Group Decision and Negotiation (2021) 30:529–551
https://doi.org/10.1007/s10726-020-09722-x

Trust and Group Efficiency in Multinational Virtual Team Collaboration: A Longitudinal Study

Xusen Cheng[1] · Ying Bao[2] · Xiaodan Yu[2] · Yuanyanhang Shen[2]

Accepted: 26 December 2020 / Published online: 9 January 2021

Abstract

Trust plays a central role in team collaboration, especially in multinational virtual teams. However, our understanding of how different types of trust interact to influence group work efficiency in this context is still limited. This study investigates the development of two types of trust and group efficiency over time in the multinational virtual team context. Three analysis phases were conducted in this research: phase 1 included a qualitative analysis of an online interview with 120 respondents in multinational virtual team collaborations over 5 weeks, phase 2 comprised a general analysis of the trust and group efficiency development with the same respondents, and phase 3 included a quantitative analysis of the interaction effects of trust on group efficiency. The results provide insights into the antecedents of group efficiency and reveal the trend of trust and group efficiency development over time. The authors also investigate trust and group efficiency from the deconstructed and decomposed perspectives. This study contributes to current research by providing evidence on the development of trust and group efficiency and by investigating the interaction effects of trust in the multinational virtual team collaboration context.

Keywords Trust development · Openness · Reliability · Group awareness · Group efficiency · Multinational virtual team collaboration

✉ Xiaodan Yu
xyu@uibe.edu.cn

Xusen Cheng
xusen.cheng@ruc.edu.cn

Ying Bao
bycoco1@outlook.com

Yuanyanhang Shen
yanhangshen@163.com

[1] School of Information, Renmin University of China, Beijing 100872, China

[2] School of Information Technology and Management, University of International Business and Economics, Beijing 100029, China

1 Introduction

The prevalence of virtual worlds has enabled frequent media-rich interactions within the context of global collaboration (Srivastava and Chandra 2018). Many firms, such as IBM, Microsoft, Intel, and E-bay, now conduct seminars, training programs, and social events via computer-mediated communication platforms (de Vreede et al. 2013). Knowledge workers often collaborate in teams that are multinational, inter-organizational, and global (Cheng et al. 2016c). In this context, the collaboration between individuals plays an important role in the effectiveness and efficiency of teams. The increase in multinational virtual team (MNVT) collaborations helps obviate expensive face-to-face interactions for global teams (Amichai-Hamburger and McKenna 2006) while incurring associated managerial issues, which have received significant attention (Charlier et al. 2016). Individuals in an MNVT are usually unfamiliar with each other and geographically distributed. Therefore, notwithstanding the rich communication and collaboration potential provided by information technology, many businesses fail to achieve successful collaboration (Gonsalves 2008). This failure can be attributed to the low level of trust between individuals. Therefore, trust has become an important issue in this context (Weber 2014).

Many scholars have specified the essential role of trust in virtual teams (Cheng et al. 2016a; Pinjani and Palvia 2013). Specifically, trust can reduce the cognitive overload involved during team collaboration, and thus, enhance outcomes (Kolfschoten and Brazier 2013). There are also existing studies on trust antecedents (Jarvenpaa et al. 1997; Ridings et al. 2002), trust formation in virtual team collaborations (Robert et al. 2009), and outcomes of trust (Jarvenpaa et al. 2004) in the virtual team context. Moreover, various types of trust have been discussed in different contexts, such as cognition-and affect-based trust using a two-dimension model (Kanawattanachai and Yoo 2007; McAllister 1995) and benevolence, ability, and integrity using a three-dimension model (Mayer et al. 1995). Cheng et al. (2016a) use seven factors to measure trust development over time: willingness to risk vulnerability, confidence, benevolence, reliability, competence, honesty, and openness. In the context of MNVT collaboration, team members may demonstrate dissimilarity in beliefs, attitudes, and values due to diverse national cultures (Han and Beyerlein 2016; Mannix and Neale 2005). Compared with face-to-face interactions, MNVT members develop trust by providing timely information or appropriate responses during communication instead of through social interaction (Henttonen and Blomqvist 2005). The absence of social interactions and trust can lead to a low level of team performance in MNVTs. As a consequence, attention to trust development in MNVTs is necessary.

According to the group awareness theory (Gross et al. 2005), individuals' awareness of other group members also affects their own performance or psychological state. Therefore, we infer that trust at both the individual and group levels play an important role in group efficiency, especially in the absence of common experiences and cultural backgrounds in the MNVT context. For example, during team collaboration, individuals may worry about the work engagement or

efficiency of other team members who they are not familiar with, which can ultimately influence their own work efficiency and trust toward the group. Although several existing studies have investigated trust from both individual and group perspectives, findings mainly focus on their difference regarding trust development over time between individual and group levels (Cheng et al. 2016c). The specific deconstructing effects of trust on group efficiency between the individual and group levels are ignored. Moreover, although existing studies have focused on the direct impact of various trust antecedents on group performance or efficiency (De Jong et al. 2016), empirical evidence on the interaction effects of these trust factors from a decomposing view on multinational group efficiency is limited. Consequently, there are still research gaps in the following areas: (1) antecedents of trust development in MNVT collaborations from the deconstructing perspective, (2) the interaction effects of various trust factors on group efficiency from the decomposing perspective, and (3) the different effects of trust on group efficiency between the individual and group levels.

To address these gaps, this study seeks to extend the existing understanding of trust and group efficiency in the MNVT collaboration context. To this end, we use a multi-method research design, integrating the findings from both qualitative and quantitative analyses. To gain a deeper understanding of the effects of trust, we adopt a decomposed structure of trust (openness-based trust and reliability-based trust) and try to further deconstruct those types of trust into two levels (individual and group). The interaction impact of certain trust factors on group efficiency is also investigated.

The rest of this paper is organized as follows. Section 2 describes the theoretical background and previous studies on trust in MNVT collaborations. Section 3 explores the three-phase multi-method research design, which provides empirical evidence to answer the research questions. Section 4 summarizes the research findings, and Sect. 5 concludes with the practical implications, theoretical contributions, study limitations, and future research opportunities.

2 Literature Review

2.1 Understanding Trust in Team Collaboration

The concept of trust has been frequently investigated in the team collaboration context and was defined as individuals' willingness to be vulnerable to another party based on the expectation of others (Mayer et al. 1995; Cheng et al. 2017). Generally speaking, existing studies have investigated trust in team collaboration from the following perspectives, including trust antecedents (Jarvenpaa et al. 1997; Ridings et al. 2002), different types of trust (Cheng et al. 2016c), trust formation (Robert et al. 2009), and several trust consequences (Hsu et al. 2007; Jarvenpaa et al. 2004). Findings indicate that trust contributes to the positive outcomes of the organizations (Chiles and McMackin 1996; Zhang et al. 2010). Despite the emphasis on trust in the team collaboration context, a deeper understanding of the decomposing and deconstructing of trust requires further investigation and has become a new trend in

trust literature (Costa and Anderson 2011; Cheng et al. 2016b). For example, existing research has largely overlooked the different effects of trust between the individual and group levels, thus leading to confounding effects of trust in different levels.

From a theoretical perspective, several representative theories in the social psychology literature have been adopted in the trust context, including the theory of planned behavior (Kim and Kankanhalli 2009), attribution theory (Johnson and Grayson 2005), and social exchange theory (Young-Ybarra and Wiersema 1999). These theories provide evidence on the tenets that the sources of trust exist in the interaction and positive attribution to other partners in organization. Considering the effects of trust in the virtual team collaboration context, team interaction is frequent and the deconstructed notion of trust at the individual and group levels needs further development.

