panel consisted of 5 members, all of whom were experts in the domain of this research. Accordingly, 2 senior IS scholars, 2 doctoral students and 1 industry practitioner were recruited for an expert panel review. The Likert instrument once developed was hosted on the Qualtrics survey software. All of the questions on the paper questionnaire (see Appendix D) were keyed into the online (Qualtrics) version (see Appendix E). Appropriate measures were taken to make sure that the question skips were adhered to while creating the Qualtrics version of the questionnaire.

Once the questionnaire was hosted online on Qualtrics, it was activated (live survey) and self-tested by the researcher to check the consistency of the questionnaire across a number of parameters such as interpretation of the questions, sequence of questions, grammatical errors, question skips, instruction write-ups, validation, abnormal inputs and expected response time of 15 minutes. Once the self-testing was complete, the questionnaire was sent to the members of the expert panel for their review. Feedback was obtained from each of the members of the expert panel across the parameters listed previously. The results from the expert panel review are reported in table 10.

<b>Input/observation</b>	<b>Result</b>
Grammatical errors	None
Question statements	Easy to follow
Sequence of questions	In order
Instruction write-ups	Easy to follow
<u>Question skips:</u>  Q: Does your team use social media for communication?  Q: Does your team use other collaborative/project management tools for communication?  Q: Do you use social media personally?	Yes- Control jumps to follow up questions No- Control jumps to next question  Yes- Control jumps to follow up questions No- Control jumps to next question  Yes- Control jumps to follow up questions No- Control jumps to next question
<u>Validations:</u>  Appropriate response keyed in  Appropriate response not keyed in	No error message displayed and the survey progressed.  Error message displayed and the survey did not progress further.
<u>Abnormal inputs:</u>  Single choice selected for single answer questions  Multiple choices selected for single answer questions  Single and multiple choices selected for multiple answer questions	Worked as expected  Could not enter multiple choices.  Worked as expected

Table 10. Results of the expert panel review of the Likert questionnaire

The results of the expert panel review showed that the Likert questionnaire was consistent with the parameters listed in table 10 and could be completed well within the anticipated 15 minute response time.

A feedback was obtained from the expert panel on the interview protocol. The feedback was generally around the interpretability of the question statements and their relevance to the domain of this research. The results of the expert panel review showed that the interview questions were easy to understand and provided a reliable instrument to gather interview data.

#### *3.3.4.2 Pilot test*

The pilot testing began in Dec 2013 and was completed in Jan 2014. The purpose of conducting a pilot test was to administer the research instruments (Likert questionnaire and interview questions) to a small number of participants in order to validate, refine and finalise the instruments for a field study. Pilot testing ensures that there are no unanticipated difficulties with the instrument (Boudreau, Gefen, & Straub, 2001; Moore and Benbasat, 1991). Pilot testing of the instrument also ensures face validity (DeVellis, 2011; Hardesty & Bearden, 2004) by demonstrating the extent to which the instrument measures what it intends to measure.

Pilot testing was necessary to ensure that the collected primary data is interpretable and can be coded with the theoretical framework and the relevant literature. The final objective was to make sure that the end results are capable of confirming or rejecting the hypotheses, validating the research model and addressing the research questions for this study. The actual pilot testing was conducted as a 'live' study and all procedures that were intended to be followed in the actual primary data collection phase were respected. Accordingly, participants who were working in virtual teams and were using social media tools for coordinating their work were contacted and requested to participate in the pilot test. Upon receiving an expression of interest, they were sent an information letter and a consent form and were asked to sign and return the consent form. Following this, unique questionnaire links were sent to the participants from the Qualtrics survey software. These unique questionnaire links could only be used once which kept a check on retaking of the survey by the participants. All recorded responses were then retrieved from Qualtrics in form of an Excel spreadsheet.

Firstly, the data was checked for missing values and out of range values, and other data scrubbing was performed as needed. The data was then analysed with the IBM SPSS Statistics software. Descriptive statistics were computed using the IBM SPSS Statistics software, and a general examination of the means, standard deviation, skewness and kurtosis was undertaken.

All trust items were analysed together to form a set of descriptive statistics. The participants rated the trust items on a 6-point scale of strongly agree (1) - agree (2) - slightly agree (3) -



slightly disagree (4) - disagree (5) - strongly disagree (6). The resulting descriptive statistics are shown in the table 11.

Trust item	N	Missing	Mean	Std. deviation	Skewness	Kurtosis
Team members work carefully	20	0	2.22	1.22	1.51	1.69
Team members meet their obligations	20	0	2.39	1.14	0.97	0.21
Team members contribute to team tasks/success	20	0	1.78	0.81	1.20	2.12
Team members help resolve the problems in the team	20	0	2.28	0.83	0.81	0.67
Team members share information even if it is unpleasant	20	0	2.50	1.04	-0.18	-1.06
Team members possess high integrity	20	0	1.83	0.92	0.87	0.01
Team members mislead me (reverse-worded)	20	0	5.22	0.81	-0.45	-1.28
Team members keep their promise	20	0	2.17	1.10	0.83	-0.47
Team members freely share ideas and feelings	20	0	2.56	1.20	0.31	-0.66
Team members share important project information with me	20	0	2.33	1.03	0.69	-0.57
Team members avoid retaliation	20	0	2.33	1.19	1.63	4.58
My opinion is taken into account when important decisions are made	20	0	2.28	0.96	0.27	-0.66
Team members trust me	20	0	2.17	0.79	0.50	0.52
<b>Column mean</b>	-	-	<b>2.47</b>	<b>1.00</b>	<b>0.69</b>	<b>0.39</b>

Table 11. Descriptive statistics of trust items

The descriptive statistics suggest lower mean values ( $<3$ ) for all the trust items except the reverse-worded item “Team members mislead me”. The lower mean values suggest an agreement with all of the trust items on the scale. The descriptive statistics indicate that the data satisfied the assumptions of normality (West, Finch, & Curran, 1995). This would strengthen the interpretation when the primary data is collected and analysed.

The team cohesion items were analysed together in a similar manner as the trust items. The participants rated the team cohesion items on a 6-point scale of strongly agree (1) - agree (2) - slightly agree (3) - slightly disagree (4) - disagree (5) - strongly disagree (6). The resulting descriptive statistics are shown in table 12.

<b>Team cohesion item</b>	<b>N</b>	<b>Missing</b>	<b>Mean</b>	<b>Std. deviation</b>	<b>Skewness</b>	<b>Kurtosis</b>
I am happy with the team's level of task commitment	20	0	2.11	0.90	0.85	0.57
I have conflicting aspirations for the team's performance (reverse-worded)	20	0	3.89	1.75	-0.03	-1.56
The team gives me opportunities to improve my performance	20	0	2.28	0.96	0.27	-0.66
The team has a collective agreement on tasks	20	0	2.22	1.06	0.50	-0.81
The team has expectations from individual members	20	0	2.06	0.80	0.66	0.77
Team members get to know of individuals' contribution to the team	20	0	1.83	0.79	1.14	2.27
Team members spend time socializing on the communication tool	20	0	3.33	1.68	0.74	-0.89
Team members have fun on the communication tool apart from work	20	0	3.11	1.64	0.79	-0.48
The team is cohesive	20	0	2.06	1.00	0.68	-0.37
<b>Column mean</b>	<b>-</b>	<b>-</b>	<b>2.54</b>	<b>1.17</b>	<b>0.62</b>	<b>-0.13</b>

Table 12. Descriptive statistics of team cohesion items

The results of the analysis suggest lower mean values for most of the team cohesion items except the items “I have conflicting aspirations for the team's performance”, “Team members spend time socializing on the communication tool” and “Team members have fun on the communication tool apart from work”. The higher mean value ( $>3$ ) indicates that the participants disagreed with the statement “I have conflicting aspirations for the team's performance”. A higher mean value for the statements “Team members spend time socializing on the communication tool” and “Team members have fun on the communication tool apart from work” suggested that the participants disagreed with these statements. This was however, contrary to what was initially expected and could be due to a small sample size. The mean values lie close to 3; hence, there is a high probability that these items may work well with the primary data collection. The descriptive statistics indicate that the data was normally distributed (West et al., 1995) which would strengthen the interpretation when the primary data is collected and analysed.

Satisfaction items were analysed together to yield a set of descriptive statistics. The participants rated the satisfaction items on a 6-point scale of strongly agree (1) - agree (2) - slightly agree (3) - slightly disagree (4) - disagree (5) - strongly disagree (6). The results of the analysis are shown in table 13.

Satisfaction item	N	Missing	Mean	Std. deviation	Skewness	Kurtosis
I am satisfied with my team members	20	0	1.83	0.71	0.25	-0.78
I am pleased with the way other team members and I work together.	20	0	1.94	0.94	1.08	0.91
I am very satisfied with working in this team	20	0	1.83	0.99	1.20	0.82
I am satisfied with team members' contribution to the team	20	0	1.94	0.80	0.88	1.31
Some aspects of the team could be better (reverse-worded)	20	0	2.72	1.23	0.38	-0.40
The team likes working with me	20	0	2.11	0.58	0.02	0.41
Team members are satisfied with the team	20	0	2.00	0.59	0.00	0.43
<b>Column mean</b>	-	-	<b>2.06</b>	<b>0.83</b>	<b>0.54</b>	<b>0.39</b>

Table 13. Descriptive statistics of satisfaction items

The descriptive statistics indicate lower means values for all of the items representing satisfaction. The lower mean values suggest an agreement with all of the satisfaction items on the scale. A lower mean value for the item “Some aspects of the team could be better” represents agreement with the statement. The descriptive statistics indicate that the data satisfied the assumptions of normality (West et al., 1995). This would strengthen the interpretation when the primary data is collected and analysed.

The conflict items were analysed to reveal some descriptive statistics. The participants rated the conflict items on a 6-point scale of strongly agree (1) - agree (2) - slightly agree (3) - slightly disagree (4) - disagree (5) - strongly disagree (6). The results of the analysis are presented in table 14.

<b>Conflict item</b>	<b>N</b>	<b>Missing</b>	<b>Mean</b>	<b>Std. deviation</b>	<b>Skewness</b>	<b>Kurtosis</b>
The team does not have a divided approach towards the project	20	0	2.11	1.02	0.87	-0.05
Team members remember critical project information	20	0	2.28	0.83	0.81	0.67
Team members' ideas are often conflicting (reverse-worded)	20	0	3.83	1.47	-0.06	-1.56
Team members often disagree on decisions (reverse-worded)	20	0	3.89	1.28	0.23	-1.19
I have good relations with my team members	20	0	1.89	0.68	0.13	-0.53
The communication tool helps my relationship with my team members work well	20	0	2.78	0.94	0.97	0.04
There is a lot of friction among the team members (reverse-worded)	20	0	5.06	1.00	-0.92	0.08
There are personality conflicts in the team (reverse-worded)	20	0	4.56	1.38	-0.43	-1.35
There is a lot of tension among the team members (reverse-worded)	20	0	5.06	1.06	-1.13	0.38
<b>Column mean</b>	<b>-</b>	<b>-</b>	<b>3.49</b>	<b>1.07</b>	<b>0.05</b>	<b>-0.39</b>

Table 14. Descriptive statistics of conflict items

The items representing communication effectiveness in virtual teams were analysed together in form of descriptive statistics. The participants rated the communication effectiveness items on a 6-point scale of strongly agree (1) - agree (2) - slightly agree (3) - slightly disagree (4) - disagree (5) - strongly disagree (6). The resulting descriptive statistics from the analysis are shown in table 15.

<b>Communication effectiveness item</b>	<b>N</b>	<b>Missing</b>	<b>Mean</b>	<b>Std. deviation</b>	<b>Skewness</b>	<b>Kurtosis</b>
The team is able to respond to a communication breakdown well	20	0	2.22	0.88	0.10	-0.64
There is little miscommunication in the team	20	0	2.61	0.98	0.50	1.03
The team was created over six months back	20	0	1.72	1.27	2.51	7.29
The team has a set communication plan	20	0	2.94	1.59	1.09	0.29
The team has clear communication policies	20	0	2.44	1.25	1.27	2.76
Team members communicate their feelings honestly	20	0	2.33	0.97	0.10	-0.84
Team members display mutual respect	20	0	1.83	0.71	0.25	-0.78
Team members communicate problems easily	20	0	2.33	1.03	0.32	-0.87
There is information overload (reverse-worded)	20	0	3.94	1.51	-0.70	-1.02
<b>Column mean</b>	-	-	<b>2.49</b>	<b>1.13</b>	<b>0.60</b>	<b>0.80</b>

Table 15. Descriptive statistics of communication effectiveness items

The descriptive statistics indicate lower mean values for most of the items on the communication effectiveness scale. A higher mean value for the reverse-worded statement “There is information overload” indicates a disagreement with it. The descriptive statistics indicate that the data was normally distributed (West et al., 1995) except for the item “The team was created over six months back” which would be revisited later. This would strengthen the interpretation when the primary data is collected and analysed.

Similarly, the items representing communication tool were analysed together in form of descriptive statistics. The participants rated the communication tool items on a 6-point scale of strongly agree (1) - agree (2) - slightly agree (3) - slightly disagree (4) - disagree (5) - strongly disagree (6). The results of the analysis are shown in table 16.

<b>Communication tool item</b>	<b>N</b>	<b>Missing</b>	<b>Mean</b>	<b>Std. deviation</b>	<b>Skewness</b>	<b>Kurtosis</b>
The team heavily relies on the communication technology	20	0	3.50	1.95	0.00	-1.61
The team experiences problems with the communication technology (reverse-worded)	20	0	4.06	1.47	-0.60	-0.72
I prefer multiple communication channels	20	0	2.83	1.29	0.53	-0.76
The team experiences communication breakdowns (reverse-worded)	20	0	3.61	1.29	0.28	-1.22
The team experiences communication breakdowns frequently (reverse-worded)	20	0	4.61	1.38	-0.72	-0.61
This communication channel is really good	20	0	2.56	1.29	1.33	2.22
Communication tool ensures participation from all team members	20	0	3.00	1.28	0.56	-0.89
The communication tool ensures transparency	20	0	2.50	1.04	1.57	2.34
The communication tool makes the team work together	20	0	3.06	1.11	0.75	-0.68
<b>Column mean</b>	<b>-</b>	<b>-</b>	<b>3.30</b>	<b>1.35</b>	<b>0.41</b>	<b>-0.21</b>

Table 16. Descriptive statistics of communication tool items

The descriptive statistics indicate higher mean value for the reverse-worded items “The team experiences problems with the communication technology”, “The team experiences communication breakdowns”, and “The team experiences communication breakdowns frequently”. The mean values of items “Communication tool ensures participation from all team members” and “The communication tool makes the team work together” are nearly 3. The descriptive statistics indicate that the data satisfied the assumptions of normality (West et al., 1995). This would strengthen the interpretation when the primary data is collected and analysed.

Lower mean values for the items “The team does not have a divided approach towards the project”, “Team members remember critical project information”, “I have good relations with my team members”, and “The communication tool helps my relationship with my team members work well” suggest an agreement with these items. Similarly, higher mean values for the items “Team members' ideas are often conflicting”, “Team members often disagree on decisions”, “There is a lot of friction among the team members”, “There are personality conflicts in the team”, and “There is a lot of tension among the team members” indicated participants' disagreement with these reverse-worded items. The descriptive statistics indicate

that the data was normally distributed which would strengthen the interpretation when the primary data is collected and analysed (West et al., 1995).

The Likert questionnaire items representing leadership were analysed for their descriptive statistics. The participants rated the leadership items on a 6-point scale of strongly agree (1) - agree (2) - slightly agree (3) - slightly disagree (4) - disagree (5) - strongly disagree (6). The descriptive statistics resulting from the analysis are presented in table 17.

<b>Leadership item</b>	<b>N</b>	<b>Missing</b>	<b>Mean</b>	<b>Std. deviation</b>	<b>Skewness</b>	<b>Kurtosis</b>
The team leader/manager establishes clear set of goals	20	0	1.83	0.86	0.35	-1.58
The manager spends time motivating and boosting team spirit	20	0	2.28	1.27	0.76	-0.50
The manager gives good feedback to the team members despite being geographically dispersed	20	0	2.56	1.29	1.51	2.18
The manager integrates the team well	20	0	2.00	0.97	0.87	0.17
The manager monitors the team and signals any trouble	20	0	2.06	0.87	0.48	-0.19
The manager is vigilant	20	0	2.11	0.96	0.65	-0.21
The manager makes informed decisions on team issues	20	0	1.89	0.90	0.78	0.06
The manager has an influence over the team	20	0	1.78	0.81	1.20	2.12
This communication tool helps the manager to manage the team well	20	0	2.50	0.99	0.00	-0.84
<b>Column mean</b>	<b>-</b>	<b>-</b>	<b>2.11</b>	<b>0.99</b>	<b>0.73</b>	<b>0.14</b>

Table 17. Descriptive statistics of leadership items

A lower mean value for all the leadership items suggests participants' agreement with the items. The descriptive statistics indicate that the data satisfied the assumptions of normality (West et al., 1995). This would strengthen the interpretation when the primary data is collected and analysed.

Finally, the Likert questionnaire items representing TMS were analysed to see what the participants felt about TMS. The participants rated the TMS items on a 6-point scale of strongly agree (1) - agree (2) - slightly agree (3) - slightly disagree (4) - disagree (5) - strongly disagree (6). The results of the analysis are shown in table 18.

<b>TMS item</b>	<b>N</b>	<b>Missing</b>	<b>Mean</b>	<b>Std. deviation</b>	<b>Skewness</b>	<b>Kurtosis</b>
I seek specialist team members' expertise when needed	20	0	1.89	0.83	0.91	1.04
Team members seek my expertise when needed	20	0	2.11	0.68	-0.13	-0.53
I know other team members' skills well	20	0	2.06	1.00	1.48	3.46
The team members have the right skills for the project	20	0	1.94	0.54	-0.07	1.21
The team is united while working on the project	20	0	1.89	0.90	0.78	0.06
Team members agree on most of the decisions	20	0	2.56	1.10	1.95	5.20
I feel that the team is more knowledgeable than individual members	20	0	2.11	1.02	1.24	2.50
The team is really effective	20	0	1.94	1.11	1.57	2.56
Team members' motives are good for the team	20	0	1.89	0.76	0.20	-1.12
I can rely on other team members	20	0	2.00	1.03	0.73	-0.47
I trust other team members	20	0	1.83	0.62	0.09	-0.10
Team members respond constructively to my problems	20	0	2.39	0.98	0.77	1.76
<b>Column mean</b>	-	-	<b>2.05</b>	<b>0.88</b>	<b>0.79</b>	<b>1.30</b>

Table 18. Descriptive statistics of TMS items

The findings suggest lower mean values for all the items on the TMS scale. The descriptive statistics indicate that the data was normally distributed which would strengthen the interpretation when the primary data is collected and analysed (West et al., 1995).

Overall, the results of the descriptive statistics suggest that the pilot test data was normally distributed with minimal signs of skewness or kurtosis. Most of the skewness values were close to zero and well within  $\pm 2$  range, which is good enough for pilot testing purposes (West et al., 1995). The only exception to this was the item “The team was created over six months back” which was positively skewed and demonstrated strong kurtosis, which may be due to a small sample size.

A construct-level correlation analysis was performed on the pilot test data (Cohen, Cohen, West, & Aiken, 2013). All items representing each of the constructs viz trust, team cohesion, satisfaction, conflicts, communication effectiveness, communication tool, leadership and TMS were summated using the IBM SPSS Statistics software and new variables representing



each of these constructs were created. A correlation analysis was conducted on these summated variables, the results of which are reported in table 19.

	Trust	Team cohesion	Satisfaction	Conflicts	Communication effectiveness	Communication tool	Leadership	TMS
Trust	1	0.537*	0.803**	-0.777**	0.776**	0.047	0.772**	0.893**
Team cohesion	0.537*	1	0.542*	-0.292	0.639**	0.064	0.404	0.524*
Satisfaction	0.803**	0.542*	1	-0.450	0.688**	-0.029	0.727**	0.958**
Conflicts	-0.777**	-0.292	-0.450	1	-0.679**	-0.032	-0.643**	-0.564*
Communication effectiveness	0.776**	0.639**	0.688**	-0.679**	1	0.005	0.688**	0.750**
Communication tool	0.047	0.064	-0.029	-0.032	0.005	1	0.074	0.008
Leadership	0.772**	0.404	0.727**	-0.643**	0.688**	0.074	1	0.814**
TMS	0.893**	0.524*	0.958**	-0.564*	0.750**	0.008	0.814**	1

Table 19. Correlation matrix of the pilot test data (\*p<0.05, \*\*p<0.01)

The correlation matrix revealed significant correlations between the TMS construct and most of the other constructs in the research model. The results showed that TMS was significantly correlated with the constructs representing the team dynamics.

Further, an item-level correlation analysis (Cohen et al., 2013) was performed on the pilot test data (see Appendix J). The results revealed that TMS items were significantly correlated with the communication tool items as well as the items on trust, team cohesion, satisfaction, conflicts, communication effectiveness and leadership.

The descriptive statistics and the results of the correlation analysis showed that even with a small sample size (N=20) the results showed a good probability of success of this research. Pilot testing was also important in order to assess the questionnaire consistency across various parameters such as interpretation of questions, sequence of questions, instruction write-ups, user-friendliness and response time under 15 minutes. Hence, upon questionnaire completion the participants were asked for feedback on the questionnaire across the parameters discussed earlier. The feedback received was good and all the participants found that the questionnaire was fine across the parameters listed above.

Finally, 5 semi-structured interviews were conducted with the participants in order to establish the design validity of the interview protocol (Venkatesh et al., 2013). The interviews

were tape-recorded after obtaining permission from the interviewees, transcribed verbatim, and were analysed using the procedure proposed by Miles and Huberman (1994) and Miles et al., (2013) (see section 3.3.7.2). The results of the analysis revealed some interesting insights into the effect of social media tools on virtual team dynamics. This again indicated that there was a good probability of success of this research. The participants were asked to provide feedback on the interview questions in regard to their interpretation and relevance of the questions to their teamwork.

The participants were sent thank you emails and the pilot testing phase was successfully completed.

#### *3.3.4.3 Instrument modifications and amendments*

Slight changes were made to the instruments following the pilot test. An open-ended question was added to the Likert questionnaire in order to record participant's designation in the organisation. The Likert item on communication effectiveness (CE3) "The team was created over six months back" was reworded to "The team was created over six months ago". The questionnaire used for primary data collection is shown in Appendix D.

In regard to the interview protocol, the instructions were made clearer. The final version of the interview protocol used in this research is presented in Appendix F.

Slight changes to the research procedure were carried out after the pilot testing phase. The participants were originally asked to print, fill, sign, scan and return the consent form via email. The participants were now able to fill and initial (instead of signature) the consent form (word document) and send it back, to make their consent to this research. This research has received support from the University's Human Ethics Committee (see Appendix C).

#### *3.3.5 Sampling*

A purposive sampling approach was used for selecting potential organisations in this research (Grover & Segars, 2005). Although a random sample provides the highest probability of achieving a representative cross-section of the population of interest (Lee & Baskerville, 2003), it was practically impossible to obtain a random sample of the users of social media tools in virtual teams because of the unknown number of virtual teams, and a lack of any

governing body that could provide access to social media users within a virtual team environment. A purposive sampling approach allowed the selection of organisations that exhibited desired features which were under consideration, in this case, organisations where social media tools were being used in virtual teams. Thus, purposive sampling was consistent with the aims of this research (Pedhazur & Schmelkin, 2013). Another advantage of using a purposive sample was that this approach has been used in Information Systems research in the past (Grover & Segars, 2005; Pinsonneault & Kraemer, 1993).

Some organisations were initially contacted to establish the use and scope of the use of social media tools in those organisations. Once the use of social media tools in VTs was confirmed, a sample frame consisting of the users of social media tools in VTs was established. Since the goal of the sampling strategy was to obtain a representative cross-section of the population of social media users in virtual teams, a sample frame consisting of a variety of participants who were software developers, analysts, consultants, executives, non-technical engineers, managers (top, mid and junior level) and CEOs at corporate organisations across New Zealand, the United States, the United Kingdom (UK) and India was established for this research. Inclusion of participants from different organisational hierarchies ensured that the context could be understood from different perspectives and the findings are more reliable. A snowball sampling approach (Goodman, 1961) was used to recruit more participants. This was achieved by networking from the participants of this research. Ultimately, the goal of the sampling strategy was to obtain a representative cross-section of the population of interest.

### ***3.3.6 Procedure***

This research began as an exploratory study but later moved into theory testing and interpretive phases. A sequential mixed method approach was followed for studying the effect of social media usage on virtual team dynamics such as trust, team cohesion, satisfaction, conflicts, communication effectiveness and leadership through a TMS lens. The primary data collection began shortly after the pilot testing phase (late Jan 2014). The participants were initially contacted and invited to participate in this research. An email with an official invitation letter indicating the research area was sent out to the participants to request their participation. Once the participants expressed interest in this research, they were provided with an information sheet detailing the purpose and scope of this research and a consent form for their participation in this research. The participants were requested to initial

(or sign) the consent form and send it back to the researcher. The consent forms were in strict accordance with the guidelines issued by the Human Ethics Committee at the University of Canterbury. Following this, web links to the questionnaire were sent out to the participants. The participants could click on the web link and complete the questionnaire which was hosted on Qualtrics survey software. The collected data was checked simultaneously to ensure the completeness of data so that no valuable insights were lost.

Upon completion of the questionnaire, the participants were invited to participate in a face-to-face or telephonic semi-structured interview (Fontana & Frey, 2000; Myers & Newman, 2007). Face-to-face or telephonic semi-structured interviews were conducted according to the preference of the participant. Each interview lasted for about 20 minutes. All interviews were conducted on an agreed date, time and place, and were tape-recorded after obtaining permission from the interviewee. The interviews were transcribed verbatim by the researcher. This was done immediately after conducting the interview to address any accuracy issues arising from a poor call as suggested by prior research (Yin, 1994). This also ensured that any aspect of the interview which was not reasonably clear could be clarified with the interviewee, while the interview was still 'fresh' in the mind of both the interviewer and the interviewee. All interview transcripts were checked for the required degree of 'accuracy', and where appropriate, were cleansed from transfer errors by 'corrective listening' (Flick, 2002). The interviews were conducted with participants across different hierarchical levels of the participating organisations to ensure that 'elite' bias associated with interviewing was averted (Miles & Huberman, 1994). Elite bias refers to the interviewing of only the key informants in an organisation, which may lead to an ignorance of other (non-elite) participants, and consequently a lack of full understanding of the broader situation (Heiskanen & Newman, 1997; Miles & Huberman, 1994).

Strict confidentiality was maintained in all phases of this research and the names of the participants and their organisation were anonymised. The participants were assured that any reports, thesis, articles, public documents or any form of research outputs would not identify themselves and their organisation. The sample size for interviewing was determined by the principle of "theoretical saturation", which has been used and adopted by prior research (Eisenhardt, 1989; Glaser & Strauss, 1967). Accordingly, theoretical saturation was decided by "the point at which incremental learning is minimal because the researchers are observing

phenomena seen before.” (Eisenhardt, 1989, p. 545). In this research, saturation was achieved after 51 interviews and the data collection in the form of interviews was concluded.

### ***3.3.7 Analysis procedure***

The primary data was analysed as soon as it was collected. A mixed method of research (Bryman, 2006; Creswell & Clark, 2007) was followed, and the quantitative data analysis was aligned with qualitative data analysis to study the phenomenon. A mixed method of research ensued in light of the goals of this research. A mixed method provided useful and detailed insights into the primary data for reaching an unbiased opinion on the subject and to reach robust research findings which were a consequence of a rigorous quantitative (Hair, Hult, Ringle, & Sarstedt, 2013) and qualitative (Denzin & Lincoln, 2005) data analysis. This study took into account different perspectives before reaching a conclusion, and hence would be of value to academics and practitioners who work in virtual teams and use social media tools.

#### ***3.3.7.1 Quantitative analysis***

The questionnaire data was downloaded in form of a Microsoft Excel file (raw data) from the Qualtrics survey software. Initially, the data was checked for any incomplete responses and inaccuracies, for consistency reasons. The questions which captured the participant’s demographic profiles and other additional information were separated from the ones with a Likert scale for undertaking an analysis. The data set consisting of demographic profiles of the participants and other additional information was analysed with Microsoft Excel in the form of simple statistics such as pie charts, percentages and frequency tables. The analysed data was then used to report some general demographic and other useful information, the details of which are discussed in Chapter 4.

The Likert questionnaire data was imported into the IBM SPSS Statistics software to conduct an analysis. An analysis of means and standard deviation was undertaken (Ghiselli, Campbell, & Zedeck, 1981). This analysis facilitated the development of a ‘scale’ to measure effectiveness of the communication tool, TMS and the six virtual team dynamics (Fabrigar, Wegener, MacCallum, & Strahan, 1999). Scale refers to the collections of items on the Likert questionnaire that were used to measure the team dynamics, TMS and the effectiveness of the

communication tool. The Likert questionnaire data was then analysed using the partial least squares structural equation modelling approach (PLS-SEM).

#### 3.3.7.1.1 Internal consistency and reliability

Reliability determines the extent to which an instrument produces results that are free from errors. There are generally five techniques for assessing reliability: internal consistency, alternative or equivalent forms, inter-rater reliability, split halves, and test-retest (Boudreau et al., 2001). Internal consistency reliability suggests the extent of consistency between the items in an instrument and with the overall instrument (Gay, Mills, & Airasian, 2006; Hair et al., 2013). Internal consistency reliability is the most commonly used technique, and hence it was adopted (Hair et al., 2013). In this research, internal consistency reliability was measured using composite reliability.

#### 3.3.7.1.2 Discriminant and convergent validity

Discriminant and convergent validity are the components of construct validity. Construct validity is understood as the extent to which a construct measures what it purports to measure (Hair et al., 2013; Straub, 1989). Discriminant validity of a measure determines if that measure can be distinguished from related constructs (Chin, 2010). Discriminant validity suggests that a construct is unique and explains a phenomenon which is not represented by any other constructs in the research model (Hair et al., 2013; Straub, Boudreau, & Gefen, 2004). Discriminant validity can be assessed using (i) Fornell-Larcker criteria, and (ii) by examining factor loadings and cross-loadings of constructs (Hair, Ringle, & Sarstedt, 2011). In accordance with the Fornell-Larcker criteria, the square root of the average variance extracted for each construct should be higher than its highest correlation with any other construct in the research model, in order to establish discriminant validity (Hair et al., 2011; Hair et al., 2013). Another method of establishing the discriminant validity is by examining the factor loadings and cross-loadings of the constructs. Accordingly, discriminant validity can be successfully established if the indicator's outer loadings exceed its cross-loadings (Chin, 2010). In this research the discriminant validity was assessed using the Fornell-Larcker criteria as well as by examining the loadings and cross-loadings for each construct.

Convergent validity refers to the extent to which a measure correlates positively with different measures of the same construct (Hair et al., 2013). Average variance extracted

(AVE) is one of the commonly used measures to establish convergent validity, and it is understood as the grand mean value of the square loadings of the indicators related to the constructs (Chin, 2010; Hair et al., 2013). As a generally accepted rule of thumb, an AVE cut-off value at 0.50 level indicates that, on an average, the construct explains more than 50% of the variance in all of its indicators (Fornell & Larcker, 1981). In this research, convergent validity was examined using the AVE values of the constructs.

#### 3.3.7.1.3 Structural equation modelling

Structural equation modelling (SEM) is a technique that is used to measure the relationship between the constructs (latent variables). SEM allows the measurement of relationships which are complex, abstract, and cannot be directly observed by using multiple items (Chin, 1998; Hair et al., 2013). SEM is described as a powerful statistical method since it provides more flexibility for the interplay between the data and the theory and is known as the 'second generation' of multivariate analysis (Chin, 1998; Hair et al., 2013). Multivariate analysis refers to a simultaneous statistical analysis of multiple variables representing some kind of measurements. SEM provides and extends the capabilities of principal component analysis, factor analysis, discriminant analysis and multiple regression. SEM allows the flexibility of modelling the relationship between multiple predictor and criterion variables, construction of latent variables (unobserved), and a means to statistically test the *a priori* theoretical measurement assumptions against the empirical data (Chin, 1998; Gefen, Straub, & Boudreau, 2000; Hair et al., 2013). SEM provides modelling capabilities for both theory development and theory testing purposes (Hair et al., 2013).

There are two widely used approaches to SEM in IS research: partial least squares (component based) structural equation modelling (PLS-SEM) and the covariance based structural equation modelling (CB-SEM). CB-SEM can be performed using statistical packages such as LISREL, AMOS and CALIS, while the PLS-SEM is performed using statistical packages such as Smart-PLS and PLS-Graph. The CB-SEM and PLS-SEM approaches can be distinguished on the basis of their distributional assumptions and the estimate objectives (Gefen, Rigdon, & Straub, 2011; Hair et al., 2013). PLS-SEM maximizes the explained variance of the dependent latent constructs while, the CB-SEM reproduces the theoretical covariance matrix without focusing on explained variance (Hair et al., 2011). Using CB-SEM or PLS-SEM depends on the goals of the research. As a guideline, Hair et al.

(2011) proposed five key criteria for the selection of the SEM approach: the research goals, measurement model specification, structural model, data characteristics and algorithm, and model evaluation.

#### Research goals

- If the goal is predicting key target constructs or identifying key “driver” constructs, select PLS-SEM.
- If the goal is theory testing, theory confirmation, or comparison of alternative theories, select CB-SEM.
- If the research is exploratory or an extension of an existing structural theory, select PLS-SEM.

#### Measurement model specification

- If formative constructs are part of the structural model, select PLS-SEM.
- Note that formative measures can also be used with CB-SEM but to do so requires accounting for relatively complex and limiting specification rules.
- If error terms require additional specification, such as covariation, select CB-SEM.

#### Structural model

- If the structural model is complex (many constructs and many indicators), select PLS-SEM.
- If the model is nonrecursive, select CB-SEM.

#### Data characteristics and algorithm

- If your data meet the CB-SEM assumptions exactly, for example, with respect to the minimum sample size and the distributional assumptions, select CB-SEM; otherwise, PLS-SEM is a good approximation of CB-SEM results.
- *Sample size considerations:*
  - If the sample size is relatively low, select PLS-SEM. With large data sets, CB-SEM and PLS-SEM results are similar, provided that a large number of indicator variables are used to measure the latent constructs (consistency at large).
  - PLS-SEM minimum sample size should be equal to the larger of the following: (1) ten times the largest number of formative indicators used to measure one construct or (2) ten times the largest number of structural paths directed at a particular latent construct in the structural model.
- If the data are to some extent nonnormal, use PLS-SEM; otherwise under normal data conditions CB-SEM and PLS-SEM results are highly similar with CB-SEM providing slightly more precise model estimates.
- If CB-SEM requirements cannot be met (e.g., model specification, identification, non-convergence, data distributional assumptions), use PLS-SEM as a good approximation of CB-SEM results.
- CB-SEM and PLS-SEM results should be similar. If not, check the model specification to ensure that CB-SEM was appropriately applied. If not, PLS-SEM results are a good approximation of CB-SEM results.

#### Model evaluation

- If you need to use latent variable scores in subsequent analyses, PLS-SEM is the best approach.
- If your research requires a global goodness-of-fit criterion, then CB-SEM is the preferred approach.
- If you need to test for measurement model invariance, use CB-SEM.

Table 20. Rules of thumb for selecting CB-SEM or PLS-SEM (Source: Hair et al., 2011)



In this research, the research model was analysed using PLS-SEM approach. PLS-SEM provided flexibility in terms of sample size, minimal demands on measurement scale, and residual distributions (Chin, 2010; Hair et al., 2013). PLS-SEM produces reliable results even with a small sample size and was well-suited for a medium sample size (N= 115) for this research. PLS-SEM considers all path coefficients simultaneously, which provides the ability to analyse direct and indirect relationships between the constructs in the research model. Additionally, PLS-SEM estimates multiple individual item loadings in light of the theoretical model specification. Hence PLS-SEM avoids inconsistent or biased parameter estimates for the equations (Lechner & Gudmundsson, 2014). Therefore, PLS-SEM supported the goals of this research.

#### 3.3.7.1.3.1 Measurement and structural models

PLS is defined by two sets of linear equations. The first one is known as the measurement model (or inner model) and it depicts the paths (relationships) between a latent construct and all of its indicators (Hair et al., 2013). The second one is the structural model (or outer model) and it predicts uni-directional paths (relationships) between the latent constructs (Hair et al., 2011; Hair et al., 2013). In the context of measurement model, PLS estimates the item loadings and their associated weights and the residual covariance (Gefen et al., 2000).

#### 3.3.7.1.3.2 Formative and reflective relationships

PLS-SEM supports two types of relationships between the observed variables (indicators) and the associated latent constructs: formative and reflective (Gefen et al., 2000). Prior to model evaluation, it is important to determine whether the latent constructs are formative or reflective (Chin, 2010). *Formative* observed variables represent the different dimensions of the latent construct (Gefen et al., 2000). Formative items are drawn with the arrow leading to the latent construct. In the case of formative, the observed variables define and/or influence the associated latent construct (Chin, 1998; Freeze & Raschke, 2007). Accordingly, any change in the formative observed variables ‘cause’ changes in the associated latent construct (Chin, 1998; Gefen et al., 2000; Hair et al., 2011). Formative observed variables are not assumed to be correlated with each other suggesting that a change in one observed variable does not imply a similar change in the other (Chin, 2010; Chin, Gopal, & Salisbury, 1997). *Reflective* observed variables, on the other hand, reflect the associated latent variable and are generally unidimensional and correlated to represent the construct (Gefen et al., 2000).

Accordingly, changes in the associated construct ‘cause’ changes in the observed variables (Gefen et al., 2000; Hair et al., 2011). A high correlation between the reflective observed variables is expected since all of them are dependent upon the same associated latent construct (Chin, 1998; Gefen et al., 2000).

#### 3.3.7.1.4 Mediation analysis and nested modelling

Mediation analysis provides an understanding of the relationship between the independent and dependent variables with the introduction of a mediator variable (MacKinnon, 2008; Shrout & Bolger, 2002). In a mediation relationship the mediator variable is influenced by the independent variable, and the mediator variable in turn influences the dependent variable. The benefit of using mediation analysis is that it provides a functional understanding of the relationship between variables in the research model.

There are two forms of mediation; full mediation and partial mediation. Full mediation occurs when the path between the independent and dependent variable becomes statistically insignificant with the introduction of the mediator variable in the research model. The mediator variable accounts for the variance explained in the dependent variable. Partial mediation occurs when the relationship between the independent and the dependent variable is not fully accounted for by the mediator variable. In the case of partial mediation, there may be statistically significant paths between the independent and the dependent variable as well as the mediator and dependent variable (MacKinnon, 2008; Shrout & Bolger, 2002). The mediator variable explains a considerable amount of variance in the dependent variable, but does not completely account for the variance in the dependent variable.

Nested modelling approach may be used to examine different research models and to identify the more comprehensive model which explains the phenomenon of interest more clearly (Bollen, 2014; Pedhazur & Schmelkin, 2013). Nested modelling is a powerful approach to test different models in light of the theory and the data. A nested model is one of the cases of a more comprehensive or specialised model.

In this research, the proposed TMS mediation (see hypotheses and research model) was investigated using a nested modelling approach.

### 3.3.7.2 *Qualitative analysis*

Qualitative interview data was analysed to study the subject in much more detail. There are various methods for analysing qualitative data which have been suggested by previous research (Flick, 2002). The analytical techniques used for semi-structured interviews within the framework of an investigation depend upon the goals of the research, the questions, and the methodological approach followed (Schmidt, 2004). In this research, the three-phase qualitative data analysis technique suggested by Miles and Huberman (1994) and Miles et al. (2013) was used. Accordingly, the three phases, data condensation (or reduction), data display and data conclusion drawing (or verifying), were executed in that order.

#### 3.3.7.2.1 Data condensation and data display

The first phase, data condensation/reduction, incorporated a process to choose, focus, simplify, build and transform that data found in the interview transcripts (Miles & Huberman, 1994). The determination of analytical categories for this research started with a detailed, intensive and repetitive reading of the interview transcripts (Miles & Huberman, 1994). Throughout this process, the theoretical knowledge of the researcher and the research questions guided his attention while reading through the transcripts (Schmidt, 2004). The main aim was to note the topics that occur for each individual transcript, and the individual aspects of the topics which can be related in a very broad sense to the context of the actual research questions. The aim here was not to find the same topics in all interview transcripts but to make a note of similarities and differences between the interview transcripts (Schmidt, 2004). Another important thing was to not relate the text passages found in the interview transcripts to the research questions (or question) hastily since doing this might have overlooked any text passages that might not have initially seen a ‘connection’ to the research questions. Further, in reading the interview transcripts it was ensured that the text (or transcript) was ‘not’ tailored to the researcher’s own theoretical assumptions, and therefore reduced the analysis process to just a search for text that could be used as a suitable illustration of these assumptions.

A repetitive reading of the transcripts ensured the identification of parts of the transcript that corresponded to the researcher’s own beliefs (or assumptions) as well as those parts that did not correspond as well to his beliefs (Hopf et al., 1995 cited in Schmidt, 2004). Based upon the topics and aspects discovered in the interview transcripts (or texts), suitable analytical

categories were developed. These analytical categories then acted as a reference for further analysis and coding of the interview data.

Coding of interview transcripts means “relating particular passages in the texts of an interview to one category, in the version that best fits these textual passages” (Schmidt, 2004, p. 255). The analytical categories were examined and finally, similar data was grouped (or coded) into categories (Strauss & Corbin, 1998). The coding of the interview transcripts was done by a single coder (the researcher). Although previous research (Glaser, 1978) has pointed to the advantages of using multiple coders, such as, higher level of accuracy and coding reliability, a single coder was used since the knowledge of team dynamics, social media tools and the TMS theory was needed to code the data appropriately. The advantages of using a single coder (the researcher) were that it removed any inaccuracies arising out of the lack of knowledge about the domain of the research within multiple coders and issues with different theoretical sensitivities. The researcher was competent in carrying out the data coding since he had sufficient exposure to coding a sample of pilot interviews, which represented the domain of this research. The second phase in qualitative data analysis was data display in which all the data was displayed, organised, compressed, and assembled to facilitate the process of drawing conclusions from the coded data (Miles & Huberman, 1994; Miles et al., 2013). Data display and data condensation (or reduction) complemented each other and were not very distinct from each other as suggested by Miles and Huberman (1994) and have therefore been presented together in this research. To ensure that no important insights were overlooked from the data and the coding outputs, frequent periodic reviews of some of the transcripts were conducted by the researcher with a senior IS scholar who was knowledgeable in the research area (Miles & Huberman, 2002; Johnson, 1997).

#### 3.3.7.2.2 Conclusion drawing/verification

The final step in qualitative data analysis entailed the interpretation of the coded and displayed data, and described patterns in the data were sought after. The aim of this phase was to find patterns, regularities, explanations and casual flows in the data to provide an insight into the research model (Miles & Huberman, 1994). The coded and displayed interview data domains were mapped onto the constructs which were of interest such as the team dynamics and the TMS (Sussman & Siegal, 2003). Once these domains mapped on well, the next step of interpreting the quantitative findings was executed. The coding sample,

themes extracted from the interviews and examples of data display are shown in Appendices G, H and I.

#### 3.3.7.2.3 Data validity and reliability

The validity of qualitative study needs to be established in order to ensure that the study is credible (Creswell & Miller, 2000). There are various procedures which can be adopted to establish the validity of a qualitative inquiry (Maxwell, 1996; Merriam, 1998). There can be different criteria to judge the validity of qualitative research such as construct validity and internal validity (Yin, 2009). In this research construct validity was established by using triangulation procedure. Triangulation is “a validity procedure where researchers search for convergence among multiple and different sources of information to form themes or categories in a study” (Creswell & Miller, 2000, p. 126). The aim of establishing construct validity was to identify correct ‘operational measures’ for the concepts that were being investigated. Triangulation was achieved by collecting evidence from participants across various hierarchical levels within the same/other organisations, to form a ‘chain’ of evidence confirming the same finding. The internal validity in this research was established by finding out the causal relationships between the constructs (Yin, 2009). The researcher aimed at finding reasons due to which social media tools led to the development of virtual team dynamics. Accordingly, if the participants suggested that social media tools positively influenced any virtual team dynamic (e.g. trust), then they were asked to describe what brought about the development of the dynamic.

Finally, the reliability of the qualitative findings was established. A study is considered reliable if the results can be achieved on repeating the study (Stuart, McCutcheon, Handfield, McLachlin, & Samson, 2002). The data was collected from different hierarchical levels across multiple organisations and the same interview protocol was followed to interview all the participants. After every fifth interview, the researcher analysed each interview independently and then all of the five interviews collectively. The summary of the findings was used to establish the credibility of the data gathering method as well as to validate the interview protocol followed in this research (Johnson, 1997; Straub et al., 2004). Further, selected transcripts and coded outputs were periodically reviewed by the researcher with a senior IS scholar who was knowledgeable in the research area. This also contributed to the rigor of the qualitative data and outputs.

The interview data uncovered some important aspects about the effect of social media use on VT dynamics which were unknown through the existing quantitative analysis. The qualitative data facilitated a ‘cross-verification’ of the findings reached in the quantitative phase of data analysis. The qualitative findings extended the findings reached during the quantitative phase and ensured more robustness in the outcomes of this research. The qualitative findings uncovered reasons for the phenomenon observed during the quantitative phase and facilitated a deeper understanding of the factors that contributed towards the effect of the use of social media tools on virtual team dynamics. This was reached through responses to an open ended set of interview questions that did not constrain the interviewee in any form whatsoever to reveal in-depth knowledge about the observed phenomenon. Qualitative data informed the existing findings from the quantitative data and facilitated the building of strong and coherent arguments for both practitioner and academic audience. Hence, the qualitative phase was an important phase of this research.

### **3.4 Chapter summary**

This chapter began with a description of the research paradigm along with a discussion of the mixed method of research. The aim of this section was to establish that mixed method of research was suitable to meet the goals of this research, in light of the epistemological and ontological assumptions. The chapter then provided an overview of the commonly used research methods in Information Systems research and explained the sequential mixed method approach undertaken to meet the research objectives.

In the following section, a detailed description of the secondary research and theory development along with the research approach followed while undertaking this research was presented. The instrument development process was then described in detail. A 6-point Likert questionnaire was used in this research in conjunction with open-ended interview questions to shed light into the naturally existing state of the domain of this research. The development of the measurement scale along with the source of the measurement items used in this research was discussed as a part of the instrument development procedure.

The details on the pilot testing of the research instruments were provided in the next subsection. The results from the pilot testing phase provided a good probability of success of this

research. In the last section, the research procedure was described followed by the procedure followed for primary data analysis. In doing so, a description of the quantitative and qualitative data analysis was presented. The quantitative and qualitative modes of enquiry were expected to mutually inform each other and provide an insight into the research model and questions. The quantitative phase comprised a PLS-SEM conducted on the Likert questionnaire data, which provided a basis for theory and hypotheses testing, and was used to validate the research model. The findings from the quantitative phase together with the findings from the qualitative phase provided rich insights into the phenomenon and supported the research goals.

The next chapter discusses the quantitative findings reached through the PLS-SEM and the qualitative findings derived from an analysis of the interview data. The research model is validated and the hypotheses are tested using the quantitative findings. The qualitative findings provide some useful insights into the hypotheses and the research model.

## **Chapter 4. Research Findings**

### **4.1 Chapter overview**

This chapter presents the findings of this research. The findings of this research are grouped into quantitative findings and qualitative findings. The quantitative findings section discusses the results from the quantitative data analysis that was conducted on the Likert questionnaire data. The quantitative findings are discussed in the next section, and they begin with a description of the sample used for this research. This is followed by an examination of the Likert questionnaire data in order to understand the descriptive statistics of the data. Finally, in the last sub-section of the quantitative data analysis, the results of PLS-SEM are presented and the measurement and structural model are analysed. The results of the hypotheses testing are reported and the research model is validated.

The qualitative findings section discusses the interview data findings. The interview findings are organised into categories (themes) that were identified while coding the interview data (see Appendix H). The chapter ends with a summary of the key points discussed in this chapter.

### **4.2. Quantitative findings**

The data collected from the Likert questionnaire was retrieved from the Qualtrics survey software in form of an Excel file. Firstly, the data was checked for missing values and out of range values, and other data scrubbing was performed as needed. The questions capturing demographic and other information about the participants were separated from the Likert-type questions and were analysed in form of percentages and frequencies. The findings are presented in the next section. The Likert-type questions were analysed with the IBM SPSS Statistics software and the SmartPLS software and the results are discussed in the sections 4.2.2 and 4.2.3.

#### ***4.2.1 Sample description***

The participants of this research were from multiple organisations and organisational hierarchies which provided the benefit of understanding the context from multiple



perspectives. The industry sectors of the participating organisations were IT, engineering, analytics, consulting, banking and healthcare. The job profiles of the participants ranged from early career and mid-level professionals to top-level management and CEOs. For reporting purposes, the job profiles of the participants were coded into the categories based upon the nature of the role as shown in table 21. Previous studies (Lee & Wingreen, 2010; Todd, McKeen, & Gallupe, 1995) were researched to get a general idea about coding the job profiles in organisations which formed a guideline while creating these job categories. The coding of these categories was done by the researcher and the coded categories were checked by a senior IS scholar in order to ensure reliability.

<b>Category</b>	<b>Job profiles included</b>
<b>Analyst/ Consultant</b>	Analyst, Business analyst, Consultant, Data analyst, Senior (Sr.) analyst, Sr. consultant
<b>CEO/Top management</b>	CEO, Director, General manager, Partner, President, Vice-president
<b>Engineer - non technical</b>	Engineer, Senior engineer
<b>Executive</b>	Human resource (HR) executive, Marketing executive, Senior executive, Sales and marketing associate
<b>Manager</b>	Accounts manager, IT delivery manager, IT manager, Manager, Marketing manager, Programme manager, Project manager, Senior manager
<b>Quality assurance (QA) analyst</b>	QA analyst, Senior test engineer, Test engineer
<b>Software developer</b>	Front-end developer, Software developer, Software engineer, Sr. software developer, Sr. web developer , Web developer
<b>Team leader</b>	Marketing lead, Programme lead, Project lead, Team lead, Team leader, Technical lead

Table 21. Job profiles of the participants grouped by category

A breakdown by job profiles of participants is represented by figure 2.

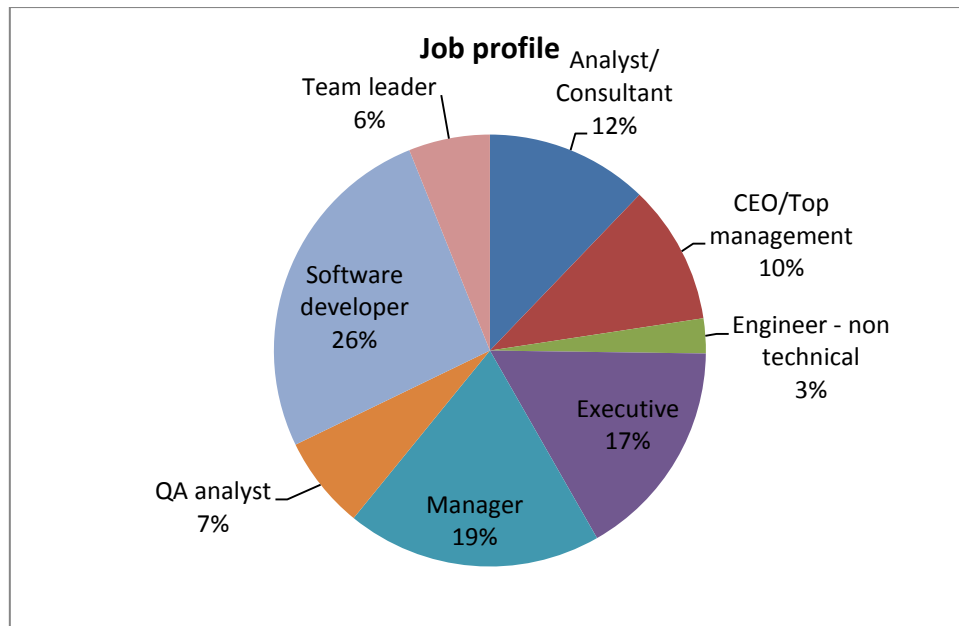


Figure 2. Breakdown by job profiles of the participants

The participants were both male (76%) and female (24%). This was important in terms of reducing the skewness of the sample. The proportion of male participants and female participants is shown in the figure below. A higher proportion of male participants can be attributed to the common workplace scenario found in many sample organisations.

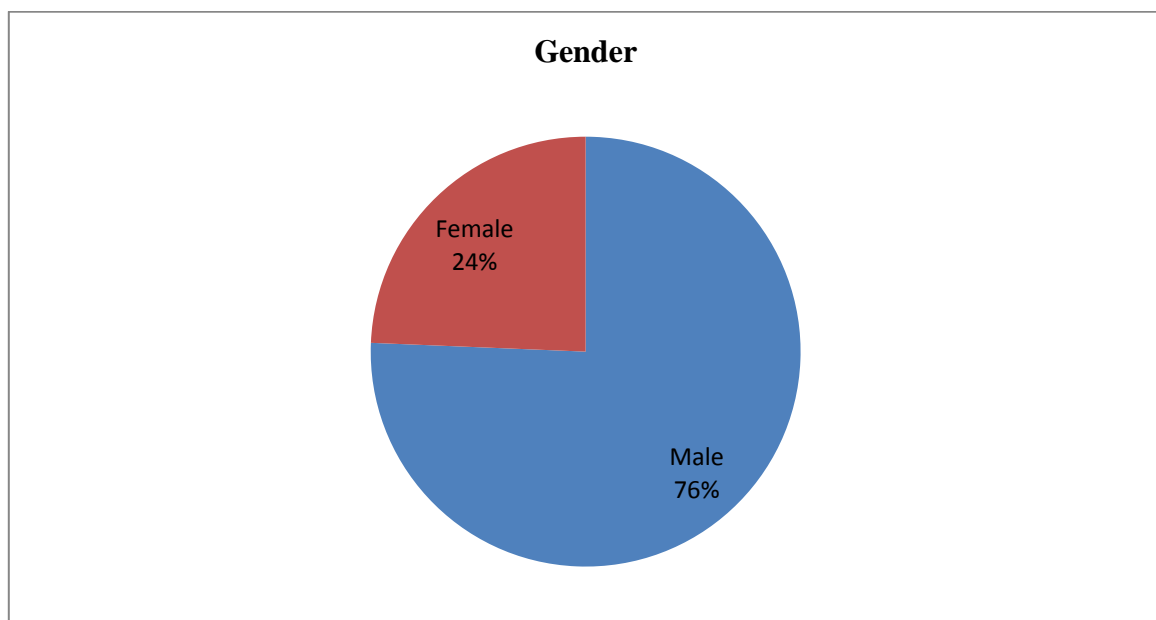


Figure 3. Breakdown by gender of the participants

The demographic profile of the participants is presented in table 22.

<b>Demographic variable (N=115)</b>	<b>Frequency</b>	<b>Percentage (%)</b>
<b>Gender</b>		
Male	87	76%
Female	28	24%
<b>Age group</b>		
18-29	72	63%
30-39	24	21%
40-59	16	14%
60+	3	3%
<b>Job profile (category)</b>		
Analyst/Consultant	14	12%
CEO/Top management	12	10%
Engineer - non technical	3	3%
Executive	19	17%
Manager	22	19%
QA analyst	8	7%
Software developer	30	26%
Team leader	7	6%
<b>Team size (Number of team members)</b>		
Up to 5	32	28%
6-10	31	27%
10-20	22	19%
21-50	20	17%
More than 50	10	9%
<b>Team members spread across (Number of locations)</b>		
2	28	24%
3	59	51%
4	16	14%
More than 4	12	10%

Table 22. Demographic profile of the participants

All of the participants were working in virtual teams and were using social media tools (one or more) for coordinating their work and other tasks. The social media tools used by the participants, their number, and time spent on social media tools each day are shown in table 23.

<b>Variable (N=115)</b>	<b>Frequency</b>	<b>Percentage of participants</b>
<b>Social media tool(s)</b>		
Internal blog	13	11%
Internal discussion forum	44	38%
Internal portal (Intranet portal)	28	24%
Lync	22	19%
Other	6	5%
Other enterprise social networks (Asana, Confluence, Jive, SAP Jam, Slack, TheHub, Tibbr)	29	25%
Salesforce chatter	9	8%
Sharepoint (integrated with social network and wiki)	24	21%
WhatsApp	39	34%
Internal wiki	11	10%
Yammer	9	8%
<b>Number of social media tools used</b>		
1	27	23%
2	64	56%
3	19	17%
4	5	4%
<b>Time spent on social media tools each day</b>		
0-2 hours	89	77%
2-5 hours	22	19%
5+ hours	4	3%

Table 23. Details of social media tools used, number and time spent by participants

The findings indicate that the participants used social media tools for various purposes including communication, knowledge management, document sharing and progress reporting. All of the participants indicated that they use social media tools for one or more of these activities.

Seventy four percent of participants used social media tools for communication while twenty six percent indicated no use of social media tools for communication.

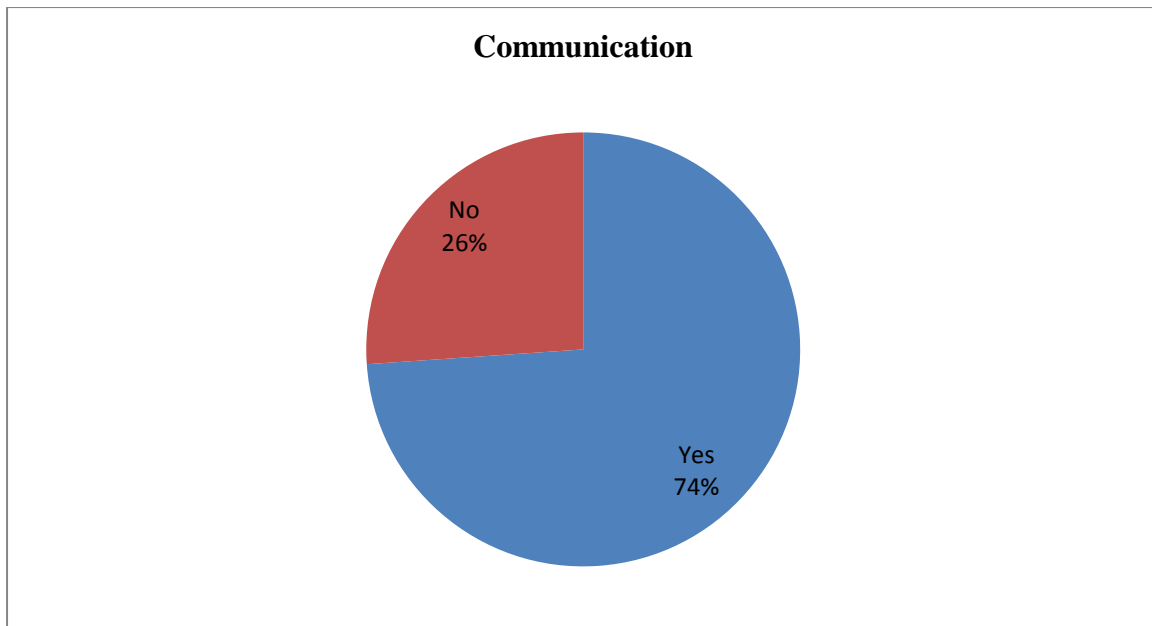


Figure 4. Percentage of participants using and not using social media tools for communication

Sixty-five percent of the participants indicated that they used some form of social media tool for knowledge management purposes, and thirty-five percent indicated that they did not use any social media tool for knowledge management.

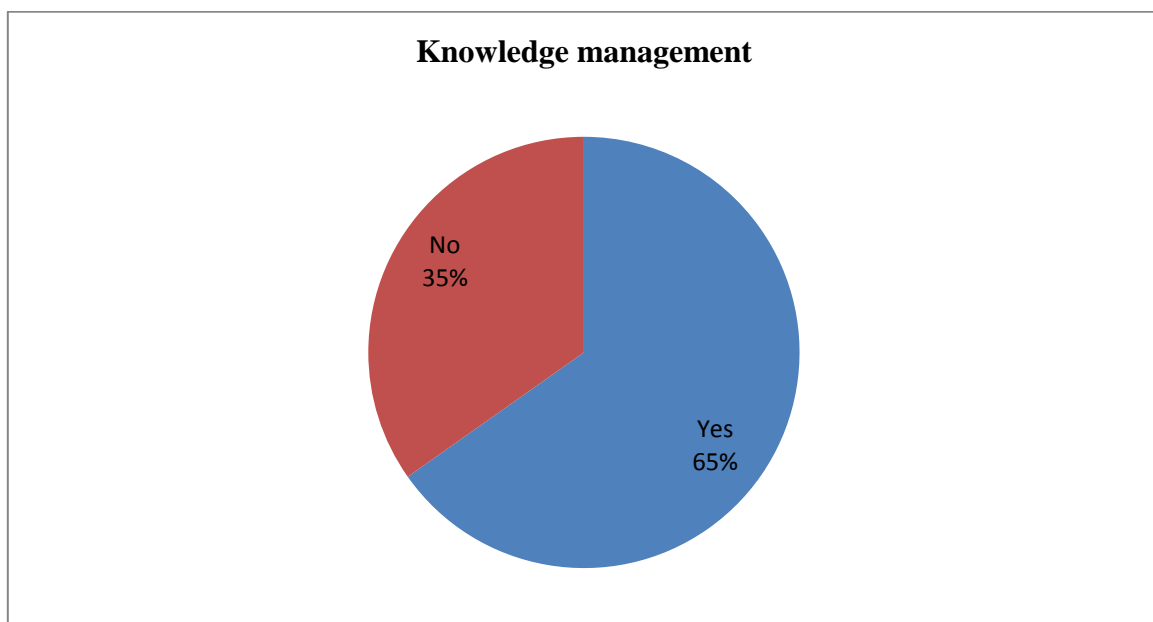


Figure 5. Percentage of participants using and not using social media tools for knowledge management

Seventy-two percent of the participants reported that they used some form of social media tool for sharing their project related documents, and twenty eight percent reported no use of social media tools for document sharing purposes.

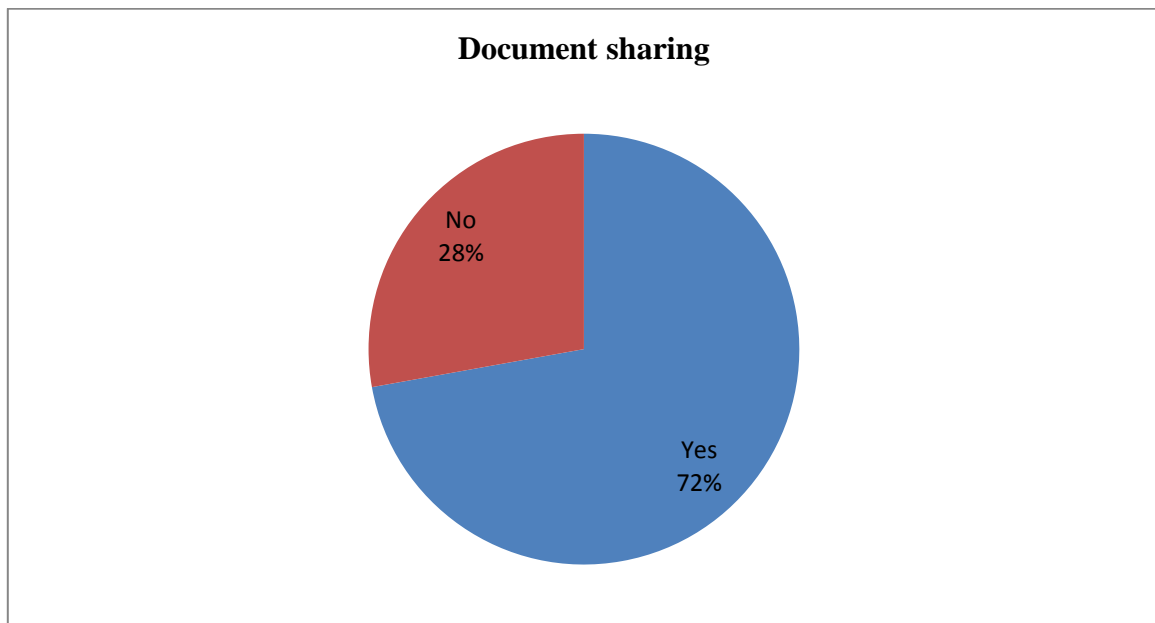


Figure 6. Percentage of participants using and not using social media tools for document sharing

Sixty percent of the participants suggested that they used some form of social media tool for progress reporting purposes, while the remaining forty percent reported no use of social media tools for progress reporting purposes.

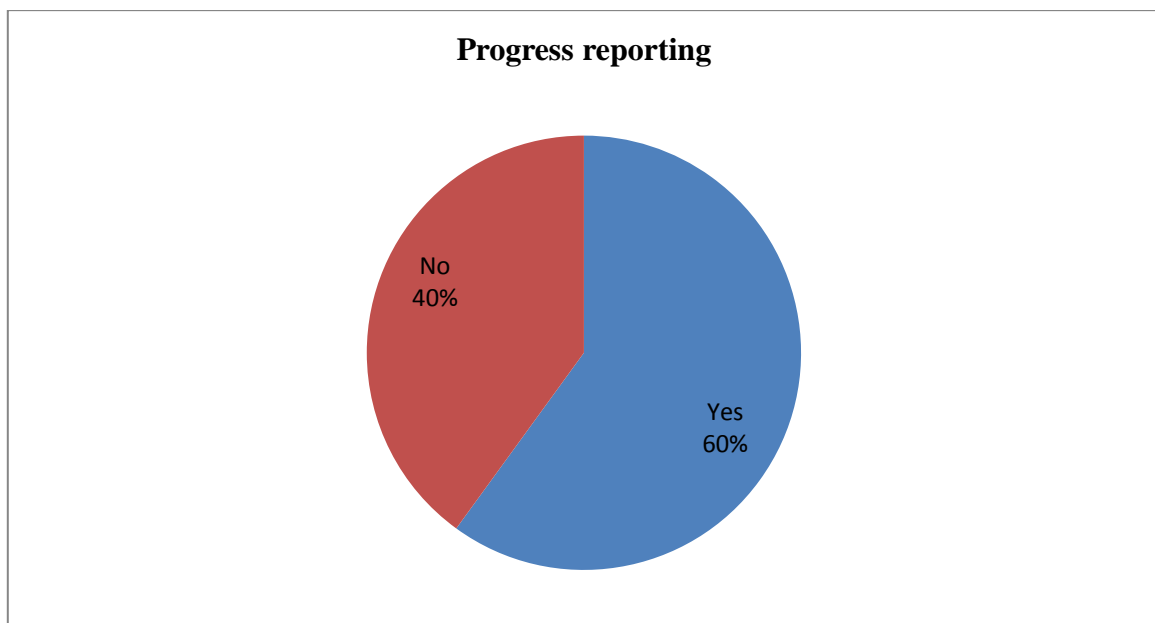


Figure 7. Percentage of participants using and not using social media tools for progress reporting

Apart from the four project related activities, communication, knowledge management, document sharing and progress reporting, some participants suggested that they used some form of social media tool for other activities such as networking within the organisation, disseminating inter-organisational news, developing methodologies, project planning with team members, recording team happiness index, event management, motivating team members, fixing meetings, and communicating with the clients. This is indicative of the widespread and varied use of social media tools in the sample organisations. The findings also suggest that social media tools were an important component of the work practices in the sample organisations.

Communication tools such as email, phone, other project management tools and fax were also used by the participants for communication purposes alongside social media tools. However, a sizable proportion of their communication was through the use of social media tools. On an average, the participants used social media tools for communication purposes for thirty-five percent of their time. Fourteen participants suggested that they used social media tools for communication purposes for more than 50% of their time. This gives an indication of the importance of social media tools for communication purposes in the participant organisations.

Twenty percent of the participants indicated that their experience with social media tools was excellent, and another sixty one percent suggested that their experience was good. Eighteen percent rated their experience as neutral and only one percent of the participants suggested that their experience with social media tools was not good. None of the participants indicated that their experience with social media tools was not at all good. These numbers indicate that social media tools were accepted by the users in the participating organisations and also suggest a good level of satisfaction with these tools.

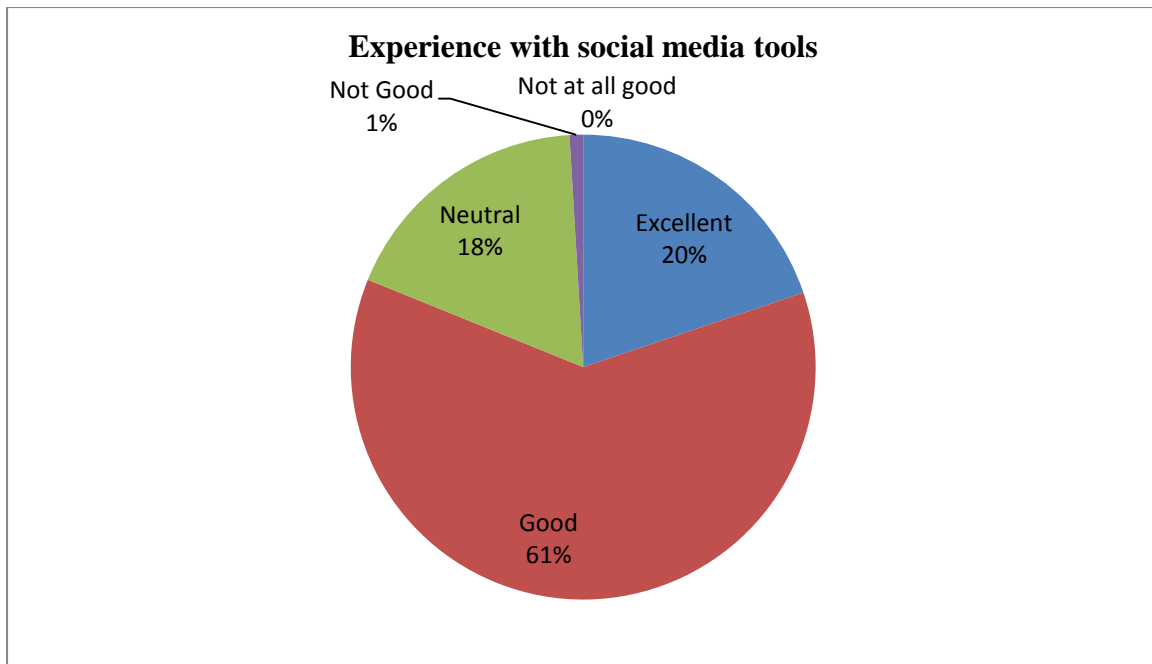


Figure 8. Breakdown by the experience of the participants with social media tools

Nineteen percent of the participants suggested that the team members never meet face-to-face and twenty-four percent suggested that the team members meet rarely. Twenty one percent suggested that the team members meet every couple of months and another twenty one percent suggested that team members meet every month. Fifteen percent suggested that the team members meet every week.

The findings suggest that the sample was appropriate and representative of the population of interest.

#### ***4.2.2 Likert questionnaire findings***

The participants were instructed to sort the 6-point Likert questionnaire according to their experiences with social media tools. The instruction statement read “Thinking about your team’s project communication, collaboration and other project related activities that are carried out through social media only, please answer the questionnaire. All your responses will be kept strictly confidential and anonymous”. A general analysis comprising an examination of the raw data was undertaken to understand the basic trends in the data. The raw data was then imported on the IBM SPSS Statistics software and a descriptive analysis for each of the virtual team dynamics viz trust, team cohesion, satisfaction, conflicts, communication effectiveness and leadership was undertaken. A similar analysis was also



conducted on the communication tool and TMS items. Although, PLS-SEM does not require data normality and can provide reliable estimates even with non-normal data and a small sample size (Hair et al., 2011; Hair et al., 2013), an examination of the means and standard deviation (std. deviation) was undertaken. The results of the analysis are presented below.

#### 4.2.2.1 Trust

All trust items were analysed together to form a set of descriptive statistics. The participants rated the trust items on a 6-point scale of strongly agree (1) - agree (2) - slightly agree (3) - slightly disagree (4) - disagree (5) - strongly disagree (6). The resulting descriptive statistics are shown in table 24.

Trust item	N		Mean	Std. deviation
	Valid	Missing		
Team members work carefully	115	0	2.10	0.84
Team members meet their obligations	115	0	2.18	0.81
Team members contribute to team tasks/success	115	0	1.84	0.79
Team members help resolve the problems in the team	115	0	1.94	0.89
Team members share information even if it is unpleasant	115	0	2.55	1.19
Team members possess high integrity	115	0	2.13	0.98
Team members mislead me (reverse-worded)	115	0	4.72	1.27
Team members keep their promise	115	0	2.34	0.83
Team members freely share ideas and feelings	115	0	2.23	0.97
Team members share important project information with me	115	0	2.02	0.85
Team members avoid retaliation	115	0	2.73	1.28
My opinion is taken into account when important decisions are made	115	0	2.14	0.89
Team members trust me	115	0	1.84	0.78
<b>Column mean</b>	-	-	<b>2.37</b>	<b>0.95</b>

Table 24. Descriptive statistics of the trust items

The descriptive statistics suggest lower mean values (<3) for all the trust items except the item “Team members mislead me”. The lower mean values suggest an agreement with all of

the trust items on the scale. A higher mean value ( $>3$ ) for the item “Team members mislead me” suggests that the participants disagreed with the reverse-worded statement.

#### 4.2.2.2 Team cohesion

The team cohesion items were analysed together in a similar manner as the trust items. The participants rated the team cohesion items on a 6-point scale of strongly agree (1) - agree (2) - slightly agree (3) - slightly disagree (4) - disagree (5) - strongly disagree (6). The resulting descriptive statistics are shown in table 25.

Team cohesion item	N		Mean	Std. deviation
	Valid	Missing		
I am happy with the team's level of task commitment	115	0	2.10	0.85
I have conflicting aspirations for the team's performance (reverse-worded)	115	0	4.53	1.22
The team gives me opportunities to improve my performance	115	0	1.98	0.82
The team has a collective agreement on tasks	115	0	2.19	0.94
The team has expectations from individual members	115	0	2.02	0.97
Team members get to know of individuals' contribution to the team	115	0	2.10	0.91
Team members spend time socializing on the communication tool	115	0	2.85	1.31
Team members have fun on the communication tool apart from work	115	0	2.79	1.40
The team is cohesive	115	0	2.26	0.92
<b>Column mean</b>	-	-	<b>2.54</b>	<b>1.04</b>

Table 25. Descriptive statistics of the team cohesion items

An examination of the descriptive statistics suggests lower mean values for all of the team cohesion items except the item “I have conflicting aspirations for the team's performance”. A higher mean value indicates that the participants disagreed with this reverse-worded item. The items “Team members spend time socializing on the communication tool” and “Team members have fun on the communication tool apart from work” had lower mean values ( $<3$ ) which is different from what was observed during the pilot test. Hence, these two items worked as expected in the actual primary data collection phase.

#### 4.2.2.3 Satisfaction

Satisfaction items were analysed together to yield a set of descriptive statistics. The participants rated the satisfaction items on a 6-point scale of strongly agree (1) - agree (2) - slightly agree (3) - slightly disagree (4) - disagree (5) - strongly disagree (6). The results of the analysis are shown in table 26.

Satisfaction item	N		Mean	Std. deviation
	Valid	Missing		
I am satisfied with my team members	115	0	2.03	0.86
I am pleased with the way other team members and I work together.	115	0	2.03	0.82
I am very satisfied with working in this team	115	0	2.09	0.92
I am satisfied with team members' contribution to the team	115	0	2.10	0.84
Some aspects of the team could be better (reverse-worded)	115	0	2.03	0.93
The team likes working with me	115	0	1.97	0.69
Team members are satisfied with the team	115	0	2.11	0.86
<b>Column mean</b>	-	-	<b>2.05</b>	<b>0.85</b>

Table 26. Descriptive statistics of the satisfaction items

An analysis of the descriptive statistics suggests lower mean values for all of the items representing satisfaction. A lower mean value represents agreement with all these items including the reverse-worded item “Some aspects of the team could be better”.

#### 4.2.2.4 Conflicts

The conflict items were analysed to reveal some descriptive statistics. The participants rated the conflict items on a 6-point scale of strongly agree (1) - agree (2) - slightly agree (3) - slightly disagree (4) - disagree (5) - strongly disagree (6). The results of the analysis are presented in table 27.

Conflict item	N		Mean	Std. deviation
	Valid	Missing		
The team does not have a divided approach towards the project	115	0	2.11	0.71
Team members remember critical project information	115	0	2.16	0.92
Team members' ideas are often conflicting (reverse-worded)	115	0	3.92	1.19
Team members often disagree on decisions (reverse-worded)	115	0	4.39	1.10
I have good relations with my team members	115	0	1.94	0.75
The communication tool helps my relationship with my team members work well	115	0	2.29	0.91
There is a lot of friction among the team members (reverse-worded)	115	0	4.16	1.34
There are personality conflicts in the team (reverse-worded)	115	0	4.18	1.22
There is a lot of tension among the team members (reverse-worded)	115	0	4.42	1.21
<b>Column mean</b>	-	-	<b>3.29</b>	<b>1.04</b>

Table 27. Descriptive statistics of the conflict items

The results show lower mean values for the items “The team does not have a divided approach towards the project”, “Team members remember critical project information”, “I have good relations with my team members”, and “The communication tool helps my relationship with my team members work well” which indicates an agreement with all of these items. Similarly, higher mean values for the items “Team members' ideas are often conflicting”, “Team members often disagree on decisions”, “There is a lot of friction among the team members”, “There are personality conflicts in the team”, and “There is a lot of tension among the team members” indicate participants’ disagreement with these reverse-worded items.

#### 4.2.2.5 Communication effectiveness

The items representing communication effectiveness in virtual teams were analysed together in form of descriptive statistics. The participants rated the communication effectiveness items on a 6-point scale of strongly agree (1) - agree (2) - slightly agree (3) - slightly disagree (4) - disagree (5) - strongly disagree (6). The resulting descriptive statistics from the analysis are shown in table 28.

Communication effectiveness item	N		Mean	Std. deviation
	Valid	Missing		
The team is able to respond to a communication breakdown well	115	0	2.26	0.82
There is little miscommunication in the team	115	0	2.82	1.17
The team was created over six months ago	115	0	2.83	1.73
The team has a set communication plan	115	0	2.52	1.13
The team has clear communication policies	115	0	2.81	1.28
Team members communicate their feelings honestly	115	0	2.35	0.97
Team members display mutual respect	115	0	2.03	0.77
Team members communicate problems easily	115	0	2.17	0.85
There is information overload (reverse-worded)	115	0	3.88	1.31
<b>Column mean</b>	-	-	<b>2.63</b>	<b>1.11</b>

Table 28. Descriptive statistics of the communication effectiveness items

Lower mean values were observed for most of the items on the communication effectiveness scale which indicates an agreement with these items. A higher mean value for the reverse-worded item “There is information overload” indicates a disagreement with it.

#### 4.2.2.6 Communication tool

The items representing communication tool were analysed together in form of descriptive statistics. The participants rated the communication tool items on a 6-point scale of strongly agree (1) - agree (2) - slightly agree (3) - slightly disagree (4) - disagree (5) - strongly disagree (6). The results of the analysis are shown in table 29.