Theoretical foundation in the collaboration context can also provide the necessity for the deconstructing of trust. Group awareness is one of the most widely investigated theories in computer-supported cooperative work (Dourish and Bellotti 1992) and collaborative learning (Leinonen and JäRVELä 2006). Following exiting research (Bodemer and Dehler 2011; Gross et al. 2005), group awareness is the state of being informed about specific aspects of other group members, including what other members are doing, how others feel about a member, and members' interests. Figure 1 presents a conceptual relationship between group awareness and collaboration effectiveness in the context of computer-supported collaborative learning, as proposed by Janssen and Bodemer (2013, p. 52). As depicted in Fig. 1, cognitive group awareness and social group awareness can be improved via other team members' knowledge, information, and opinions, and by providing information about individuals' participation in a collaboration or the perceived quality of a discussion, respectively. According to Jermann and Dillenbourg (2008), team members can achieve effective collaboration not only in the content space (such as increased participation in discussions) but also in the relational space (such as increased symmetry in contributions) by improving group awareness.

Compared with face-to-face communication, group members receive limited context and environmental cues in a computer-mediated collaborative environment (Kiesler et al. 1984). The lack of context cues and co-location can limit the sharing of expectations, similarities, and other important information (Srivastava and Chandra 2018). Therefore, we investigate the trust antecedents at both the individual and group levels from a deconstructed perspective in this study. Trust at the individual

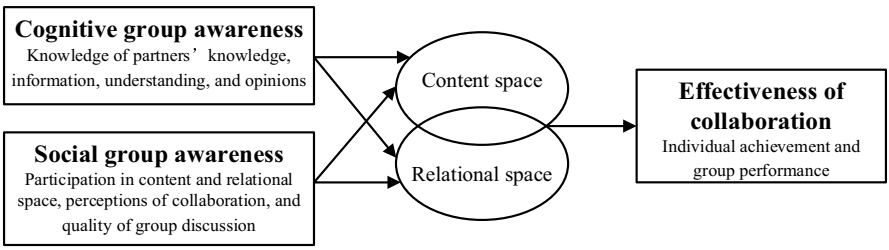


Fig. 1 Conceptual framework for group awareness (Janssen and Bodemer 2013)

level depicts the trust in one's own intentions and behaviors. Trust at the group level depends on the positive view of others' intentions and behaviors, which represents the individuals' awareness of other group members. To investigate the antecedents of trust development in the MNVT context, we propose the first research question:

Research question 1 (RQ1) What are the antecedents of trust development in MNVT collaborations from the deconstructed perspective?

2.2 Trust Development in Multinational Virtual Team Collaboration

A virtual team can be defined as "a group of people who interact through interdependent tasks guided by common purpose and work across space, time, and organizational boundaries with links strengthened by webs of communication technologies'' (Lipnack and Stamps 1997; Maznevski and Chudoba 2000, p. 473). This has become an established work design in many companies (Breuer et al. 2016). Studies have identified several types of team collaboration, including face-to-face, global/multinational, semi-virtual/hybrid, and virtual (Cheng et al. 2016b). With the globalization of the economy and emergence of collaborative technologies, multinational teams and organizations have increased and play important roles in business (Han and Beyerlein 2016).

The MNVT is a new organizational form in which trust is impeded due to both the virtual and global contexts. Under these circumstances, typical factors contributing to team success, such as a close physical location, common experiences, and shared cultural backgrounds, are absent. Therefore, trust becomes a key element of team success in this context (Han and Beyerlein 2016). Low levels of trust in the team can lead to low commitment, lack of information sharing, and the intention to avoid interactions with team members (Kanawattanachai and Yoo 2007). These behaviors can undermine the overall efficiency of the team. According to previous related literature, we define trust as an individual's or group's willingness to be vulnerable to the behavior of another individual or group (Mayer et al. 1995). Trust is a critical factor in any kind of team collaboration; however, it plays a pivotal role in virtual team collaboration by weakening the impact of psychological distance caused by geographical distance (Snow et al. 1996).

Previous studies have examined the antecedents of trust in MNVTs from several perspectives. The importance of trust has also been identified by many scholars (Breuer et al. 2016; Cheng et al. 2016a, b, c; Ford et al. 2017). Jarvenpaa et al. (1997) investigate three antecedents of trust in MNVTs: ability, benevolence, and integrity. There is also evidence that trust within a team can affect the attitudes and behaviors of individuals, thereby affecting task performance (Jarvenpaa et al. 2004; Kanawattanachai and Yoo 2007; Wildman et al. 2012). In MNVTs, trust develops with the dynamic relationships of the team members. For example, Wilson et al. (2006) provide evidence on the difference in trust development between computer-mediated and face-to-face teams. In more recent work, trust is regarded as a dynamic process in long-term interactions (Cheng et al. 2016a). Studies have also been conducted on the management of dynamic trust in projects (Rose and Schlichter 2013).

To investigate trust development over time in MNVTs, we propose the second research question:

Research question 2a (RQ2a) How does trust develop over time in the context of MNVT collaborations at the individual level?

Research question 2b (RQ2b) How does trust develop over time in the context of MNVT collaborations at the group level?

2.3 The Interaction Between Reliability-Based Trust and Openness-Based Trust

In recent decades, numerous studies on different types of trust, including dispositional, interpersonal, situational, and structural trust (Bjørn and Ngwenyama 2009; Cheng and Macaulay 2014; McKnight and Chervany 1996; Rotter 1980), have emerged. According to Hoy and Tschannen-Moran (1999), there are five factors of trust: benevolence, reliability, competence, honesty, and openness. Among the five factors, benevolence, competence, and honesty can be categorized as dispositional trust, which is mainly based on the trustees' personality and is specific to the individual (Cheng et al. 2016a). Reliability is a combination of confidence and benevolence in the group (Wilson et al. 2006). Openness is the degree to which individuals are willing to share information and are involved in open communication with other group members (Ibrahim and Ribbers 2009).

Although several studies have been conducted on the impact of these factors on trust and team performance (Cheng et al. 2016c, b; Eisenberg et al. 2019; Jarvenpaa et al. 1997, 2004), the interaction effects of these factors are largely ignored. In the context of MNVTs, team members' relationship development depends largely on effective communication and interactions between group members. Group awareness enables group members to identify the person-related cues and behaviors of collaboration partners during interactions (Bodemer and Dehler 2011). According to the group awareness theory (Gross et al. 2005), individuals' awareness of the surroundings is essential in teamwork, especially in MNVT collaborations. Sometimes, the benefits of being aware of other group members may surpass the benefits of face-to-face interactions (Bodemer and Dehler 2011). Moreover, trust development in MNVTs mainly depends on team members' timely responses and information sharing, such that a high level of communication openness can impact individuals' perceptions and awareness of the whole group. Therefore, we focused on openness and reliability as the two main factors of trust and refer to these types as reliability- and openness-based trust from a decomposing perspective in this study.

Reliability-based trust refers to the degree to which individuals can count on other group members to meet their needs (Hoy and Tschannen-Moran 1999). Reliability is based on the sense of benevolence and predictability of others' behavior (Cheng et al. 2016c). The concept of reliability is also related to the confidence that individuals will perform predictably and take the interests of other group members into consideration (Kanawattanachai and Yoo 2007; Mishra 2012). In the context of MNVTs,

reliability-based trust is essential, and a high level of reliability can lead to individuals' positive perceptions of the collaboration outcomes.