Communication tool item	N		Mean	Std. deviation
	Valid	Missing		
The team heavily relies on the communication technology	115	0	2.41	1.07
The team experiences problems with the communication technology (reverse-worded)	115	0	3.90	1.29
I prefer multiple communication channels	115	0	2.43	1.17
The team experiences communication breakdowns (reverse-worded)	115	0	3.73	1.26
The team experiences communication breakdowns frequently (reverse-worded)	115	0	4.23	1.24
This communication channel is really good	115	0	2.36	0.94
Communication tool ensures participation from all team members	115	0	2.34	0.98
The communication tool ensures transparency	115	0	2.37	1.04
The communication tool makes the team work together	115	0	2.28	1.00
<b>Column mean</b>	-	-	<b>2.89</b>	<b>1.11</b>

Table 29. Descriptive statistics of the communication tool items

The descriptive statistics reveal that the participants expressed their agreement with most of the items about the communication tool as suggested by lower mean values. A higher mean value for items “The team experiences problems with the communication technology”, “The team experiences communication breakdowns”, and “The team experiences communication breakdowns frequently” indicates a disagreement with all of the reverse-worded items.

#### 4.2.2.7 Leadership

The Likert questionnaire items representing leadership were analysed for their descriptive statistics. The participants rated the leadership items on a 6-point scale of strongly agree (1) - agree (2) - slightly agree (3) - slightly disagree (4) - disagree (5) - strongly disagree (6). The descriptive statistics resulting from the analysis are presented in table 30.

Leadership item	N		Mean	Std. deviation
	Valid	Missing		
The team leader/manager establishes clear set of goals	115	0	2.08	0.92
The manager spends time motivating and boosting team spirit	115	0	2.37	1.10
The manager gives good feedback to the team members despite being geographically dispersed	115	0	2.35	1.04
The manager integrates the team well	115	0	2.26	0.95
The manager monitors the team and signals any trouble	115	0	2.29	0.95
The manager is vigilant	115	0	2.43	0.97
The manager makes informed decisions on team issues	115	0	2.13	0.76
The manager has an influence over the team	115	0	2.23	0.91
This communication tool helps the manager to manage the team well	115	0	2.30	1.04
<b>Column mean</b>	-	-	<b>2.27</b>	<b>0.96</b>

Table 30. Descriptive statistics of the leadership items

A lower mean value for all the leadership items suggests participants’ agreement with these items.

#### 4.2.2.8 Transactive memory system

Finally, the Likert questionnaire items representing TMS were analysed to see what the participants felt about the TMS. The participants rated the TMS items on a 6-point scale of strongly agree (1) - agree (2) - slightly agree (3) - slightly disagree (4) - disagree (5) - strongly disagree (6). The results of the analysis are shown in table 31.

TMS item	N		Mean	Std. deviation
	Valid	Missing		
I seek specialist team members' expertise when needed	115	0	1.84	0.86
Team members seek my expertise when needed	115	0	1.85	0.81
I know other team members' skills well	115	0	2.08	0.88
The team members have the right skills for the project	115	0	2.09	0.87
The team is united while working on the project	115	0	1.90	0.90
Team members agree on most of the decisions	115	0	2.20	0.75
I feel that the team is more knowledgeable than individual members	115	0	1.80	0.75
The team is really effective	115	0	2.07	0.89
Team members' motives are good for the team	115	0	2.08	0.79
I can rely on other team members	115	0	2.35	1.08
I trust other team members	115	0	1.97	0.92
Team members respond constructively to my problems	115	0	2.15	0.81
<b>Column mean</b>	-	-	<b>2.03</b>	<b>0.86</b>

Table 31. Descriptive statistics of the transactive memory system items

The findings suggest lower mean values for all the items on the TMS scale. The participants agreed with all of the items on the TMS scale as suggested by the descriptive statistics.

#### 4.2.3 PLS structural equation modelling

The Likert questionnaire data was analysed with the SmartPLS software and the measurement and structural models were assessed. PLS-SEM provided statistical robustness

in the estimates and also minimised the effect of statistical specification problems such as multicollinearity (Westlund, Källström, & Parmler, 2008).

A nested modelling approach was used to identify the more comprehensive model which explained the phenomenon of interest more clearly (Bollen, 2014; Pedhazur & Schmelkin, 2013). Nested modelling is a powerful approach to test different models in light of the theory and the data. A nested model is one of the cases of a more comprehensive or specialised model. The data analysis tested nested research models (Bollen, 2014; Pedhazur & Schmelkin, 2013) showing that social media tools positively affected virtual team dynamics, and the effect was mediated (fully or partially) by the TMS of the virtual team. The models named 'Model without TMS' and 'Model with TMS' are discussed below. An examination of these models using a nested modelling approach is also discussed.

#### *4.2.3.1 Model without TMS*

This analysis refers to the measurement and structural model assessment, without the introduction of a TMS construct (latent variable).

##### *4.2.3.1.1 Measurement model assessment*

In this phase of data analysis, the measurement model was assessed for the reliability and validity of the constructs. All the constructs were modelled to be reflective based upon their item correlations and where applicable the construct's previous development and validation as a reflective construct. An examination of the reliability, convergent validity, and the discriminant validity was undertaken, and the results are discussed in this section.

*Reliability:* Internal consistency reliability was used to measure the reliability of all constructs in this research (Hair et al., 2013). In order to determine internal consistency, composite reliability (CR) was examined using the SmartPLS software (Chin, 2010; Hair et al., 2013). The CRs ranged from 0.874 to 0.944 (see table 32) and were above the 0.70 level. Thus, the internal consistency of all the constructs was established and all constructs were reliable (Hair et al., 2013).

Factor loadings for all the items were also examined. The factor loadings ranged from 0.713 to 0.933. All factor loadings were above the recommended 0.70 level (see table 32).



<b>Construct/Item</b>	<b>Factor loadings</b>	<b>CR</b>	<b>AVE</b>
<b>Communication tool</b>		<b>0.932</b>	<b>0.820</b>
CT7	0.921		
CT8	0.861		
CT9	0.933		
<b>Trust</b>		<b>0.922</b>	<b>0.798</b>
T1	0.919		
T2	0.894		
T3	0.866		
<b>Team cohesion</b>		<b>0.874</b>	<b>0.636</b>
TC1	0.834		
TC4	0.837		
TC6	0.783		
TC9	0.731		
<b>Satisfaction</b>		<b>0.944</b>	<b>0.772</b>
S1	0.886		
S2	0.898		
S3	0.898		
S4	0.891		
S7	0.820		
<b>Conflicts</b>		<b>0.900</b>	<b>0.642</b>
CON3	0.818		
CON4	0.771		
CON7	0.792		
CON8	0.822		
CON9	0.803		
<b>Communication effectiveness</b>		<b>0.917</b>	<b>0.735</b>
CE1	0.817		
CE6	0.865		
CE7	0.857		
CE8	0.888		
<b>Leadership</b>		<b>0.932</b>	<b>0.605</b>
L1	0.798		
L2	0.776		
L3	0.713		
L4	0.817		
L5	0.801		
L6	0.778		
L7	0.843		
L8	0.723		
L9	0.745		

Table 32. Factor loadings, CR and AVE (model without TMS)

*Convergent validity:* Convergent validity refers to the extent to which a measure correlates positively with different measures of the same construct (Hair et al., 2013). Convergent validity can be measured using average variance extracted (AVE). Accordingly, an AVE value of 0.50 or above indicates a satisfactory convergent validity. AVE values above 0.50 indicate that the construct explains more than half of the variance in its indicators (items). In this research the AVE values ranged from 0.605 to 0.820 (see table 32), which were well over the accepted 0.50 AVE cut-off.

*Discriminant validity:* Discriminant validity suggests that a construct is unique and explains a phenomenon which is not represented by any other constructs in the research model (Hair et al., 2013; Straub et al., 2004). Discriminant validity was measured using two approaches in this research: (i) by comparing the square root of the AVE with the correlations among the constructs in the research model, and (ii) by examining whether each item loads higher on its own construct than any other constructs in the research model.

By using the first approach to examine discriminant validity, the results showed that the square root of the AVE for each construct was more than its highest correlation with any other construct. Hence, discriminant validity was established and the results are shown in table 33.

<b>Construct</b>	<b>CR</b>	<b>AVE</b>	Communication tool	Trust	Team cohesion	Satisfaction	Conflicts	Communication effectiveness	Leadership
Communication tool	<b>0.932</b>	<b>0.820</b>	<b>0.906</b>						
Trust	<b>0.922</b>	<b>0.798</b>	0.510	<b>0.893</b>					
Team cohesion	<b>0.874</b>	<b>0.636</b>	0.594	0.705	<b>0.797</b>				
Satisfaction	<b>0.944</b>	<b>0.772</b>	0.477	0.713	0.769	<b>0.879</b>			
Conflicts	<b>0.900</b>	<b>0.642</b>	-0.127	-0.275	-0.154	-0.241	<b>0.801</b>		
Communication effectiveness	<b>0.917</b>	<b>0.735</b>	0.508	0.653	0.669	0.714	-0.283	<b>0.857</b>	
Leadership	<b>0.932</b>	<b>0.605</b>	0.597	0.670	0.694	0.690	-0.291	0.665	<b>0.778</b>

Table 33. Correlations between constructs in the model without TMS (Square root of AVE on the diagonal)

Discriminant validity was also examined using a second approach; by examining whether each item loaded higher on its own construct than any other construct. The results indicate

that each item loaded higher on its own construct than other constructs, and hence discriminant validity was established. The results are shown in table 34.

Indicator	Factor loading	Communication tool	Trust	Team cohesion	Satisfaction	Conflicts	Communication effectiveness	Leadership
CT7	0.921	0.921	0.572	0.585	0.505	-0.136	0.511	0.577
CT8	0.861	0.861	0.404	0.499	0.370	-0.112	0.398	0.495
CT9	0.933	0.933	0.389	0.520	0.405	-0.094	0.460	0.542
T1	0.919	0.521	0.919	0.620	0.640	-0.309	0.602	0.616
T2	0.894	0.446	0.894	0.678	0.673	-0.167	0.571	0.631
T3	0.866	0.383	0.866	0.593	0.597	-0.252	0.577	0.540
TC1	0.834	0.483	0.741	0.834	0.728	-0.179	0.618	0.648
TC4	0.837	0.546	0.497	0.837	0.563	-0.121	0.573	0.525
TC6	0.783	0.405	0.504	0.783	0.597	-0.016	0.434	0.494
TC9	0.731	0.440	0.508	0.731	0.571	-0.165	0.489	0.544
S1	0.886	0.373	0.633	0.678	0.886	-0.185	0.586	0.593
S2	0.898	0.465	0.660	0.751	0.898	-0.205	0.727	0.621
S3	0.898	0.408	0.590	0.663	0.898	-0.200	0.535	0.590
S4	0.891	0.451	0.682	0.735	0.891	-0.236	0.706	0.669
S7	0.820	0.384	0.556	0.528	0.820	-0.233	0.556	0.550
CON3	0.818	-0.143	-0.174	-0.141	-0.138	0.818	-0.165	-0.308
CON4	0.771	-0.056	-0.307	-0.230	-0.254	0.771	-0.242	-0.166
CON7	0.792	-0.078	-0.201	-0.015	-0.125	0.792	-0.146	-0.178
CON8	0.822	-0.071	-0.245	-0.110	-0.153	0.822	-0.283	-0.197
CON9	0.803	-0.111	-0.235	-0.134	-0.312	0.803	-0.324	-0.237
CE1	0.817	0.401	0.582	0.570	0.594	-0.265	0.817	0.541
CE6	0.865	0.452	0.488	0.510	0.593	-0.242	0.865	0.568
CE7	0.857	0.387	0.570	0.592	0.593	-0.251	0.857	0.529
CE8	0.888	0.490	0.602	0.623	0.663	-0.220	0.888	0.633
L1	0.798	0.525	0.611	0.569	0.571	-0.203	0.587	0.798
L2	0.776	0.392	0.444	0.431	0.460	-0.152	0.431	0.776
L3	0.713	0.325	0.443	0.448	0.502	-0.190	0.512	0.713
L4	0.817	0.535	0.537	0.607	0.549	-0.203	0.510	0.817
L5	0.801	0.444	0.590	0.602	0.647	-0.282	0.566	0.801
L6	0.778	0.461	0.560	0.590	0.501	-0.316	0.510	0.778
L7	0.843	0.468	0.578	0.622	0.622	-0.238	0.598	0.843
L8	0.723	0.349	0.376	0.421	0.454	-0.194	0.413	0.723
L9	0.745	0.569	0.490	0.506	0.506	-0.243	0.502	0.745

Table 34. Item loadings and cross loadings for constructs (model without TMS)

#### 4.2.3.1.2 Structural model assessment

The structural model was examined to perform an evaluation of the model. The structural model assessment was the next step after reliability and validity assessment of the measurement model. In order to compute the strength of the structural paths, bootstrapping using 1000 samples was conducted. Bootstrapping also evaluated the product-indicator approach to provide an assessment of the interaction effect (Chin, Marcolin, & Newsted, 2003).

The results of the structural model analysis are shown in figure 9. The results revealed the structural model accounted for 0.261 of the variance explained for trust. The communication tool, social media in this case, was positively related with trust (0.510,  $p < 0.001$ ), implying that social media tools positively affected trust in virtual teams.

In the case of team cohesion, the structural model accounted for 0.352 of the variance explained for team cohesion. Hence, the communication tool, social media, was positively related with team cohesion (0.594,  $p < 0.001$ ). This implied that social media tools positively affected team cohesion in virtual teams.

Moving further to satisfaction, the model accounted for 0.227 of the variance explained for satisfaction. The communication tool, social media, was positively related with satisfaction (0.477,  $p < 0.001$ ). This suggested that social media tools positively affected satisfaction in virtual teams.

The model accounted for 0.016 of the variance explained in conflicts and the communication tool, social media, was not significant with respect to conflicts (-0.127). A small negative path from communication tool to conflicts was rejected on account of insignificance. This was contrary to what was expected.

Further investigation revealed that the structural model accounted for 0.258 of the variation explained for communication effectiveness. Social media was positively related with communication effectiveness (0.508,  $p < 0.001$ ), suggesting that social media tools led to communication effectiveness in virtual teams.

Finally, the model explained 0.356 of the variance in leadership. The communication tool, social media, was positively related with leadership (0.597,  $p < 0.001$ ). This led to the conclusion that social media tools positively affected leadership in virtual teams.

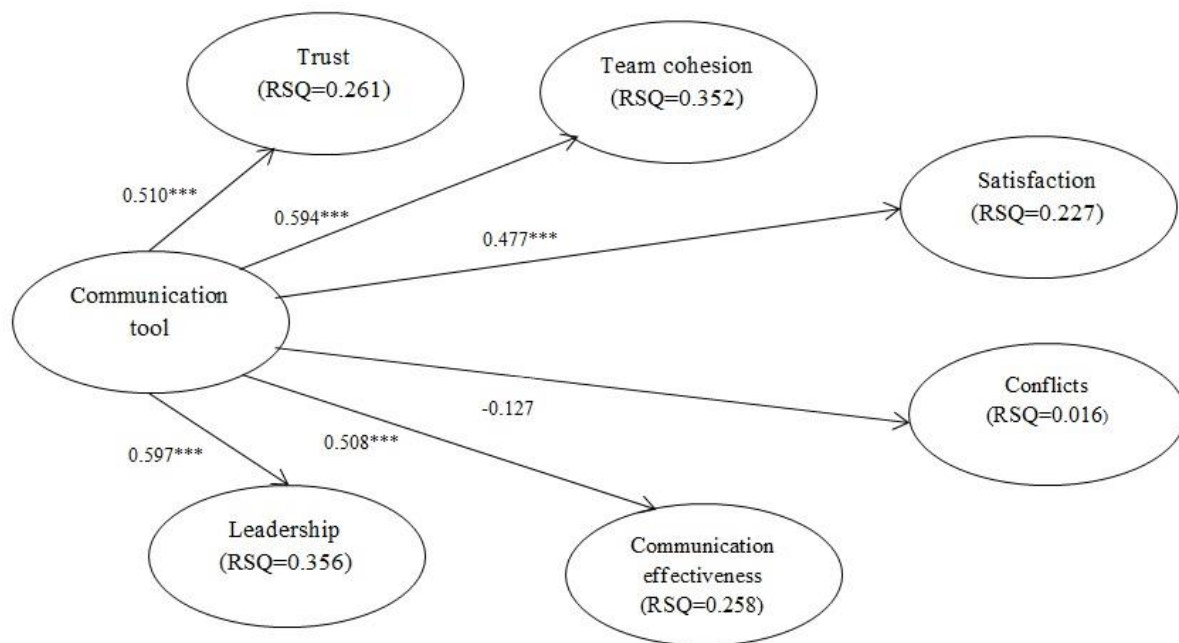


Figure 9. Structural model without TMS (\*\*\* $p < 0.001$ )

#### 4.2.3.2 Model with TMS

This analysis refers to the measurement and structural model assessment, with the introduction of a TMS construct (latent variable).

##### 4.2.3.2.1 Measurement model assessment

In this phase of data analysis, the measurement model was assessed for the reliability and validity of the constructs. All the constructs were modelled to be reflective. An examination of the reliability, convergent validity, and the discriminant validity was undertaken, and the results are discussed in this section.

**Reliability:** Internal consistency reliability was used to measure the reliability in this research (Hair et al., 2013). In order to determine internal consistency, composite reliability (CR) was examined using the SmartPLS software (Chin, 2010; Hair et al., 2013). The CRs ranged from

0.874 to 0.944 (see table 35) and were above the 0.70 level. Thus, the internal consistency of all the constructs was established and all constructs were reliable (Hair et al., 2013). Factor loadings for all the items were also examined.

The factor loadings ranged from 0.728 to 0.934. All factor loadings were above the recommended 0.70 level (see table 35).

<b>Construct/Item</b>	<b>Factor loadings</b>	<b>CR</b>	<b>AVE</b>
<b>Communication tool</b>		<b>0.932</b>	<b>0.820</b>
CT7	0.921		
CT8	0.860		
CT9	0.934		
<b>Transactive memory system</b>		<b>0.880</b>	<b>0.648</b>
TMS7	0.768		
TMS8	0.834		
TMS9	0.810		
TMS12	0.807		
<b>Trust</b>		<b>0.923</b>	<b>0.799</b>
T1	0.908		
T2	0.892		
T3	0.881		
<b>Team cohesion</b>		<b>0.874</b>	<b>0.636</b>
TC1	0.836		
TC4	0.817		
TC6	0.775		
TC9	0.757		
<b>Satisfaction</b>		<b>0.944</b>	<b>0.772</b>
S1	0.888		
S2	0.899		
S3	0.895		
S4	0.896		
S7	0.812		
<b>Conflicts</b>		<b>0.902</b>	<b>0.648</b>
CON3	0.748		
CON4	0.839		
CON7	0.767		
CON8	0.848		
CON9	0.811		
<b>Communication effectiveness</b>		<b>0.917</b>	<b>0.736</b>
CE1	0.825		
CE6	0.853		
CE7	0.873		
CE8	0.878		
<b>Leadership</b>		<b>0.933</b>	<b>0.607</b>
L1	0.795		
L2	0.779		
L3	0.728		
L4	0.819		
L5	0.799		
L6	0.771		
L7	0.851		
L8	0.732		
L9	0.728		

Table 35. Factor loadings, CR and AVE (model with TMS)

*Convergent validity:* Convergent validity refers to the extent to which a measure correlates positively with different measures of the same construct (Hair et al., 2013). Convergent validity can be measured using average variance extracted (AVE). Accordingly, an AVE value of 0.50 or above indicates a satisfactory convergent validity. AVE values above 0.50 indicate that the construct explains more than half of the variance in its indicators (items). In this research the AVE values ranged from 0.607 to 0.820 (see table 35), which were well over the accepted 0.50 AVE cut-off.

*Discriminant validity:* Discriminant validity suggests that a construct is unique and explains a phenomenon which is not represented by any other constructs in the research model (Hair et al., 2013; Straub et al., 2004). Discriminant validity was measured using two approaches in this research: (i) by comparing the square root of the AVE with the correlations among the constructs in the research model, and (ii) by examining whether each item loads higher on its own construct than any other constructs in the research model.

By using the first approach to examine discriminant validity, the results showed that the square root of the AVE for each construct was more than its highest correlation with any other construct. Hence, discriminant validity was established, and the results are shown in table 36.

Construct	CR	AVE	Communication tool	TMS	Trust	Team cohesion	Satisfaction	Conflicts	Communication effectiveness	Leadership
Communication tool	<b>0.932</b>	<b>0.820</b>	<b>0.906</b>							
TMS	<b>0.880</b>	<b>0.648</b>	0.550	<b>0.805</b>						
Trust	<b>0.923</b>	<b>0.799</b>	0.506	0.749	<b>0.894</b>					
Team cohesion	<b>0.874</b>	<b>0.636</b>	0.592	0.763	0.708	<b>0.797</b>				
Satisfaction	<b>0.944</b>	<b>0.772</b>	0.476	0.755	0.714	0.773	<b>0.879</b>			
Conflicts	<b>0.902</b>	<b>0.648</b>	-0.113	-0.308	-0.295	-0.174	-0.258	<b>0.805</b>		
Communication effectiveness	<b>0.917</b>	<b>0.736</b>	0.505	0.748	0.655	0.670	0.714	-0.301	<b>0.858</b>	
Leadership	<b>0.933</b>	<b>0.607</b>	0.590	0.739	0.666	0.695	0.692	-0.268	0.663	<b>0.779</b>

Table 36. Correlations between constructs in the model with TMS (Square root of AVE on the diagonal)

It is noted that the correlations between trust, team cohesion, satisfaction, communication effectiveness and leadership constructs are high. There may be an existence of a second-order latent construct (Schumacker & Lomax, 2004) which represents interactions between these



constructs. The discussion of the second-order latent construct is beyond the scope of this research.

Discriminant validity was also examined using a second approach, by examining whether each item loaded higher on its own construct than any other construct. The results indicate that each item loaded higher on its own construct than other constructs, and hence discriminant validity was established. The results are shown in table 37.

Indicator	Factor loading	Communication tool	TMS	Trust	Team cohesion	Satisfaction	Conflicts	Communication effectiveness	Leadership
CT7	0.921	0.921	0.539	0.568	0.582	0.505	-0.123	0.509	0.570
CT8	0.860	0.860	0.426	0.401	0.499	0.371	-0.101	0.394	0.490
CT9	0.934	0.934	0.518	0.386	0.519	0.404	-0.080	0.457	0.535
TMS7	0.768	0.310	0.768	0.475	0.614	0.560	-0.235	0.524	0.504
TMS8	0.834	0.540	0.834	0.686	0.647	0.690	-0.293	0.632	0.730
TMS9	0.810	0.481	0.810	0.687	0.622	0.623	-0.236	0.692	0.552
TMS12	0.807	0.409	0.807	0.532	0.572	0.540	-0.222	0.545	0.570
T1	0.908	0.521	0.695	0.908	0.621	0.642	-0.314	0.603	0.613
T2	0.892	0.445	0.655	0.892	0.683	0.674	-0.189	0.572	0.632
T3	0.881	0.383	0.656	0.881	0.596	0.597	-0.286	0.580	0.537
TC1	0.836	0.482	0.628	0.739	0.836	0.731	-0.199	0.621	0.648
TC4	0.817	0.546	0.601	0.496	0.817	0.565	-0.126	0.575	0.520
TC6	0.775	0.405	0.515	0.506	0.775	0.597	-0.040	0.437	0.497
TC9	0.757	0.440	0.673	0.509	0.757	0.572	-0.173	0.488	0.541
S1	0.888	0.372	0.639	0.631	0.681	0.888	-0.200	0.587	0.595
S2	0.899	0.465	0.714	0.659	0.755	0.899	-0.226	0.728	0.622
S3	0.895	0.408	0.610	0.591	0.666	0.895	-0.218	0.529	0.591
S4	0.896	0.451	0.771	0.681	0.735	0.896	-0.252	0.707	0.668
S7	0.812	0.384	0.546	0.556	0.531	0.812	-0.235	0.556	0.549
CON3	0.748	-0.142	-0.208	-0.171	-0.143	-0.138	0.748	-0.164	-0.307
CON4	0.839	-0.056	-0.311	-0.309	-0.232	-0.254	0.839	-0.243	-0.168
CON7	0.767	-0.078	-0.151	-0.200	-0.016	-0.123	0.767	-0.146	-0.177
CON8	0.848	-0.071	-0.241	-0.246	-0.113	-0.152	0.848	-0.284	-0.193
CON9	0.811	-0.111	-0.279	-0.235	-0.137	-0.312	0.811	-0.328	-0.236
CE1	0.825	0.401	0.628	0.582	0.567	0.594	-0.276	0.825	0.539
CE6	0.853	0.452	0.591	0.488	0.513	0.592	-0.255	0.853	0.567
CE7	0.873	0.387	0.691	0.571	0.592	0.597	-0.271	0.873	0.530
CE8	0.878	0.489	0.655	0.602	0.622	0.665	-0.233	0.878	0.634
L1	0.795	0.525	0.618	0.609	0.568	0.572	-0.181	0.588	0.795
L2	0.779	0.392	0.512	0.440	0.432	0.461	-0.125	0.431	0.779
L3	0.728	0.325	0.520	0.441	0.453	0.503	-0.175	0.511	0.728
L4	0.819	0.535	0.618	0.536	0.607	0.550	-0.193	0.508	0.819
L5	0.799	0.444	0.577	0.591	0.602	0.648	-0.273	0.563	0.799
L6	0.771	0.461	0.534	0.559	0.591	0.503	-0.286	0.508	0.771
L7	0.851	0.468	0.685	0.577	0.625	0.623	-0.236	0.596	0.851
L8	0.732	0.349	0.505	0.377	0.428	0.454	-0.175	0.410	0.732
L9	0.728	0.569	0.574	0.489	0.512	0.505	-0.222	0.498	0.728

Table 37. Item loadings and cross loadings for constructs (model with TMS)

#### 4.2.3.2.2 Structural model assessment

Following the reliability and validity assessment of the measurement model, the structural model was examined to provide an insight into the hypotheses and perform an evaluation of the model and to understand the role of TMS construct. Bootstrapping using 1000 samples was conducted to compute the strength of the structural paths. Bootstrapping also evaluated the product-indicator approach to provide an assessment of the interaction effect (Chin et al., 2003).

The results of the structural model analysis are shown in figure 10. The results revealed that the structural model accounted for 0.573 of the variance explained for trust which was higher than R-squared (RSQ) = 0.261 in the model without TMS (figure 9). The communication tool, social media in this case, was not significant with respect to trust (0.134). This was a notable difference when compared with the model without TMS (figure 9).

Similarly, in the case of team cohesion, the structural model (figure 10) accounted for 0.626 of the variance explained for team cohesion which was higher than RSQ=0.352 in the model without TMS (figure 9). The communication tool, social media, was significant with respect to team cohesion (0.245,  $p < 0.05$ ). The path coefficient, however, reduced to 0.245 in this case when compared 0.594 in the model without TMS (figure 9).

Moving further to satisfaction, the model (figure 10) accounted for 0.576 of the variance explained for satisfaction, which was much better than RSQ=0.227 in case of model without TMS (figure 9). The communication tool, social media, was insignificant with respect to satisfaction (0.088) in this model when contrasted with the model without TMS (figure 9).

The structural model accounted for 0.302 of the variance explained for TMS (see figure 10). There was a significant path from communication tool to TMS (0.550,  $p < 0.001$ ), suggesting that the communication tool, social media, positively affected TMS development in virtual teams.

The structural model (figure 10) accounted for 0.103 of the variance explained for conflicts which was better than RSQ=0.016 in the model without TMS (figure 9). Social media, the communication tool, was not significant with respect to conflicts (0.090). A small path from

communication tool to conflicts was rejected on account of insignificance. This was in agreement with the analysis of the model without TMS (figure 9).

Further investigation revealed that the structural model (figure 10) accounted for 0.573 of the variance explained for communication effectiveness. This was higher than  $RSQ=0.258$  in the model without TMS (figure 9). Social media was insignificant with respect to communication effectiveness (0.131).

The structural model (figure 10) explained 0.594 of the variance explained for leadership which was again greater than  $RSQ=0.356$  in the case of model without TMS (figure 9). The communication tool, social media, was significant with respect to leadership (0.261,  $p<0.01$ ). However, when contrasted with the path coefficient in case of model without TMS (figure 9), a reduction in the path coefficient was observed i.e. from 0.597 in the model without TMS to 0.261 in model with TMS.

Finally, the findings revealed that TMS was significant with respect to trust (0.675,  $p<0.001$ ), team cohesion (0.630,  $p<0.001$ ), satisfaction (0.707,  $p<0.001$ ), conflicts (-0.361,  $p<0.05$ ), communication effectiveness (0.677,  $p<0.001$ ), and leadership (0.596,  $p<0.001$ ).

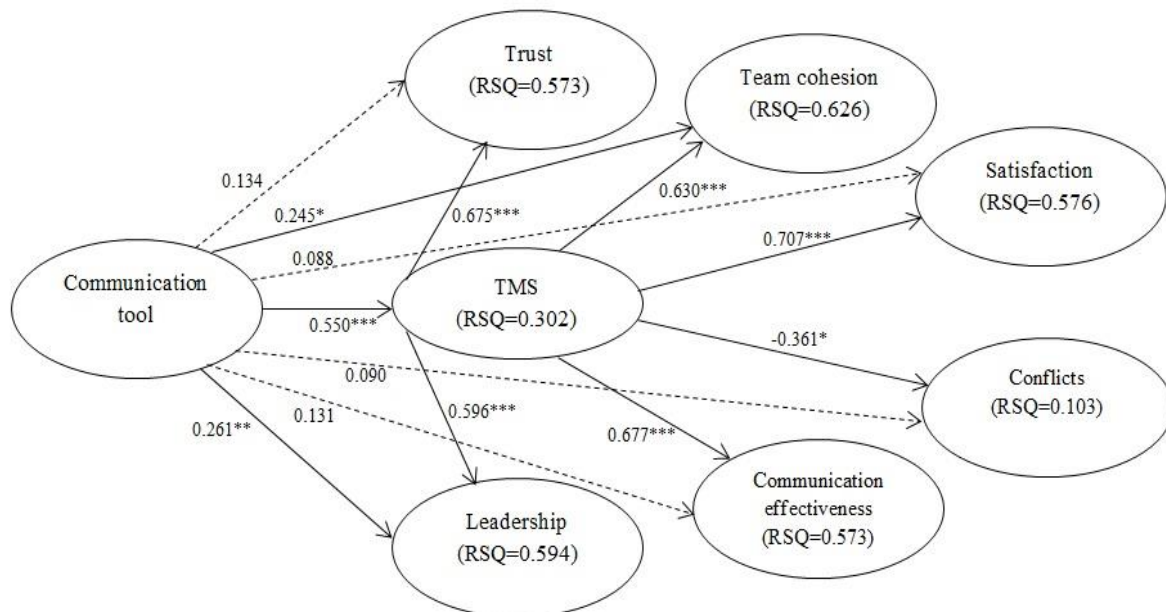


Figure 10. Structural model with TMS (\* $p<0.05$ , \*\* $p<0.01$ , \*\*\* $p<0.001$ )

#### 4.2.3.3 Hypotheses testing

It can now be inferred from an examination of the model with TMS and the model without TMS that the model with TMS is a more comprehensive model and it explained more variance in the constructs representing the model as explained by the RSQ values. A summary of these models is shown in the tables 38 and 39.

<b>Construct</b>	<b>R-squared</b>	<b>Direct path coefficient (communication tool -&gt; construct)</b>	<b>p-value (direct path)</b>	<b>Mediated path coefficient</b>	<b>p-value (mediated path)</b>
Trust	0.261	0.510	p<0.001	-	-
Team cohesion	0.352	0.594	p<0.001	-	-
Satisfaction	0.227	0.477	p<0.001	-	-
Conflicts	0.016	-0.127	NS	-	-
Communication effectiveness	0.258	0.508	p<0.001	-	-
Leadership	0.356	0.597	p<0.001	-	-

Table 38. Model without TMS (NS= not significant)

<b>Construct</b>	<b>R-squared</b>	<b>Direct path coefficient (communication tool -&gt; construct)</b>	<b>p-value (direct path)</b>	<b>Mediated path coefficient (TMS -&gt; construct)</b>	<b>p-value (mediated path)</b>
Trust	0.573	0.134	NS	0.675	p<0.001
Team cohesion	0.626	0.245	p<0.05	0.630	p<0.001
Satisfaction	0.576	0.088	NS	0.707	p<0.001
Conflicts	0.103	0.090	NS	-0.361	p<0.05
Communication effectiveness	0.573	0.131	NS	0.677	p<0.001
Leadership	0.594	0.261	p<0.01	0.596	p<0.001
TMS	0.302	0.550	p<0.001	-	-

Table 39. Model with TMS (NS= not significant)

The findings showed that the communication tool, social media in this case, positively affected the development of TMS in virtual teams. There was a significant path from communication tool to TMS (0.550, p<0.001) which provides support for hypothesis 1.

The model without TMS indicated the existence of a significant path between communication tool, in this case, social media, and virtual team trust (0.510, p<0.001). The model with TMS suggested the existence of an insignificant path between communication tool and trust

(0.134) but a strong significant path between TMS and trust (0.675,  $p < 0.001$ ). It can therefore be inferred that TMS fully mediates the positive effect of social media tools on virtual team trust. Hence, hypothesis 2 is fully supported.

The model without TMS showed the existence of a significant path between communication tool (social media tools) and team cohesion (0.594,  $p < 0.001$ ). The model with TMS showed the existence of a significant path (0.245,  $p < 0.05$ ) between communication tool and team cohesion. It was noted that the path coefficient between communication tool and team cohesion was reduced with the introduction of the TMS construct in the model with TMS. A strong and significant path between TMS and team cohesion (0.630,  $p < 0.001$ ) was found in the model with TMS. It can therefore be inferred that TMS partially mediates the positive effect of social media tools on virtual team cohesion. Hypothesis 3 is therefore supported.

The research findings suggest the existence of a significant path between communication tool, social media in this case, and satisfaction (0.477,  $p < 0.001$ ) when the model without TMS was examined. In the model with TMS, the path between communication tool and satisfaction was rejected on account of insignificance, however there was a significant path between TMS and satisfaction (0.707,  $p < 0.001$ ). It can therefore be concluded that TMS fully mediates the positive effect of social media tools on virtual team satisfaction. Hypothesis 4 is therefore fully supported.

The results of the PLS procedure suggest that the communication tool, social media in this case, was insignificant with respect to conflicts when the model without TMS was examined. A small negative path from the communication tool to conflicts was rejected on account of insignificance (-0.127). An examination of the model with TMS indicated an insignificant path from communication tool to conflicts. However, there was a significant path (-0.361,  $p < 0.05$ ) from TMS to conflicts. It can therefore be concluded that TMS fully mediates the positive effect of social media tools in reduction of conflicts in virtual teams. This finding provides support for hypothesis 5.

The research findings indicated the existence of a significant path between communication tool (social media) and communication effectiveness (0.508,  $p < 0.001$ ) in the model without TMS. However, in the model with TMS, the path between communication tool and communication effectiveness was insignificant with a low path coefficient (0.131) when

contrasted with the path coefficient in the model without TMS (0.508). Further, in the model with TMS, there was a significant path between TMS and communication effectiveness (0.677,  $p < 0.001$ ). The findings clearly indicate that TMS fully mediates the positive effect of social media tools on communication effectiveness in virtual teams. Hypothesis 6 is therefore fully supported.

The results of the PLS procedure revealed that there was a significant path from communication tool (social media) to leadership (0.597,  $p < 0.001$ ) in the model without TMS. An examination of the model with TMS showed that there was a path from the communication tool to leadership (0.261,  $p < 0.01$ ) which had a lower path coefficient than that observed in the case of model without TMS (0.597). There was a significant path from TMS to leadership (0.596,  $p < 0.001$ ). It can therefore be inferred that TMS partially mediates the positive effect of social media tools on virtual team leadership. Hence, hypothesis 7 is supported.

A summary of the hypotheses testing is shown in table 40.

<b>Hypothesis</b>	<b>Hypothesis statement</b>	<b>Supported</b>
H1	<i>Social media tools positively affect TMS development in virtual teams.</i>	Yes
H2	<i>TMS mediates the positive effect of social media tools on virtual team trust.</i>	Yes
H3	<i>TMS mediates the positive effect of social media tools on virtual team cohesion.</i>	Yes
H4	<i>TMS mediates the positive effect of social media tools on virtual team satisfaction.</i>	Yes
H5	<i>TMS mediates the positive effect of social media tools in reduction of virtual team conflicts.</i>	Yes
H6	<i>TMS mediates the positive effect of social media tools on communication effectiveness in virtual teams.</i>	Yes
H7	<i>TMS mediates the positive effect of social media tools on virtual team leadership.</i>	Yes

Table 40. Results of hypotheses testing

#### 4.2.3.4 Common method bias

Common method bias or common method variance is understood as “variance that is attributable to the measurement method rather than to the constructs the measures represent”

(Podsakoff, MacKenzie, Lee, & Podsakoff, 2003, p.879). Accordingly, the intercorrelations among the measures can be inflated or deflated due to several factors under the influence of common method bias (William & Brown, 1994). Common method bias may lead to a measurement error which threatens the validity of any inference that is established about the relationships between measures (Podsakoff et al., 2003). Podsakoff et al. (2003) suggested some procedural recommendations for reducing common method bias which include (i) obtaining measures of the dependent and independent variables from different sources, (ii) psychological, temporal, proximal or methodological separation of measurement, (iii) counterbalancing of the order of questions, (iv) improvements in the items on scale, and (v) maintaining anonymity of the participants. All of these take place during instrument design and are referred to as procedural remedies.

Temporal and methodological separation guidelines were used in this research by measuring the dependent and independent variables in different sections of the questionnaire. Strict confidentiality and anonymity was maintained during this research, and a header depicting this information was added to the online questionnaire. A reduction in method biases was also considered during the construction of survey items (Tourangeau, 2000). Special care was taken to (i) define ambiguous and unfamiliar terms, (ii) avoid the use of vague concepts and include examples when any vague concept was used, (iii) keep the questions simple and easy to interpret, (iv) decompose questions related to more than one concept into simpler questions, and (v) avoid double-barrelled questions. As an example, a definition for social media and TMS (provided in the email containing the questionnaire link) and examples of social media tools were provided to the participants. Details about the scope and purpose of this research were also provided to the participants. The entire population that was surveyed made use of social media tools, which was an advantage to this research, but still technical terms were made clear to the participants. Further, all questions were easy to interpret as suggested by the expert panel review and also by the participants after the pilot test. Questions that suggested more than one answer were broken down into separate questions.

A counter-balancing of the question order was done, and the questions measuring predictor and criterion variables were kept separate from each other. This prevented the participants from combining related items and controlled for priming effects and item-context induced mood states (Chang, van Witteloostuijn, & Eden, 2010). Finally, obtaining measures of predictor and criterion variables from separate sources was not feasible, since both predictor



and criterion variables were perceptual in nature and could not be obtained otherwise, except personal judgement of the participant on a self-reported scale. Self-reported items were best suited to be answered by the participants considering the goal of this research, to understand the effect of social media tools on virtual team dynamics through a TMS lens.

The procedural remedies discussed above were applied during the instrument design phase. Certain statistical techniques were also applied to detect and control for common method bias. Accordingly, to detect common method bias Harman's one factor test (Podsakoff et al., 2003) was conducted on all the items that were used to identify the research model (model with TMS). The results of Harman's one factor test revealed that common method bias was not a concern for this research for two reasons. First, all the items used to identify the research model did not load on a single factor in an unrotated solution, when an exploratory factor analysis (Fabrigar et al., 1999) was conducted on the IBM SPSS Statistics software using all these items. Second, no single factor resulting from the exploratory factor analysis accounted for more than 0.260 of the variance explained.