As mentioned, openness-based trust is based on the degree to which individuals can share information and make communications freely in a group. This kind of trust derives from the communication openness between group members (Cheng et al. 2016c). Instead of being conservative regarding opinions, openness means that individuals are curious, creative, original, and imaginative while performing teamwork (Godar 2003). According to studies on computer-mediated communication (Lowry et al. 2006, 2009), in an open collaboration environment, individuals are more likely to explore the group's perceptions of their own and others' ideas.

2.4 Trust and Group Efficiency

Group efficiency has been identified as one of the most important dependent variables of trust in existing studies (De Jong et al. 2016; Dirks 1999), and their relationship has been discussed from several angles (Cogliser et al. 2012). For example, trust can reduce transaction costs (Chiles and McMackin 1996), promote open and efficient information sharing (Zhang et al. 2010), and increase individual and group confidence in the relationship, as well as group efficiency. Trust, however, has been mainly modeled as one of many predictors of group efficiency (De Jong et al. 2016). In this study, we aim to provide a more holistic understanding of the effects of trust on group efficiency. Although existing studies have identified the effects of trust in virtual team collaborations, they merely investigate the independent effects of various types of trust. Few studies provide quantitative evidence on the interaction effects of different trust influencing factors (Cheng et al. 2017). Given the limited research on this topic, we investigate the types of trust and their interaction effects on group efficiency in MNVTs to inform this study.

Additionally, previous studies only focus on trust factors at the individual level. In the virtual team collaboration context, however, trust factors at the group level are essential. According to the group awareness theory, the awareness of other group members' interactions with the group and the environment plays an important role in team collaboration, especially in virtual teams. In other words, individuals' perceived trust of the group could be as important as their trust at the individual level on the group's efficiency. Therefore, instead of only focusing on trust at the individual level, we also take the impact of trust at the group level on group efficiency into consideration.

Based on these research gaps, we propose the third research question:

Research question 3 (RQ3) How do different antecedents of trust at the individual and group levels influence group efficiency in the context of MNVT collaborations?

3 Multi-Method Design

To explore the trust development and interaction of two trust factors in MNVT collaborations, we adopted a multi-method research design, which uses both qualitative and quantitative methods (Tashakkori et al. 1998). The multi-method design provides stronger evidence than a single method. It also can produce divergent or complementary views (Venkatesh et al. 2016). Given the aim to discover the antecedents of trust development and investigate the effects of trust at different levels on group efficiency, the multi-method research design was adopted (Wunderlich et al. 2019).

To answer the research questions, we conducted a longitudinal survey study with 139 undergraduate students in China. An online interview was also conducted after each week's collaboration to measure the perceived antecedents of trust development. We selected students in two classes in different areas of China to ensure virtual team collaboration. The demographic information of the samples is presented in Table 1. The sample consists of 46.8% males and 53.2% females. Of the participants, 46.8% are between 18 and 20 years and 53.2% are between 21 and 23 years, with an average age of 21. The students hail from China, Indonesia, France, Kazakhstan, Russia, Malawi, Sweden, Uzbekistan, Korea, Dominica, Philippines, North Korea, Mongolia, and Saudi. More than 60% are from Asian countries, and approximately 30% are from Europe. These students were divided randomly into virtual team groups of 4–5 students, which yielded 34 MNVTs. During 5 weeks in the semester, the students were assigned group work to perform a business case analysis and compose a new business plan for the case company. During the study, the students were allowed to use software to collaborate, such as WeChat.

We conducted the data analysis in three phases. Phase 1 consisted of a qualitative analysis of online interviews with the respondents, which provided a general understanding of the antecedents of trust development in the 5-week team collaboration and helped answer the first research question (RQ1). After two researchers performed a coding process, several important constructs were derived from these data. Phase 2 included a general analysis of the trust development and work efficiency development during the team collaboration, which was conducted to answer the second research question (RQ2). Phase 3 comprised a quantitative analysis of

Table 1 Demographics of participants (N = 139)

Items	Category	Frequency (N = 139)	%
Gender	Males	65	46.8
	Females	74	53.2
Age	18–20	65	46.8
	21–23	74	53.2
Continent	Asia	86	61.9
	Europe	42	30.2
	North America	1	0.7
	South America	1	0.7
	Africa	1	0.7

the causal relationships between trust and group efficiency, providing evidence to answer research question 3 (RQ3).

3.1 Phase 1: Qualitative Analysis

Phase 1 of the multi-method design sought to answer RQ1 (*What are the antecedents of trust development in MNVT collaborations from the deconstructed perspective?*). To answer this research question, we conducted a qualitative study to specify the antecedents of trust development over time. Specifically, we asked several questions to the participants, who were directed to carefully reflect on their perceptions of trust with the group and the factors of trust development during the collaboration process. Following Hua et al. (2019), we then conducted a content analysis of the qualitative data. As the trust level fluctuates over the 5 weeks, we derive both negative and positive antecedents of trust based on the interview data.

Table 2 presents the key antecedents of trust development derived from the qualitative data. As mentioned, two members of our research team conducted a coding analysis following Miles and Huberman (1994). As shown in Table 2, the data analysis process yielded four frequently mentioned antecedents of trust development, involving the deconstructing notion of trust: reliability at the individual level, reliability at the group level, openness at the individual level, and openness at the group level. As previously mentioned, reliability-based trust at the individual level is based on an individual's sense of confidence that he/she will perform predictably to meet the group's needs (Hoy and Tschannen-Moran 1999). Similarly, according to Cheng et al. (2016a), reliability-based trust at the group level refers to an individual's belief that other individuals in the group will perform predictably to meet the group's needs. Openness-based trust at the individual level refers to an individual's degree of openness to other group members, and at the group level, it is based on an individual's belief that other individuals in the group share information freely and are open, creative, and imaginative while performing teamwork (Godar 2003).

According to the participants' answers, we can infer that individuals' perceived openness and reliability at both the individual and group levels are related to the trust development over the 5 weeks. However, as depicted in Table 2, both reliability and openness are more frequently mentioned at the group level than at the individual level. This finding can be attributed to the group awareness theory, which asserts that individuals' awareness of other group members' interactions plays an essential role in the group. In the hybrid virtual team collaboration context, we can infer that individuals' perceived openness and reliability of the group are more important than the perceptions of themselves. Consequently, we hypothesized that the interaction effect of trust antecedents at the group level on work efficiency is more prominent than that at the individual level.

3.2 Phase 2: General Analysis of the Development of Trust and Group Efficiency

To answer the second research question (RQ2a and RQ2b) (*How does trust develop over time in the context of MNVT collaborations at the individual and group*

Table 2 Data supporting the antecedents of trust development

Representative answers	Antecedents of trust development	Definition
1. "I think members trust me because I already proved that I did what I said." 2. "I already did almost one-third of the work. Members are grateful for my work; they often say thank you for the hard work." 3. "I gave tasks to everybody; everybody gave their point of view on the subject and everyone wants to do well."	Reliability-based trust at the individual level	An individuals' sense of confidence that he/she will perform predictably to meet the group's needs (Hoy and Tschannen-Moran 1999)
4. "I lost my computer so I couldn't work much this week, but members of my team took initiative and they worked hard. So, my trust has changed because now I know they care about this work." 5. "Some people don't care about the project and are not involved at all. It is difficult to trust people that don't do anything." 6. "Everyone's efficiency is improving, and the work can be done well without others saying anything." 7. "Everyone is taking responsibility." 8. "The trust in the team changed because I gave them tasks and deadlines, and they didn't respect them."	Reliability-based trust at the group level	Individuals' belief that other individuals in the group will perform predictably to meet the group's needs (Cheng et al. 2016c)
9. "I'm acting as the leader by sharing my ideas, giving members suggestions, and helping them understand what we should put in each part of the plan." 10. "I asked my team's opinion about what we were doing and for some information to be researched, and I received nothing from one of them." 11. "I keep the group members updated about my progress, and I think they trust that when I say I'm going do something, I do it."	Openness-based trust at the individual level	Individual's degree of openness to other group members (Godar 2003)

Table 2 (continued)

Representative answers	Antecedents of trust development	Definition
12. "Our communication is good. Also, everyone does his job on time." 13. "My team listens to each other and cares about all team members; we can easily discuss and determine what we will do in the group quickly." 14. "We share ideas with each other." 15. "We are able to divide tasks and work very well because the group seems really motivated." 16. "The first week of the project went fine, but then two of my group mates did not answer for 2 weeks. I don't trust them—they don't do their job." 17. "We finally named the leader. I gave tasks to everybody; everybody gave their point of view on the subject and everyone wants to do well." 18. "Trust in our team changed because everyone was open and warm." 19. "Through more communication and tasks, people developed trust and began to understand each other better." 20. "My team listen to each other and very care about all team member, we can easily discuss and find what we will do in the group quickly."	Openness-based trust at the group level	Individual's perception of other individuals' degree of openness in the group (Godar 2003)

levels?), we plotted the average score of group efficiency, reliability-based trust, and openness-based trust over the 5 weeks at the individual and group levels.

We adopted the measurement items developed by Cheng et al. (2016a) to assess the openness-and reliability-based trust and group efficiency, which proved to have satisfactory reliability and validity. The items evaluating the reliability and openness at both the individual and group levels were evaluated on a five-point Likert scale (1 = "strongly disagree," 3 = "neutral," and 5 = "strongly agree"). We also used age, gender, and nationality as control variables in the study.

The level of *reliability-based trust* was measured with three items. The respondents were asked to recall their perceived reliability-based trust at the individual level by responding to statements, such as "I did what I promised to do this week" (Cheng et al. 2016c). Their perceived level of reliability-based trust at the group level was measured with the following statement: "The group did what we promised to do this week." The level of *openness-based trust* was measured with three items. Participants were asked to report the extent of their perceived openness-based trust at the individual level by responding to statements, such as "I was open to my group about my progress this week" (Cheng et al. 2016c). Their perceived openness-based trust at the group level was measured with the following statement: "The group was open to me about the progress this week." The level of *group efficiency* was measured with a five-point Likert scale (1 = "much less," 3 = "equal," and 5 = "much more"). The respondents were also asked to share their perceived development of group efficiency by responding to the statement, "Overall, I think we have established less/more group efficiency in our team this week" (He et al. 2007) (see "Appendix 1").

All the constructs in our study are reflective. Following Cheng et al. (2020) and Hua et al. (2019), we employed the Cronbach's alpha (α), composite reliability, and the average variance extracted with acceptable values higher than 0.7, 0.6, and 0.5, respectively, to measure the reliability and validity of the constructs. The results are presented in Table 3, which shows that the value of Cronbach's α of each construct is above 0.7, indicating internal consistency reliability in the constructs. The composite reliability values range from 0.891 to 0.969, indicating acceptable composite reliability. The average variance extracted value is higher than 0.5, which suggests high convergent validity in the constructs.

As is depicted in Fig. 2, for the changing pattern of trust at the individual level, we found that both kinds of trust increased in the first 2 weeks and reached the highest level in the third week, followed by a decrease in the last few weeks. For the development of trust at the group level, both kinds of trust increase in the first week. Reliability-based trust reached the highest level in the second week and openness-based trust reached the highest level in the third week, followed by a sharp decrease in the following weeks and an upturn in the last week.

To explore the group work efficiency development, we tested its changing pattern and plotted the mean of the group efficiency score over the 5 weeks. As indicated in Fig. 3, we notice an increase in the first 3 weeks and a decrease in the following 2 weeks. To further evaluate the changing pattern of group work efficiency over time, we conducted a generalized estimating equation (GEE). A GEE is considered suitable for longitudinal data analyses, such as a cross-sectional time-series analysis or panel analysis (Heimbach and Hinz 2018; Zeger and Liang 1986). Thus, this method

Table 3 Means, standard deviations, reliability, and validity of constructs

Constructs	Mean	Standard deviation	Cronbach's α (> 0.7)	Composite reliability (> 0.6)	Average variance extracted (> 0.5)
Reliability-based trust at					
Individual level	4.008	0.762	0.930	0.934	0.825
Week = 1	4.028	0.693	0.909	0.911	0.774
Week = 2	4.033	0.777	0.922	0.926	0.807
Week = 3	3.907	0.864	0.936	0.937	0.833
Week = 4	4.008	0.762	0.930	0.934	0.825
Week = 5					
Reliability-based trust at group					
Level	3.728	0.877	0.969	0.969	0.912
Week = 1	3.838	0.778	0.915	0.914	0.781
Week = 2	3.757	0.955	0.940	0.941	0.841
Week = 3	3.677	0.948	0.955	0.955	0.877
Week = 4	3.728	0.877	0.969	0.969	0.912
Week = 5					
Openness-based trust at					
Individual level	3.898	0.777	0.922	0.921	0.795
Week = 1	3.955	0.726	0.898	0.896	0.742
Week = 2	4.027	0.728	0.878	0.893	0.739
Week = 3	3.964	0.801	0.894	0.902	0.754
Week = 4	3.898	0.777	0.922	0.921	0.795
Week = 5					
Openness-based trust at group					
Level	3.762	0.915	0.936	0.936	0.831
Week = 1	3.771	0.759	0.892	0.891	0.732
Week = 2	3.848	0.882	0.951	0.952	0.871
Week = 3	3.724	0.929	0.939	0.940	0.841
Week = 4	3.762	0.915	0.936	0.936	0.831
Week = 5					

is suitable for this study, as there are repeated observations of students over 5 weeks. Moreover, a GEE can also address the problem of underestimated standard errors in other models (Heimbach and Hinz 2018).

For the statistical analysis, we took the fifth week (week = 5) as the baseline and made a comparison at different time points (week = 1, 2, 3, 4). As shown in Table 4, coefficients of the second, third, and fourth weeks were all statistically significant ($\beta = 0.155$, $p < 0.05$; $\beta = 0.209$, $p < 0.001$; $\beta = 0.205$, $p < 0.001$, respectively). The results indicate that compared to the fifth week, the level of group efficiency increased in the second week (all coefficients are positive and increase), reaching the highest level with the maximum coefficient in the third week, and then slightly decreasing in the next week. The results of the GEE are consistent with the

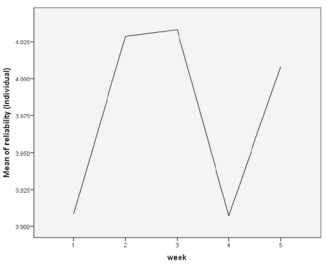
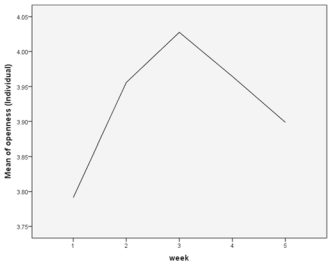
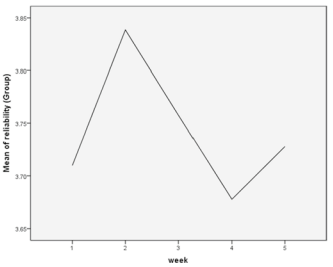
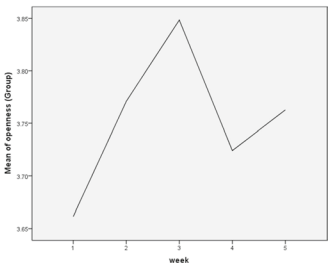
Trust factors	Reliability	Openness
Individual level		
Group level		