### **4.3 Qualitative findings**

The qualitative data collected in form of interviews was coded and analysed in light of the research framework to provide an insight into the domain of this research and to add richness to the quantitative findings. The data analysis technique proposed by Miles and Huberman (1994) and Miles et al., (2013) was used to code and analyse the interview data. The interview findings complement the quantitative findings and depict the role played by social media tools when co-ordinating project work in virtual teams. The interview findings also illustrate how social media tools may have caused a positive effect on trust, team cohesion, satisfaction, conflicts, communication effectiveness and leadership. The interview findings are presented in this section.

Based upon the emerging themes from the interviews (see Appendix H) the findings are grouped into the following categories.

#### ***4.3.1 The role of social media tools in virtual team work***

The interview findings suggest that social media tools offered capabilities which allowed their use for both work related and other tasks in organisations. Broadly, social media tools

encouraged collaboration and participation among team members and also organised the project information well. Social media tools had advantages over some other tools such as email which came to light while conducting the interviews.

#### *4.3.1.1 Collaboration*

The interview findings revealed how social media tools encouraged collaboration in virtual teams (Peters & Manz, 2007). Collaboration included (i) Collaboration among team members for work related purposes (ii) Collaboration between team members for non-work related purposes such as social networking within the organisation. All of the interview participants experienced at least one form of collaboration while working with social media tools.

##### *4.3.1.1.1 Collaboration among team members for work related purposes*

The interview findings reveal that social media tools allowed the participants to collaborate for work related activities. There were multiple mentions of this form of collaboration in the interviews. The interviewees described how social media tools helped them to collaborate for work related purposes. The following example quotes from the interviewees illustrate this form of collaboration:

Discussion forums were used for global communication within the organisation which provided a platform to collaborate for work related purposes. For example: *“We have created discussion forums, so that is what we use for global communication”* [CEO].

In some organisations internal blog groups were created which provided a common place for users to share information and collaborate. For example: *“We have already created a group, so whenever we have any project related information we share it on that group. Also, any important documents, any necessary information, any adhoc meetings, we share on that group”* [Business analyst].

*“It’s so easy to share and collaborate over one document”* [Project manager].

Social media tools were used to collaborate informally for work related purposes such as discussing important technical details. This is exemplified by the following quote: *“TheHub*

*is our internal communication network which the employees use among themselves for informal chats, discussing various technical subjects and posting any queries” [Engineer].*

WhatsApp was also used for various work-related purposes. WhatsApp provided capabilities of collaboration, both formally and informally. For example: *“We have our office groups, and a lot of formal and informal communication happens on WhatsApp... Such as notifications about team things or if the team is having a discussion, then usually a message is dropped in our office group and that’s how we follow up on that” [Senior analyst].*

Social media tools provided capabilities where all team members can collaborate and contribute to the task: *“It’s [Asana] not personal; it’s very much a tool which we all contribute to” [Programme lead].*

Social media tools also improved performance and co-ordination among team members by encouraging collaboration: *“It [blog tool] really helps me perform much better, not just for official work.... The other thing is that it really helps us in co-ordinating with each other” [Analyst].*

TheHub provided a platform where team members could collaborate across locations: *“We use TheHub, for discussing technical issues. Sometimes you can ask what is happening in a particular location, you can just send a message to the team member working in that location” [Engineer].*

Hence, it can be concluded that social media tools facilitated collaboration for work related purposes (Peters & Manz, 2007). Another important finding is that social media tools provide capabilities of both formal and informal collaboration between the team members. The findings of this research are novel and indicate how social media tools encourage collaboration in virtual teams.

#### 4.3.1.1.2 Collaboration among team members for non-work related purposes

The interview findings suggest that social media tools not only provided a means for work-related collaboration but were also an excellent tool to collaborate for non-work related purposes. This was evident from multiple interviews.

For example, WhatsApp was used to collaborate for non-work related activities. This was done using a dedicated WhatsApp group for discussions between the team members: *“We have a group on WhatsApp where we do a general discussion of ‘how about the day’ and stuff like that apart from work”* [HR executive].

Yammer was used for non-work related discussion and collaboration between the team members. This was facilitated by the creation of dedicated groups on Yammer and is exemplified by the following quote: *“We use Yammer for different activities, we have made some groups over there”* [Senior analyst].

Some social media tools allowed the team members to collaborate over topics and stay connected with each other outside work hours as well. For example, in the context of WhatsApp, one interviewee remarked: *“It’s [discussion among team members] also after work hours or on the weekends”* [HR executive].

WhatsApp was used for collaboration between team members and it proved successful in doing so. The participant suggested: *“It’s purely group communication on WhatsApp... Almost everyone is actively involved... Almost everyone replies”* [Marketing lead].

In summary, social media tools provided a platform for non-work related social collaboration among team members. This is another interesting finding of this research since previous research does not explain how social media tools may encourage collaboration in virtual teams for non-work related tasks.

#### *4.3.1.2 Participation*

Participation is achieved by the encouragement of meaningful conversation between the team members and sharing of information and resources (Henttonen & Blomqvist, 2005; Kirkman et al., 2002). There were many mentions of participation in the interviews. The interview findings reveal how social media tools encouraged active discussions between team members. Team members could provide feedback while working in a team.

When asked of the participants if social media tools encourage participation, the general consensus was that they do so. This is exemplified by the following quote: *“Well, clearly, they do provide that sort of benefit”* [Manager].

For example, in an organisation the technical staff members liaised with human resource (HR) staff members on social media tools for designing technical job advertisements for the organisation. They used social media tools, and the HR team member explained how participation occurred in the team: *“It is like within an HR team they [technical staff] do participate sometimes, and when we need a feedback from the technical team or if they [technical staff] feel there are things to be changed then they [technical staff] do give a feedback on that”* [HR executive].

Similarly in the context of WhatsApp, official groups created on WhatsApp encouraged participation among the team members. For example, one of the interviewees confidently suggested that team members participate in discussions and all of them reply to messages within half an hour: *“We will get reply within half an hour from all our team members”* [Business analyst].

Interviewees suggested that team participation was more when using WhatsApp as opposed to some other communication tools. For example: *“Team participation is more while using WhatsApp”* [Senior software developer].

Social media tools provided a capability to create project specific interest groups which encouraged team participation in form of posts and comments. This is exemplified by the following quote: *“You can make interest groups and if something is in mind, you can put it up there [on TheHub] and then if somebody is interested, they can follow up and give comments”* [Engineer].

Interest groups encouraged active discussion between team members. For example: *“They [team members] can also form particular interest groups and they can have discussions on that and chat. So just like Facebook kind of thing but it is a secure internal setup”* [Engineer].

*“If we are having a group conversation then every team member has to reply to it because you cannot simply ignore what is going on in our group”* [Software developer].

Project specific groups on social media tools in different organisations helped promote interaction and information sharing in the team. This is exemplified by the following quote: *“When people are face-to-face they really don’t come up with any ideas or they don’t want to share anything. They are really scared and even if they have some doubts, they are reluctant to ask. So when we are on these tools [social media] they come up with ideas and thoughts and share them”* [Senior executive].

*“People have less fear because they don’t have to face people. So they come up with ideas much better, and they don’t hesitate to ask questions, which are a much better part”* [Engineer].

These findings suggest that social media tools may be better than face-to-face communication to share knowledge with team members and also to elicit tacit knowledge of the team members (Huh et al., 2007 cited in Leonardi et al., 2013).

Hence, it can be concluded that participation is brought about by the use of social media tools in form of active discussions between team members. The findings are novel and illustrate how social media tools lead to participation in virtual teams.

#### *4.3.1.3 Information organisation and transparency in project information*

The interview findings suggest that social media tools provided excellent information organisation capabilities. Information organisation refers to the ability of social media tools to keep the project information and communication organised (Bastida et al., 2013; Darisipudi & Sharma, 2008; Juch & Stobbe, 2005). All interview participants agreed that social media tools provided good information organisation capabilities.

As an example, social media tools were used for sharing project related documents in organisations and they provided a place for storing the project data, in a manner that it could

be used for future reference: *“You can search the documents which have been sent at the start of the project very easily... So ease of use is there”* [Engineer].

Wikis, a form of social media, were in use in some of the sample organisations. The participants suggested that posting information onto a wiki provided a central place for all project information and this made the project information visible and accessible by all the team members. For example: *“If you use a wiki and post information onto the wiki, everybody in the project can go to the wiki and have a look”* [Analyst].

It was mentioned across multiple interviews that social media tools created visibility and transparency in communication and document sharing. For example, in the context of social media communication, the following quotes illustrate this: *“I think it [communication on social media tools] is much easier than emails because everything is open there, you can see it very clearly rather than searching for the subject and opening the email”* [Engineer].

*“Everybody keeps track of what you are sharing. If you share something really good, and knowledge-rich it will be appreciated by the team members”* [Consultant].

Any information posted on the Wiki was visible to all team members and this created a sense of transparency as opposed to the use of email, where the information usually ended up in individual team members' mailbox. As an example, one interviewee suggested: *“Wiki is another tool that we use in our projects. We post information onto a Wiki, which is a place where everybody can go to look at stuff to do with the project. If you look at email it's different because you get your stuff going into your inbox”* [Project manager].

Similarly, social media tools also facilitated sharing of project related documents. Social media tools provided visibility and transparency in terms of sharing and accessing the same document, which reflected in the form of ease of use. This is exemplified by the following quotes: *“This is basically making the process for sharing the document and for taking an update easier. Everybody can be in sync with the same document at the same time”* [Software developer].

*“It [Sharepoint] provides a common platform to share and access things”* [IT delivery manager].

Social media tools provided a channel to create a permanent record of information since information once posted/shared stayed there for future use. The following quote explains how this happens: *“If you are working with somebody face-to-face and you are sending typed letters then, these letters do undergo the signatory, and then it is a permanent record. Same thing is happening here on an internet based channel”* [Engineer].

In summary, information organisation on account of social media tools was widely observed in the sample organisations. Organised records of information created transparency and visibility in the project information and benefited the project work. The findings are novel and add value to the literature (Bastida et al., 2013; Bertot et al., 2011; Ferrazzi, 2012; Juch & Stobbe, 2005) by explaining how information organisation and transparency happened through the use of social media tools.

#### ***4.3.2 The role of social media tools in development of trust***

Trust is an important component of a virtual team (Greenberg et al., 2007). The interview findings suggest how social media tools led to trust development in virtual teams. The interviewees suggested how the use of social media tools encouraged the development of trust.

As an example, social media tools helped in building relations with other team members which formed the basis for trust development: *“It [social media] does help us build relations with team members as a group in the company, everyone is involved in different projects so we do not get to spend time or to talk and to share anything”* [HR executive].

Social media tools provided excellent information sharing capabilities that help build trust among the team members. For example: *“I think being able to share those things that you might not often share, so it helps you to build more of a person around the person you work around remotely, otherwise it’s hard to build a relationship with someone whom you haven’t ever met in person”* [Programme lead]. This finding extends the previous literature on trust (Henttonen & Blomqvist, 2005; Kirkman et al., 2002).



Working with social media tools helped build stronger team ties as suggested by the interview findings. Social media tools supported relationship building and gave a feeling of trust while working in a team. This is exemplified by the following quotes:

*“You can get in touch with people from the offshore team and share your ideas and thoughts, so it’s good in relationship building”* [Consultant].

*“Team building and relationship building is done when you are working in a team”* [Software engineer].

In summary, the interview findings depict how the use of social media tools encouraged trust development in virtual teams. The findings are novel and illustrate the potential reasons for which social media tools led to trust development.

#### ***4.3.3 The role of social media tools in promoting team cohesion***

Team cohesion is highly desirable in virtual teams. Team cohesion in virtual teams was supported by the use of social media tools. Team cohesion is classified as task cohesion and social cohesion (Malhotra et al., 2007; Sivunen & Valo, 2006; Widemeyer et al., 1985 cited in Carless & De Paola, 2000). The interview findings revealed how social media tools supported the development of both task and social cohesion.

Social media tools provided a central space for team members to work together, see what others are doing, and help other team members if needed. This ensured the development of cohesiveness in the team. Social media tools allowed the team to work together on a task, help each other out, and also discuss each other’s work. Hence, these tools provided a basis for the team to be cohesive. For example: *“We can go in there and see what each other is working on at any one time and can offer help to each other, can ask for help when we need it, so it’s a central place where we can all see what each other is doing and that really gives us cohesiveness”* [Programme lead].

The use of social media tools led to task cohesion by improving information sharing while working on projects. For example: *“They [social media tools] are improving information sharing and providing another communication channel”* [Business analyst].

The interview findings explained how social media tools helped build team cohesion and coordination in distributed team projects. This is illustrated by the following example quotes: *“We have to coordinate people across five different locations in two countries. So we can’t all meet in a room together, so we use these tools to make sure that they are a mechanism to help us stay on the same wavelength”* [Project manager].

*“If there are teams working in different locations then they have to coordinate among themselves, without actually meeting with each other, so social media tools really help”* [Senior consultant].

It was evident from the interviews that all team members contributed to the task and worked together which gave them cohesiveness. For example: *“For cohesiveness, we use Asana which is a central tool where we all contribute our work and because of the way that tool is setup, it’s not one person driving the work, every person contributes to it, can assign work to each other, can write comments to each other’s work.”* [Programme lead].

Social media tools allowed the team members to know each other well and supported the development of social cohesion. This is exemplified by the following quotes: *“Social with colleagues, definitely you get to know somebody who you presume comes up as a little stuck up, but then there is a brighter side to that guy, that you get to know through these tools”* [Marketing manager].

*“It [social media tool] helps us connect with each other not just for official things but on a casual basis as well, so you get a chance to develop a sort of co-operation and understanding between each other”* [Project manager].

It can be concluded that social media tools helped promote task and social cohesion (Malhotra et al., 2007; Sivunen & Valo, 2006; Widmeyer et al., 1985 cited in Carless & De Paola, 2000) in the sample organisations. Task and social cohesion improved team work and were highly desirable. The interview findings suggest how the use of social media tools led to the development of team cohesion in virtual teams which is a novel finding of this research.

#### ***4.3.4 The role of social media tools in promoting satisfaction***

Satisfaction is another theme that was suggested by the interview findings. Satisfaction included satisfaction with social media tools and task satisfaction. There were multiple mentions of both of these forms of satisfaction in the interviews.

Participants clearly expressed their satisfaction with the use of social media tools as exemplified by the following quote: *“Yes, I am satisfied with these tools”* [Software engineer]. When asked about their team members’ level of satisfaction with social media tools, the participant replied: *“Yes, I think they are satisfied with it”* [Software engineer].

*“I am satisfied and the team members are also satisfied. The actual reason is that we have some common interface and we can interact with each other, so it’s good to have these tools”* [Software engineer].

Satisfaction with social media tools was reached through multiple benefits of social media tools, as suggested by the participants. For example: *“There are different benefits of this tool”* [Software engineer].

*“The tool is feature-wise more efficient”* [Engineer].

Satisfaction with social media tools also resulted from having multiple advantages of social media tools over some other tools such as email. These included social communication, one-to-many communication and the ‘social networking’ characteristics of social media tools. For example: *“On email, we can’t share our thoughts and feelings. Email is just one-to-one or one-to-many communication in the form of some text or in form of some file, but if you look at Yammer, it’s like a social networking site”* [Software engineer].

Satisfaction with social media tools resulting from discontent with email was also found in the interview findings. The participants felt satisfied with social media tools on account of their ‘appeal’ and benefits. This is illustrated by the following example quotes:

*“Email communication is a boring kind of communication nowadays. If you use Yammer there will be a resemblance with Facebook, so you are just trying to attract newcomers. So if someone is attracted towards something then, I think it will be better for the organisation”* [Technical lead].

*“I am satisfied... I feel that email is not a very good platform for knowledge sharing. Whereas our knowledge group [internal wiki] provides a much bigger platform for knowledge sharing”* [Senior analyst].

The participants had similar opinions about task satisfaction resulting from the use of social media tools. Some participants felt that social media tools helped achieve the purpose they were put into use for which resulted in task satisfaction. When asked about other team members' satisfaction with social media tools, the participants had similar opinions. For example: *“Mostly, when someone wants to use it [social media tool] for some purpose and they achieve it then everyone is happy”* [Software engineer].

The participants suggested that task satisfaction was achieved by the effective use of tools in their team. For example: *“It's [satisfaction] about how we use those tools”* [IT delivery manager].

Another participant suggested that team satisfaction was reached by having processes in place, which included how to use the tools. The participant remarked: *“I think having robust processes contributes to team satisfaction... We come to an agreement as to what will work for us and as soon as it doesn't work for us, we change it”* [Programme lead].

In summary, the interview findings are novel suggest how satisfaction resulted with the use of social media tools and how the use of social media tools may have led to task satisfaction (Curseu et al., 2008; Lin et al., 2008; Shachaf, 2008). This resulted from greater benefits of social media tools over other tools such as email. Satisfaction led to a better team performance. Task satisfaction resulting from the use of social media tools was reached since social media tools achieved the purpose for which they were put into use for, while others suggested that team satisfaction was brought about by the effective use of the tool.

#### **4.3.5 Social media tools and virtual team conflicts**

Social media tools provided a platform for mutual discussions between the team members which helped resolve the problems of conflicting opinions on the task. The example quotes provide evidence for this:

*“Sometimes it gets conflicting, some people don’t agree to the information you post. A lot of people feel positive about it and a lot of people feel negative about it. Then we come to a mutual agreement through an exchange of information”* [Consultant].

*“Everyone is sharing their ideas in the group [discussion forum], everyone is coming in”* [Engineer].

*“Definitely, these tools help in gelling up, so basically saving all the different communications, organising them together and putting them together, so it helps in bringing the team together and especially when you have remote teams”* [Project manager].

*“The whole team is reading that message, so that’s a better thing”* [Senior software developer].

*“Yes, it’s [social media] helping because sometimes, a wrong email can go out. Project managers can see the conversations, so it’s helping us improve our communication skills by not sending out wrong messages randomly”* [QA analyst].

*“I feel that in emails the discipline of maintaining threads and conversations is not there”* [Project manager].

Social media tools also provided mechanisms that may help prevent conflicts among virtual team members. For example, some social media tools like WhatsApp have a mechanism that supported a double check on other team members such as determining whether the message is delivered or not. This contributed towards removing assumptions about other team members and reduced the likelihood of conflicts. For example:

*“We can also check when the ping is delivered at the other end [other team member] so a double check is there”* [Business analyst].

*“We can also check whether the other user has seen the ping or not”. We can check whether he is not replying intentionally”* [Business analyst].

Hence, it can be established that social media tools provided a platform and mechanisms that worked towards reduction in virtual team conflicts. In summary, it can be concluded that social media tools encouraged team work which helped in preventing and resolving issues among the team members and reducing the chances of task and relationship conflicts (Kankanhalli et al., 2006; Maznevski et al., 2006). The findings are novel and add value to the existing literature on social media tools and virtual team conflicts.

#### ***4.3.6 The role of social media tools in communication effectiveness in virtual teams***

The interview findings suggest that social media tools had advantages which may have led to communication effectiveness in virtual teams. There were numerous mentions of the benefits of social media tools over other tools such as email in the interviews.

Social media tools provided better capabilities than email hence email communication was believed to be a small part of social media: *“I believe that email is a small part of social media”* [Senior analyst].

*“It [intranet portal] is better than email because everything is not there in email, it takes time to open up stuff. But this tool all in all is a good tool to communicate”* [Consultant].

Participants suggested that social media tools could be distinguished from email since both of them provided a different look and feel. For example: *“They do feel different because they are different communication channels”* [Project manager].

Some social media tools provided chat capability which made communication advantageous over email which lacked the chat capability. For example, in the context of Yammer and email one interviewee suggested: *“Chat feature is not present in email”* [Software engineer].

Social media tools provided visibility in terms of who is present in the organisation as opposed to email where to know somebody came with a prerequisite to know their email address. This finding also highlights the social networking characteristics of social media tools. For example, one interviewee explained: *“Everyone will be there on Yammer irrespective of the location. If you are using email, then you will have to know the person’s email id, whereas with Yammer you would know everyone”* [Software engineer].

Interview findings suggested that social media tools provided capabilities of sending out information to multiple team members. For example: *“The tools may help you get there faster”*.

*“It’s the company’s internal network, so if you want to communicate with anyone in the team then it’s a better option”* [Software developer].

*“They are quicker and easier. The team I guess would use them to communicate more easily”* [IT delivery manager].

In summary, social media tools helped promote communication effectiveness in virtual teams (Daim et al., 2012; Malhotra et al., 2007; Rosen et al., 2007) because of certain features that were not present in email. Communication effectiveness resulted in minimal communication failures. The findings are novel and demonstrate how social media tools led to communication effectiveness in virtual teams.

#### ***4.3.7 The role of social media tools in virtual team leadership***

The interview findings suggested that the use of social media tools had implications in terms of effective virtual team leadership.

Social media tools helped in creating visibility for the team management in terms of project communication and project data, which was useful for the management to provide feedback and support to the team members. For example, an interviewee remarked: *“Our manager is sitting somewhere else, I am working here and our senior management is in the US, so in a sense everybody has visibility and they don’t have to go to that specific location or contact that office to get the data”* [Senior engineer].

Participants suggested that social media tools supported effective monitoring of the team and were used by the managers to give feedback to the team members. For example:

*“These tools help immensely to get any feedback or for any type of monitoring”* [Project manager].

*“Every manager uses them [social media tools] and gives feedback to the team members”* [Software engineer].

In the context of Lync tool one interviewee remarked: *“The manager can manage the team well and he can keep a check on us. He can also check what times we are available and when not”* [Software developer].

The participants were in agreement with the fact that social media tools helped the manager in managing the team well. For example, from a management perspective one of the interviewee suggested: *“These are definitely very useful tools”* [IT manager].

Hence, it can be inferred how social media tools helped promote effective leadership in virtual teams. Effective leadership boosted team co-ordination and helped raise the team spirit (Furst et al., 2004; Leinonen et al., 2005). The research findings are novel and demonstrate the capabilities of social media tools to promote effective leadership in virtual teams.

#### ***4.3.8 The role of social media tools in social networking***

Social networking characteristics of social media tools within the organisation provided capabilities of knowing more people within the team and the organisation (Gupta et al., 2012; Standing & Kiniti, 2011). This is evident from the interviews in multiple contexts. Example quotes from the interviews illustrate the same:

*“On TheHub you can reach more people and whatever you say, a lot of people can see simultaneously. But email is more a sort of personalised thing”* [Engineer].



*“With Yammer you can share your thoughts with a large number of people present in the team and within the organisation”* [Software engineer].

*“Suppose you want to raise a concern about your organisation that you want to be followed up by the management, then it [internal discussion forum] is a very good forum to share your thoughts”* [Senior analyst].

*“We get to know people from different projects whom you may never see in person”* [Software engineer].

Hence, it can be inferred how social media tools promoted social networking for work as well as non-work reasons. This research finding extends the previous literature (Case & King, 2011; Culnan et al., 2010; Kaplan & Haenlein, 2010) which mainly focused on the ‘external’ social networking capabilities of social media tools, that is, not within organisational teams.

#### ***4.3.9 Downsides of tools other than social media***

Communication tools other than social media tools had some downsides. The interview findings suggest that there were downsides of using traditional communication tools such as email and videoconferencing. For example, email communication was more personalised and associated with less amount of data that could be exchanged. The downsides of non-social media tools are exemplified by the following quotes:

*“Email has a constraint... The amount of data that you can send through email is restricted; you cannot send large amounts of data”* [Engineer].

*“In email there might be challenges that you missed out someone, so a communication gap might be built between the team members”* [Software developer].

*“I feel that email is not the best way to communicate”* [Software developer].

*“We are using email but that is more on a personalised level and with very less data. But if you have to send huge amounts of data like our drawings which might sometimes run into gigabytes so for that we have to use some other platform”* [Senior engineer].

*“I don’t think email is the best way of communication, often it gets ignored”* [Senior software developer].

*“For long discussions I will not prefer email because it is very difficult to keep a track of all the things”* [Software engineer].

*“On one email id all sort of emails are coming, your client emails are coming, emails related to the general affairs of the organisation are also coming so, after a while your inbox gets piled up with all sort of emails, so it’s very difficult for us to track down how the project is running”* [Business analyst].

Thus it can be concluded that the use of some non-social media tools had certain challenges. The previous literature suggested that email may lead to clutter and information disintegration (Bastida et al., 2013; Darisipudi & Sharma, 2008) and the interview findings confirm the assertion. The interview findings are novel and extend the literature by demonstrating some other challenges of using email such as poor capabilities in terms of handling large amount of data and tracking project information.

In summary, the interview findings explored how the use of social media tools led to the development of trust, team cohesion, satisfaction, communication effectiveness and leadership, and also supported a reduction in virtual team conflicts. The interview findings also revealed some other benefits of using social media tools over other tools such as email.

#### **4.4 Chapter summary**

The aim of this chapter was to present the findings of this research. The chapter began with a description of the quantitative data analysis which was performed on the Likert questionnaire data. The sample population was described in form of frequencies and percentages to understand the basic composition and some key demographic variables which were relevant to this research. The Likert questionnaire data was analysed with the IBM SPSS Statistics software to examine the descriptive statistics. The results of the PLS-SEM were discussed and the measurement and structural models were assessed for both model without TMS and model with TMS. A nested modelling approach was used to understand TMS mediation and

the effect of social media tools on virtual team trust, team cohesion, satisfaction, conflicts, communication effectiveness and leadership. The nested modelling approach revealed that the model with TMS was a more comprehensive model and it explained the phenomenon more clearly. The hypotheses were tested positive and the research model was successfully validated. The quantitative findings provided an explanation of the effect of social media tools on virtual team dynamics which was consistent with the goals of this research.

The qualitative interview data was analysed with the categories determined during the data coding process. The results of the interview data analysis were compared with the quantitative findings and the research model. The interview findings were consistent with the quantitative findings and extended the quantitative findings by providing a description of how social media tools affected virtual team dynamics. The interview findings described the characteristics of social media tools and how they affected team work in virtual teams. The interview findings demonstrate the benefits of using social media tools over other tools such as email and explain the relevance of social media tools to organisations.

The chapter to follow consolidates the quantitative and the qualitative findings and presents a discussion of the research findings. In doing so, the research questions RQ1 and RQ2 are answered and some additional insights into this research are provided.

## **Chapter 5. Discussion**

### **5.1 Chapter overview**

This chapter presents the discussion of the research findings. The findings of this research were grouped into quantitative findings and qualitative findings. The aim of this research is to understand the effect of social media tools on virtual team dynamics. Transactive memory system provided a theoretical lens to help interpret the research findings. This chapter discusses how the quantitative findings of this research inform the theoretical framework, address the hypotheses, validate the research model and answer the research questions.

The qualitative findings help explain the potential reasons why social media tools may have encouraged the development of trust, team cohesion, satisfaction, communication effectiveness and leadership, and affected a reduction in virtual team conflicts. The qualitative findings add depth to the quantitative findings by going beyond the content of the Likert questionnaire items. The qualitative findings provide a rich and interpretive discussion of the phenomenon of interest. Finally, the qualitative findings add value to the quantitative findings. In the last section, a summary of this chapter is presented.

### **5.2. Discussion of the research findings**

Social media tools are being used in many organisations for communication, knowledge management, document sharing and other project related and non-work related purposes. Hence, it is important to understand the effect of social media tools on virtual team dynamics. To achieve this, this research empirically investigated the effect of social media tools on virtual team dynamics using a Likert questionnaire and follow-up semi-structured interviews. Initially, a description of the sample used for this research was presented to establish whether the data was representative of the larger population, and thereafter an examination of the descriptive statistics was undertaken. In order to test the research hypotheses, a PLS-SEM was conducted. The measurement and structural models were then assessed and the path coefficients and RSQ values were examined to understand the relationship between the constructs in the research model. The research questions for this study were:

RQ 1: How does the use of social media tools affect virtual team dynamics?

RQ 2: Can the use of social media tools encourage TMS development in organisational virtual teams?

### ***5.2.1 The effect of social media tools on TMS of a virtual team***

Based on the literature on communication tools and the transactive memory system (Lewis, 2003; Lewis, 2004), it was proposed that social media tools positively affect TMS development in a virtual team. In order to investigate the effect of social media tools on TMS of a virtual team and to answer RQ2, hypothesis 1 was proposed. H1: Social media tools positively affect TMS development in virtual teams.

The results of the PLS-SEM verified that social media tools positively affected the development of TMS in virtual teams. The results of the structural model assessment for model with TMS confirmed the existence of a significant path between the communication tool, in this case social media and the TMS. The communication tool construct was represented by the items “Communication tool ensures participation from all team members”, “The communication tool ensures transparency” and “The communication tool makes the team work together”. Accordingly, the use of social media tools made the virtual teams collaborate and participate, and encouraged transparency in project information and communication which led to increased co-ordination, specialization and credibility (Goodwin-Jones, 2003; Lewis, 2003; Lewis, 2004; Standing & Kiniti, 2011) and made the virtual team work together.

The TMS construct was represented by the statements “I feel that the team is more knowledgeable than individual members”, “The team is really effective”, “Team members' motives are good for the team”, and “Team members respond constructively to my problems”. As a result of increased coordination, the virtual team members worked together on the projects. They helped each other while performing the task and sought other's expertise when needed. Virtual team members trusted each other and believed that the team members worked in the best interest of the project. They believed in the credibility of knowledge possessed by other team members, and that it was put into good use while working on projects (Choi et al., 2010; Hsu et al., 2012). The virtual team members shared knowledge and knew each other's expertise well. They pooled expertise while working on

projects which made the virtual team more specialized with a wide range of expertise, and this also improved knowledge sharing. The virtual team members worked together as a team and not as individual entities (Choi et al., 2010; Lewis, 2003; Lewis, 2004). Finally, a well-developed TMS accounted towards team effectiveness in virtual teams.

The research question (RQ2) asked: Can the use of social media tools encourage TMS development in organisational virtual teams? The research findings suggest that the use of social media tools positively affected TMS development in virtual teams and answer RQ2 of this research.

The interview findings explain how social media tools encouraged TMS development in virtual teams. Accordingly, social media tools encourage collaboration for work related as well as other tasks (Peters & Manz, 2007). In regard to work related tasks, collaboration was brought about by sharing of information, project documents and effective communication such as discussing technical issues and answering queries from team members. Social media tools helped the virtual team members to coordinate with each other well. Collaboration was also brought about by tasks that were not work related. Groups created on social media tools provided a platform for informal chats and collaboration between virtual team members. Communication between team members outside work hours strengthened the collaboration level. Collaboration helped team members in understanding each other and supporting each other with the task in hand (Peters & Karren, 2009). The finding on collaboration extends the previous literature (Goodwin-Jones, 2003; Standing & Kiniti, 2011) and explains how collaboration happens in virtual teams.

Virtual team members felt that participation was brought about by the use of social media tools through meaningful conversations between the team members (Henttonen & Blomqvist, 2005; Kirkman et al., 2002) as suggested by the interview findings. Social media tools provided a platform to liaise with other team members while working on projects and also encouraged other team members to reply to the topics that were already posted. Team members were actively involved in project related discussions and also shared ideas and knowledge freely on social media tools. Participation was also encouraged by the creation of special interest groups on social media tools in order to exchange meaningful conversations. The finding on participation adds value to the literature (Hoffman & Fodor, 2010) and explains how social media tools lead to participation in virtual teams.

Social media tools provided ease of use and made it easier to share and search for information and documents as opposed to email. For example, social media tools organised the project documents very well and made information retrieval easier (Juch & Stobbe, 2005; Nardi et al., 2004). Information sharing on social media tools such as wikis made it easier to access information and also created visibility and transparency in project information. Transparency and visibility in project information improved the information clutter associated with the use of some other tools such as email (Bastida et al., 2013; Bjorn & Ngwenyama, 2009).

Hence, the use of social media tools encouraged TMS development in virtual teams due to increased collaboration, participation, transparency and effective information organisation. A well-developed TMS created task-expertise associations in the team (Bastida et al., 2013; Darisipudi & Sharma, 2008; Hoffman & Fodor, 2010). A good task-expertise association in the virtual team ensured that team members know each other's skills well and which information resides with which team member; hence, the project information stayed well organised.

### ***5.2.2 TMS mediation and the effect of social media tools on virtual team trust***

Drawing on the literature on trust and TMS (Chen, 2014; Henttonen & Blomqvist, 2005; Kirkman et al., 2002; Lewis, 2003; Meister & Willyerd, 2010; Wegner, 1987), it was theorised that TMS mediates the positive effect of social media tools on virtual team trust. In order to investigate the role of TMS while studying the effect of social media tools on virtual team trust, hypothesis 2 was proposed. H2: TMS mediates the positive effect of social media tools on virtual team trust.

An examination of the model without TMS and model with TMS using a nested modelling approach provided support for hypothesis 2. The trust construct was represented by the statements "Team members work carefully", "Team members meet their obligations" and "Team members contribute to team tasks/success". Virtual team members believed that other team members performed well on the tasks allocated to them which accelerated trust building (Peters & Manz, 2007). They trusted in their co-workers' abilities and believed that team members made their contribution to the task in hand. Team members shared project information which positively impacted team performance (Brown et al., 2004) and created a

sense of mutual understanding in the virtual team. Mutual understanding is highly desirable in virtual teams (Peters & Manz, 2007). The virtual team members completed the tasks allocated to them without letting other team members down.

Trust is a vital component of a successful virtual team (Greenberg et al., 2007). The interview findings explained the role that social media tools played in trust building. Social media tools helped in relationship building and led to a better team understanding which contributed to trust building. It is desirable that team members develop good relations among themselves in a virtual team environment since by doing so the team members may work well with each other and this creates an effective virtual team (Horwitz et al., 2006). The literature (Henttonen & Blomqvist, 2005; Kirkman et al., 2002) suggested that trust building in virtual teams is brought about by timely and repeated sharing of information and resources. The interview findings added value to the literature and suggested how sharing of project and other information on social media tools contributed towards trust building. Further, if virtual team members get credible knowledge from others, it accelerates trust building in the virtual team (Lewis, 2003), and team members may actively seek information from each other (Chen, 2014). This again helped in developing stronger team ties and increased the level of trust in virtual teams (Meister & Willyerd, 2010).

The findings on trust are novel and explain how the use of social media tools lead to trust development in virtual teams.

### ***5.2.3 TMS mediation and the effect of social media tools on virtual team cohesion***

The literature on team cohesion and TMS suggested that TMS has an ability to affect team cohesion in virtual teams (Carron & Brawley, 2012; Chen, 2014; Lewis, 2003; Meister & Willyerd, 2010; Sivunen & Valo, 2006; Wegner, 1987). Therefore, it was theorised that TMS mediates the positive effect of social media tools on virtual team cohesion. Hypothesis 3 was proposed to investigate the mediating role of TMS in the development of virtual team cohesion while working with social media tools. H3: TMS mediates the positive effect of social media tools on virtual team cohesion.

The model without TMS and model with TMS were examined using a nested modelling approach in order to interpret the results of the PLS procedure, which provided support for



hypothesis 3. The team cohesion construct was represented by the statements “I am happy with the team's level of task commitment”, “The team has a collective agreement on tasks”, “Team members get to know of individuals' contribution to the team” and “The team is cohesive”. Accordingly, the team members were committed to performing the tasks that were allocated to them with finesse. The virtual team members believed that the team was cohesive and there was an agreement on how to perform the tasks. The virtual team members worked together as a team to achieve the project and everyone was pulling their weight. Social media tools thus helped in building strong team ties (Meister & Willyerd, 2010) which ensured that team members co-ordinated well. A cohesive virtual team has a greater control over projects and responds to any situation well (Malhotra et al., 2007). This leads to an increased task success in virtual teams and produces good project outcomes.

The interview findings explained how social media tools promoted task and social cohesion in virtual teams. Social media tools provided a central space for project communication and effective information sharing which contributed towards cohesiveness. Team members could see what other team members are working on, contribute to the task, share information relevant to the task and could also ask each other for help. Thus, social media tools provided a mechanism for co-ordination which led to task cohesion (Lewis, 2003). Task cohesion ensured that team members worked with a united approach towards project completion (Carron & Brawley, 2012). Social media tools supported informal communication between team members which helped them understand each other well on a personal level, and this provided social cohesiveness. Social cohesion created team bonding which is required in virtual teams since team members may not meet each other often.

The finding on team cohesion is novel and sheds light on how the use of social media tools can affect virtual team cohesion. The finding extends the literature (Xue et al., 2004) which suggested that it may be difficult to develop a team bonding by the use of electronic communication tools.

#### ***5.2.4 TMS mediation and the effect of social media tools on virtual team satisfaction***

It was theorised that TMS mediates the positive effect of social media tools on virtual team satisfaction. This was drawn from the existing literature on satisfaction (Curseu et al., 2008; Lin et al., 2008; Shachaf, 2008) and TMS (Choi et al., 2010; Lewis, 2003). In order to

understand the mediating role of TMS when studying the effect of social media tools on virtual team satisfaction, hypothesis 4 was proposed. H4: TMS mediates the positive effect of social media tools on virtual team satisfaction.

The nested modelling approach provided support for hypothesis 4. The satisfaction construct was represented by the statements “I am satisfied with my team members”, “I am pleased with the way other team members and I work together”, “I am very satisfied with working in this team”, “I am satisfied with team members' contribution to the team” and “Team members are satisfied with the team”. The virtual team members had a feeling of satisfaction with the team work and were happy being a part of the team. They felt a sense of satisfaction when working with their team members which was productive for the project. Satisfaction is vital for a virtual team since satisfied team members exhibit a greater commitment towards the task and are more organised in their approach (Curseu et al., 2008; Shachaf, 2008). This has a potential to increase task effectiveness, performance and productivity. Team members believed that other team members were performing well and made a satisfactory contribution to the task in hand. Overall, this led to satisfaction across the virtual team with the task as well as with the team.

There were multiple reasons why social media tools led to satisfaction; the interview findings shed light on some of the potential reasons. Social media tools provided multiple benefits which led to satisfaction with these tools. Some of these benefits included social networking and increased information and knowledge sharing which provided social media tools an edge over email. Social communication made the team members well aware of each other's expertise and skills, and also gave them clarity in terms of how to progress with the task (Curseu et al., 2008; Shachaf, 2008). Discontent with the use of email attracted team members towards social media tools. Task satisfaction was achieved by the use of social media tools in a manner that benefits the task. Social media tools supported virtual team tasks which kept the team members satisfied. Team members resolved any dissatisfaction arising due to the use of tools or the task by using social media tools which kept the team members satisfied.

These findings improve our understanding of how social media tools contributed towards satisfaction in virtual teams. Satisfaction is also reached if the team knows who knows what. By using the task-member associations (Lewis, 2003; Lewis, 2004) team members may be

assigned tasks according to their expertise. Increased team satisfaction created increased team responsiveness because the team members could co-ordinate work among themselves, and each team member could contribute to the task with their expertise (Curseu et al., 2008; Lin et al., 2008; Shachaf, 2008).

#### ***5.2.5 TMS mediation and the effect of social media tools on virtual team conflicts***

Conflicts are common to both co-located and virtual teams but have a greater tendency of happening in a virtual team environment due to a lack of face-to-face communication and lesser understanding between the team members. Conflicts can often intensify in a VT environment, and can take a form of task related conflicts. Conflicts have a potential to reduce the efficiency of the VT, and can downgrade the project outcomes. Drawing on the existing literature on conflicts (Brown et al., 2007; Griffith et al., 2003; Montoya-Weiss et al., 2001), social media tools (Bastida et al., 2013; Ferrazzi, 2012) and TMS (Lewis, 2003; Wegner, 1987), it was theorised that TMS mediates the positive effect of social media tools on a reduction in virtual team conflicts. Hypothesis 5 was proposed to investigate the mediating role of TMS in examining the effect of social media tools on virtual team conflicts. H5: TMS mediates the positive effect of social media tools in reduction of virtual team conflicts.

The research findings reached through an examination of the model without TMS and model with TMS provided support for hypothesis 5. The conflicts construct was represented by the statements “Team members' ideas are often conflicting”, “Team members often disagree on decisions”, “There is a lot of friction among the team members”, “There are personality conflicts in the team” and “There is a lot of tension among the team members”. The participants expressed their disagreement with these statements, all of which were reverse-worded.

Accordingly, the use of social media tools helped in reducing conflicts in virtual teams. Team members worked together on the task in hand and mutually resolved any problems that were encountered by the team. They adopted a collective approach while working on the project which was beneficial for the team as well as the task that was allocated to the team. A collective approach ensured sharing of ideas and encouraged effective knowledge sharing among members of virtual teams (Chen, 2014; Oshri et al., 2008) by locating the relevant

knowledge and transferring it to where it is needed (Alavi & Liedner, 2001; Choi et al., 2010). This further reduced conflicts in the virtual team by preventing conflicts that arise in the team on account of inefficient or incorrect knowledge sharing. Minimal differences in team members' opinions ensured that there is no task related conflict in the virtual team (Maznevski et al., 2006). A collective team approach also removed any sort of disagreements and misunderstandings in the team which have a potential to cause conflicts (Brown et al., 2007). This created a productive and healthy working environment for the team with minimal friction and tension between the team members.

The interview findings explained how social media tools may have supported a reduction in virtual team conflicts. Social media tools encouraged information sharing with the team members which led to mutual agreement on tasks and reduced the likelihood of conflicts. Social media tools provided mechanisms to ensure that there is no misunderstanding between team members. This contributed towards removing assumptions about the team members, which have a potential to cause conflicts (Brown et al., 2007). Further, the project manager could monitor the team well and used social media tools to communicate with the virtual team to resolve any disagreements.

The research finding on conflicts is in agreement with the literature which suggests that social media tools such as online discussion boards may reduce conflicts in teams (Ferrazzi, 2012; Meister & Willyerd, 2010). Extending the previous literature, this research fully explores the effect of social media tools on virtual team conflicts and provides reasons why social media tools may have affected a reduction in virtual team conflicts.

#### ***5.2.6 TMS mediation and the effect of social media tools on communication effectiveness in virtual teams***

Based upon the literature on communication effectiveness (Bjorn & Ngwenyama, 2009; Carvalho, 2008; Daim et al., 2012) and the transactive memory system (Lewis, 2003; Lewis, 2004; Wegner, 1987), it was proposed that TMS mediates the effect of social media tools on communication effectiveness in virtual teams. In order to investigate the mediating role of TMS in the relationship between social media tools and communication effectiveness in virtual teams, hypothesis 6 was proposed. H6: TMS mediates the positive effect of social media tools on communication effectiveness in virtual teams.

The research findings supported hypothesis 6 following an examination of the model without TMS and the model with TMS. The communication effectiveness construct was represented by the statements “The team is able to respond to a communication breakdown well”, “Team members communicate their feelings honestly”, “Team members display mutual respect” and “Team members communicate problems easily”. The use of social media tools was associated with increased communication effectiveness and an increased responsiveness towards communication barriers such as communication breakdowns. In the sample organisations, there was active information sharing between team members which helped tackle communication breakdowns. This is an interesting finding of this research since communication breakdowns have a potential to affect the efficiency of the team (Bjorn & Ngwenyama, 2009). Virtual team members communicated any issues or problems with other team members in order to resolve the problem. This is vital in a virtual team environment since communication itself is a big challenge (Horwitz et al., 2006). The use of social media tools encouraged effective communication between the virtual team members which minimised the problem of inadequate communication. Inadequate communication may pose a risk to the overall team performance and efficiency, and may slow down team work due to delayed communication. This finding extends the previous literature (Malhotra et al., 2007; Rosen et al., 2007) which suggested that communication failures are quite common in virtual teams. Further, effective communication ensured that no useful information is lost (Bastida et al., 2013; Wallace, 1999; Wallace & Keil, 2004).

The interview findings suggested that the advantages of social media tools over other tools such as email were the key to communication effectiveness in virtual teams. Social media tools provided capabilities such as dissemination of project information to multiple team members at the same time, which was more efficient than sending out emails. Social media tools also provided a platform to share thoughts and raise concerns which encouraged information sharing in virtual teams. Thus, social media tools prevented problems that arise on account of inadequate communication in virtual teams (Malhotra et al., 2007; Rosen et al., 2007). Communication tools such as email had downsides in terms of not having some essential features such as ease of finding information.

Due to an increased reliance on communication tools such as social media in the sample organisations, communication effectiveness was adjudged to be a crucial factor determining

VT project success (Wallace, 1999; Wallace & Keil, 2004). The research findings are novel and indicate that the use of social media tools led to communication effectiveness in virtual teams and the team members were able to pull out relevant knowledge based on the member-expertise associations, and this may reduce any delays (communication breakdowns). Credible knowledge added to the communication effectiveness in virtual teams under consideration, since team members believed in the information they received and tend not to verify it from other team members when the information was sent to multiple team members at the same time. This reduced miscommunication arising out of getting inconsistent information from different sources (Choi et al., 2010).

### ***5.2.7 TMS mediation and the effect of social media tools on virtual team leadership***

Drawing on the literature on leadership (Ayoko et al., 2012; Furst et al., 2004; Gaudes et al., 2007; Shachaf, 2008) and TMS (Choi et al., 2010; Lewis, 2003; Wegner, 1987), it was proposed that TMS mediates the effect of social media tools on virtual team leadership. To examine the mediating role of TMS while studying the effect of social media tools on virtual team leadership, hypothesis 7 was proposed. H7: TMS mediates the positive effect of social media tools on virtual team leadership.

Following an examination of the model without TMS and the model with TMS, hypothesis 7 was tested positive. The leadership construct was represented by the statements “The team leader/manager establishes clear set of goals”, “The manager spends time motivating and boosting team spirit”, “The manager gives good feedback to the team members despite being geographically dispersed”, “The manager integrates the team well”, “The manager monitors the team and signals any trouble”, “The manager is vigilant”, “The manager makes informed decisions on team issues”, “The manager has an influence over the team” and “This communication tool helps the manager to manage the team well”. The virtual team members had a clear direction in mind regarding the project which was supported by encouragement and feedback from the leadership. This boosted team spirit and helped in building a stronger virtual team. Virtual team members tend to stay motivated while working on projects, which positively reflected on the project outcomes (Furst et al., 2004; Tuffley, 2012).

Effective leadership also integrated the team well (Davidson et al., 1996), which is vital for the functioning of the virtual team. Further, effective team monitoring and team co-ordination

while the team members were geographically dispersed helped in building a stronger team (Bjorn & Ngwenyama, 2009; Schmidt & Bannon, 1992). Feedback from leadership motivated the team members and integrated the team well. Virtual teams were protected from any trouble by their vigilant team leadership, which is another crucial factor in determining team success. Finally, the team leadership is likely to get a better picture of the virtual team on account of team member-expertise associations in the team, and this assisted the leadership in making important decisions such as creating a good task-skills match for the virtual team (Lewis, 2003; Lewis 2004), giving a clear direction to the team and helping manage the team well.

Social media tools played an important role in ensuring the effectiveness of virtual team leadership by creating visibility in the virtual team communication and keeping project information and communication organised as suggested by the interview findings. Team leadership could monitor the virtual team through these tools and also provide feedback to individual team members. This virtual supervision again demonstrates the usefulness of social media tools in ensuring active leadership (Bjorn & Ngwenyama, 2009; Schmidt & Bannon, 1992). Social media tools provided capabilities which assisted the leadership in managing the team well even in the absence of a complete picture of the task in front of them (Carmel, 2002; Joinson, 2002).

The research findings on leadership are novel and explain the effect of social media tools on virtual team leadership. The potential reasons causing this effect are also highlighted by the research findings.

#### ***5.2.8 How does the use of social media tools affect virtual team dynamics?***

The research question (RQ1) for this research was: How does the use of social media tools affect virtual team dynamics? It was observed in this research that the relationship between social media tools and each of the six virtual team dynamics viz trust, team cohesion, satisfaction, conflicts, communication effectiveness and leadership was mediated by the TMS of the virtual team. The results of the nested modelling (using model without TMS and model with TMS) reached through the PLS-SEM provided evidence for this mediation relationship. It was observed in the case of model without TMS that the communication tool (social media) positively affected trust, team cohesion, satisfaction, communication effectiveness

and leadership in virtual teams. The model with TMS showed that social media tools encouraged the development of TMS in virtual teams and the TMS positively affected the development of trust, team cohesion, satisfaction, communication effectiveness and leadership, and also affected a reduction in VT conflicts. The path coefficients between communication tool (social media) and trust, team cohesion, satisfaction, conflicts, communication effectiveness and leadership were noticeably reduced with the introduction of the TMS construct in the model with TMS. The nested modelling showed that TMS fully mediated the relationship between social media tools and trust, satisfaction, conflicts and communication effectiveness and partially mediated the relationship between social media tools and team cohesion and leadership. The partial TMS mediation in the relationship between social media tools and leadership may be attributed to a number of other factors that affect leadership such as feedback from leadership (Furst et al., 2004) and the effectiveness of the VT leadership itself (Leinonen et al., 2005). Similarly, the partial TMS mediation in the relationship between social media tools and team cohesion may also be attributed to other factors apart from TMS such as the selection of team members with the right skills for a task (Malhotra et al., 2007). The partial mediation may also be due to a medium sample size (N=115) used in this research. It is recommended that these partial mediation relationships should be revisited by future research in light of social media tools and TMS using a bigger sample size.

Further, the social networking characteristics of social media tools provided capabilities of knowing the team members well (Culnan et al., 2010; Gupta et al., 2012; Standing and Kiniti, 2011) which supported the development of virtual team dynamics. The advantages of using social media tools over other tools such as email in terms of communication, information sharing and knowledge management supported virtual team work and encouraged the development of VT dynamics.

Thus it can be concluded that the use of social media positively affected virtual team dynamics such as trust, team cohesion, satisfaction, communication effectiveness and leadership, and also affected a reduction in VT conflicts. The findings of this research are novel and extend the literature on virtual team dynamics (Bjorn & Ngwenyama, 2009; Greenberg et al., 2007; Henttonen & Blomqvist, 2005; Horwitz et al., 2006; Hsu et al., 2012; Kraut & Streeter, 1995; Lin et al., 2008; Malhotra et al., 2007; Maznevski et al., 2006; Peters & Manz, 2007; Shachaf, 2008; Sivunen & Valo, 2006), social media tools (Bastida et al.,



2013; Bertot et al., 2011; Curseu et al., 2008; Goodwin-Jones, 2003; Gupta et al., 2012; Gupta & Wingreen, 2014; Hoffmann & Fodor, 2010; Kaplan & Haenlein, 2010; McAfee, 2006; Ou et al., 2013; Standing & Kiniti, 2011), and the TMS theory (Choi et al., 2010; Lewis, 2003; Kanawattanachai & Yoo, 2007; Wegner, 1987; Wegner et al., 1985).

### **5.3 Chapter summary**

The objective of this chapter was to consolidate the quantitative and qualitative findings and provide a rich description of the effect of social media tools on virtual team dynamics in light of TMS mediation. The quantitative findings provided support for the research hypotheses and the research model. Social media tools allowed the virtual team members to work together, which positively affected TMS development in virtual teams as suggested by the quantitative findings. The interview findings suggested how social media tools encouraged collaboration, participation, transparency and effective information organisation in virtual teams which accelerated TMS development. This was an interesting and novel finding of this research.

The quantitative findings supported the notion of TMS mediation while examining the effect of social media tools on trust, team cohesion, satisfaction, conflicts, communication effectiveness and leadership. Generally, it was observed that social media tools promoted effective communication, team co-ordination, effective information sharing and social networking which explained the TMS mediation and the effect of social media tools on virtual team dynamics. The qualitative findings added a level of richness to the quantitative findings and explained potential reasons that may have caused the observed effect of social media tools on virtual team dynamics. Throughout the discussion of the interview findings it was observed that social media tools led to collaboration, participation, effective information organisation and transparency in virtual teams which positively affected the development of TMS and virtual team dynamics. The findings of this research are novel and extend the previous literature on social media tools, TMS and virtual team dynamics.

This chapter also answered the research questions RQ1 and RQ2 through an analysis of the quantitative and qualitative findings, and bridged the gap in IS literature.

The next chapter revisits the findings of this research and highlights the contribution of this research to both theory and practice. The main contributions to literature in IS and other disciplines and the TMS theory are highlighted, and the relevance of this research to practitioners is demonstrated. The next chapter also discusses the limitations of this research and the opportunities for further research into social media tools and virtual team dynamics.

## **Chapter 6. Conclusion**

### **6.1 Chapter overview**

This chapter discusses the contribution of this research. Initially the contribution of the research findings towards the literature is presented. To follow, it is explained how this research adds value to IS theories and particularly the transactive memory system theory. The theoretical contribution of this research in the form of a research model and a reliable research instrument is highlighted.

The practical contribution of this research is discussed in the next section. The relevance of this research to virtual team managers and other industry practitioners is explained. This research opens up new opportunities for future research in the area of virtual teams and social media which are discussed in the following section.

Finally, the chapter acknowledges the limitations of this research and provides concluding remarks to this research study.

### **6.2 Contributions to theory and literature**

Theoretically, this research made a contribution by examining how social media tools affect virtual team dynamics. Accordingly, the effect of social media tools on trust, team cohesion, satisfaction, conflicts, communication effectiveness and leadership was investigated in this research using a transactive memory system lens. Specifically this research answered the following research questions:

RQ 1: How does the use of social media tools affect virtual team dynamics?

RQ 2: Can the use of social media tools encourage TMS development in organisational virtual teams?

This research makes a number of contributions to the literature.

First, there was a dearth of literature that empirically investigated the use of social media tools in virtual teams. Previous research focused on communication in a virtual team environment through the use of communication tools such as email (Brown et al., 2007; Jarvenpaa & Leidner, 1998), videoconferencing (Brown et al., 2007; Duarte & Snyder, 2011) and telephone (Brown et al., 2007; Duarte & Snyder, 2011). However, none of these studies researched the internal use of social media tools for work and non-work related tasks. Although, Brown et al. (2007) mention the use of social media tools for virtual team communication and project work, their research did not explain how social media tools could be used.

Similarly, some other research studies investigated the use of group decision support systems (Dennis, 1996), group support systems (Dennis, 1996) and computer-mediated communication (Luo et al., 2011; Ou et al., 2013; Riemer et al., 2012) and their use in facilitating team work. However, none of these studies investigated the internal use of social media tools in organisations for work and non-work related tasks. Ou et al. (2013) were limited to studying the effect of instant messenger and email on work performance.

The external use of social media tools (except within organisational teams) was thoroughly researched by the literature (Case & King, 2011; Culnan et al., 2010; Gupta et al., 2012; Kaplan & Haenlein, 2010). However, to the best of researcher's knowledge the internal use of social media tools in organisations for project related and non-project related tasks was not investigated by any of the previous studies. Bastida et al. (2013) investigated the effect of blog tool on virtual team work but the study was conducted under quasi-experimental conditions and had limitations in terms of studying only blog tool and not having the same level of task complexity as the real world projects within organisations. Hence, the study could not fully investigate the role of social media tools in virtual team work.

Going beyond the previous research, this research investigated the use of social media tools in organisations for work and non-work related purposes. The research findings are novel and demonstrate how social media tools supported work processes and other tasks in organisations. This research contributes literature on the organisational use of social media tools.

Second, the effect of social media tools on virtual team dynamics has not been investigated by any of the previous studies. While, previous research (Henttonen & Blomqvist, 2005; Kirkman et al., 2002) acknowledged that timely communication and sharing of project information and resources leads to trust development, it did not explicitly investigate the effect of social media tools on trust. Previous research on group support systems (Bui & Jarke, 1986) suggested how these tools support group work and co-operative team working by enhancing team's cognitive capabilities but did not expand into the role of social media tools in the development of trust and team cohesion in virtual teams. Edwards and Sridhar (2003) linked the use of communication tools with satisfaction but it did not explain the effect of social media tools on virtual team satisfaction. In regard to communication in virtual teams, Daim et al. (2012) discussed the communication problems that virtual teams encounter and emphasised on the need for communication planning. Bjorn and Ngwenyama (2009) explained the role of communication technology in the development of shared meaning in virtual teams and how it played a role in resolving communication breakdowns and improving group performance. Ferrazzi (2012) explained how online discussion boards may help prevent conflicts in teams but did not empirically investigate the role of online discussion boards on virtual team conflicts. The importance of communication tool to virtual team leadership was highlighted by the existing research (Hambley et al., 2007; Kayworth & Leidner, 2001; Pauleen & Yoong, 2001); however, it primarily focused on communication tools other than social media tools. Hence, the effect of social media tools on virtual team dynamics was hitherto unknown.

This research extended these previous studies and investigated the effect of social media tools on six virtual team dynamics: trust, team cohesion, satisfaction, conflicts, communication effectiveness and leadership. This research contributed literature on these virtual team dynamics and also studied the effect of social media tools on organisational virtual team dynamics.

Third, this research added value to the theory of media richness (Daft & Lengel, 1986) and the theory of media synchronicity (Dennis et al., 2008) by exploring the concept of feature richness. The theory of media richness posited that richer media gave a feeling of co-presence to the team members. Communication tools such as videoconferencing had advantages over email since they provided a feeling of co-presence and more synchronous communication between team members. Videoconferencing was classified as a richer media as opposed to

email which was less synchronous. Similarly, the theory of media synchronicity posited that an appropriate match between media capabilities and the communication processes decided the communication performance while performing a particular task (Dennis & Kinney, 1998; Dennis et al., 2008). This research operationalised the concept of feature richness which builds upon these existing theories and distinguishes social media tools from email, videoconferencing and some other communication tools. There was an abundance of research which suggested that social media tools offered a collaborative work environment and led to participation (Goodwin-Jones, 2003; Gupta et al., 2012; Juch & Stobbe, 2005; Standing & Kiniti, 2011). Previous research also posited that social media tools led to information organisation and transparency (Bertot et al., 2011; Ferrazzi, 2012; Kaplan & Haenlein, 2010). The concept of feature richness amalgamated collaboration, participation, information organisation and transparency and was investigated in light of the internal use of social media tools in this research.

This research investigated the capabilities offered by social media tools; primarily how social media tools support communication, collaboration, participation, information organisation and transparency when used within organisational virtual teams. This research explored how these capabilities of social media tools supported work processes, and also discovered some other benefits provided by the use of social media tools. The research findings demonstrate how social media tools supported work and non-work related tasks in virtual teams. Therefore, this research operationalised and extended the theory of media richness and theory of media synchronicity in the context of social media tools which is another interesting and novel contribution of this research.

Fourth, this research contributes to the transactive memory system theory (Wegner, 1987; Wegner et al., 1985) by examining the effect of social media tools on virtual team dynamics through a TMS lens. The TMS theory provided a good framework for studying the effect of social media tools on virtual team dynamics on account of its relevance to team work. TMS theory was a good fit with the concepts of trust, team cohesion, satisfaction, conflicts, communication effectiveness and leadership due to its ability to capture how TMS may affect each of these VT dynamics. Although, TMS has been studied in the context of communication tools (Choi et al., 2010; Kanawattanachai & Yoo, 2007), none of these studies explained the effect of social media tools on the TMS in virtual teams. Extending the previous research, this research adds value to the TMS theory by operationalising it in the

context of virtual team dynamics. This process led to the development of a novel theoretical framework for examining the effect of social media tools on virtual team dynamics. The relationship between TMS and team dynamics has not been investigated in detail by prior research hence, establishing the relationship between TMS and team dynamics is yet another contribution of this research.

Fifth, this research contributed a reliable instrument to capture the effect of social media tools on virtual team dynamics. The existing measurements for trust, team cohesion, satisfaction, conflicts, communication effectiveness and leadership were researched and a measurement scale to investigate the effect of social media tools on virtual team dynamics was put together in light of the previous literature. Some new measurement items were created in case there was a dearth of existing measurements to understand the phenomenon of interest. The instrument was thoroughly pilot-tested and validated. Subsequently, the instrument was used for data collection in a field study. The instrument supported the goals of this research and facilitated an investigation of the effect of social media tools on virtual team dynamics. The research instrument expands the existing metrics for team cohesion, satisfaction, conflicts, communication effectiveness, leadership and TMS and also contributes new items. The measurement scale can be replicated by future research within IS as well as other disciplines and can also be used in the industry. Similarly, this research contributed a reliable interview protocol which was pilot tested and then used in the field study.

Finally, this research contributed a research model towards IS literature (figure 1). The research model is novel and captures a phenomenon that has not been previously investigated by any other research studies. The research model was empirically examined and validated; hence it provides a robust foundation to future research studies that investigate social media tools and virtual team dynamics. The research model statistically tested the effect of social media tools on TMS, hypothesis one (H1), and provided an insight into the research question RQ1. It was established that the use of social media tools encouraged TMS development in virtual teams. The research model provided an insight into the role of TMS in the development of virtual team dynamics. To ascertain the mediating role of TMS, nested modelling approach was used, and the research model (model with TMS) was adjudged to be a more comprehensive model that captured the phenomenon in much more detail than the model without TMS. The research model statistically tested the TMS mediation on virtual team dynamics. The statistical analysis provided evidence for TMS mediation on trust (H2),

team cohesion (H3), satisfaction (H4), conflicts (H5), communication effectiveness (H6) and leadership (H7) in virtual teams. Further, the research model attempted to bridge the theories of media richness (Daft & Lengel, 1986), the theory of media synchronicity (Dennis et al., 2008) and the TMS theory (Wegner, 1987; Wegner et al., 1985). The theory of media richness and media synchronicity related to the communication tool (or medium) and the TMS theory related to team work. The research model provided an application oriented overview of the functionalities gained through the communication tool and how it fits well in context of virtual team tasks and dynamics. Finally, the research model is meaningful for the IS as well as other disciplines because it contributes a phenomenon that may affect the work practices in organisations.

### **6.3 Contributions to practice**

Virtual teams are increasingly being used by organisations (Gabel & Bruner, 2003; Horwitz et al., 2006) as is the case with the uptake of social media tools internally within organisations. Keeping pace with these developments, this research has several implications for practitioners who work in virtual teams and use social media tools for a variety of tasks or do a combination of both.

For virtual team managers, the research model provides a framework that can assist with their decision-making processes in terms of enhancing the productivity of virtual team work and the effective use of communication tools to support the work processes. Virtual team work is a combination of several processes, and the research model can assist the managers by identification of factors that may affect virtual team performance.

For virtual team managers, it is important that team members have a balance of task related and interpersonal skills (Horwitz et al., 2006). The research has implications in terms of the effective use of the communication tools to ensure a productive work environment. Specifically, the managers can tap into the capabilities of social media tools to ensure a balance between the task and people side of things in the virtual team. The effective use of social media tools must be encouraged within a virtual team. Social media tools provide capabilities to support both work related and other tasks such as connecting with team members.



In terms of the work related tasks, social media tools provided excellent capabilities such as collaboration and participation between the team members, documenting the project information well, making the process for the retrieval of the project information easier, and creating visibility and transparency in project communication. All of these capabilities may improve virtual team work and may also benefit the team while working towards complex tasks which need a concerted team effort.

In regard to social aspects, social media tools may help team members better understand each other and may also help in the development of a 'connect' between the team members. This may enhance bonding between the team members.

To enhance the productivity of the team, it is important for the managers to understand how virtual team dynamics function. Managers can use this research as a reference to understand this phenomenon. This research may also provide guidelines for managers in terms of assembling teams with a variety of skills and scheduling tasks according to the expertise of the virtual team members, which creates a task-skill match and may benefit the task.

Managers may also use this research as a reference while evaluating the effectiveness of communication tools that are currently in use at their organisation. This research highlighted some major factors that affect virtual team work and the role of communication tool in enhancing those factors. Since the factors are related to virtual teams and depend on the communication tool; therefore, this research provides a means for understanding the effectiveness of communication tools on virtual team work. An ideal communication tool not only provides a medium for communication but also provides additional work and non-work benefits. This research evaluated the use of social media tools on virtual team dynamics, and the same or similar approach can be used by managers to understand the effect of other communication tools on virtual team dynamics.

For virtual team members, this research explains how social media tools may help them in pooling their expertise with other team members and work collectively on the task rather than as individuals. The capabilities of social media tools may help in connecting with co-workers better and this may positively affect team performance. Team members can share knowledge with each other and may also seek help from others when needed.

This research contributed an improved understanding of how social media tools can affect virtual team work and work processes and also improve collaboration and communication among team members. This research calls for a greater understanding of the effect of social media tools in an organisational context which was hitherto unknown. Further, organisations that are already using social media tools may use this research as a reference for quantifying the benefits of social media tools to their organisational virtual teams.

The findings of this research also have implications in terms of design of feature rich communication tools. Communication tools that provide capabilities such as encouragement of collaborative team work, support work processes and provide a good fit with the task, and provide a means to establish social relations with team members may be more suited to organisations.

#### **6.4 Future research and limitations**

Another major contribution of this research is that it opens up new research areas for investigation. This research developed and validated a research model which may be used as a basis for further research into social media tools, team dynamics and TMS.

The avenues for further research into social media tools include an investigation of social media tools in the context of specific virtual team tasks. A task-level research into social media tools is important since virtual team work comprises a number of different tasks such as communication, knowledge management, knowledge sharing and task scheduling to name a few. A detailed investigation into how social media tools support each of these tasks in virtual teams can be considered for future research. Further, different social media tools offer different capabilities (Nissen & Bergin, 2013) and future research may also investigate different social media tools and their effect on virtual team task performance. This can build a social media tool-task typology and may help ascertain which social media tool is the best for which task.

Moreover, future research may also compare the use of social media tools and other communication tools such as email, or videoconferencing by using the same instrument but administering different ‘control’ in the instrumentation. This may be done by asking the participants to answer the Likert questionnaire in regard to their use of social media tools and

then in regard to their use of other tools such as email or videoconferencing. The resulting research models could then be compared, and the key differences between the use of social media tools and other tools would become more apparent. It would also provide another comparison factor in order to more fully understand the role of social media tools.

The research findings showed that the relationship between social media tools and virtual team dynamics was mediated by the TMS construct. Future research may consider studying some more team dynamic constructs or may study the effect of social media tools on each of the individual virtual team dynamics such as trust, team cohesion, satisfaction, conflicts, communication effectiveness and leadership using more rigorously controlled methods. The use of a different theoretical lens to examine the effect of social media or other communication tools on virtual team dynamics is also encouraged. This will provide another perspective into the research area, and a comparison with this research study will address any other potential research gaps.

This research showed that TMS partially mediated the effect of social media tools on virtual team cohesion and leadership. Future research may fully explore the cause of partial mediation. Further, there may be an existence of additional constructs that may affect team cohesion and leadership apart from TMS, which is another area for further investigation. There may be a second order latent construct which represents interactions between two or more virtual team dynamics under consideration (Schumacker & Lomax, 2004). The existence of such a construct can be established by future research by using a bigger sample size and performing a confirmatory factor analysis.

The introduction of a 'control' variable may also provide another perspective into the effect of social media tools on virtual team dynamics. Specifically, it is recommended that future research investigates a mix of virtual teams where some team members meet face-to-face often or at regular intervals while others meet rarely or never. The frequency of face-to-face meetings may be used as a control condition to understand the effect of social media tools on virtual team dynamics more thoroughly.

Additionally, the mediating role of TMS may be explored more fully by using a component-level approach and studying the individual effects of specialization, co-ordination and credibility (Choi et al., 2010; Hsu et al., 2012; Wegner, 1987) on each of the virtual team

dynamics. This may be preceded by a detailed component-level examination of feature richness of social media tools on work processes. The interview findings of this research have already confirmed the role of feature richness. Thus, an appropriate component-level mapping between feature richness i.e. participation, collaboration, information organisation and transparency, and the components of the TMS construct i.e. specialization, co-ordination and credibility may provide a deeper understanding of the effect of social media tools on the TMS and consequently, the effect on virtual team dynamics. This may form the basis for a more comprehensive theory building and testing.

The primary limitation of this research was that the sample size was not large (N=115). This research used PLS structural equation modelling which produced reliable results even with a medium sample size. In saying that, researchers may look into conducting studies on a much larger scale and use a bigger sample size to see if there is any variation in the results compared to this research. This research has definitely contributed knowledge in the research area and hence may be used as the basis for any future research into the same area.

## **6.5 Chapter summary**

This chapter aimed to discuss the contribution of this research to literature, theory and practice. Initially, the contribution of this research to the IS literature was discussed. First, this research contributed by studying the internal use of social media tools within organisational virtual teams. Social media tools supported a variety of tasks in virtual teams both work related and unrelated to work. This research added value to the literature on social media tools and virtual team dynamics by studying the effect of social media tools on virtual team dynamics.

This research explored the theories of media richness and media synchronicity in the context of social media tools. Another contribution of this research is that it studied the phenomenon of interest through a TMS lens. TMS mediated the effect of social media tools on virtual team dynamics which was a significant and novel contribution to the research on TMS and team dynamics.

In terms of the theoretical contributions, this research put together a reliable research instrument and validated it through a pilot test and a field study. This research instrument

could be used by future studies in the same or a similar research area. Similarly, the interview protocol developed for this research was pilot tested and validated through a field study and may be used for conducting further research in the same or similar area. Further, this research contributed a novel research model towards IS theory. The research model was duly validated; hence, it can be used as a theoretical basis for future research. The research model has implications for practitioners as well.

Second, this research made a number of practical contributions and can be used as a reference by virtual team managers and other industry practitioners for understanding the strategic internal use of social media tools and for a better understanding of virtual team dynamics. This research has provided a new research direction for studying social media tools as well as virtual team dynamics. It calls for a more detailed research on feature richness and how it affects work processes.

The limitations of this research were acknowledged, and the improvement suggestions provided opportunities for researchers to explore the research area. The chapter finished with some final concluding remarks.

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## **Appendix A. Information letter for participants**



**Tel: +64-(0)-2040052973**

**Email: hritik.gupta@pg.canterbury.ac.nz**

### **How Communication Tools (Social Media) Affect Virtual Team Dynamics (e.g. Trust, Team Cohesion, Satisfaction, Conflicts, Communication Effectiveness and Leadership)**

#### **Information Sheet for Participants**

I am a full-time PhD student at the Department of Accounting and Information Systems, University of Canterbury. I would like to invite you to participate in my research relating to communication within organisational virtual teams. The study is classified as an empirical field research towards understanding the effect of communication technologies (social media tools) on the key dynamics of organisational virtual teams.

“Social media” refers to applications like Blogs, Discussion Forums, Yammer, Jive, Enterprise social networks, Wikis, Intranet portals etc.

“Other collaborative technologies/Project Management tools” refer to online project management and collaboration software such as Base Camp etc.

“Virtual teams” refer to organisational teams that communicate primarily via electronic means such as social media, project management/collaborative tools and email etc. and may or may not have met face-to-face.

If you agree to participate you will be requested to complete the following:

A 6 point Likert-style questionnaire to record your impression and experiences with social media tools in your organisational virtual team. This questionnaire takes no more than **15 minutes** to complete. The questionnaire would be completed online (Qualtrics) or can be completed on a paper and returned to me in a prepaid envelope (would be provided to you), according to your preference.

Later, you would be asked to participate in a short follow-up interview (**takes 15-30 minutes**).

Participation in the study is voluntary. You can participate in all or selected phases of this research. If you do participate, you have the right to withdraw at any time. If you do withdraw I will use the data already gathered from you provided that this is useable and practical.

As most of the work will be done online you will need access to a computer and the internet. You will need an email address. You will need to be comfortable with using the equivalent of word processor/online survey software (Qualtrics) computer program. You are free at your will to complete

the questionnaire whenever convenient. Interview would be conducted on an agreed date, time and place face-to-face and/or telephonically.

I will take particular care to safeguard the confidentiality of the data collected. I will ensure that any published work has participants' names removed and anonymised. I intend to make all the data anonymous as a matter of course so that the study can be submitted to journal articles, conference proceedings, reports and any other public documents.

The results of the research will be used to study the effect of social media tools on virtual team dynamics using a Transactive Memory System approach and it is hoped that it will uncover some other areas for further investigation. The results will be used for completion of my PhD dissertation/thesis. The data would also be used for academic and practitioner publications. In any case, anonymity would be maintained.

Please contact me by email if you have further questions. This project has received ethical approval from the University of Canterbury Human Ethics Committee, and that participants should address any complaints to The Chair, Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch ([human-ethics@canterbury.ac.nz](mailto:human-ethics@canterbury.ac.nz)).

If you agree to participate in this study please complete the attached consent form and return it to me via email by [day/month/year].

Thank you for your consideration and I look forward to your participation in this research.

Yours Sincerely

Hritik Gupta

## **Appendix B. Consent form for participants**



**Tel: +64-(0)-2040052973**

**Email: [hritik.gupta@pg.canterbury.ac.nz](mailto:hritik.gupta@pg.canterbury.ac.nz)**

### **How Communication Tools (Social Media) Affect Virtual Team Dynamics (e.g. Trust, Team Cohesion, Satisfaction, Conflicts, Communication Effectiveness and Leadership)**

#### **Consent Form for Participants**

I have been given a full explanation of this project and have been given an opportunity to ask questions.

I understand what will be required of me if I agree to take part in this project.

I understand that my participation is voluntary and that I may withdraw at any stage without penalty.

I understand that any information or opinions I provide will be kept confidential to the researcher and that any published or reported results will not identify me.

I understand that all data collected for this study will be kept in locked and secure facilities at the University of Canterbury and will be destroyed after five years.

I understand that I will receive a report on the findings of this study. I have provided my email details below for this.

If interviewed, I consent/ do not consent (delete as appropriate) to tape-recording of the interview by the researcher, Hritik Gupta.

I understand that if I require further information I can contact the researcher, Hritik Gupta. If I have any complaints, I can contact the Chair of the University of Canterbury Human Ethics Committee.

By signing below, I agree to participate in this research project.

Name: \_\_\_\_\_

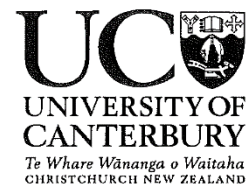
Date: \_\_\_\_\_

Signature (Please put your initials): \_\_\_\_\_

Email: \_\_\_\_\_

Please complete and return this consent form by email to **[hritik.gupta@pg.canterbury.ac.nz](mailto:hritik.gupta@pg.canterbury.ac.nz)** by [day/month/year].

## Appendix C. Human ethics committee approval



### HUMAN ETHICS COMMITTEE

Secretary, Lynda Griffioen  
Email: [human-ethics@canterbury.ac.nz](mailto:human-ethics@canterbury.ac.nz)

Ref: HEC 2013/34/LR-PS

25 September 2013

Hritik Gupta  
Department of Accounting & Information Systems  
UNIVERSITY OF CANTERBURY

Dear Hritik

Thank you for forwarding to the Human Ethics Committee a copy of the low risk application you have recently made for your research proposal "Social media useage and its effect on virtual team dynamics and performance".

I am pleased to advise that this application has been reviewed and I confirm support of the Department's approval for this project.

Please note that this approval is subject to the incorporation of the amendments you have provided in your email of 19 September 2013.

With best wishes for your project.

Yours sincerely

A handwritten signature in black ink, appearing to read 'L. MacDonald'.

Lindsey MacDonald  
*Chair, Human Ethics Committee*



## **Appendix D. Questionnaire**

The entire questionnaire takes about **15 minutes** to complete. All your responses will be kept strictly confidential and would be used for academic purposes only.

### **Part A: Sampling Questions**

<b>Question</b>	<b>Response</b>
Q1. How many members does your team have?	
Q2. The team members are spread in how many geographic locations?	
Q3. What communication tools does your team use for communicating within the team (e.g. email, phone, social media, collaborative/project management tools etc.)?	
Q4. Does your team use social media for communication?	Yes/No
Q4.a. Which social media (e.g. Blogs, Yammer, Jive, Enterprise social networks, Wikis, Discussion Forums etc.) does your team use?	
Q4.b. What tasks does your team perform using social media?	<b>4.b. SELECT ALL THAT APPLY (X)</b> 1. Communication 2. Knowledge Management 3. Document Sharing 4. Progress Reporting Others (please specify) _____
Q5. Does your team use other collaborative/project management tools?	Yes/No
Q5.a. What collaborative/project management tools does your team use?	
Q5.b. What tasks does your team perform using collaborative/project management tools?	<b>5.b. SELECT ALL THAT APPLY (X)</b> 1. Communication 2. Knowledge Management 3. Document Sharing 4. Progress Reporting Others (please specify) _____
Q6. Do you use social media personally? <b>IF YES GOTO Q6.a. ELSE GOTO Q7.</b>	Y/N
Q6.a. How would you rate your experience with social media?	<b>6.a. SELECT ONLY ONE (X)</b> 1. Excellent 2. Good 3. Neutral

	4. Not good 5. Not at all good.
Q6.b. How many hours do you spend on social media each day?	<b>6.b. SELECT ONLY ONE (X)</b> 1. 0-2 2. 2-5 3. 5+
Q7. How often do your team members meet face to face?	<b>7.SELECT ONLY ONE (X)</b> 1. Everyday 2. Every couple of days 3. Every week 4. Every month 5. Every couple of months 6. Rarely 7. Never
Q8. What percentage of your time spent communicating is via the following: 1. Social Media 2. Other project management / collaborative tools 3. Face to face 4. Email 5. Others (e.g. Phone, fax, videoconferencing etc) TOTAL=	1. 2. 3. 4. 5.  100%

Thinking about your team's project communication, collaboration and other project related activities that are carried out through **social media tools only**, please answer the questionnaire. All your responses will be kept strictly confidential and anonymous.

## **Part B: Likert questionnaire**

### **Trust**

Rate the following statements on a scale of strongly agree-strongly disagree.

<b>Code</b>	<b>Item</b>	<b>Strongly Agree</b>	<b>Agree</b>	<b>Slightly Agree</b>	<b>Slightly Disagree</b>	<b>Disagree</b>	<b>Strongly Disagree</b>
<b>T1</b>	Team members work carefully						
<b>T2</b>	Team members meet their obligations						
<b>T3</b>	Team members contribute to team tasks/success						
<b>T4</b>	Team members help resolve the problems in the team						
<b>T5</b>	Team members share information even if it is unpleasant						
<b>T6</b>	Team members possess high integrity						
<b>T7</b>	Team members mislead me						
<b>T8</b>	Team members keep their promise						
<b>T9</b>	Team members freely share ideas and feelings						
<b>T10</b>	Team members share important project information with me						
<b>T11</b>	Team members avoid retaliation						
<b>T12</b>	My opinion is taken into account when important decisions are made						
<b>T13</b>	Team members trust me						

### **Team cohesion**

Rate the following statements on a scale of strongly agree-strongly disagree.

Code	Item	Strongly Agree	Agree	Slightly Agree	Slightly Disagree	Disagree	Strongly Disagree
TC1	I am happy with the team's level of task commitment						
TC2	I have conflicting aspirations for the team's performance						
TC3	The team gives me opportunities to improve my performance						
TC4	The team has a collective agreement on tasks						
TC5	The team has expectations from individual members						
TC6	Team members get to know of individuals' contribution to the team						
TC7	Team members spend time socializing on the communication tool						
TC8	Team members have fun on the communication tool apart from work						
TC9	The team is cohesive						

### **Satisfaction**

Rate the following statements on a scale of strongly agree-strongly disagree.

Code	Item	Strongly Agree	Agree	Slightly Agree	Slightly Disagree	Disagree	Strongly Disagree
S1	I am satisfied with my team members						
S2	I am pleased with the way other team members and I work together.						
S3	I am very satisfied with working in this team						
S4	I am satisfied with team members' contribution to the team						
S5	Some aspects of the team could be better						
S6	The team likes working with me						
S7	Team members are satisfied with the team						

### **Conflicts**

Rate the following statements on a scale of strongly agree-strongly disagree.