Fig. 2 Changing pattern of trust development over time

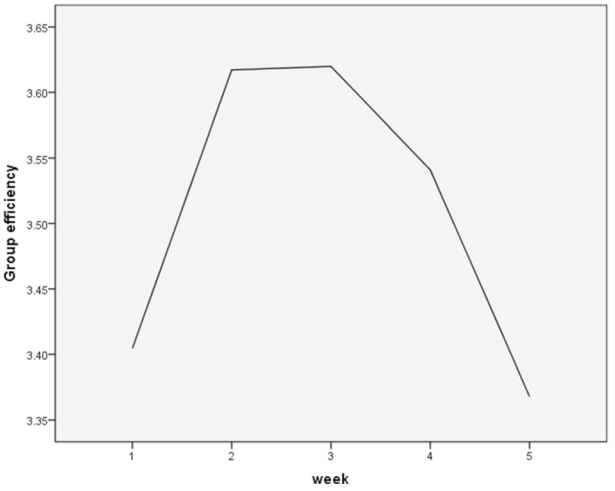


Fig. 3 Changing pattern of group efficiency development over time

developing trend of group efficiency in Fig. 3 and provide statistical evidence on the development of group efficiency over time. The findings indicate that trust and group work efficiency increased in the first few weeks and then decreased in the following weeks.

Table 4 Development of group efficiency over time

Model term	Coefficients	SE	95% CI		Wald χ^2	*df*	*p*
			Lower	Upper			
Intercept	0.854	0.203	0.455	1.252	17.646	1	0.000
Week = 1	0.099	0.063	− 0.024	0.222	2.483	1	0.115
Week = 2	0.155	0.064	0.028	0.281	5.743	1	0.017
Week = 3	0.209	0.059	0.093	0.324	12.537	1	0.000
Week = 4	0.205	0.063	0.081	0.328	10.579	1	0.001
Week = 5	0	–	–	–	–	–	–

3.3 Phase 3: Quantitative Analysis

In Phase 3, we sought to answer RQ3 (*How do different antecedents of trust at the individual and group levels influence group efficiency in the context of MNVT collaborations?*). As previously mentioned, a longitudinal survey study was conducted with 139 respondents over 5 weeks for the quantitative analysis. After deleting rushed and incomplete surveys, we obtained 126 usable responses. According to group awareness theory and the results of Phase 2, we infer that perceived reliability and openness at both the individual and group levels play important roles in team collaboration. We also investigated the interaction relationship between trust factors, involving the moderating effects of openness-based trust.

To answer RQ3, we test the interaction effects of reliability-and openness-based trust on group efficiency at the individual and group levels. As mentioned, trust development in an MNVT depends mostly on the communication openness and information sharing among the team members. For example, although the task-related ability of other team members can be high, if they are not willing to share their expertise, knowledge, or other task information with the group, the trust relationship between the group members will be hindered, thus leading to inefficient collaboration. Thus, we infer that the relationship between reliability-based trust and group efficiency can be moderated by the level of openness-based trust, such that the positive influence will be stronger when individuals' perceived openness is high. Therefore, we investigated the relationship between reliability-based trust and group efficiency, with reliability-based trust as an independent variable, group efficiency as a dependent variable, and openness-based trust as a moderator.

The research model testing was conducted using SPSS 22.0. Following Sarstedt et al. (2014), we tested the interaction model by examining the coefficients. The results of the interaction effects of both types of trust over the 5 weeks are presented in Fig. 4 and Table 5. As shown in Fig. 4, the predictors explained 0.319, 0.221, 0.386, 0.465, and 0.432 of the variance in the group efficiency over each of the 5 weeks, respectively.

From the longitudinal perspective, the interaction of openness and reliability at the group level is statistically significant in week 1 ($\beta = 0.066$, $p < 0.05$), week 3 ($\beta = 0.102$,$p < 0.001$), week 4 ($\beta = 0.099$, $p < 0.01$), and week 5 ($\beta = 0.117$,

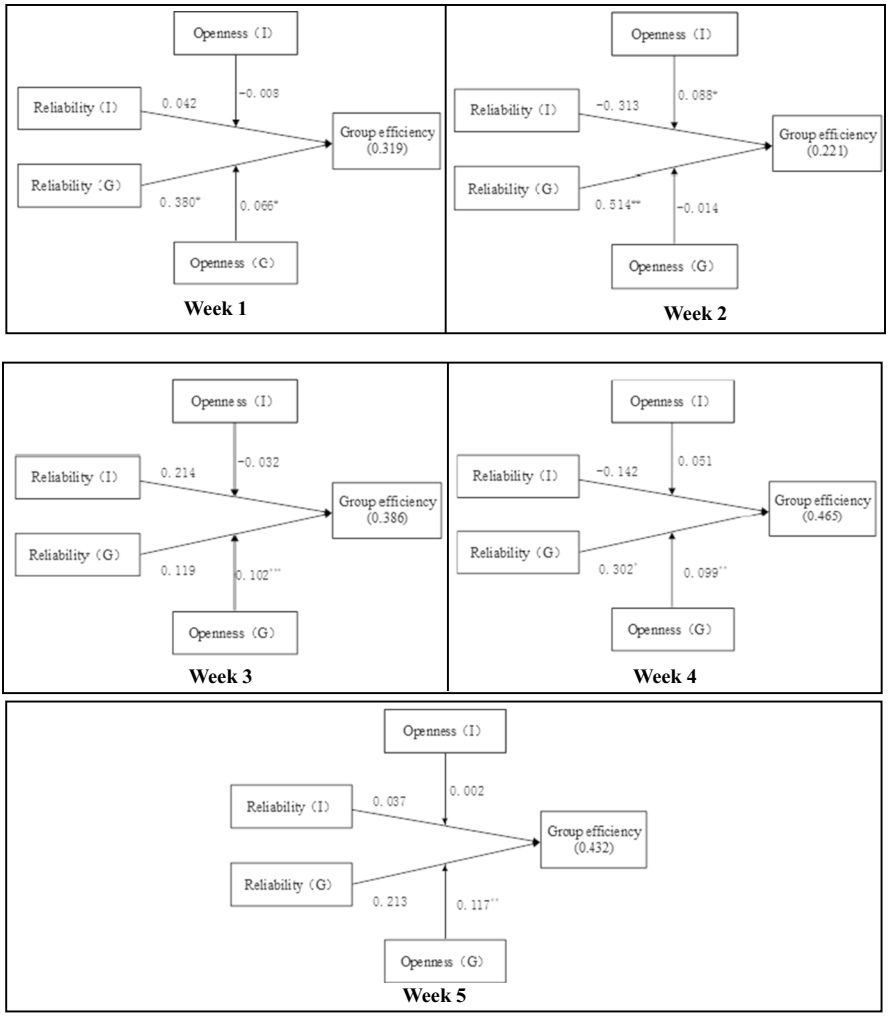


Fig. 4 Interaction effects of trust on group efficiency over time (*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$)

$p < 0.01$). In week 2, the interaction at the individual level is statistically significant ($\beta = 0.088$, $p < 0.05$). These findings indicate that individuals' perceived openness at the group level positively moderates the relationship between perceived reliability and group efficiency most of the time during team collaborations. However, the relationship between individuals' perceived reliability at the individual level and group efficiency is not statistically significant. Moreover, individuals' perceived reliability at the group level has a significant positive impact on group efficiency in week 1 ($\beta = 0.380$, $p < 0.05$), week 2 ($\beta = 0.514$, $p < 0.01$), and week 4 ($\beta = 0.302$, $p < 0.05$).