<b>Code</b>	<b>Item</b>	<b>Strongly Agree</b>	<b>Agree</b>	<b>Slightly Agree</b>	<b>Slightly Disagree</b>	<b>Disagree</b>	<b>Strongly Disagree</b>
<b>CON1</b>	The team does not have a divided approach towards the project						
<b>CON2</b>	Team members remember critical project information						
<b>CON3</b>	Team members' ideas are often conflicting						
<b>CON4</b>	Team members often disagree on decisions						
<b>CON5</b>	I have good relations with my team members						
<b>CON6</b>	The communication tool helps my relationship with my team members work well						
<b>CON7</b>	There is a lot of friction among the team members						
<b>CON8</b>	There are personality conflicts in the team						
<b>CON9</b>	There is a lot of tension among the team members						

### **Communication effectiveness**

Rate the following statements on a scale of strongly agree-strongly disagree.

<b>Code</b>	<b>Item</b>	<b>Strongly Agree</b>	<b>Agree</b>	<b>Slightly Agree</b>	<b>Slightly Disagree</b>	<b>Disagree</b>	<b>Strongly Disagree</b>
<b>CE1</b>	The team is able to respond to a communication breakdown well						
<b>CE2</b>	There is little miscommunication in the team						
<b>CE3</b>	The team was created over six months ago						
<b>CE4</b>	The team has a set communication plan						
<b>CE5</b>	The team has clear communication policies						
<b>CE6</b>	Team members communicate their feelings honestly						
<b>CE7</b>	Team members display mutual respect						
<b>CE8</b>	Team members communicate problems easily						
<b>CE9</b>	There is information overload						

### **Communication tool**

Rate the following statements on a scale of strongly agree-strongly disagree.

Code	Item	Strongly Agree	Agree	Slightly Agree	Slightly Disagree	Disagree	Strongly Disagree
CT1	The team heavily relies on the communication technology						
CT2	The team experiences problems with the communication technology						
CT3	I prefer multiple communication channels						
CT4	The team experiences communication breakdowns						
CT5	The team experiences communication breakdowns frequently						
CT6	This communication channel is really good						
CT7	Communication tool ensures participation from all team members						
CT8	The communication tool ensures transparency						
CT9	The communication tool makes the team work together						

### **Leadership**

Rate the following statements on a scale of strongly agree-strongly disagree.

Code	Item	Strongly Agree	Agree	Slightly Agree	Slightly Disagree	Disagree	Strongly Disagree
L1	The team leader/manager establishes clear set of goals						
L2	The manager spends time motivating and boosting team spirit						
L3	The manager gives good feedback to the team members despite being geographically dispersed						
L4	The manager integrates the team well						
L5	The manager monitors the team and signals any trouble						
L6	The manager is vigilant						
L7	The manager makes informed decisions on team issues						
L8	The manager has an influence over the team						
L9	This communication tool helps the manager to manage the team well						

### **Transactive Memory System**

Rate the following statements on a scale of strongly agree-strongly disagree.

Code	Item	Strongly Agree	Agree	Slightly Agree	Slightly Disagree	Disagree	Strongly Disagree
TMS1	I seek specialist team members' expertise when needed						
TMS2	Team members seek my expertise when needed						
TMS3	I know other team members' skills well						
TMS4	The team members have the right skills for the project						
TMS5	The team is united while working on the project						
TMS6	Team members agree on most of the decisions						
TMS7	I feel that the team is more knowledgeable than individual members						
TMS8	The team is really effective						
TMS9	Team members' motives are good for the team						
TMS10	I can rely on other team members						
TMS11	I trust other team members						
TMS12	Team members respond constructively to my problems						

### **Demographics**


Please enter your name (only for follow-up purposes).	
Gender	Male Female
Please enter your age group	18-29 30-39 40-59 60+
Please indicate your company name (optional and only for follow-up purposes).	
Please enter your designation.	

**I appreciate your time spent in completing this questionnaire. Your responses would be of value to this research.**

## Appendix E. Screenshots of the online questionnaire

Screen 1

Your responses will be kept strictly confidential and anonymous



How many members does your team have?

The team members are spread in how many geographic locations?

What communication tools does your team use for communicating within the team (e.g. email, phone, social media, collaborative/project management tools etc.)?


Does your team use social media for communication?

☐ Yes

☐ No

<< >>

Screen 2



Which social media (e.g. Blogs, Yammer, Jive, Enterprise social networks, Wikis, Discussion Forums etc.) does your team use?

What tasks does your team perform using social media (select all that apply)?

☐ Communication

☐ Knowledge Management

☐ Document Sharing

☐ Progress Reporting

☐ Others (please specify)

Does your team use other collaborative/project management tools?

☐ Yes


☐ No

<< >>



## Screen 3

Your responses will be kept strictly confidential and anonymous.



What collaborative/project management tools does your team use?

What tasks does your team perform using collaborative/project management tools (select all that apply)?

- ☐ Communication
- ☐ Knowledge Management
- ☐ Document Sharing
- ☐ Progress Reporting
- ☐ Others (please specify)

Do you use social media personally?

☐ Yes

☐ No

---

How would you rate your experience with social media?

☐ Excellent

☐ Good

☐ Neutral

☐ Not good

☐ Not at all good

How many hours do you spend on social media each day?

☐ 0-2 hours

☐ 2-5 hours

☐ 5+ hours

How often do your team members meet face to face?

☐ Everyday

☐ Every couple of days

☐ Every week

☐ Every month

☐ Every couple of months

☐ Rarely

☐ Never


What percentage of your time spent communicating is via the following (Total=100%)

Social Media	<input type="text" value="0"/>
Other project management/ collaborative tools	<input type="text" value="0"/>
Face to face	<input type="text" value="0"/>
Email	<input type="text" value="0"/>
Others (e.g. Phone, fax, videoconferencing etc.)	<input type="text" value="0"/>
<b>Total</b>	<input type="text" value="0"/>

<< >>

## Screen 4

Your responses will be kept strictly confidential and anonymous




Thinking about your team's project communication, collaboration and other project related activities that are carried out through **social media tools only**, please answer the questionnaire. All your responses will be kept strictly confidential and anonymous.

<< >>

Survey Powered By [Qualtrics](#)

## Screen 5

Your responses will be kept strictly confidential and anonymous



**Trust**

Rate the following statements on a scale of strongly agree-strongly disagree.

	Strongly Agree	Agree	Slightly Agree	Slightly Disagree	Disagree	Strongly Disagree
Team members work carefully	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Team members meet their obligations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Team members contribute to team tasks/success	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Team members help resolve the problems in the team	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Team members share information even if it is unpleasant	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Team members possess high integrity	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Team members mislead me	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Team members keep their promise	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Team members freely share ideas and feelings	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Team members share important project information with me	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Team members avoid retaliation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	My opinion is taken into account when important decisions are made	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Team members trust me	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Team cohesion</b>							
Rate the following statements on a scale of strongly agree-strongly disagree.							
		Strongly Agree	Agree	Slightly Agree	Slightly Disagree	Disagree	Strongly Disagree
	I am happy with the team's level of task commitment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	I have conflicting aspirations for the team's performance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	The team gives me opportunities to improve my performance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	The team has a collective agreement on tasks	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	The team has expectations from individual members	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Team members get to know of individuals' contribution to the team	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Team members spend time socializing on the communication tool	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Team members have fun on the communication tool apart from work	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	The team is cohesive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Satisfaction</b>							
Rate the following statements on a scale of strongly agree-strongly disagree.							
		Strongly Agree	Agree	Slightly Agree	Slightly Disagree	Disagree	Strongly Disagree
	I am satisfied with my team members	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	I am pleased with the way other team members and I work together.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	I am very satisfied with working in this team	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	I am satisfied with team members' contribution to the team	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Some aspects of the team could be better	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	The team likes working with me	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Team members are satisfied with the team	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Conflicts</b>							
Rate the following statements on a scale of strongly agree-strongly disagree.							
		Strongly Agree	Agree	Slightly Agree	Slightly Disagree	Disagree	Strongly Disagree
	The team does not have a divided approach towards the project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Team members remember critical project information	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Team members' ideas are often conflicting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Team members often disagree on decisions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	I have good relations with my team members	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	The communication tool helps my relationship with my team members work well	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	There is a lot of friction among the team members	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	There are personality conflicts in the team	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	There is a lot of tension among the team members	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Communication effectiveness</b>							
Rate the following statements on a scale of strongly agree-strongly disagree.							
		Strongly Agree	Agree	Slightly Agree	Slightly Disagree	Disagree	Strongly Disagree
	The team is able to respond to a communication breakdown well	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	There is little miscommunication in the team	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	The team was created over six months ago	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	The team has a set communication plan	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	The team has clear communication policies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Team members communicate their feelings honestly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Team members display mutual respect	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Team members communicate problems easily	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	There is information overload	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

### Communication tool

Rate the following statements on a scale of strongly agree-strongly disagree.

	Strongly Agree	Agree	Slightly Agree	Slightly Disagree	Disagree	Strongly Disagree
The team heavily relies on the communication technology	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The team experiences problems with the communication technology	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I prefer multiple communication channels	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The team experiences communication breakdowns	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The team experiences communication breakdowns frequently	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This communication channel is really good	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Communication tool ensures participation from all team members	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The communication tool ensures transparency	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The communication tool makes the team work together	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

### Leadership

Rate the following statements on a scale of strongly agree-strongly disagree.

	Strongly Agree	Agree	Slightly Agree	Slightly Disagree	Disagree	Strongly Disagree
The team leader/manager establishes clear set of goals	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The manager spends time motivating and boosting team spirit	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The manager gives good feedback to the team members despite being geographically dispersed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The manager integrates the team well	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The manager monitors the team and signals any trouble	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The manager is vigilant	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The manager makes informed decisions on team issues	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The manager has an influence over the team	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This communication tool helps the manager to manage the team well	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

### Transactive Memory System

Rate the following statements on a scale of strongly agree-strongly disagree.

	Strongly Agree	Agree	Slightly Agree	Slightly Disagree	Disagree	Strongly Disagree
I seek specialist team members' expertise when needed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Team members seek my expertise when needed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I know other team members' skills well	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The team members have the right skills for the project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The team is united while working on the project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Team members agree on most of the decisions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel that the team is more knowledgeable than individual members	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The team is really effective	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Team members' motives are good for the team	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can rely on other team members	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I trust other team members	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Team members respond constructively to my problems	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## Screen 6

Please enter your name (only for follow-up purposes).

Gender.

☐ Male

☐ Female

Please indicate your age group.

☐ 18-29

☐ 30-39

☐ 40-59

☐ 60+


Please enter your company name (optional and only for follow-up purposes).

Please enter your designation.

Survey Powered By [Qualtrics](#)

## Screen 7

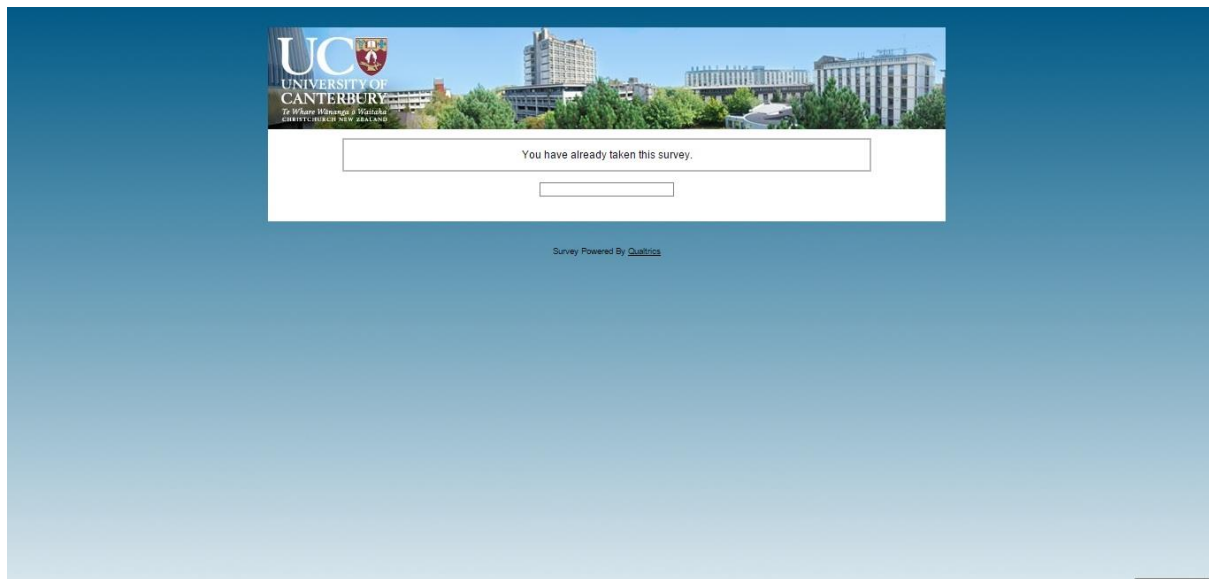
Your responses will be kept strictly confidential and anonymous.



We thank you for your time spent taking this survey.  
Your response has been recorded.

Survey Powered By [Qualtrics](#)

Screen: Error message displayed on retaking the survey



## **Appendix F. Interview protocol**

<b>1.0</b>	<b>INTRODUCTION</b>
1.1	<i>Thank the interviewee for their participation and convey the focus of this research.</i>
1.2	<i>Introduce the agenda and explain the interview structure.</i>
1.3	<i>Explain that the interview is completely confidential and anonymous, and obtain consent for tape-recording the interview.</i>
1.4	<i>Put the interviewee at ease and ask if they have any questions before asking the actual interview questions.</i>
<b>2.0</b>	<b>SOCIAL MEDIA TOOLS</b>
2.1	<i>What social media tool(s) do you use in the workplace? (Give examples of social media tools such as blogs, discussion forums, Yammer, Jive, Enterprise social networks, Wikis, Intranet portals etc.)</i>
2.2	<i>Can you tell me what tasks do you complete through <i>this/these</i> social media tool(s)?</i>
2.3	<i>What other tools do you use in the workplace?</i>
2.4	<i>Can you tell me what tasks do you complete through <i>this/these</i> tool(s)?</i>
<b>3.0</b>	<b>TRUST</b>
3.1	<i>Do you think <i>this/these</i> social media tool(s) affect(s) your team's trust?</i>
3.1.1	<i>Why is that? (Repeat or rephrase question until nothing further is mentioned.)</i>
3.2	<i>Do you think that the team trust would be more if you used tools other than <i>this/these</i> social media tool(s)?</i>
<b>4.0</b>	<b>TEAM COHESION</b>
4.1	<i>(Explain team cohesiveness.)</i> <i>Do you think that <i>this/these</i> social media tool(s) play(s) a role in your team's cohesiveness?</i>
4.1.1	<i>Why is that? (Repeat or rephrase question until nothing further is mentioned.)</i>
<b>5.0</b>	<b>SATISFACTION</b>
5.1	<i>Do you think that <i>this/these</i> social media tool(s) affect(s) your team's satisfaction?</i>
5.1.1	<i>Why is that? (Repeat or rephrase question until nothing further is mentioned.)</i>
<b>6.0</b>	<b>REDUCED CONFLICTS</b>
6.1	<i>Does/do <i>this/these</i> social media tool(s) help in avoiding team conflicts?</i>
6.1.1	<i>Why is that? (Repeat or rephrase question until nothing further is mentioned.)</i>
<b>7.0</b>	<b>COMMUNICATION EFFECTIVENESS</b>
7.1	<i>Do you think that the social media tool(s) that you are using <i>is/are</i> good?</i>
7.1.1	<i>Why is that? (Repeat or rephrase question until nothing further is mentioned.)</i>
7.2	<i>Are <i>these/is this</i> social media tool(s) better than some other tools that you use? (Read out all tools which interviewee mentioned at 2.3.)</i>
7.2.1	<i>Why is that? (Repeat or rephrase question until nothing further is mentioned.)</i>
7.3	<i>Do <i>these/does this</i> social media tool(s) help in promoting team understanding?</i>
7.3.1	<i>Why is that? (Repeat or rephrase question until nothing further is mentioned.)</i>
7.4	<i>Are <i>these/is this</i> social media tool(s) effective in promoting participation in the team?</i>
7.4.1	<i>Why is that? (Repeat or rephrase question until nothing further is mentioned.)</i>
7.5	<i>Are <i>these/is this</i> social media tool(s) effective in promoting collaboration in the team?</i>
7.5.1	<i>Why is that? (Repeat or rephrase question until nothing further is mentioned.)</i>
<b>8.0</b>	<b>LEADERSHIP</b>
8.1	<i>(If the interviewee is <u>not</u> a manager/senior manager, ask the following question.)</i>

	Can the manager monitor the team well because of <i>this/these</i> social media tool(s)?
8.2	(If the interviewee is a manager/senior manager, ask the following question.) Can you monitor the team well because of <i>this/these</i> social media tool(s)?
<b>9.0</b>	<b>CLOSURE AND END OF INTERVIEW</b>
9.1	Do you have any other comments you would like to make?
9.2	Do you have any questions you would like to ask before we end this interview?
9.3	Thank the interviewee for their participation and their time spent while completing this interview.



## **Appendix G. Coding sample**

<b>Extract from interviews</b>	<b>Code</b>	<b>Explanation</b>
<i>"It [internal discussion forum] helps me to collaborate and to understand things in a better way".</i>	Collaboration	This code refers to team collaboration resulting from the use of social media tools.
<i>"I do feel that this [Yammer] is a good platform where everyone can comment and give their points or feedback".</i>	Participation	This code refers to team participation resulting from the use of social media tools.
<i>"Yes, he [project manager] can see all the conversations".</i>	Project monitoring	This code refers to the act of monitoring the team conversations by the project manager.
<i>"We usually use it [wiki] as a repository, where you want to go back to".</i>	Information organisation	This code refers to the creation of an organised repository of project information on social media tools.
<i>"The tools [social media] may help you get there faster".</i>	Communication effectiveness	This code refers to the efficiency of social media communication.
<i>On an organisation scales, we cannot depend on somebody's personal emails or somebody's personal Dropbox or drive folders".</i>	Lack of transparency	This code refers to the lack of transparency in email communication.
<i>"Communication wise, I feel yes it's [WhatsApp] helping. There are a few people I haven't talked to, but on WhatsApp I have communicated with them".</i>	Social networking	This code refers to the act of networking with people within the organisation.
<i>"If I talk about email, it's not very user friendly in terms of connecting with people".</i>	Minimal social networking	This code refers to the challenges of email with respect to networking within the organisation.
<i>"I like to use social media as a whole".</i>	Satisfaction	This code refers to satisfaction with social media tools.
<i>"They [social media] are basically used to keep the files or keep the artefacts that the offshore and onsite team is building so that both the teams can refer to the same document at the same time".</i>	Transparency	This code refers to the transparency in information on social media tools while working on projects.
<i>"Every manager uses these [social media] tools and gives feedback to team members".</i>	Feedback from management	This code refers to the use of social media tools to give feedback to team members by monitoring the

		conversations.
<i>“Well it’s a communication channel and a communication channel is something which enables people to get an understanding of each other, and so in that context, it assists with trust”.</i>	Trust	This code suggests how social media tools lead to the development of trust.
<i>“You can be cohesive if you are all on the same wavelength and all have the same understanding and these [social media] tools help you to improve the understanding when people aren’t located at the same place”.</i>	Team cohesion	This code refers to how social media tools help in building cohesive teams.
<i>“The whole team is reading that message, so that’s a better thing”.</i>	Reduced conflicts	This code refers to how social media tools help in reducing virtual team conflicts.

## **Appendix H. Themes extracted from interviews**

<b>Identified theme</b>	<b>Codes included</b>	<b>Definition</b>
Participation	Participation	This theme represents how social media tools encourage participation between team members.
Collaboration	Collaboration	This theme represents how social media tools lead to collaboration between virtual team members.
Information organisation	Information organisation, transparency	This theme explains transparency and the information organisation capabilities of social media tools.
Social networking	Social networking	This theme represents the social networking capabilities of social media tools.
Trust	Trust	This theme represents how social media tools help in trust building in teams.
Team cohesion	Team cohesion	This theme represents how social media tools help in building cohesive teams.
Satisfaction	Satisfaction	This theme represents user satisfaction.
Reduced conflicts	Reduced conflicts	This theme represents how social media tools may lead to reduced conflicts in teams.
Communication effectiveness	Communication effectiveness	This theme represents how social media tools lead to effective communication in teams.
Leadership	Project monitoring, feedback from management	This theme represents the relevance of social media tools to team leadership.
Challenges of non-social media tools	Minimal social networking, lack of transparency	This theme represents some of the challenges associated with the use of tools other than social media.

## **Appendix I. Data display examples to identify relationships**

<b>Description</b>	<b>Supporting extract from interviews</b>	<b>Explanation</b>
Team cohesion	<i>“Yes, surely they [company portal, Lync] help in building cohesiveness. My senior team members are in the UK and I can take their expertise and advice while working on the project”.</i>	This text segment reflects how the use of social media tools contributes towards team cohesion.
Trust building	<i>“It [intranet portal] is helping us build relationships. You can talk and share things with team members”.</i>	This text segment explains how social media tools may contribute towards trust building.
Communication effectiveness	<i>“If I need to communicate then I need to send emails to individuals but if I use Yammer then we have groups there and I can post on those groups. Anyone in the team can then reply to those posts. So it’s a better option”.</i>	This text segment reflects how social media tools may contribute towards communication effectiveness.
Collaboration among team members	<i>“It [company portal] connects you to your team mates onshore, offshore, everywhere”.</i>	This text segment reflects the capabilities of social media tools to encourage collaboration.
Downside of non-social media tools e.g. email	<i>“With email if you don’t setup rules that say any inbound messages to do with this project automatically get delivered in the project folder, then you might find that information specific to our organisation sitting in an individual person’s inbox. So you get information hidden from other project members by one member not putting it into a shared folder”.</i>	This text segment explains the downsides of using non-social media tools by citing email as an example.
Social networking	<i>“Yammer is just like Facebook; it’s like a social networking site where you can do multiple things. You can share your status updates, you can look for different people from different projects, you can share your pictures, and you can share your knowledge and raise your concern, so it can be used for multiple things”.</i>	This text segment explains how the use of social media tools encouraged social networking within an organisation.

## **Appendix J: Item-level correlations of pilot test data**

\*\*. Correlation is significant at the 0.01 level (2-tailed).

\*. Correlation is significant at the 0.05 level (2-tailed).

	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13
T1	1	0.822**	0.532*	0.228	-0.325	0.192	-0.412	0.544*	0.314	0.502*	0.109	0.499*	0.575*
T2	0.822**	1	0.671**	0.377	-0.172	0.232	-0.544*	0.460	0.133	0.583*	-0.014	0.486*	0.708**
T3	0.532*	0.671**	1	0.450	0.209	0.420	-0.460	0.574*	0.196	0.589*	0.020	0.540*	0.617**
T4	0.228	0.377	0.450	1	0.512*	0.372	-0.450	0.465	0.488*	0.507*	0.080	0.565*	0.287
T5	-0.325	-0.172	0.209	0.512*	1	0.397	-0.349	0.180	0.329	0.329	-0.285	0.265	0.108
T6	0.192	0.232	0.420	0.372	0.397	1	-0.657**	0.783**	0.354	0.681**	0.161	0.454	0.608**
T7	-0.412	-0.544*	-0.460	-0.450	-0.349	-0.657**	1	-0.707**	-0.438	-0.801**	-0.143	-0.540*	-0.802**
T8	0.544*	0.460	0.574*	0.465	0.180	0.783**	-0.707**	1	0.640**	0.833**	0.271	0.624**	0.579*
T9	0.314	0.133	0.196	0.488*	0.329	0.354	-0.438	0.640**	1	0.652**	0.110	0.370	0.146
T10	0.502*	0.583*	0.589*	0.507*	0.329	0.681**	-0.801**	0.833**	0.652**	1	0.144	0.736**	0.655**
T11	0.109	-0.014	0.020	0.080	-0.285	0.161	-0.143	0.271	0.110	0.144	1	0.121	-0.063
T12	0.499*	0.486*	0.540*	0.565*	0.265	0.454	-0.540*	0.624**	0.370	0.736**	0.121	1	0.482*
T13	0.575*	0.708**	0.617**	0.287	0.108	0.608**	-0.802**	0.579*	0.146	0.655**	-0.063	0.482*	1
TC1	0.514*	0.583*	0.763**	0.668**	0.376	0.731**	-0.683**	0.813**	0.593**	0.783**	0.128	0.508*	0.637**
TC2	-0.570*	-0.566*	-0.394	-0.059	0.097	-0.341	0.394	-0.389	-0.166	-0.568*	0.132	-0.508*	-0.586*
TC3	0.449	0.378	0.236	0.194	0.265	0.321	-0.540*	0.233	0.319	0.378	-0.189	0.295	0.638**
TC4	0.279	0.215	0.610**	0.328	0.532*	0.461	-0.473*	0.472*	0.452	0.413	-0.156	0.341	0.447
TC5	0.288	0.295	0.383	0.153	0.035	0.172	-0.111	0.389	0.455	0.475*	-0.144	0.438	0.078
TC6	0.411	0.403	0.309	0.166	0.036	0.203	-0.216	0.375	0.479*	0.655**	-0.063	0.534*	0.143
TC7	-0.010	-0.071	-0.202	0.311	0.201	0.000	0.029	0.159	0.574*	0.170	-0.059	0.158	-0.267
TC8	0.046	0.038	-0.113	0.366	0.069	-0.026	0.069	0.152	0.535*	0.186	-0.020	0.166	-0.243
TC9	0.522*	0.598**	0.818**	0.693**	0.367	0.585*	-0.526*	0.742**	0.513*	0.725**	0.132	0.659**	0.512*
S1	0.319	0.521*	0.755**	0.487*	0.359	0.676**	-0.652**	0.644**	0.393	0.728**	0.000	0.333	0.688**
S2	0.373	0.515*	0.759**	0.477*	0.451	0.804**	-0.681**	0.695**	0.343	0.691**	0.018	0.411	0.732**
S3	0.426	0.635**	0.837**	0.494*	0.315	0.679**	-0.615**	0.680**	0.282	0.696**	0.050	0.426	0.722**
S4	0.436	0.537*	0.796**	0.468	0.387	0.701**	-0.705**	0.679**	0.401	0.665**	0.021	0.327	0.762**
S5	-0.311	-0.295	-0.007	-0.093	-0.069	-0.251	0.599**	-0.400	-0.329	-0.435	-0.134	-0.081	-0.498*
S6	0.627**	0.725**	0.680**	0.543*	0.193	0.583*	-0.680**	0.704**	0.580*	0.817**	-0.057	0.573*	0.728**
S7	0.489*	0.519*	0.490*	0.599**	0.380	0.536*	-0.612**	0.631**	0.743**	0.866**	0.000	0.620**	0.504*
CE1	0.667**	0.611**	0.654**	0.558*	0.128	0.266	-0.405	0.630**	0.714**	0.694**	0.038	0.621**	0.369
CE2	0.522*	0.458	0.554*	0.432	0.086	0.184	-0.330	0.338	0.295	0.487*	0.118	0.498*	0.472*
CE3	0.270	0.320	-0.063	-0.090	-0.111	-0.142	-0.108	-0.259	-0.278	0.075	-0.168	0.260	0.343
CE4	0.281	0.239	0.173	0.550*	-0.018	0.234	-0.310	0.545*	0.727**	0.480*	0.415	0.165	0.055
CE5	0.125	0.201	0.279	0.444	0.226	0.528*	-0.512*	0.544*	0.533*	0.519*	0.370	0.038	0.340
CE6	0.432	0.406	0.625**	0.758**	0.465	0.525*	-0.625**	0.718**	0.742**	0.648**	0.102	0.464	0.463

CE7	0.388	0.521*	0.755**	0.487*	0.439	0.585*	-0.652**	0.644**	0.532*	0.728**	0.000	0.333	0.688**
CE8	0.549*	0.483*	0.589*	0.576*	0.329	0.557*	-0.660**	0.781**	0.795**	0.722**	0.096	0.378	0.509*
CE9	-0.760**	-0.700**	-0.588*	-0.081	0.317	-0.175	0.203	-0.313	-0.079	-0.327	-0.022	-0.313	-0.486*
CT1	-0.099	-0.013	0.149	0.457	0.391	-0.082	-0.037	0.041	0.126	-0.176	-0.229	-0.110	-0.058
CT2	-0.500*	-0.467	-0.088	-0.158	0.210	0.050	0.088	-0.042	-0.251	-0.323	0.157	-0.220	-0.262
CT3	0.361	0.443	0.468*	0.211	0.283	0.517*	-0.524*	0.641**	0.215	0.530*	-0.153	0.419	0.434
CT4	-0.580*	-0.609**	-0.483*	-0.721**	-0.022	-0.403	0.539*	-0.575*	-0.385	-0.606**	-0.256	-0.717**	-0.513*
CT5	-0.297	-0.458	-0.716**	-0.778**	-0.348	-0.516*	0.346	-0.577*	-0.396	-0.608**	-0.132	-0.671**	-0.317
CT6	0.665**	0.719**	0.687**	0.618**	0.131	0.574*	-0.687**	0.676**	0.396	0.604**	0.102	0.438	0.772**
CT7	0.528*	0.561*	0.227	0.388	0.000	0.149	-0.397	0.417	0.420	0.312	-0.116	0.000	0.292
CT8	0.325	0.566*	0.418	0.307	0.189	0.153	-0.349	0.180	-0.188	0.110	-0.332	0.088	0.395
CT9	0.296	0.399	0.080	0.175	-0.381	-0.163	-0.080	0.088	-0.025	-0.069	0.342	-0.237	-0.011
CON1	0.594**	0.614**	0.672**	0.449	0.221	0.706**	-0.672**	0.821**	0.618**	0.801**	0.113	0.387	0.634**
CON2	0.579*	0.563*	0.538*	0.483*	0.102	0.604**	-0.538*	0.724**	0.666**	0.784**	0.319	0.491*	0.468
CON3	-0.705**	-0.731**	-0.579*	-0.542*	-0.096	-0.543*	0.579*	-0.713**	-0.346	-0.780**	-0.135	-0.845**	-0.639**
CON4	-0.740**	-0.733**	-0.595**	-0.637**	-0.044	-0.415	0.538*	-0.698**	-0.495*	-0.730**	-0.168	-0.694**	-0.566*
CON5	0.103	0.287	0.705**	0.690**	0.667**	0.628**	-0.598**	0.502*	0.371	0.563*	-0.024	0.413	0.590**
CON6	0.405	0.630**	0.472*	0.235	-0.060	0.293	-0.317	0.322	-0.040	0.202	-0.140	0.072	0.450
CON7	-0.253	-0.432	-0.567*	-0.519*	-0.537*	-0.564*	0.713**	-0.545*	-0.568*	-0.706**	-0.017	-0.325	-0.612**
CON8	-0.393	-0.405	-0.357	-0.452	-0.286	-0.384	0.673**	-0.607**	-0.730**	-0.634**	-0.119	-0.168	-0.470*
CON9	-0.377	-0.603**	-0.743**	-0.558*	-0.401	-0.593**	0.743**	-0.617**	-0.444	-0.722**	-0.063	-0.365	-0.721**
L1	0.320	0.370	0.537*	0.235	0.296	0.483*	-0.453	0.593**	0.610**	0.667**	-0.058	0.346	0.393
L2	0.527*	0.567*	0.577*	0.313	0.066	0.741**	-0.749**	0.890**	0.470*	0.867**	0.207	0.607**	0.715**
L3	0.441	0.402	0.350	0.342	0.174	0.574*	-0.688**	0.842**	0.624**	0.869**	0.179	0.627**	0.482*
L4	0.349	0.424	0.375	0.367	0.291	0.657**	-0.750**	0.773**	0.607**	0.884**	0.153	0.569*	0.617**
L5	0.320	0.448	0.519*	0.467	0.355	0.669**	-0.686**	0.604**	0.475*	0.633**	-0.019	0.332	0.672**
L6	0.430	0.439	0.336	0.328	0.176	0.551*	-0.562*	0.649**	0.707**	0.732**	0.017	0.347	0.440
L7	0.239	0.330	0.207	0.360	0.251	0.472*	-0.449	0.496*	0.660**	0.677**	0.037	0.311	0.360
L8	0.053	0.353	0.370	0.538*	0.418	0.657**	-0.640**	0.442	0.256	0.589*	0.020	0.312	0.617**
L9	-0.049	0.183	0.000	0.253	0.258	0.226	-0.369	0.190	0.249	0.116	-0.302	-0.280	0.266
TMS1	0.375	0.604**	0.748**	0.390	0.135	0.663**	-0.660**	0.665**	0.242	0.595**	0.040	0.262	0.749**
TMS2	0.541*	0.701**	0.693**	0.678**	0.083	0.408	-0.478*	0.607**	0.427	0.704**	0.024	0.676**	0.516*
TMS3	0.038	0.237	0.453	0.622**	0.537*	0.521*	-0.453	0.474*	0.464	0.611**	-0.066	0.352	0.362
TMS4	0.558*	0.609**	0.780**	0.565*	0.366	0.453	-0.645**	0.513*	0.414	0.671**	-0.061	0.601**	0.717**
TMS5	0.615**	0.672**	0.853**	0.518*	0.251	0.613**	-0.611**	0.793**	0.496*	0.741**	0.147	0.583*	0.610**
TMS6	0.167	0.146	0.280	0.014	-0.309	0.097	-0.081	0.163	-0.025	0.087	0.843**	0.068	0.023
TMS7	0.405	0.413	0.387	0.101	-0.055	0.332	-0.316	0.559*	0.618**	0.634**	-0.081	0.207	0.268
TMS8	0.446	0.574*	0.772**	0.467	0.330	0.794**	-0.707**	0.732**	0.290	0.635**	0.104	0.402	0.753**
TMS9	0.092	0.188	0.533*	0.240	0.520*	0.728**	-0.533*	0.589*	0.460	0.729**	-0.087	0.450	0.526*
TMS10	0.470*	0.549*	0.707**	0.415	0.329	0.867**	-0.707**	0.833**	0.429	0.833**	0.144	0.537*	0.727**
TMS11	0.444	0.429	0.275	0.211	0.228	0.567*	-0.510*	0.390	0.212	0.555*	-0.160	0.480*	0.666**

TMS12	0.368	0.540*	0.636**	0.659**	0.375	0.401	-0.636**	0.538*	0.607**	0.798**	0.084	0.631**	0.523*
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	TC1	TC2	TC3	TC4	TC5	TC6	TC7	TC8	TC9	S1	S2	S3	S4	S5	S6	S7
T1	0.51 4*	- 0.57 0*	0.44 9	0.27 9	0.28 8	0.41 1	- 0.01 0	0.04 6	0.52 2*	0.31 9	0.37 3	0.42 6	0.43 6	- 0.31 1	0.62 7**	0.48 9*
T2	0.58 3*	- 0.56 6*	0.37 8	0.21 5	0.29 5	0.40 3	- 0.07 1	0.03 8	0.59 8**	0.52 1*	0.51 5*	0.63 5**	0.53 7*	- 0.29 5	0.72 5**	0.51 9*
T3	0.76 3**	- 0.39 4	0.23 6	0.61 0**	0.38 3	0.30 9	- 0.20 2	- 0.11 3	0.81 8**	0.75 5**	0.75 9**	0.83 7**	0.79 6**	- 0.00 7	0.68 0**	0.49 0*
T4	0.66 8**	- 0.05 9	0.19 4	0.32 8	0.15 3	0.16 6	0.31 1	0.36 6	0.69 3**	0.48 7*	0.47 7*	0.49 4*	0.46 8	- 0.09 3	0.54 3*	0.59 9**
T5	0.37 6	0.09 7	0.26 5	0.53 2*	0.03 5	0.03 6	0.20 1	0.06 9	0.36 7	0.35 9	0.45 1	0.31 5	0.38 7	- 0.06 9	0.19 3	0.38 0
T6	0.73 1**	- 0.34 1	0.32 1	0.46 1	0.17 2	0.20 3	0.00 0	- 0.02 6	0.58 5*	0.67 6**	0.80 4**	0.67 9**	0.70 1**	- 0.25 1	0.58 3*	0.53 6*
T7	- 0.68 3**	0.39 4	- 0.54 0*	- 0.47 3*	- 0.11 1	- 0.21 6	0.02 9	0.06 9	- 0.52 6*	- 0.65 2**	- 0.68 1**	- 0.61 5**	- 0.70 5**	- 0.59 9**	- 0.68 0*	- 0.61 2**
T8	0.81 3**	- 0.38 9	0.23 3	0.47 2*	0.38 9	0.37 5	0.15 9	0.15 2	0.74 2**	0.64 4**	0.69 5**	0.68 0**	0.67 9**	- 0.40 0	0.70 4**	0.63 1**
T9	0.59 3**	- 0.16 6	0.31 9	0.45 2	0.45 5	0.47 9*	0.57 4*	0.53 5*	0.51 3*	0.39 3	0.34 3	0.28 2	0.40 1	- 0.32 9	0.58 0*	0.74 3**
T10	0.78 3**	- 0.56 8*	0.37 8	0.41 3	0.47 5*	0.65 5**	0.17 0	0.18 6	0.72 5**	0.72 8**	0.69 1**	0.69 6**	0.66 5**	- 0.43 5	0.81 7**	0.86 6**
T11	0.12 8	0.13 2	- 0.18 9	- 0.15 6	- 0.14 4	- 0.06 3	- 0.05 9	- 0.02 0	0.13 2	0.00 0	0.01 8	0.05 0	0.02 1	- 0.13 4	- 0.05 7	00.0 00
T12	0.50 8*	- 0.50 8*	0.29 5	0.34 1	0.43 8	0.53 4*	0.15 8	0.16 6	0.65 9**	0.33 3	0.41 1	0.42 6	0.32 7	- 0.08 1	0.57 3*	0.62 0**
T13	0.63 7**	- 0.58 6*	0.63 8**	0.44 7	0.07 8	0.14 3	- 0.26 7	- 0.24 3	0.51 2*	0.68 8**	0.73 2**	0.72 2**	0.76 2**	- 0.49 8*	0.72 8**	0.50 4*
TC1	1	- 0.32 9	0.37 1	0.65 1**	0.39 8	0.36 0	0.16 9	0.23 0	0.90 9**	0.86 2**	0.91 4**	0.88 4**	0.90 5**	- 0.29 0	0.87 2**	0.77 0**
TC2	- 0.32 9	1	- 0.54 3*	- 0.24 0	- 0.12 1	- 0.52 9*	0.17 4	0.14 8	- 0.33 4	- 0.39 7	- 0.39 9	- 0.45 6	- 0.34 1	0.17 7	- 0.45 0	- 0.51 1*
TC3	0.37 1	- 0.54 3*	1	0.63 0**	- 0.09 8	0.14 3	- 0.02 4	- 0.09 6	0.29 0	0.33 3	0.47 6*	0.36 3	0.48 0*	- 0.33 1	0.46 8	0.51 7*
TC4	0.65 1**	- 0.24 0	0.63 0**	1	0.26 1	0.11 8	0.12 1	0.05 3	0.65 4**	0.52 3*	0.72 3**	0.60 1**	0.70 7**	- 0.04 0	0.52 9*	0.46 7
TC5	0.39 8	- 0.12 1	- 0.09 8	0.26 1	1	0.66 9**	0.55 3*	0.62 1**	0.51 0*	0.22 5	0.23 9	0.23 6	0.18 8	0.19 6	0.61 5**	0.49 4*
TC6	0.36 0	- 0.52 9*	0.14 3	0.11 8	0.66 9**	1	0.22 3	0.33 4	0.38 7	0.37 0	0.22 6	0.26 6	0.17 1	0.07 1	0.55 6*	0.75 6**
TC7	0.16 9	0.17 4	- 0.02 4	0.12 1	0.55 3*	0.22 3	1	0.94 6**	0.30 4	- 0.19 8	- 0.02 5	- 0.07 1	- 0.16 0	- 0.06 7	0.26 0	0.29 5
TC8	0.23 0	0.14 8	- 0.09 6	0.05 3	0.62 1**	0.33 4	0.94 6**	1	0.35 5	- 0.08 4	0.00 4	0.01 2	- 0.12 9	0.01 6	0.35 5	0.36 2
TC9	0.90 9**	- 0.33 4	0.29 0	0.65 4**	0.51 0*	0.38 7	0.30 4	0.35 5	1	0.68 0**	0.82 0**	0.84 7**	0.73 8**	- 0.13 1	0.79 7**	0.69 4**
S1	0.86 2**	- 0.39 7	0.33 3	0.52 3*	0.22 5	0.37 0	- 0.19 8	- 0.08 4	0.68 0**	1	0.87 2**	0.88 7**	0.91 6**	- 0.26 0	0.76 1**	0.70 0**

S2	0.91 4**	- 0.39 9	0.47 6*	0.72 3**	0.23 9	0.22 6	- 0.02 5	0.00 4	0.82 0**	0.87 2**	1	0.94 5**	0.93 4**	- 0.27 0	0.76 5**	0.63 4**
S3	0.88 4**	- 0.45 6	0.36 3	0.60 1**	0.23 6	0.26 6	- 0.07 1	0.01 2	0.84 7**	0.88 7**	0.94 5**	1	0.88 1**	- 0.28 4	0.75 1**	0.60 3**
S4	0.90 5**	- 0.34 1	0.48 0*	0.70 7**	0.18 8	0.17 1	- 0.16 0	- 0.12 9	0.73 8**	0.91 6**	0.93 4**	0.88 1**	1	- 0.31 5	0.76 8**	0.61 7**
S5	- 0.29 0	0.17 7	- 0.33 1	- 0.04 0	0.19 6	0.07 1	- 0.06 7	0.01 6	- 0.13 1	- 0.26 0	- 0.27 0	- 0.28 4	- 0.31 5	1	- 0.28 3	- 0.24 2
S6	0.87 2**	- 0.45 0	0.46 8	0.52 9*	0.61 5**	0.55 6*	0.26 0	0.35 5	0.79 7**	0.76 1**	0.76 5**	0.75 1**	0.76 8**	- 0.28 3	1	0.84 9**
S7	0.77 0**	- 0.51 1*	0.51 7*	0.46 7	0.49 4*	0.75 6**	0.29 5	0.36 2	0.69 4**	0.70 0**	0.63 4**	0.60 3**	0.61 7**	- 0.24 2	0.84 9**	1
CE1	0.71 1**	- 0.48 2*	0.41 2	0.57 6*	0.56 6*	0.65 3**	0.34 5	0.43 1	0.79 0**	0.53 7*	0.51 6*	0.58 9*	0.51 9*	- 0.10 3	0.75 3**	0.78 9**
CE2	0.51 9*	- 0.47 5*	0.31 0	0.25 8	0.10 4	0.29 3	- 0.09 5	- 0.00 8	0.50 5*	0.49 6*	0.42 4	0.47 8*	0.49 5*	- 0.34 0	0.49 3*	0.50 6*
CE3	- 0.22 8	0.51 7*	0.50 0*	0.16 9	- 0.21 4	0.18 6	- 0.28 4	- 0.29 4	- 0.17 2	- 0.12 0	- 0.11 2	- 0.08 6	- 0.13 1	- 0.05 2	0.04 4	0.15 5
CE4	0.58 0*	0.04 0	- 0.06 7	0.07 8	0.32 5	0.32 2	0.47 0*	0.58 9*	0.48 4*	0.41 0	0.27 4	0.33 2	0.32 0	- 0.28 0	0.51 5*	0.56 1*
CE5	0.68 7**	- 0.13 8	0.23 5	0.32 1	- 0.02 6	0.14 0	0.12 2	0.20 4	0.49 9*	0.68 9**	0.62 6**	0.63 8**	0.61 4**	- 0.41 4	0.49 4*	0.55 6*
CE6	0.89 8**	- 0.11 6	0.40 1	0.72 4**	0.35 3	0.23 1	0.32 5	0.34 5	0.83 0**	0.68 6*	0.73 3**	0.67 7**	0.78 1**	- 0.26 3	0.76 3**	0.71 4**
CE7	0.86 2**	- 0.39 7	0.50 6*	0.68 0**	0.22 5	0.26 5	0.00 0	0.01 7	0.76 4**	0.88 2**	0.87 2**	0.88 7**	0.91 6**	- 0.39 5	0.76 1**	0.70 0**
CE8	0.91 0**	- 0.24 0	0.43 7	0.68 3**	0.40 4	0.36 4	0.30 6	0.32 5	0.78 3**	0.72 8**	0.75 2**	0.69 6**	0.80 7**	- 0.38 8	0.81 7**	0.77 0**
CE9	- 0.38 4	0.68 8**	- 0.47 5*	- 0.32 2	- 0.14 3	- 0.40 4	0.33 2	0.23 9	- 0.38 7	- 0.39 4	- 0.37 5	- 0.44 1	- 0.43 9	- 0.13 5	- 0.45 9	- 0.39 3
CT1	0.16 8	0.55 4*	- 0.04 7	0.28 5	- 0.09 4	- 0.48 0*	0.19 8	0.12 9	0.19 7	0.02 1	0.08 1	0.07 7	0.16 9	- 0.06 2	0.00 0	- 0.15 2
CT2	- 0.13 8	0.71 1**	- 0.42 8	0.10 5	- 0.05 2	- 0.55 0*	0.04 0	- 0.05 1	- 0.08 2	- 0.21 6	- 0.04 0	- 0.11 5	- 0.09 7	- 0.07 4	- 0.35 0	- 0.53 7*
CT3	0.47 1*	- 0.42 5	0.18 2	0.41 4	0.17 9	0.14 5	0.05 4	- 0.07 4	0.50 8*	0.35 3	0.52 5*	0.53 0*	0.44 4	- 0.32 7	0.33 8	0.22 9
CT4	- 0.56 9*	0.55 5*	- 0.38 3	- 0.23 4	- 0.09 2	- 0.35 8	0.00 9	- 0.09 0	- 0.57 6*	- 0.46 2	- 0.40 8	- 0.47 1*	- 0.42 0	- 0.07 6	- 0.56 5*	- 0.61 4**
CT5	- 0.76 9**	0.27 5	- 0.09 2	- 0.46 1	- 0.51 1*	- 0.44 4	- 0.27 1	- 0.39 6	- 0.88 1**	- 0.61 4**	- 0.65 5**	- 0.70 1**	- 0.55 3*	- 0.20 7	- 0.67 5**	- 0.64 7**
CT6	0.85 3**	- 0.44 0	0.58 0*	0.59 1**	0.08 2	0.15 4	- 0.03 6	0.05 2	0.74 9**	0.75 0**	0.80 3**	0.81 5**	0.82 5**	- 0.37 9	0.77 1**	0.61 2**
CT7	0.45 8	- 0.18 4	0.23 9	0.17 3	0.00 00	0.05 8	0.16 4	0.14 0	0.32 1	0.32 4	0.29 3	0.32 6	0.40 0	- 0.44 8	0.39 3	0.30 9
CT8	0.31 3	- 0.19 4	0.20 6	0.26 6	- 0.17 6	- 0.17 9	- 0.20 1	- 0.24 1	0.31 1	0.27 9	0.39 1	0.42 9	0.38 7	- 0.16 1	0.19 3	0.00 00
CT9	0.11 1	0.15 5	- 0.23 7	- 0.26 1	- 0.20 2	- 0.25 8	- 0.04 2	- 0.00 4	0.05 0	0.01 2	- 0.05 3	0.06 3	0.07 0	- 0.24 7	- 0.01 0	- 0.17 8
CON 1	0.94 4**	- 0.42	0.38 7	0.57 3*	0.42 2	0.46 4	0.14 8	0.20 3	0.80 0**	0.84 1**	0.86 6**	0.83 7**	0.86 8**	- 0.39	0.86 6**	0.77 5**



		1												6		
CON 2	0.82 6**	- 0.50 8*	0.41 7	0.46 2	0.41 9	0.61 9**	0.26 8	0.36 6	0.76 4**	0.68 8**	0.70 4**	0.71 0**	0.64 6**	- 0.26 7	0.78 7**	0.83 9**
CON 3	- 0.60 9**	0.61 3**	- 0.38 4	- 0.24 0	- 0.29 2	- 0.53 6*	- 0.02 4	- 0.06 5	- 0.67 7**	- 0.48 3*	- 0.52 1*	- 0.59 1**	- 0.45 9	0.26 7	- 0.66 6**	- 0.67 6**
CON 4	- 0.65 3**	0.44 2	- 0.30 9	- 0.19 8	- 0.28 0	- 0.48 8*	- 0.00 9	- 0.07 8	- 0.64 0**	- 0.54 2*	- 0.44 7	- 0.52 9*	- 0.52 3*	0.27 9	- 0.69 3**	- 0.69 7**
CON 5	0.79 4**	- 0.16 1	0.41 3	0.69 3**	0.12 0	0.07 4	0.06 9	0.04 1	0.70 7**	0.82 0**	0.82 4**	0.76 5**	0.85 5**	- 0.11 0	0.63 0**	0.58 6*
CON 6	0.44 7	- 0.33 8	0.26 8	0.34 7	0.01 7	- 0.05 3	- 0.02 5	0.01 7	0.45 1	0.38 2	0.51 8*	0.59 1**	0.44 9	- 0.15 8	0.36 9	0.10 5
CON 7	- 0.79 3**	0.37 5	- 0.57 0*	- 0.67 9**	- 0.22 4	- 0.21 2	- 0.22 2	- 0.18 4	- 0.71 1**	- 0.73 6**	- 0.81 3**	- 0.76 8**	- 0.80 4**	0.39 7	- 0.71 9**	- 0.69 4**
CON 8	- 0.66 7**	0.22 2	- 0.39 0	- 0.41 1	- 0.13 6	- 0.12 6	- 0.23 7	- 0.15 9	- 0.49 3*	- 0.56 2*	- 0.52 0*	- 0.49 0*	- 0.66 0**	0.61 7**	- 0.59 2**	- 0.57 3*
CON 9	- 0.87 3**	0.41 9	- 0.48 1*	- 0.64 2**	- 0.21 2	- 0.20 1	- 0.04 4	- 0.07 2	- 0.78 5**	- 0.85 4**	- 0.88 8**	- 0.89 6**	- 0.89 9**	0.37 6	- 0.77 5**	- 0.65 7**
L1	0.63 5**	- 0.48 5*	0.48 9*	0.69 0**	0.44 2	0.56 7*	0.20 4	0.22 3	0.63 0**	0.63 1**	0.64 6**	0.66 1**	0.58 4*	- 0.10 2	0.62 8**	0.69 3**
L2	0.68 9**	- 0.62 0**	0.31 8	0.34 3	0.27 2	0.46 0	- 0.10 1	- 0.07 2	0.58 8*	0.70 7**	0.65 4**	0.69 5**	0.64 9**	- 0.43 7	0.66 9**	0.62 2**
L3	0.55 0*	- 0.49 2*	0.15 3	0.16 2	0.30 9	0.50 1*	0.12 6	0.08 0	0.47 6*	0.49 3*	0.41 5	0.44 6	0.42 8	- 0.56 4*	0.53 7*	0.61 2**
L4	0.60 6**	- 0.55 6*	0.44 3	0.34 3	0.22 7	0.46 3	0.14 4	0.11 1	0.54 7*	0.60 0**	0.58 2*	0.61 5**	0.52 9*	- 0.54 3*	0.62 4**	0.71 4**
L5	0.74 0**	- 0.45 9	0.68 4**	0.68 5**	0.07 9	0.27 2	- 0.01 3	0.03 7	0.60 4**	0.77 9**	0.79 5**	0.76 4**	0.76 1**	- 0.25 9	0.68 1**	0.68 1**
L6	0.66 3**	- 0.51 7*	0.53 8*	0.49 3*	0.37 2	0.64 7**	0.26 6	0.32 7	0.54 4*	0.63 3**	0.59 3**	0.57 8*	0.54 1*	- 0.27 1	0.71 0**	0.82 2**
L7	0.52 4*	- 0.49 5*	0.51 5*	0.33 6	0.25 3	0.55 4*	0.33 7	0.36 7	0.46 5	0.52 4*	0.48 0*	0.50 8*	0.39 8	- 0.29 6	0.58 5*	0.77 0**
L8	0.60 2**	- 0.35 2	0.46 4	0.33 5	- 0.07 1	0.21 6	- 0.11 5	- 0.02 5	0.45 3	0.75 5**	0.68 1**	0.68 9**	0.61 5**	- 0.24 4	0.55 5*	0.61 2**
L9	0.26 5	0.03 4	0.28 0	0.22 5	- 0.18 6	- 0.26 6	0.14 2	0.07 3	0.09 0	0.29 6	0.28 7	0.27 3	0.33 5	- 0.36 5	0.20 5	0.10 1
TMS 1	0.80 2**	- 0.25 2	0.26 2	0.49 6*	0.27 4	0.15 0	- 0.18 2	- 0.07 7	0.64 5**	0.86 6**	0.82 1**	0.83 7**	0.87 1**	- 0.20 5	0.75 4**	0.47 6*
TMS 2	0.75 1**	- 0.33 8	0.13 1	0.29 2	0.63 8**	0.59 0**	0.22 4	0.41 2	0.77 4**	0.65 6**	0.56 7*	0.64 7**	0.55 4*	- 0.03 1	0.86 2**	0.73 2**
TMS 3	0.71 3**	- 0.26 6	0.22 9	0.43 2	0.21 6	0.38 7	0.19 9	0.31 9	0.64 6**	0.76 4**	0.69 5**	0.72 8**	0.59 2**	- 0.22 7	0.59 5**	0.69 4**
TMS 4	0.74 0**	- 0.44 4	0.60 1**	0.64 0**	0.27 9	0.39 3	- 0.17 3	- 0.12 6	0.66 2**	0.74 6**	0.69 2**	0.64 6**	0.80 8**	- 0.11 4	0.76 9**	0.73 4**
TMS 5	0.88 7**	- 0.38 3	0.37 9	0.70 5**	0.49 8*	0.38 8	0.14 3	0.16 8	0.92 4**	0.70 8**	0.82 9**	0.84 0**	0.80 5**	- 0.13 6	0.80 9**	0.66 0**
TMS 6	0.23 2	0.06 5	- 0.10 0	0.09 0	0.03 0	- 0.02 3	- 0.07 4	0.02 9	0.29 3	0.12 6	0.20 3	0.25 4	0.17 1	0.03 4	0.08 2	0.00 00
TMS 7	0.56 1*	- 0.42 1	0.14 7	0.30 1	0.63 7**	0.75 6**	0.25 1	0.37 8	0.45 5	0.59 7**	0.43 6	0.48 7*	0.43 8	- 0.16 1	0.66 9**	0.67 8**

TMS 8	0.89 0**	- 0.33 7	0.45 8	0.71 1**	0.20 2	0.12 4	- 0.08 4	- 0.06 1	0.79 9**	0.81 2**	0.95 8**	0.90 6**	0.92 1**	- 0.22 8	0.73 7**	0.53 5*
TMS 9	0.62 2**	- 0.54 3*	0.45 0	0.61 8**	0.30 1	0.46 1	- 0.01 5	- 0.03 7	0.55 2*	0.73 1**	0.73 5**	0.68 2**	0.66 6**	- 0.16 1	0.56 2*	0.65 3**
TMS 10	0.88 9**	- 0.49 1*	0.35 8	0.53 9*	0.35 6	0.36 4	0.03 4	0.03 5	0.80 2**	0.80 8**	0.91 5**	0.87 0**	0.85 5**	- 0.37 3	0.78 4**	0.67 4**
TMS 11	0.45 8	- 0.72 7**	0.77 8**	0.41 9	0.02 0	0.42 4	- 0.05 7	- 0.03 9	0.39 7	0.47 1*	0.59 2**	0.53 1*	0.45 4	- 0.29 7	0.54 4*	0.64 1**
TMS 12	0.68 3**	- 0.38 7	0.38 0	0.42 2	0.42 0	0.54 8*	0.09 5	0.15 5	0.63 9**	0.69 4**	0.53 8*	0.55 9*	0.62 9**	- 0.15 0	0.74 5**	0.80 9**

	CE1	CE2	CE3	CE4	CE5	CE6	CE7	CE8	CE9	CT1	CT2	CT3	CT4	CT5	CT6	CT7	CT8	CT9
T1	0.66 7**	0.52 2*	0.27 0	0.28 1	0.12 5	0.43 2	0.38 8	0.54 9*	- 0.76 0**	- 0.09 9	- 0.50 0*	0.36 1	- 0.58 0*	- 0.29 7	0.66 5**	0.52 8*	0.32 5	0.29 6
T2	0.61 1**	0.45 8	0.32 0	0.23 9	0.20 1	0.40 6	0.52 1*	0.48 3*	- 0.70 0**	- 0.01 3	- 0.46 7	0.44 3	- 0.60 9**	- 0.45 8	0.71 9**	0.56 1*	0.56 6*	0.39 9
T3	0.65 4**	0.55 4*	- 0.06 3	0.17 3	0.27 9	0.62 5**	0.75 5**	0.58 9*	- 0.58 8*	0.14 9	- 0.08 8	0.46 8*	- 0.48 3*	- 0.71 6**	0.68 7**	0.22 7	0.41 8	0.08 0
T4	0.55 8*	0.43 2	- 0.09 0	0.55 0*	0.44 4	0.75 8**	0.48 7*	0.57 6*	- 0.08 1	0.45 7	- 0.15 8	0.21 1	- 0.72 1**	- 0.77 8**	0.61 8**	0.38 8	0.30 7	0.17 5
T5	0.12 8	0.08 6	- 0.11 1	- 0.01 8	0.22 6	0.46 5	0.43 9	0.32 9	0.31 7	0.39 1	0.21 0	0.28 3	- 0.02 2	- 0.34 8	0.13 1	00.0 00	0.18 9	- 0.38 1
T6	0.26 6	0.18 4	- 0.14 2	0.23 4	0.52 8*	0.52 5*	0.58 5*	0.55 7*	- 0.17 5	- 0.08 2	0.05 0	0.51 7*	- 0.40 3	- 0.51 6*	0.57 4*	0.14 9	0.15 3	- 0.16 3
T7	- 0.40 5	- 0.33 0	- 0.10 8	- 0.31 0	- 0.51 2*	- 0.62 5**	- 0.65 2**	- 0.66 0**	0.20 3	- 0.03 7	0.08 8	- 0.52 4*	0.53 9*	0.34 6	- 0.68 7**	- 0.39 7	- 0.34 9	- 0.08 0
T8	0.63 0**	0.33 8	- 0.25 9	0.54 5*	0.54 4*	0.71 8**	0.64 4**	0.78 1**	- 0.31 3	0.04 1	- 0.04 2	0.64 1**	- 0.57 5*	- 0.57 7*	0.67 6**	0.41 7	0.18 0	0.08 8
T9	0.71 4**	0.29 5	- 0.27 8	0.72 7**	0.53 3*	0.74 2**	0.53 2*	0.79 5**	- 0.07 9	0.12 6	- 0.25 1	0.21 5	- 0.38 5	- 0.39 6	0.39 6	0.42 0	- 0.18 8	- 0.02 5
T10	0.69 4**	0.48 7*	0.07 5	0.48 0*	0.51 9*	0.64 8**	0.72 8**	0.72 2**	- 0.32 7	- 0.17 6	- 0.32 3	0.53 0*	- 0.60 6**	- 0.60 8**	0.60 4**	0.31 2	0.11 0	- 0.06 9
T11	0.03 8	0.11 8	- 0.16 8	0.41 5	0.37 0	0.10 2	0.00 0	0.09 6	0.02 2	- 0.22 9	0.15 7	- 0.15 3	- 0.25 6	0.13 2	0.10 2	- 0.11 6	- 0.33 2	0.34 2
T12	0.62 1**	0.49 8*	0.26 0	0.16 5	0.03 8	0.46 4	0.33 3	0.37 8	- 0.31 3	- 0.11 0	- 0.22 0	0.41 9	- 0.71 7**	- 0.67 1**	0.43 8	00.0 00	0.08 8	- 0.23 7
T13	0.36 9	0.47 2*	0.34 3	0.05 5	0.34 0	0.46 3	0.68 8**	0.50 9*	- 0.48 6*	- 0.05 8	- 0.26 2	0.43 4	- 0.51 3*	- 0.31 7	0.77 2**	0.29 2	0.39 5	- 0.01 1
TC1	0.71 1**	0.51 9*	- 0.22 8	0.58 0*	0.68 7**	0.89 8**	0.86 2**	0.91 0**	- 0.38 4	0.16 8	- 0.13 8	0.47 1*	- 0.56 9*	- 0.76 9**	0.85 3**	0.45 8	0.31 3	0.11 1
TC2	- 0.48 2*	- 0.47 5*	- 0.51 7*	0.04 0	- 0.13 8	- 0.11 6	- 0.39 7	- 0.24 0	0.68 8**	0.55 4*	0.71 1**	- 0.42 5	0.55 5*	0.27 5	- 0.44 0	- 0.18 4	- 0.19 4	0.15 5
TC3	0.41 2	0.31 0	0.50 0*	- 0.06 7	0.23 5	0.40 1	0.50 6*	0.43 7	- 0.47 5*	- 0.04 7	- 0.42 8	0.18 2	- 0.38 3	- 0.09 2	0.58 0*	0.23 9	0.20 6	- 0.23 7
TC4	0.57 6*	0.25 8	- 0.16 9	0.07 8	0.32 1	0.72 4**	0.68 0**	0.68 3**	- 0.32 2	0.28 5	0.10 5	0.41 4	- 0.23 4	- 0.46 1	0.59 1**	0.17 3	0.26 6	- 0.26 1
TC5	0.56 6*	0.10 4	- 0.21 4	0.32 5	- 0.02 6	0.35 3	0.22 5	0.40 4	- 0.14 3	- 0.09 4	- 0.05 2	0.17 9	- 0.09 2	- 0.51 1*	0.08 2	00.0 00	- 0.17 6	- 0.20 2
TC6	0.65 3**	0.29 3	0.18 6	0.32 2	0.14 0	0.23 1	0.26 5	0.36 4	- 0.40	- 0.48	- 0.55	0.14 5	- 0.35	- 0.44	0.15 4	0.05 8	- 0.17	- 0.25

									4	0*	0*		8	4			9	8
TC7	0.34 5	- 0.09 5	- 0.28 4	0.47 0*	0.12 2	0.32 5	0.00 0	0.30 6	0.33 2	0.19 8	0.04 0	0.05 4	0.00 9	- 0.27 1	- 0.03 6	0.16 4	- 0.20 1	- 0.04 2
TC8	0.43 1	- 0.00 8	- 0.29 4	0.58 9*	0.20 4	0.34 5	0.01 7	0.32 5	0.23 9	0.12 9	- 0.05 1	- 0.07 4	- 0.09 0	- 0.39 6	0.05 2	0.14 0	- 0.24 1	- 0.00 4
TC9	0.79 0**	0.50 5*	- 0.17 2	0.48 4*	0.49 9*	0.83 0**	0.76 4**	0.78 3**	- 0.38 7	0.19 7	- 0.08 2	0.50 8*	- 0.57 6*	- 0.88 1**	0.74 9**	0.32 1	0.31 1	0.05 0
S1	0.53 7*	0.49 6*	- 0.12 0	0.41 0	0.68 9**	0.68 6**	0.88 2**	0.72 8**	- 0.39 4	0.02 1	- 0.21 6	0.35 3	- 0.46 2	- 0.61 4**	0.75 0**	0.32 4	0.27 9	0.01 2
S2	0.51 6*	0.42 4	- 0.11 2	0.27 4	0.62 6**	0.73 3**	0.87 2**	0.75 2**	- 0.37 5	0.08 1	- 0.04 0	0.52 5*	- 0.40 8	- 0.65 5**	0.80 3**	0.29 3	0.39 1	- 0.05 3
S3	0.58 9*	0.47 8*	- 0.08 6	0.33 2	0.63 8**	0.67 7**	0.88 7**	0.69 6**	- 0.44 1	0.07 7	- 0.11 5	0.53 0*	- 0.47 1*	- 0.70 1**	0.81 5**	0.32 6	0.42 9	0.06 3
S4	0.51 9*	0.49 5*	- 0.13 1	0.32 0	0.61 4**	0.78 1**	0.91 6**	0.80 7**	- 0.43 9	0.16 9	- 0.09 7	0.44 4	- 0.42 0	- 0.55 3*	0.82 5**	0.40 0	0.38 7	0.07 0
S5	- 0.10 3	- 0.34 0	- 0.05 2	- 0.28 0	- 0.41 4	- 0.26 3	- 0.39 5	- 0.38 8	- 0.13 5	- 0.06 2	0.07 4	- 0.32 7	0.07 6	- 0.20 7	- 0.37 9	- 0.44 8	- 0.16 1	- 0.24 7
S6	0.75 3**	0.49 3*	0.04 4	0.51 5*	0.49 4*	0.76 3**	0.76 1**	0.81 7**	- 0.45 9	0.00 0	- 0.35 0	0.33 8	- 0.56 5*	- 0.67 5**	0.77 1**	0.39 3	0.19 3	- 0.01 0
S7	0.78 9**	0.50 6*	0.15 5	0.56 1*	0.55 6*	0.71 4**	0.70 0**	0.77 0**	- 0.39 3	- 0.15 2	- 0.53 7*	0.22 9	- 0.61 4**	- 0.64 7**	0.61 2**	0.30 9	00.0 00	- 0.17 8
CE1	1	0.51 7*	- 0.04 7	0.55 7*	0.38 8	0.73 6**	0.63 2**	0.75 9**	- 0.56 5*	0.06 9	- 0.41 9	0.34 5	- 0.64 6**	- 0.70 2**	0.66 2**	0.41 8	0.12 8	0.04 7
CE2	0.51 7*	1	0.14 4	0.25 0	0.24 6	0.45 4	0.49 6*	0.42 8	- 0.33 3	- 0.13 9	- 0.43 3	0.08 5	- 0.50 0*	- 0.42 4	0.55 3*	0.14 1	0.02 9	0.02 1
CE3	- 0.04 7	0.14 4	1	- 0.38 6	- 0.25 1	- 0.30 1	- 0.05 4	- 0.28 4	- 0.37 4	- 0.43 8	- 0.61 8**	- 0.17 2	- 0.24 9	- 0.16 9	- 0.00 8	- 0.18 0	0.02 2	- 0.28 0
CE4	0.55 7*	0.25 0	- 0.38 6	1	0.75 5**	0.66 1**	0.41 0	0.69 5**	- 0.02 6	0.10 5	- 0.19 9	- 0.03 3	- 0.44 2	- 0.46 7	0.44 5	0.43 3	- 0.16 0	0.33 5
CE5	0.38 8	0.24 6	- 0.25 1	0.75 5**	1	0.64 8**	0.68 9**	0.70 3**	- 0.08 0	00.0 00	- 0.14 2	0.08 5	- 0.36 2	- 0.40 7	0.60 4**	0.33 1	00.0 00	0.15 1
CE6	0.73 6**	0.45 4	- 0.30 1	0.66 1**	0.64 8**	1	0.77 2**	0.94 3**	- 0.22 7	0.40 5	- 0.05 5	0.32 8	- 0.54 8*	- 0.68 9**	0.78 1**	0.47 2*	0.23 2	0.09 1
CE7	0.63 2**	0.49 6*	- 0.05 4	0.41 0	0.68 9**	0.77 2**	1	0.80 8**	- 0.39 4	0.14 9	- 0.21 6	0.41 8	- 0.39 8	- 0.55 3*	0.75 0**	0.38 9	0.27 9	0.01 2
CE8	0.75 9**	0.42 8	- 0.28 4	0.69 5**	0.70 3**	0.94 3**	0.80 8**	1	- 0.32 7	0.23 5	- 0.16 8	0.39 7	- 0.47 3*	- 0.56 7*	0.78 1**	0.57 9*	0.21 9	0.13 7
CE9	- 0.56 5*	- 0.33 3	- 0.37 4	- 0.02 6	- 0.08 0	- 0.22 7	- 0.39 4	- 0.32 7	1	0.24 9	- 0.60 8**	- 0.24 5	- 0.56 1*	- 0.32 7	- 0.55 4*	- 0.33 3	- 0.31 7	- 0.17 3
CT1	0.06 9	- 0.13 9	- 0.43 8	0.10 5	00.0 00	0.40 5	0.14 9	0.23 5	0.24 9	1	0.46 1	0.19 8	0.03 5	- 0.12 1	0.21 0	0.42 4	0.47 8*	0.34 0
CT2	- 0.41 9	- 0.43 3	- 0.61 8**	- 0.19 9	- 0.14 2	- 0.05 5	- 0.21 6	- 0.16 8	0.60 8**	0.46 1	1	0.09 8	0.50 7*	0.12 7	- 0.26 4	- 0.28 0	0.01 9	- 0.00 2
CT3	0.34 5	0.08 5	- 0.17 2	- 0.03 3	0.08 5	0.32 8	0.41 8	0.39 7	- 0.24 5	0.19 8	0.09 8	1	- 0.25 2	- 0.30 2	0.41 0	0.53 1*	0.67 5**	0.21 1
CT4	- 0.64 6**	0.50 0*	- 0.24 9	- 0.44 2	- 0.36 2	- 0.54 8*	- 0.39 8	- 0.47 3*	0.56 1*	0.03 5	0.50 7*	- 0.25 2	1	0.67 1**	- 0.70 9**	- 0.35 5	- 0.24 0	- 0.18 9
CT5	- 0.70 2**	- 0.42 4	0.16 9	- 0.46 7	- 0.40 7	- 0.68 9**	- 0.55 3*	- 0.56 7*	0.32 7	- 0.12 1	0.12 7	- 0.30 2	0.67 1**	1	- 0.59 8**	- 0.13 3	- 0.18 4	0.01 5

CT6	0.66 2**	0.55 3*	- 0.00 8	0.44 5	0.60 4**	0.78 1**	0.75 0**	0.78 1**	- 0.55 4*	0.21 0	- 0.26 4	0.41 0	- 0.70 9**	- 0.59 8**	1	0.56 7*	0.48 0*	0.26 4
CT7	0.41 8	0.14 1	- 0.18 0	0.43 3	0.33 1	0.47 2*	0.38 9	0.57 9*	- 0.33 3	0.42 4	- 0.28 0	0.53 1*	- 0.35 5	- 0.13 3	0.56 7*	1	0.65 9**	0.70 2**
CT8	0.12 8	0.02 9	0.02 2	- 0.16 0	0.00 00	0.23 2	0.27 9	0.21 9	- 0.31 7	0.47 8*	0.01 9	0.67 5**	- 0.24 0	- 0.18 4	0.48 0*	0.65 9**	1	0.48 3*
CT9	0.04 7	0.02 1	- 0.28 0	0.33 5	0.15 1	0.09 1	0.01 2	0.13 7	- 0.17 3	0.34 0	- 0.00 2	0.21 1	- 0.18 9	0.01 5	0.26 4	0.70 2**	0.48 3*	1
CON 1	0.69 1**	0.45 7	- 0.20 1	0.58 3*	0.69 7**	0.79 1**	0.84 1**	0.91 3**	- 0.45 2	0.00 0	- 0.23 8	0.50 3*	- 0.45 6	- 0.59 4**	0.79 6**	0.53 8*	0.27 6	0.15 0
CON 2	0.80 1**	0.50 5*	- 0.09 0	0.63 9**	0.67 2**	0.68 5**	0.68 8**	0.78 4**	- 0.50 4*	0.20 1	0.40 0	0.32 1	- 0.61 0**	- 0.67 4**	0.72 8**	0.38 8	0.03 4	0.11 0
CON 3	- 0.65 5**	- 0.45 8	- 0.34 1	- 0.25 7	- 0.21 5	- 0.45 5	- 0.48 3*	- 0.46 8	0.55 3*	0.09 3	0.41 3	- 0.51 2*	0.77 3**	0.60 7**	- 0.63 1**	- 0.31 3	- 0.28 9	- 0.03 0
CON 4	- 0.71 0**	- 0.50 7*	- 0.20 1	- 0.46 6	- 0.29 9	- 0.58 5*	- 0.54 2*	- 0.59 6**	0.57 4*	- 0.09 4	0.47 2*	- 0.36 7	0.79 3**	0.57 5*	- 0.67 2**	- 0.50 2*	- 0.26 5	- 0.24 4
CON 5	0.44 0	0.46 4	0.10 6	0.26 8	0.55 0*	0.77 7**	0.82 0**	0.64 8**	0.17 9	0.31 3	0.00 7	0.24 6	- 0.45 7	0.68 0**	0.68 0**	0.13 6	0.25 0	- 0.14 8
CON 6	0.34 7	0.09 2	- 0.15 2	0.03 1	0.18 9	0.27 9	0.38 2	0.32 3	- 0.46 3	0.28 8	- 0.03 3	0.64 2**	- 0.31 7	- 0.34 2	0.63 8**	0.63 2**	0.77 8**	0.51 8*
CON 7	- 0.55 2*	- 0.39 8	0.01 3	- 0.40 6	- 0.68 2**	- 0.74 9**	- 0.90 3**	- 0.76 3**	0.23 6	0.10 6	0.19 8	0.40 2	0.38 3	0.53 0*	- 0.66 3**	- 0.36 7	- 0.25 4	- 0.00 3
CON 8	- 0.49 6*	- 0.35 3	0.16 0	0.60 1**	- 0.63 0**	- 0.71 7**	- 0.74 3**	- 0.80 0**	0.18 4	0.24 0	0.24 4	0.40 6	0.35 9	0.24 4	- 0.57 8*	- 0.69 7**	- 0.24 5	- 0.36 7
CON 9	- 0.58 5*	- 0.49 0*	0.05 6	- 0.41 9	- 0.69 0**	- 0.76 6**	- 0.93 3**	- 0.77 6**	0.37 0	0.12 9	0.18 7	0.46 6	0.49 2*	0.62 2**	- 0.79 9**	- 0.43 4	- 0.40 1	- 0.15 3
L1	0.75 5**	0.12 9	- 0.09 9	0.33 8	0.51 3*	0.56 6*	0.72 8**	0.66 7**	- 0.46 1	- 0.05 3	- 0.22 5	0.45 0	- 0.32 8	- 0.50 6*	0.51 3*	0.26 7	0.09 9	- 0.17 5
L2	0.57 2*	0.37 5	- 0.02 2	0.35 7	0.47 3*	0.49 2*	0.64 2**	0.59 8**	0.44 9	0.17 8	0.22 8	0.63 6**	- 0.61 0**	0.47 1*	0.65 0**	0.36 0	0.19 9	0.07 2
L3	0.50 6*	0.36 7	- 0.04 4	0.44 5	0.38 5	0.45 3	0.49 3*	0.56 0*	- 0.16 4	- 0.14 0	- 0.23 3	0.62 0**	- 0.49 8*	- 0.33 4	0.40 2	0.39 0	0.08 7	0.05 9
L4	0.55 2*	0.24 8	0.14 3	0.42 0	0.58 3*	0.50 0*	0.68 6**	0.58 9*	0.24 0	0.15 6	0.28 8	0.51 5*	- 0.51 7*	0.39 6	0.51 6*	0.28 3	0.05 8	- 0.10 9
L5	0.59 7**	0.23 3	0.01 5	0.34 2	0.67 9**	0.67 2**	0.77 9**	0.69 9**	- 0.44 3	0.08 7	0.23 1	0.37 3	- 0.55 5*	- 0.51 9*	0.80 5**	0.36 8	0.29 1	- 0.06 4
L6	0.73 4**	0.17 3	- 0.02 1	0.54 2*	0.64 2**	0.58 7*	0.63 3**	0.73 2**	- 0.43 9	- 0.15 7	- 0.41 9	0.34 6	- 0.48 4*	- 0.45 3	0.60 8**	0.42 8	0.05 9	- 0.06 1
L7	0.62 8**	0.14 8	0.12 5	0.48 9*	0.62 3**	0.44 9	0.61 6**	0.55 0*	0.30 7	0.16 8	0.48 3*	0.23 6	- 0.44 5	0.41 6	0.46 0	0.30 5	- 0.06 3	- 0.11 1
L8	0.32 2	0.18 2	0.16 5	0.31 0	0.68 7**	0.47 5*	0.65 2**	0.44 8	- 0.20 3	0.00 00	0.23 6	0.18 7	0.53 9*	- 0.50 5*	0.63 1**	0.17 0	0.20 9	- 0.11 7
L9	0.06 8	- 0.27 5	- 0.21 1	0.20 7	0.38 3	0.30 8	0.38 0	0.34 8	0.02 0	0.53 6*	0.02 0	0.39 2	- 0.06 9	0.02 2	0.36 9	0.69 8**	0.54 4*	0.40 3
TMS 1	0.43 8	0.23 3	- 0.19 7	0.35 1	0.56 0*	0.63 1**	0.76 6**	0.66 4**	- 0.42 5	0.18 1	0.00 5	0.41 8	- 0.42 6	- 0.55 3*	0.77 1**	0.38 5	0.40 6	0.19 8
TMS 2	0.74 8**	0.51 3*	- 0.03 0	0.55 3*	0.35 6	0.65 7**	0.53 3*	0.62 0**	- 0.39 6	0.04 5	- 0.30 2	0.22 4	- 0.68 9**	0.83 4**	0.66 5**	0.27 1	0.16 7	0.07 0
TMS 3	0.52 2*	0.44 5	- 0.17	0.52 1*	0.73 5**	0.64 8**	0.68 0**	0.61 1**	0.00 2	0.04 5	- 0.16	0.19 0	- 0.39	- 0.66	0.56 7*	0.13 8	0.08 5	- 0.21

			2								2		3	8**				5
TMS 4	0.64 9**	0.62 5**	0.23 3	0.20 2	0.30 1	0.71 2**	0.74 6**	0.67 1**	0.58 1*	0.08 4	0.36 6	0.23 9	0.62 5**	0.58 5*	0.72 1**	0.25 5	0.26 1	0.09 3
TMS 5	0.77 7**	0.34 9	0.13 1	0.40 7	0.46 6	0.78 6**	0.80 1**	0.80 4**	0.56 6*	0.16 8	0.08 4	0.58 9*	0.54 6*	0.74 8**	0.76 3**	0.40 7	0.37 6	0.12 4
TMS 6	0.17 0	0.21 3	0.22 0	0.28 9	0.32 5	0.14 7	0.12 6	0.13 9	0.19 3	0.22 0	0.19 8	0.13 8	0.17 1	0.27 7	0.22 6	0.16 7	0.20 6	0.31 1
TMS 7	0.69 1**	0.22 2	0.24 6	0.54 7*	0.46 6	0.43 5	0.51 5*	0.63 4**	0.37 6	0.23 6	0.35 6	0.28 1	0.23 3	0.38 5	0.39 5	0.35 9	0.05 5	0.00 6
TMS 8	0.49 6*	0.30 4	0.13 6	0.26 5	0.57 1*	0.72 8**	0.81 2**	0.73 8**	0.45 7	0.17 7	0.03 8	0.56 6*	0.46 8	0.63 0**	0.84 2**	0.37 2	0.48 3*	0.09 8
TMS 9	0.48 1*	0.33 5	0.03 4	0.09 2	0.42 8	0.45 3	0.73 1**	0.50 3*	0.26 2	0.19 9	0.15 2	0.45 9	0.28 7	0.49 4*	0.42 6	00.0 00	0.00 0	0.41 2
TMS 10	0.52 1*	0.46 7	0.09 0	0.32 4	0.55 0*	0.64 8**	0.80 8**	0.72 2**	0.37 8	0.08 8	0.11 6	0.61 8**	0.44 3	0.62 2**	0.70 7**	0.31 2	0.27 4	00.0 00
TMS 11	0.39 7	0.37 3	0.53 5*	0.01 0	0.33 1	0.29 4	0.47 1*	0.37 0	0.45 0	0.36 6	0.50 5*	0.25 7	0.45 5	0.28 8	0.56 4*	0.07 4	0.13 7	0.41 4
TMS 12	0.71 5**	0.53 6*	0.09 2	0.43 1	0.38 0	0.66 1**	0.69 4**	0.62 3**	0.38 2	0.04 6	0.38 3	0.24 0	0.66 5**	0.66 7**	0.56 3*	0.28 1	0.08 6	0.03 3