Table 5 Parameter estimates

	Week 1	Week 2	Week 3	Week 4	Week 5
Independent variables					
Reliability(I)	0.042	−0.313	0.214	−0.142	0.037
Reliability(G)	0.380*	0.514**	0.119	0.302*	0.213
Interaction terms					
Reliability(I)*Openness(I)	−0.008	0.088*	−0.032	0.051	0.002
Reliability(G)*Openness(G)	0.066*	−0.014	0.102***	0.099**	0.117**
Control variables					
Nationality	0.017	0.007	−0.021	−0.024	0.018
Gender	−0.175	0.055	−0.147	−0.041	0.075
Age	−0.061	−0.006	0.016	−0.027	−0.021
Constant	3.094	2.953	2.072	3.553	2.711
R^2	0.319	0.221	0.386	0.465	0.432

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

4 Discussion

With a focus on MNVT collaborations, this study responds to the call for further investigation into trust issues in this context. By conducting three analysis phases that included qualitative, longitudinal pattern, and quantitative analyses, this study identifies the trust antecedents in MNVT collaborations, investigates the changing pattern of these antecedents over the 5-week collaboration effort, and examines the antecedents' interaction effects on group efficiency. This study also suggests that team members, team leaders, and online collaboration software companies place emphasis on reliability and openness during the collaboration process.

We now present a summary of the findings in consideration of the research questions. Regarding RQ1, the qualitative analysis results in Phase 1 reveal the antecedents of trust development over time in the MNVT collaboration context, which include both openness and reliability at the individual and group levels. Based on this finding, we identify four types of trust in this research context: openness-based trust at the individual level, openness-based trust at the group level, reliability-based trust at the individual level, and reliability-based trust at the group level. The findings in Phase 1 provide qualitative evidence on the essential roles of these trust factors in determining group efficiency. The decomposing (openness-based and reliability-based) and deconstructing (individual and group level) of trust are also consistent with the tenets of group awareness theory.

Regarding RQ2, the general analysis results in Phase 2 provide insight on trust development and group efficiency at the individual and group levels during the 5-week collaboration. As for trust development, the results indicate that the changing pattern of both openness-and reliability-based trust at the individual and group levels are nearly the same, showing an increase in the first 2 weeks and a sharp decrease in the following weeks. Except for openness-based trust at the individual level, trust levels rise in the last week. As for group efficiency, the results indicate

that it increases in the first few weeks, reaching the highest level in the middle stage of the team collaboration, and then decreases in the last few weeks. The developing trend of group efficiency is similar to that of trust development, thus providing empirical evidence on the relationship between trust and group efficiency in the MNVT collaboration context.

Regarding RQ3, the quantitative survey data analysis results in Phase 3 provide evidence on the effects of different trust factors' interactions on group efficiency. Specifically, we test the relationship between reliability-based trust and group efficiency with the moderating effects of openness-based trust. Trust at both the individual and group levels was included in the research model. Findings indicate that reliability-based trust at the individual level does not impact group efficiency during team collaborations; however, it significantly increases group efficiency at the group level. Findings also show that the moderating effects of openness-based trust at the group level are significant in most stages, which is consistent to the argument that group awareness plays important roles in team collaboration. Therefore, the positive relationship between reliability-based trust and group efficiency is stronger if individuals perceive a high level of openness in group communication and collaboration but weakens if the group is not open in these aspects.

5 Conclusion

5.1 Theoretical Contributions

Theoretically, this study provides a holistic understanding of the relationship between trust and group efficiency in the MNVT collaboration context, thereby offering the following key contributions. First, by adopting group awareness and relevant social psychology theory, we extend the understanding of trust from the individual perspective to the group perspective. This extension is meaningful in the MNVT collaboration context because the behavior of geographically distributed team members is more likely to be affected by their perceived trust of other group members. Although previous studies have investigated the effects of trust on group performance (Chiles and McMackin 1996; De Jong et al. 2016; Zhang et al. 2010), the distinction between trust at the individual and group levels is still limited. Findings of this study can be useful for understanding the key antecedents of group efficiency, involving the deconstructed notion of trust. We can also infer from the findings that trust at the group level plays a more important role than at the individual level on group efficiency, especially in the MNVT collaboration context.

Second, in terms of understanding the exact impact of trust in MNVT collaborations, this study broadens the scope of trust literature by investigating the interactions of different trust antecedents. We also provide a deeper understanding of the deconstructed (individual and group level) and decomposed (openness-based and reliability-based) notion of trust. More specifically, different types of trust interact to affect group efficiency. Previous studies have investigated the impact of individual trust factors on group efficiency separately (Cheng et al. 2016a, c; Eisenberg et al. 2019; Jarvenpaa et al. 1997, 2004), but their interaction effects are largely ignored.

The findings of this study provide insight into the moderating effects of openness-based trust in MNVT collaborations.

Third, previous studies on virtual team collaborations primarily investigate the antecedents and consequences of group performance. With the development of the global economy, MNVT collaborations have become common. Although the effects of multinational factors such as cultural diversity are examined in existing studies (Han and Beyerlein 2016), this study emphasizes communication openness in the multinational context. From a longitudinal perspective, trust and group efficiency develop similarly. Instead of considering trust and group efficiency as a steady state, we provide a dynamic understanding of their development in the virtual team collaboration context.

5.2 Practical Implications

This study offers several key practical implications. First, it highlights trust antecedents that may have a positive impact on group efficiency in MNVT collaborations. Effective team leadership can help overcome trust issues and increase group efficiency. To successfully facilitate team collaboration, leaders need to ensure the reliability of the team members, as well as increase the communication openness of the group. To increase communication openness, leaders can encourage their team members to regularly report their processes or problems via an online communication platform.

Second, this study provides suggestions for team members to obtain higher group efficiency. Specifically, team members should not only be responsible for their own behaviors but also communicate with other team members regularly, especially in virtual team collaborations. Being informed of other team members' behaviors or states can help increase openness-based trust during collaborations. Therefore, team members should exchange their opinions and information freely. From a longitudinal perspective, as the trust level decreases in the last stage of a collaboration, individuals should ensure timely communication with other team members, thereby increasing the trust level and group efficiency.

Third, this study can also provide suggestions for the online collaboration software company. From the collaboration platform design perspective, this study suggests that collaboration software companies should put more emphasis on the interaction and communication functions of their products. For example, interactions during team collaborations need to be documented, such as through automatic storage or by sending e-mails to team members. Moreover, online feedback mechanisms can be designed to document a team member's trust level, ensuring awareness of the current trust level of other team members and increasing communication transparency.

5.3 Limitations and Future Research

There are several limitations in this study. First, the data in this study were collected from young students. Although young participants are among the most active users

of information technology, different demographics should be included in future research. Second, the antecedents of group efficiency development are complex. Group efficiency can be influenced by many other factors, such as task interdependence (DeChurch and Mesmer-Magnus 2010) and the level of team virtuality (De Guinea et al. 2012). We did not control for these factors in this study. Therefore, researchers could control for more factors that may influence group efficiency in the virtual team collaboration context in the future. Finally, it would be meaningful to capture other moderation factors between trust and group efficiency and to examine more interaction effects between different trust antecedents in future research.