	CO NI	CON 2	CON 3	CON 4	CON 5	CON 6	CON 7	CON 8	CON 9	L1	L2	L3	L4	L5	L6	L7	L8	L9
T1	0.5 94**	0.57 9*	0.70 5**	0.74 0**	0.10 3	0.4 05	0.25 3	0.39 3	0.37 7	0.32 0	0.52 7*	0.44 1	0.34 9	0.32 0	0.43 0	0.23 9	0.05 3	0.0 49
T2	0.6 14**	0.56 3*	0.73 1**	0.73 3**	0.28 7	0.6 30*	0.43 2	0.40 5	0.60 3**	0.37 0	0.56 7*	0.40 2	0.42 4	0.44 8	0.43 9	0.33 0	0.35 3	0.1 83
T3	0.6 72**	0.53 8*	0.57 9*	0.59 5**	0.70 5**	0.4 72*	0.56 7*	0.35 7	0.74 3**	0.53 7*	0.57 7*	0.35 0	0.37 5	0.51 9*	0.33 6	0.20 7	0.37 0	00. 000
T4	0.4 49	0.48 3*	0.54 2*	0.63 7**	0.69 0**	0.2 35	0.51 9*	0.45 2	0.55 8*	0.23 5	0.31 3	0.34 2	0.36 7	0.46 7	0.32 8	0.36 0	0.53 8*	0.2 53
T5	0.2 21	0.10 2	0.09 6	0.04 4	0.66 7**	0.0 60	0.53 7*	0.28 6	0.40 1	0.29 6	0.06 6	0.17 4	0.29 1	0.35 5	0.17 6	0.25 1	0.41 8	0.2 58
T6	0.7 06**	0.60 4**	0.54 3*	0.41 5	0.62 8**	0.2 93	0.56 4*	0.38 4	0.59 3**	0.48 3*	0.74 1**	0.57 4*	0.65 7**	0.66 9**	0.55 1*	0.47 2*	0.65 7**	0.2 26
T7	0.6 72**	0.53 8*	0.57 9*	0.53 8*	0.59 8**	0.3 17	0.71 3**	0.67 3**	0.74 3**	0.45 3	0.74 9**	0.68 8**	0.75 0**	0.68 6**	0.56 2*	0.44 9	0.64 0**	0.3 69
T8	0.8 21**	0.72 4**	0.71 3**	0.69 8**	0.50 2*	0.3 22	0.54 5*	0.60 7**	0.61 7**	0.59 3**	0.89 0**	0.84 2**	0.77 3**	0.60 4**	0.64 9**	0.49 6*	0.44 2	0.1 90
T9	0.6 18**	0.66 6**	0.34 6	0.49 5*	0.37 1	0.0 40	0.56 8*	0.73 0**	0.44 4	0.61 0**	0.47 0*	0.62 4**	0.60 7**	0.47 5*	0.70 7**	0.66 0**	0.25 6	0.2 49
T10	0.8 01**	0.78 4**	0.78 0**	0.73 0**	0.56 3*	0.2 02	0.70 6**	0.63 4**	0.72 2**	0.66 7**	0.86 7**	0.86 9**	0.88 4**	0.63 3**	0.73 2**	0.67 7**	0.58 9*	0.1 16
T11	0.1 13	0.31 9	0.13 5	0.16 8	0.02 4	0.1 40	0.01 7	0.11 9	0.06 3	0.05 8	0.20 7	0.17 9	0.15 3	0.01 9	0.01 7	0.03 7	0.02 0	0.3 02
T12	0.3 87	0.49 1*	0.84 5**	0.69 4**	0.41 3	0.0 72	0.32 5	0.16 8	0.36 5	0.34 6	0.60 7**	0.62 7**	0.56 9*	0.33 2	0.34 7	0.31 1	0.31 2	0.2 80
T13	0.6 34**	0.46 8	0.63 9**	0.56 6*	0.59 0**	0.4 50	0.61 2**	0.47 0*	0.72 1**	0.39 3	0.71 5**	0.48 2*	0.61 7**	0.67 2**	0.44 0	0.36 0	0.61 7**	0.2 66
TC1	0.9	0.82	-	-	0.79	0.4	-	-	-	0.63	0.68	0.55	0.60	0.74	0.66	0.52	0.60	0.2

	44 **	6 **	0.60 9**	0.65 3**	4 **	47	0.79 3**	0.66 7**	0.87 3**	5 **	9 **	0 *	6 **	0 **	3 **	4 *	2 **	65
TC2	- 0.4 21	- 0.50 8*	- 0.61 3**	- 0.44 2	- 0.16 1	- 0.3 38	- 0.37 5	- 0.22 2	- 0.41 9	- 0.48 5*	- 0.62 0**	- 0.49 2*	- 0.55 6*	- 0.45 9	- 0.51 7*	- 0.49 5*	- 0.35 2	- 0.0 34
TC3	0.3 87	0.41 7	- 0.38 4	- 0.30 9	0.41 3	0.2 68	- 0.57 0*	- 0.39 0	- 0.48 1*	0.48 9*	0.31 8	0.15 3	0.44 3	0.68 4**	0.53 8*	0.51 5*	0.46 4	0.2 80
TC4	0.5 73 *	0.46 2	- 0.24 0	- 0.19 8	0.69 3**	0.3 47	- 0.67 9**	- 0.41 1	- 0.64 2**	0.69 0**	0.34 3	0.16 2	0.34 3	0.68 5**	0.49 3*	0.33 6	0.33 5	0.2 25
TC5	0.4 22	0.41 9	- 0.29 2	- 0.28 0	0.12 0	0.0 17	- 0.22 4	- 0.13 6	- 0.21 2	0.44 2	0.27 2	0.30 9	0.22 7	0.07 9	0.37 2	0.25 3	- 0.07 1	- 0.1 86
TC6	0.4 64	0.61 9**	- 0.53 6*	- 0.48 8*	0.07 4	- 0.0 53	- 0.21 2	- 0.12 6	- 0.20 1	0.56 7*	0.46 0	0.50 1*	0.46 3	0.27 2	0.64 7**	0.55 4*	0.21 6	- 0.2 66
TC7	0.1 48	0.26 8	- 0.02 4	- 0.00 9	- 0.06 9	- 0.0 25	- 0.22 2	- 0.23 7	- 0.04 4	0.20 4	- 0.10 1	0.12 6	0.14 4	- 0.01 3	0.26 6	0.33 7	- 0.11 5	0.1 42
TC8	0.2 03	0.36 6	- 0.06 5	- 0.07 8	- 0.04 1	0.0 17	0.18 4	0.15 9	- 0.07 2	0.22 3	- 0.07 2	0.08 0	0.11 1	0.03 7	0.32 7	0.36 7	- 0.02 5	0.0 73
TC9	0.8 00 **	0.76 4**	- 0.67 7**	- 0.64 0**	0.70 7**	0.4 51	- 0.71 1**	- 0.49 3*	- 0.78 5**	0.63 0**	0.58 8*	0.47 6*	0.54 7*	0.60 4**	0.54 4*	0.46 5	0.45 3	0.0 90
S1	0.8 41 **	0.68 8**	- 0.48 3*	- 0.54 2*	0.82 0**	0.3 82	- 0.73 6**	- 0.56 2*	- 0.85 4**	0.63 1**	0.70 7**	0.49 3*	0.60 0**	0.77 9**	0.63 3**	0.52 4*	0.75 5**	0.2 96
S2	0.8 66 **	0.70 4**	- 0.52 1*	- 0.44 7	0.82 4*	0.5 18*	0.81 3**	0.52 0*	- 0.88 8**	0.64 6**	0.65 4**	0.41 5	0.58 2*	0.79 5**	0.59 3**	0.48 0*	0.68 1**	0.2 87
S3	0.8 37 **	0.71 0**	- 0.59 1**	- 0.52 9*	0.76 5**	0.5 91*	- 0.76 8**	- 0.49 0*	- 0.89 6**	0.66 1**	0.69 5**	0.44 6	0.61 5**	0.76 4**	0.57 8*	0.50 8*	0.68 9**	0.2 73
S4	0.8 68 **	0.64 6**	- 0.45 9	- 0.52 3*	0.85 5**	0.4 49	- 0.80 4**	- 0.66 0**	- 0.89 9**	0.58 4*	0.64 9**	0.42 8	0.52 9*	0.76 1**	0.54 1*	0.39 8	0.61 5**	0.3 35
S5	- 0.3 96	- 0.26 7	- 0.26 7	- 0.27 9	- 0.11 0	- 0.1 58	0.39 7	0.61 7**	0.37 6	- 0.10 2	- 0.43 7	0.56 4*	0.54 3*	- 0.25 9	- 0.27 1	- 0.29 6	- 0.24 4	- 0.3 65
S6	0.8 66 **	0.78 7**	- 0.66 6**	- 0.69 3**	0.63 0**	0.3 69	- 0.71 9**	- 0.59 2**	- 0.77 5**	0.62 8**	0.66 9**	0.53 7*	0.62 4**	0.68 1**	0.71 0**	0.58 5*	0.55 5*	0.2 05
S7	0.7 75 **	0.83 9**	- 0.67 6**	- 0.69 7**	0.58 6*	0.1 05	0.69 4**	0.57 3*	0.65 7**	0.69 3**	0.62 2**	0.61 2**	0.71 4**	0.68 1**	0.82 2**	0.77 0**	0.61 2**	0.1 01
CE1	0.6 91 **	0.80 1**	0.65 5**	0.71 0**	0.44 0	0.3 47	0.55 2*	0.49 6*	0.58 5*	0.75 5**	0.57 2*	0.50 6*	0.55 2*	0.59 7**	0.73 4**	0.62 8**	0.32 2	0.0 68
CE2	0.4 57	0.50 5*	- 0.45 8	- 0.50 7*	0.46 4	0.0 92	- 0.39 8	- 0.35 3	- 0.49 0*	0.12 9	0.37 5	0.36 7	0.24 8	0.23 3	0.17 3	0.14 8	0.18 2	- 0.2 75
CE3	- 0.2 01	- 0.09 0	- 0.34 1	- 0.20 1	- 0.10 6	- 0.1 52	0.01 3	0.16 0	0.05 6	- 0.09 9	- 0.02 2	- 0.04 4	0.14 3	0.01 5	- 0.02 1	0.12 5	0.16 5	- 0.2 11
CE4	0.5 83 *	0.63 9**	0.25 7	0.46 6	0.26 8	0.0 31	0.40 6	0.60 1**	0.41 9	0.33 8	0.35 7	0.44 5	0.42 0	0.34 2	0.54 2*	0.48 9*	0.31 0	0.2 07
CE5	0.6 97 **	0.67 2**	- 0.21 5	- 0.29 9	0.55 0*	0.1 89	- 0.68 2**	- 0.63 0**	- 0.69 0**	0.51 3*	0.47 3*	0.38 5	0.58 3*	0.67 9**	0.64 2**	0.62 3**	0.68 7**	0.3 83
CE6	0.7 91 **	0.68 5**	- 0.45 5	- 0.58 5*	0.77 7**	0.2 79	0.74 9**	0.71 7**	0.76 6**	0.56 6*	0.49 2*	0.45 3	0.50 0*	0.67 2**	0.58 7*	0.44 9	0.47 5*	0.3 08
CE7	0.8 41 **	0.68 8**	- 0.48 3*	- 0.54 2*	0.82 0**	0.3 82	- 0.90 3**	- 0.74 3**	- 0.93 3**	0.72 8**	0.64 2**	0.49 3*	0.68 6**	0.77 9**	0.63 3**	0.61 6**	0.65 2**	0.3 80
CE8	0.9 13 **	0.78 4**	- 0.46 8	- 0.59 6**	0.64 8**	0.3 23	- 0.76 3**	- 0.80 0**	- 0.77 6**	0.66 7**	0.59 8**	0.56 0*	0.58 9*	0.69 9**	0.73 2**	0.55 0*	0.44 8	0.3 48
CE9	- 0.4 52	- 0.50 4*	0.55 3*	0.57 4*	- 0.17 9	- 0.4 63	0.23 6	0.18 4	0.37 0	- 0.46 1	- 0.44 9	- 0.16 4	- 0.24 0	- 0.44 3	- 0.43 9	- 0.30 7	- 0.20 3	0.0 20

CT1	0.0 00	- 0.20 1	0.09 3	- 0.09 4	0.31 3	0.2 88	- 0.10 6	- 0.24 0	- 0.12 9	- 0.05 3	- 0.17 8	- 0.14 0	- 0.15 6	0.08 7	- 0.15 7	- 0.16 8	00.0 00	0.5 36*
CT2	- 0.2 38	0.40 0	0.41 3	0.47 2*	0.00 7	- 0.0 33	0.19 8	0.24 4	0.18 7	0.22 5	0.22 8	0.23 3	0.28 8	0.23 1	0.41 9	0.48 3*	- 0.23 6	0.0 20
CT3	0.5 03*	0.32 1	- 0.51 2*	- 0.36 7	0.24 6	0.6 42*	- 0.40 2	- 0.40 6	0.46 6	0.45 0	0.63 6**	0.62 0**	0.51 5*	0.37 3	0.34 6	0.23 6	0.18 7	0.3 92
CT4	- 0.4 56	- 0.61 0**	0.77 3**	0.79 3**	- 0.45 7	- 0.3 17	0.38 3	0.35 9	0.49 2*	- 0.32 8	- 0.61 0**	- 0.49 8*	- 0.51 7*	- 0.55 5*	- 0.48 4*	- 0.44 5	- 0.53 9*	- 0.0 69
CT5	- 0.5 94**	- 0.67 4**	0.60 7**	0.57 5*	- 0.68 0**	- 0.3 42	0.53 0*	0.24 4	0.62 2**	- 0.50 6*	- 0.47 1*	- 0.33 4	0.39 6	- 0.51 9*	- 0.45 3	- 0.41 6	- 0.50 5*	0.0 22
CT6	0.7 96**	0.72 8**	- 0.63 1**	- 0.67 2**	0.68 0*	0.6 38*	- 0.66 3**	- 0.57 8*	0.79 9**	0.51 3*	0.65 0**	0.40 2	0.51 6*	0.80 5**	0.60 8**	0.46 0	0.63 1**	0.3 69
CT7	0.5 38*	0.38 8	- 0.31 3	- 0.50 2*	0.13 6	0.6 32*	- 0.36 7	- 0.69 7**	0.43 4	0.26 7	0.36 0	0.39 0	0.28 3	0.36 8	0.42 8	0.30 5	0.17 0	0.6 98*
CT8	0.2 76	0.03 4	- 0.28 9	- 0.26 5	0.25 0	0.7 78*	- 0.25 4	- 0.24 5	0.40 1	0.09 9	0.19 9	0.08 7	0.05 8	0.29 1	0.05 9	- 0.06 3	0.20 9	0.5 44*
CT9	0.1 50	0.11 0	- 0.03 0	- 0.24 4	0.14 8	0.5 18*	0.00 3	0.36 7	0.15 3	0.17 5	0.07 2	0.05 9	0.10 9	0.06 4	0.06 1	0.11 1	0.11 7	0.4 03
CON 1	1	0.86 6**	- 0.57 6*	- 0.62 0**	0.61 4**	0.4 54	- 0.75 5**	- 0.71 2**	0.82 3**	0.69 3**	0.74 2**	0.61 8**	0.65 2**	0.71 8**	0.76 3**	0.58 9*	0.53 0*	0.2 92
CON 2	0.8 66**	1	- 0.64 0**	- 0.63 7**	0.47 9*	0.3 86	- 0.66 1**	- 0.55 5*	0.69 3**	0.73 3**	0.70 4**	0.56 2*	0.66 0**	0.71 1**	0.84 6**	0.75 5**	0.53 8*	0.1 08
CON 3	- 0.5 76*	- 0.64 0**	1	0.90 0**	- 0.37 6	- 0.3 26	0.36 9	0.31 0	0.46 3	- 0.44 5	- 0.76 1**	- 0.69 3**	- 0.70 3**	- 0.49 8*	- 0.52 8*	- 0.50 5*	- 0.48 0*	0.0 20
CON 4	- 0.6 20**	- 0.63 7**	0.90 0**	1	- 0.42 3	- 0.2 66	0.37 4	0.50 3*	0.48 4*	- 0.39 4	- 0.70 2**	- 0.67 2**	- 0.61 7**	- 0.46 9*	- 0.51 5*	- 0.47 1*	- 0.42 4	- 0.0 93
CON 5	0.6 14**	0.47 9*	0.37 6	0.42 3	1	0.2 36	0.77 4**	0.49 7*	0.81 5**	0.47 3*	0.44 7	0.27 6	0.44 8	0.70 9**	0.38 1	0.36 5	0.70 5**	0.2 65
CON 6	0.4 54	0.38 6	- 0.32 6	- 0.26 6	0.23 6	1	- 0.36 1	- 0.26 1	0.51 9*	0.38 8	0.39 7	0.10 7	0.19 3	0.51 6*	0.35 3	0.24 6	0.31 7	0.5 70*
CON 7	- 0.7 55**	- 0.66 1**	0.36 9	0.37 4	- 0.77 4**	0.3 61	1	0.78 7**	0.94 6**	- 0.67 6**	- 0.52 1*	0.43 5	0.66 8**	0.74 6**	0.61 8**	0.64 7**	0.64 0**	0.4 49
CON 8	- 0.7 12**	- 0.55 5*	0.31 0	0.50 3*	- 0.49 7*	- 0.2 61	0.78 7**	1	0.74 4**	- 0.46 3	- 0.52 7*	- 0.61 1**	- 0.61 4**	- 0.51 5*	- 0.53 5*	- 0.51 5*	- 0.35 7	- 0.5 62*
CON 9	- 0.8 23**	- 0.69 3**	0.46 3	0.48 4*	- 0.81 5**	- 0.5 19*	0.94 6**	0.74 4**	1	- 0.63 9**	- 0.62 4**	- 0.45 5	- 0.63 2**	- 0.77 0**	- 0.58 5*	- 0.55 0*	- 0.67 4**	- 0.4 24
L1	0.6 93**	0.73 3**	0.44 5	0.39 4	0.47 3*	0.3 88	0.67 6**	0.46 3	0.63 9**	1	0.63 7**	0.46 0	0.70 7**	0.79 9**	0.87 8**	0.81 3**	0.53 7*	0.3 13
L2	0.7 42**	0.70 4**	- 0.76 1**	- 0.70 2**	0.44 7	0.3 97	0.52 1*	0.52 7*	0.62 4**	0.63 7**	1	0.86 4**	0.85 6**	0.67 3**	0.69 2**	0.59 2**	0.57 7*	0.2 11
L3	0.6 18**	0.56 2*	- 0.69 3**	- 0.67 2**	0.27 6	0.1 07	0.43 5	0.61 1**	0.45 5	0.46 0	0.86 4**	1	0.84 4**	0.38 8	0.56 1*	0.51 1*	0.35 0	0.1 38
L4	0.6 52**	0.66 0*	- 0.70 3**	- 0.61 7**	0.44 8	0.1 93	0.66 8**	0.61 4**	0.63 2**	0.70 7**	0.85 6**	0.84 4**	1	0.69 5**	0.75 5**	0.80 8**	0.67 5**	0.3 08
L5	0.7 18	0.71 1**	- 0.49	- 0.46	0.70 9**	0.5 16*	- 0.74	- 0.51	- 0.77	0.79 9**	0.67 3**	0.38 8	0.69 5**	1	0.83 2**	0.75 7**	0.85 2**	0.5 13*

	**		8*	9*			6**	5*	0**									
L6	0.7 63 **	0.84 6**	- 0.52 8*	- 0.51 5*	0.38 1	0.3 53	- 0.61 8**	- 0.53 5*	- 0.58 5*	0.87 8**	0.69 2**	0.56 1*	0.75 5**	0.83 2**	1	0.89 7**	0.63 8**	0.3 72
L7	0.5 89 *	0.75 5**	- 0.50 5*	- 0.47 1*	0.36 5	0.2 46	- 0.64 7**	- 0.51 5*	- 0.55 0*	0.81 3**	0.59 2**	0.51 1*	0.80 8**	0.75 7**	0.89 7**	1	0.69 1**	0.3 98
L8	0.5 30 *	0.53 8*	- 0.48 0*	- 0.42 4	0.70 5**	0.3 17	- 0.64 0**	- 0.35 7	- 0.67 4**	0.53 7*	0.57 7*	0.35 0	0.67 5**	0.85 2**	0.63 8**	0.69 1**	1	0.4 43
L9	0.2 92	0.10 8	0.02 0	0.09 3	0.26 5	0.5 70*	- 0.44 9	- 0.56 2*	- 0.42 4	0.31 3	0.21 1	0.13 8	0.30 8	0.51 3*	0.37 2	0.39 8	0.44 3	1
TMS 1	0.7 76 **	0.56 1*	- 0.45 0	- 0.51 0*	0.70 8**	0.5 66*	- 0.62 9**	- 0.50 6*	- 0.79 6**	0.54 9*	0.69 6**	0.38 9	0.51 0*	0.73 8**	0.53 0*	0.37 5	0.66 0**	0.4 30
TMS 2	0.6 61 **	0.67 8**	- 0.69 2**	- 0.73 3**	0.54 3*	0.3 18	- 0.44 5	- 0.32 2	- 0.58 6*	0.43 9	0.57 6*	0.46 3	0.44 8	0.48 7*	0.52 2*	0.40 8	0.47 8*	00. 000
TMS 3	0.6 27 **	0.62 2**	- 0.35 5	- 0.31 8	0.70 7**	0.2 01	- 0.65 2**	- 0.36 5	- 0.67 3**	0.56 1*	0.44 9	0.38 5	0.54 7*	0.67 1**	0.60 5**	0.59 6**	0.74 5**	0.2 09
TMS 4	0.6 52 **	0.56 5*	- 0.60 8**	- 0.69 2**	0.78 8**	0.2 06	- 0.64 9**	- 0.50 9*	- 0.71 8**	0.48 8*	0.53 7*	0.38 4	0.45 0	0.63 2**	0.46 5	0.35 0	0.51 0*	0.0 55
TMS 5	0.8 45 **	0.75 5**	- 0.68 4**	- 0.67 6**	0.65 5**	0.5 24*	- 0.71 3**	- 0.56 2*	- 0.79 8**	0.73 7**	0.69 5**	0.51 1*	0.60 6**	0.68 2**	0.62 5**	0.49 2*	0.44 9	0.1 99
TMS 6	0.2 04	0.40 4	- 0.04 9	- 0.03 7	0.08 8	0.1 26	- 0.13 7	- 0.02 2	- 0.23 1	0.10 4	0.13 6	- 0.06 5	00.0 00	0.08 9	0.04 9	0.00 7	0.01 5	- 0.3 27
TMS 7	0.7 19 **	0.72 7**	- 0.34 0	- 0.39 5	0.18 9	0.2 71	- 0.41 0	- 0.42 1	- 0.44 2	0.76 0**	0.60 7**	0.52 9*	0.53 4*	0.52 0*	0.82 3**	0.65 3**	0.31 6	0.1 75
TMS 8	0.8 35 **	0.65 9**	- 0.54 9*	- 0.50 2*	0.77 5**	0.6 06*	- 0.74 0**	- 0.51 6*	- 0.85 1**	0.60 8**	0.67 7**	0.39 1	0.54 6*	0.79 3**	0.55 6*	0.40 6	0.64 1**	0.3 50
TMS 9	0.6 24 **	0.61 5**	- 0.44 1	- 0.31 7	0.66 3**	0.2 10	- 0.69 1**	- 0.38 7	- 0.65 3**	0.78 4**	0.70 3**	0.54 6*	0.72 0**	0.72 1**	0.66 2**	0.67 0**	0.62 9**	0.1 57
TMS 10	0.8 94 **	0.76 1**	- 0.66 3**	- 0.58 1*	0.67 6**	0.4 24	- 0.74 4**	- 0.57 9*	- 0.81 2**	0.60 0**	0.80 7**	0.66 3**	0.70 7**	0.65 5**	0.59 3**	0.50 8*	0.56 6*	0.1 74
TMS 11	0.4 96 *	0.55 6*	- 0.61 7*	- 0.39 7	0.37 5	0.2 35	- 0.46 1	- 0.16 1	- 0.43 6	0.49 9*	0.51 0*	0.34 3	0.58 8*	0.67 2**	0.62 5**	0.59 9**	0.62 8**	0.0 48
TMS 12	0.6 01 **	0.65 9**	- 0.60 9**	- 0.71 6**	0.69 1**	0.1 63	- 0.68 6**	- 0.60 4**	- 0.70 5**	0.57 3*	0.61 6**	0.56 3*	0.62 0**	0.59 3**	0.57 5*	0.58 6*	0.56 2*	0.1 53

	TMS1	TMS2	TMS3	TMS4	TMS5	TMS6	TMS7	TMS8	TMS9	TMS10	TMS11	TMS12
T1	0.375	0.541*	0.038	0.558*	0.615**	0.167	0.405	0.446	0.092	0.470*	0.444	0.368
T2	0.604**	0.701**	0.237	0.609**	0.672**	0.146	0.413	0.574*	0.188	0.549*	0.429	0.540*
T3	0.748**	0.693**	0.453	0.780**	0.853**	0.280	0.387	0.772**	0.533*	0.707**	0.275	0.636**
T4	0.390	0.678**	0.622**	0.565*	0.518*	0.014	0.101	0.467	0.240	0.415	0.211	0.659**
T5	0.135	0.083	0.537*	0.366	0.251	-0.309	-0.055	0.330	0.520*	0.329	0.228	0.375
T6	0.663**	0.408	0.521*	0.453	0.613**	0.097	0.332	0.794**	0.728**	0.867**	0.567*	0.401
T7	- 0.660**	-0.478*	-0.453	- 0.645**	- 0.611**	-0.081	-0.316	- 0.707**	-0.533*	- 0.707**	-0.510*	- 0.636**
T8	0.665**	0.607**	0.474*	0.513*	0.793**	0.163	0.559*	0.732**	0.589*	0.833**	0.390	0.538*
T9	0.242	0.427	0.464	0.414	0.496*	-0.025	0.618*	0.290	0.460	0.429	0.212	0.607**
T10	0.595**	0.704**	0.611**	0.671**	0.741**	0.087	0.634*	0.635**	0.729**	0.833**	0.555*	0.798**
T11	0.040	0.024	-0.066	-0.061	0.147	0.843*	-0.081	0.104	-0.087	0.144	-0.160	0.084

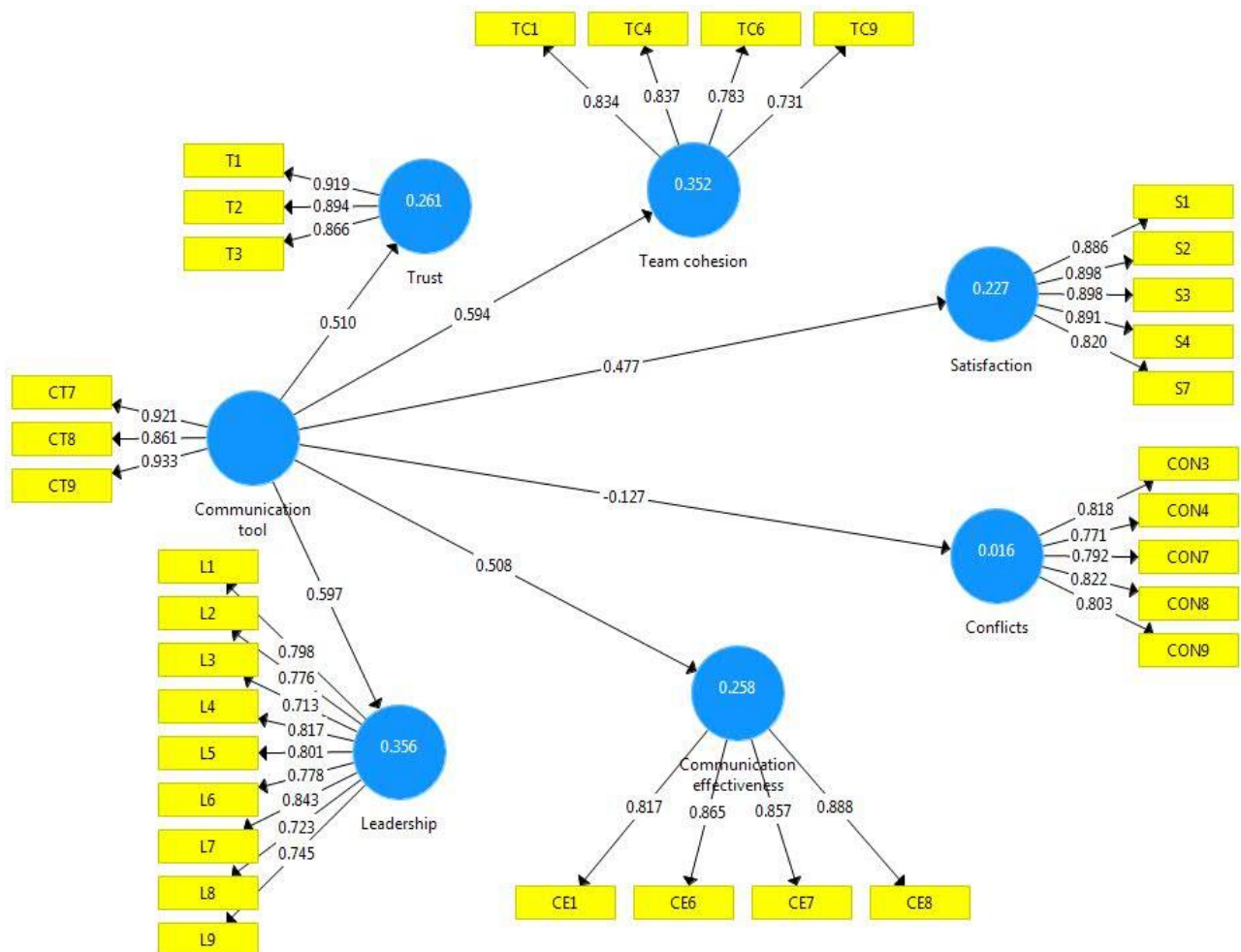


T12	0.262	0.676**	0.352	0.601**	0.583*	0.068	0.207	0.402	0.450	0.537*	0.480*	0.631**
T13	0.749**	0.516*	0.362	0.717**	0.610**	0.023	0.268	0.753**	0.526*	0.727**	0.666**	0.523*
TC1	0.802**	0.751**	0.713**	0.740**	0.887**	0.232	0.561*	0.890**	0.622**	0.889**	0.458	0.683**
TC2	-0.252	-0.338	-0.266	-0.444	-0.383	0.065	-0.421	-0.337	-0.543*	-0.491*	0.727**	-0.387
TC3	0.262	0.131	0.229	0.601**	0.379	-0.100	0.147	0.458	0.450	0.358	0.778**	0.380
TC4	0.496*	0.292	0.432	0.640**	0.705**	0.090	0.301	0.711**	0.618**	0.539*	0.419	0.422
TC5	0.274	0.638**	0.216	0.279	0.498*	0.030	0.637*	0.202	0.301	0.356	0.020	0.420
TC6	0.150	0.590**	0.387	0.393	0.388	-0.023	0.756*	0.124	0.461	0.364	0.424	0.548*
TC7	-0.182	0.224	0.199	-0.173	0.143	-0.074	0.251	-0.084	-0.015	0.034	-0.057	0.095
TC8	-0.077	0.412	0.319	-0.126	0.168	0.029	0.378	-0.061	-0.037	0.035	-0.039	0.155
TC9	0.645**	0.774**	0.646**	0.662**	0.924**	0.293	0.455	0.799**	0.552*	0.802**	0.397	0.639**
S1	0.866**	0.656**	0.764**	0.746**	0.708**	0.126	0.597*	0.812**	0.731**	0.808**	0.471*	0.694**
S2	0.821**	0.567*	0.695**	0.692**	0.829**	0.203	0.436	0.958**	0.735**	0.915**	0.592**	0.538*
S3	0.837**	0.647**	0.728**	0.646**	0.840**	0.254	0.487*	0.906**	0.682**	0.870**	0.531*	0.559*
S4	0.871**	0.554*	0.592**	0.808**	0.805**	0.171	0.438	0.921**	0.666**	0.855**	0.454	0.629**
S5	-0.205	-0.031	-0.227	-0.114	-0.136	0.034	-0.161	-0.228	-0.161	-0.373	-0.297	-0.150
S6	0.754**	0.862**	0.595**	0.769**	0.809**	0.082	0.669*	0.737**	0.562*	0.784**	0.544*	0.745**
S7	0.476*	0.732**	0.694**	0.734**	0.660**	00.000	0.678*	0.535*	0.653**	0.674**	0.641**	0.809**
CE1	0.438	0.748**	0.522*	0.649**	0.777**	0.170	0.691*	0.496*	0.481*	0.521*	0.397	0.715**
CE2	0.233	0.513*	0.445	0.625**	0.349	0.213	0.222	0.304	0.335	0.467	0.373	0.536*
CE3	-0.197	-0.030	-0.172	0.233	-0.131	-0.220	-0.246	-0.136	-0.034	-0.090	0.535*	0.092
CE4	0.351	0.553*	0.521*	0.202	0.407	0.289	0.547*	0.265	0.092	0.324	-0.010	0.431
CE5	0.560*	0.356	0.735**	0.301	0.466	0.325	0.466	0.571*	0.428	0.550*	0.331	0.380
CE6	0.631**	0.657**	0.648**	0.712**	0.786**	0.147	0.435	0.728**	0.453	0.648**	0.294	0.661**
CE7	0.766**	0.533*	0.680**	0.746**	0.801**	0.126	0.515*	0.812**	0.731**	0.808**	0.471*	0.694**
CE8	0.664**	0.620**	0.611**	0.671**	0.804**	0.139	0.634*	0.738**	0.503*	0.722**	0.370	0.623**
CE9	-0.425	-0.396	0.002	-0.581*	-0.566*	-0.193	-0.376	-0.457	-0.262	-0.378	-0.450	-0.382
CT1	0.181	0.045	0.045	0.084	0.168	-0.220	-0.236	0.177	-0.199	-0.088	-0.366	0.046
CT2	0.005	-0.302	-0.162	-0.366	-0.084	0.198	-0.356	0.038	-0.152	-0.116	-0.505*	-0.383
CT3	0.418	0.224	0.190	0.239	0.589*	-0.138	0.281	0.566*	0.459	0.618**	0.257	0.240
CT4	-0.426	0.689**	-0.393	0.625**	-0.546*	-0.171	-0.233	-0.468	-0.287	-0.443	-0.455	0.665**
CT5	-0.553*	0.834**	0.668**	-0.585*	0.748**	-0.277	-0.385	0.630**	-0.494*	0.622**	-0.288	0.667**
CT6	0.771**	0.665**	0.567*	0.721**	0.763**	0.226	0.395	0.842**	0.426	0.707**	0.564*	0.563*
CT7	0.385	0.271	0.138	0.255	0.407	-0.167	0.359	0.372	00.000	0.312	0.074	0.281
CT8	0.406	0.167	0.085	0.261	0.376	-0.206	-0.055	0.483*	0.000	0.274	0.137	0.086
CT9	0.198	0.070	-0.215	-0.093	0.124	0.311	-0.006	0.098	-0.412	00.000	-0.414	0.033
CON1	0.776**	0.661**	0.627**	0.652**	0.845**	0.204	0.719*	0.835**	0.624**	0.894**	0.496*	0.601**
CON2	0.561*	0.678**	0.622**	0.565*	0.755**	0.404	0.727*	0.659**	0.615**	0.761**	0.556*	0.659**
CON3	-0.450	0.692**	-0.355	0.608**	0.684**	-0.049	-0.340	-0.549*	-0.441	0.663**	0.617**	0.609**

CON4	-0.510*	0.733**	-0.318	0.692**	0.676**	-0.037	-0.395	-0.502*	-0.317	-0.581*	-0.397	0.716**
CON5	0.708**	0.543*	0.707**	0.788**	0.655**	0.088	0.189	0.775**	0.663**	0.676**	0.375	0.691**
CON6	0.566*	0.318	0.201	0.206	0.524*	0.126	0.271	0.606**	0.210	0.424	0.235	0.163
CON7	0.629**	-0.445	0.652**	0.649**	0.713**	-0.137	-0.410	0.740**	0.691**	0.744**	-0.461	0.686**
CON8	-0.506*	-0.322	-0.365	-0.509*	-0.562*	-0.022	-0.421	-0.516*	-0.387	-0.579*	-0.161	0.604**
CON9	0.796**	-0.586*	0.673**	0.718**	0.798**	-0.231	-0.442	0.851**	0.653**	0.812**	-0.436	0.705**
L1	0.549*	0.439	0.561*	0.488*	0.737**	0.104	0.760*	0.608**	0.784**	0.600**	0.499*	0.573*
L2	0.696**	0.576*	0.449	0.537*	0.695**	0.136	0.607*	0.677**	0.703**	0.807**	0.510*	0.616**
L3	0.389	0.463	0.385	0.384	0.511*	-0.065	0.529*	0.391	0.546*	0.663**	0.343	0.563*
L4	0.510*	0.448	0.547*	0.450	0.606**	0.000	0.534*	0.546*	0.720**	0.707**	0.588*	0.620**
L5	0.738**	0.487*	0.671**	0.632**	0.682**	0.089	0.520*	0.793**	0.721**	0.655**	0.672**	0.593**
L6	0.530*	0.522*	0.605**	0.465	0.625**	0.049	0.823*	0.556*	0.662**	0.593**	0.625**	0.575*
L7	0.375	0.408	0.596**	0.350	0.492*	0.007	0.653*	0.406	0.670**	0.508*	0.599**	0.586*
L8	0.660**	0.478*	0.745**	0.510*	0.449	0.015	0.316	0.641**	0.629**	0.566*	0.628**	0.562*
L9	0.430	0.000	0.209	0.055	0.199	-0.327	0.175	0.350	0.157	0.174	0.048	0.153
TMS1	1	0.650**	0.503*	0.641**	0.768**	0.200	0.499*	0.884**	0.538*	0.755**	0.305	0.562*
TMS2	0.650**	1	0.600**	0.663**	0.698**	0.150	0.576*	0.557*	0.369	0.592**	0.328	0.731**
TMS3	0.503*	0.600**	1	0.443	0.465	0.024	0.512*	0.534*	0.630**	0.573*	0.492*	0.518*
TMS4	0.641**	0.663**	0.443	1	0.713**	0.055	0.332	0.682**	0.559*	0.636**	0.500*	0.824**
TMS5	0.768**	0.698**	0.465	0.713**	1	0.305	0.525*	0.876**	0.584*	0.826**	0.387	0.653**
TMS6	0.200	0.150	0.024	0.055	0.305	1	0.047	0.268	0.008	0.209	-0.116	0.116
TMS7	0.499*	0.576*	0.512*	0.332	0.525*	0.047	1	0.369	0.548*	0.503*	0.310	0.483*
TMS8	0.884**	0.557*	0.534*	0.682**	0.876**	0.268	0.369	1	0.621**	0.876**	0.500*	0.508*
TMS9	0.538*	0.369	0.630**	0.559*	0.584*	0.008	0.548*	0.621**	1	0.754**	0.585*	0.617**
TMS10	0.755**	0.592**	0.573*	0.636**	0.826**	0.209	0.503*	0.876**	0.754**	1	0.555*	0.584*
TMS11	0.305	0.328	0.492*	0.500*	0.387	-0.116	0.310	0.500*	0.585*	0.555*	1	0.308
TMS12	0.562*	0.731**	0.518*	0.824**	0.653**	0.116	0.483*	0.508*	0.617**	0.584*	0.308	1

## Appendix K: SmartPLS images of model without TMS and model with TMS

Model without TMS



## Model with TMS