Acknowledgements We sincerely thank the editor and anonymous reviewers' constructive comments and suggestions that are very helpful for the development of this paper. This research is partially supported by funding from the National Natural Science of China (No.71501044, 71571045), and Fundamental Research Funds for the Central Universities in UIBE (16YQ07, CXTD10-06).

Appendix

Constructs and measurement items	References
Reliability-based trust at the individual level I did what I promised to do this week I did what I said I would do this week I fulfilled all tasks as we agreed this week	Cheng et al. (2016c)
Reliability-based trust at the group level The group did what we promised to do this week The group did what we said they would do this week The group fulfilled all tasks we agreed to do this week	Cheng et al. (2016c)
Openness-based trust at the individual level I was open to my group about my progress this week I kept my group fully informed about my progress this week I told the group everything about my progress this week	Cheng et al. (2016c)
Openness-based trust at the group level The group was open to me about the progress this week The group kept me fully informed about our progress this week The group told me everything about our progress this week	Cheng et al. (2016c)
Group efficiency Overall, I think we have established less/more group efficiency in our team this week	He et al. (2007)

References

Amichai-Hamburger Y, McKenna KYA (2006) The contact hypothesis reconsidered: interacting via the internet. J Comput Commun 11:825–843. https://doi.org/10.1111/j.1083-6101.2006.00037.x

Bjørn P, Ngwenyama O (2009) Virtual team collaboration: building shared meaning, resolving breakdowns and creating translucence. Inf Syst J 19:227–253. https://doi.org/10.1111/j.1365-2575.2007.00281.x

Bodemer D, Dehler J (2011) Group awareness in CSCL environments. Comput Human Behav 27:1043–1045. https://doi.org/10.1016/j.chb.2010.07.014

Breuer C, Hüffmeier J, Hertel G (2016) Does trust matter more in virtual teams? A meta-analysis of trust and team effectiveness considering virtuality and documentation as moderators. J Appl Psychol 101:1151–1177. https://doi.org/10.1037/apl0000113

Charlier SD, Stewart GL, Greco LM, Reeves CJ (2016) Emergent leadership in virtual teams: a multilevel investigation of individual communication and team dispersion antecedents. Leadersh Q 27:745–764. https://doi.org/10.1016/j.leaqua.2016.05.002

Cheng X, Macaulay L (2014) Exploring individual trust factors in computer mediated group collaboration: a case study approach. Gr Decis Negot 23:533–560. https://doi.org/10.1007/s10726-013-9340-z

Cheng X, Fu S, Druckenmiller D (2016a) Trust development in globally distributed collaboration: a case of U.S. and Chinese mixed teams. J Manag Inf Syst 33:978–1007. https://doi.org/10.1080/07421222.2016.1267521

Cheng X, Fu S, Sun J et al (2016b) Investigating individual trust in semi-virtual collaboration of multicultural and unicultural teams. Comput Human Behav 62:267–276. https://doi.org/10.1016/j.chb.2016.03.093

Cheng X, Yin G, Azadegan A, Kolfschoten G (2016c) Trust evolvement in hybrid team collaboration: a longitudinal case study. Gr Decis Negot 25:267–288. https://doi.org/10.1007/s10726-015-9442-x

Cheng X, Fu S, de Vreede GJ (2017) Understanding trust influencing factors in social media communication: a qualitative study. Int J Inf Manag 37:25–35. https://doi.org/10.1016/j.ijinfomgt.2016.11.009

Cheng X, Bao Y, Zarifis A (2020) Investigating the impact of IT-mediated information interruption on emotional exhaustion in the workplace. Inf Process Manag 57:102281. https://doi.org/10.1016/j.ipm.2020.102281

Chiles TH, Mcmackin JF (1996) Integrating variable risk preferences, trust, and transaction cost economics. Acad Manag Rev 21:73–99. https://doi.org/10.5465/AMR.1996.9602161566

Cogliser CC, Gardner WL, Gavin MB, Broberg JC (2012) Big five personality factors and leader emergence in virtual teams: relationships with team trustworthiness, member performance contributions, and team performance. Gr Organ Manag 37:752–784. https://doi.org/10.1177/1059601112464266

Costa AC, Anderson N (2011) Measuring trust in teams: development and validation of a multifaceted measure of formative and reflective indicators of team trust. Eur J Work Organ Psychol 20:119–154. https://doi.org/10.1080/13594320903272083

De Jong BA, Dirks KT, Gillespie N (2016) Trust and team effectiveness: a meta-analysis of critical contingencies and mediating mechanisms. J Appl Psychol 101:1134–1150

De Vreede GJ, Limayem M, Boughzala I (2013) Introduction to the working and gaming in 3D virtual environments minitrack. Proc Annu Hawaii Int Conf Syst, Sci, p 843

De Church LA, Mesmer-Magnus JR (2010) The cognitive underpinnings of effective teamwork: a meta-analysis. J Appl Psychol 95:32–53. https://doi.org/10.1037/a0017328

Dirks KT (1999) The effects of interpersonal trust on work group performance. J Appl Psychol 84:445–455. https://doi.org/10.1037/0021-9010.84.3.445

Dourish P, Bellotti V (1992) Awareness and coordination in shared workspaces. In: Proceedings of the conference on computer-supported cooperative work

Eisenberg J, Post C, DiTomaso N (2019) Team dispersion and performance: the role of team communication and transformational leadership. Small Gr Res 50:348–380. https://doi.org/10.1177/1046496419827376

Ford RC, Piccolo RF, Ford LR (2017) Strategies for building effective virtual teams: trust is key. Bus Horiz 60:25–34. https://doi.org/10.1016/j.bushor.2016.08.009

Godar SH (ed) (2003) Virtual and collaborative teams: process, technologies, and practice. IGI Global, Pennsylvania

Gonsalves A (2008) Most business-launched virtual worlds fail, gartner says, information week, May 16. http://www.informationweek.com/news/personal_tech/virtualworlds/showArticle.jhtml?articleID=207800625

Gross T, Stary C, Totter A (2005) User-centered awareness in computer-supported cooperative work-systems: structured embedding of findings from social sciences. Int J Hum Comput Interact 18:323–360. https://doi.org/10.1207/s15327590ijhc1803_5
Han SJ, Beyerlein M (2016) Framing the effects of multinational cultural diversity on virtual team processes. Small Gr Res 47:351–383. https://doi.org/10.1177/1046496416653480
He J, Butler BS, King WR (2007) Team cognition: development and evolution in software project teams. J Manag Inf Syst 24:261–292. https://doi.org/10.2753/MIS0742-1222240210
Heimbach I, Hinz O (2018) The impact of sharing mechanism design on content sharing in online social networks. Inf Syst Res 29:592–611. https://doi.org/10.1287/isre.2017.0738
Henttonen K, Blomqvist K (2005) Managing distance in a global virtual team: the evolution of trust through technology-mediated relational communication. Strateg Chang 14:107–119. https://doi.org/10.1002/jsc.714
Hoy WK, Tschannen-Moran M (1999) Five faces of trust: an empirical confirmation in urban elementary schools. J Sch Leadersh 9:184–208. https://doi.org/10.1177/105268469900900301
Hsu MH, Ju TL, Yen CH, Chang CM (2007) Knowledge sharing behavior in virtual communities: the relationship between trust, self-efficacy, and outcome expectations. Int J Hum Comput Stud 65:153–169. https://doi.org/10.1016/j.ijhcs.2006.09.003
Hua Y, Cheng X, Hou T, Luo R (2020) Monetary rewards, intrinsic motivators, and work engagement in the it-enabled sharing economy: a mixed-methods investigation of internet taxi drivers. Decis Sci 51:755–785. https://doi.org/10.1111/deci.12372
Ibrahim M, Ribbers PM (2009) The impacts of competence-trust and openness-trust on interorganizational systems. Eur J Inf Syst 18:223–234. https://doi.org/10.1057/ejis.2009.17
Janssen J, Bodemer D (2013) Coordinated computer-supported collaborative learning: awareness and awareness tools. Educ Psychol 48:40–55. https://doi.org/10.1080/00461520.2012.749153
Jarvenpaa SL, Knoll K, Leidner DE (1997) Is anybody out there? Antecedents of trust in global virtual teams. J Manag Inf Syst 14:29–64. https://doi.org/10.1080/07421222.1998.11518185
Jarvenpaa SL, Shaw TR, Staples DS (2004) Toward contextualized theories of trust: the role of trust in global virtual teams. Inf Syst Res 15:250–267. https://doi.org/10.1287/isre.1040.0028
Jermann P, Dillenbourg P (2008) Group mirrors to support interaction regulation in collaborative problem solving. Comput Educ 51:279–296. https://doi.org/10.1016/j.compedu.2007.05.012
Johnson D, Grayson K (2005) Cognitive and affective trust in service relationships. J Bus Res 58:500–507. https://doi.org/10.1016/S0148-2963(03)00140-1
Kanawattanachai P, Yoo Y (2007) The impact of knowledge coordination on virtual team performance over time. MIS Q 31:783–808. https://doi.org/10.2307/25148820
Kiesler S, Siegel J, McGuire TW (1984) Social psychological aspects of computer-mediated communication. Am Psychol 39:1123–1134. https://doi.org/10.1037/0003-066X.39.10.1123
Kim HW, Kankanhalli A (2009) Investigating user resistance to information systems implementation: a status quo bias perspective. MIS Q 33:567–582. https://doi.org/10.2307/20650309
Kolfschoten GL, Brazier FMT (2013) Cognitive load in collaboration: convergence. Gr Decis Negot 22:975–996. https://doi.org/10.1007/s10726-012-9322-6
Leinonen P, Järvelä S (2006) Facilitating interpersonal evaluation of knowledge in a context of distributed team collaboration. Br J Educ Technol 37:897–916
Lipnack J, Stamps J (1997) Reaching across space, time, and organizations with technology
Lowry PB, Roberts TL, Romano NC et al (2006) The impact of group size and social presence on small-group communication: Does computer-mediated communication make a difference? Small Gr Res 37:631–661. https://doi.org/10.1177/1046496406294322
Lowry P, Romano N, Jenkins J, Guthrie R (2009) The CMC interactivity model: how interactivity enhances communication quality and process satisfaction in lean-media groups. J Manag Inf Syst 26:155–196. https://doi.org/10.2753/MIS0742-1222260107
Mannix E, Neale MA (2005) What differences make a difference? The promise and reality of diverse teams in organizations. Psychol Sci Public Interes Suppl 6:31–55
Mayer RC, Davis JH, Schoorman FD (1995) An integrative model of organizational trust. Acad Manag Rev 20:709–734. https://doi.org/10.5465/amr.1995.9508080335
Maznevski ML, Chudoba KM (2000) Bridging space over time: global virtual team dynamics and effectiveness. Organ Sci 11:473–492. https://doi.org/10.1287/orsc.11.5.473.15200
McAllister DJ (1995) Affect- and cognition-based trust as foundations for interpersonal cooperation in organizations. Acad Manag J 38:24–59. https://doi.org/10.5465/256727

McKnight DH, Chervany NL (1996) The meanings of trust. Technical Report MISRC 96-04. Management Information Systems Research Center, University of Minnesota, MN
Miles MB, Huberman AM (1994) Qualitative data analysis: an expanded sourcebook. Sage, New York
Mishra AK (2012) Organizational responses to crisis: the centrality of trust. In: Trust in organizations: frontiers of theory and research, pp 261–287
Ortiz De Guinea A, Webster J, Staples DS (2012) A meta-analysis of the consequences of virtualness on team functioning. Inf Manag 49:301–308. https://doi.org/10.1016/j.im.2012.08.003
Pinjani P, Palvia P (2013) Trust and knowledge sharing in diverse global virtual teams. Inf Manag 50:144–153. https://doi.org/10.1016/j.im.2012.10.002
Ridings CM, Gefen D, Arinze B (2002) Some antecedents and effects of trust in virtual communities. J Strateg Inf Syst 11:271–295. https://doi.org/10.1016/S0963-8687(02)00021-5
Robert L, Denis A, Hung YT (2009) Individual swift trust and knowledge-based trust in face-to-face and virtual team members. J Manag Inf Syst 26:241–279. https://doi.org/10.2753/MIS0742-1222260210
Rose J, Schlichter BR (2013) Decoupling, re-engaging: managing trust relationships in implementation projects. Inf Syst J 23:5–33. https://doi.org/10.1111/j.1365-2575.2011.00392.x
Rotter JB (1980) Interpersonal trust, trustworthiness, and gullibility. Am Psychol 35:1–7. https://doi.org/10.1037/0003-066X.35.1.1
Sarstedt M, Ringle CM, Smith D et al (2014) Partial least squares structural equation modeling (PLS-SEM): a useful tool for family business researchers. J Fam Bus Strateg 5:105–115. https://doi.org/10.1016/j.jfbs.2014.01.002
Snow CC, Snell SA, Davison SC, Hambrick DC (1996) Use transnational teams to globalize your company. Org Dyn 24:50–67
Srivastava SC, Chandra S (2018) Social presence in virtual world collaboration: an uncertainty reduction perspective using a mixed methods approach 1. MIS Q 42:779–803. https://doi.org/10.25300/MISQ/2018/11914
Tashakkori A, Teddlie C, Teddlie CB (1998) Mixed methodology: combining qualitative and quantitative approaches. Sage, New York
Venkatesh V, Brown SA, Sullivan YW (2016) Guidelines for conducting mixed-methods research: an extension and illustration. J Assoc Inf Syst 17:435–495. https://doi.org/10.17705/1jais.00433
Weber TA (2014) Intermediation in a sharing economy: insurance, moral hazard, and rent extraction. J Manag Inf Syst 31:35–71. https://doi.org/10.1080/07421222.2014.995520
Wildman JL, Shuffler ML, Lazzara EH et al (2012) Trust development in swift starting action teams: a multilevel framework. Gr Organ Manag 37:137–170. https://doi.org/10.1177/1059601111434202
Wilson JM, Straus SG, McEvily B (2006) All in due time: the development of trust in computer-mediated and face-to-face teams. Organ Behav Hum Decis Process 99:16–33. https://doi.org/10.1016/j.obhdp.2005.08.001
Wunderlich P, Veit DJ, Sarker S (2019) Adoption of sustainable technologies: a mixed-methods study of German households. MIS Q 43:673–691. https://doi.org/10.25300/MISQ/2019/12112
Young-Ybarra C, Wiersema M (1999) Strategic flexibility in information technology alliances: the influence of transaction cost economics and social exchange theory. Organ Sci 10:439–459. https://doi.org/10.1287/orsc.10.4.439
Zeger SL, Liang K-Y (1986) Longitudinal data analysis for discrete and continuous outcomes. Biometrics 42:121. https://doi.org/10.2307/2531248
Zhang Y, Fang Y, Wei KK, Chen H (2010) Exploring the role of psychological safety in promoting the intention to continue sharing knowledge in virtual communities. Int J Inf Manag 30:425–436. https://doi.org/10.1016/j.ijinfomgt.2010.02.003