Decision Support Systems 52 (2011) 61–72

Contents lists available at ScienceDirect

Decision Support Systems

journal homepage: www.elsevier.com/locate/dss

Interactive or interruptive? Instant messaging at work

Carol X.J. Ou [a,1], Robert M. Davison [b,*]

[a] Department of Information Management, Tilburg University, Tilburg, The Netherlands
[b] Department of Information Systems, City University of Hong Kong, Tat Chee Avenue, Kowloon, Hong Kong

ARTICLE INFO

Article history:
Received 7 July 2010
Received in revised form 1 May 2011
Accepted 15 May 2011
Available online 18 May 2011

Keywords:
Instant messaging (IM)
Work interruption
Communication performance
Communication quality
Trust
Group outcomes

ABSTRACT

The use of instant messaging (IM) technology at work is controversial, due to the interruptions it may cause and the difficulties associated with quantifying its benefits for individuals, teams and organizations. In this study, we investigate the use and impact of IM tools in the workplace. Based on theories of communication performance and social networks, we propose that while the use of IM will cause work interruption, it will also lead to improved communication quality and the establishment of trust between colleagues. These mediating variables will in turn influence group outcomes. We validate our research model with data collected through a survey of 253 working professionals. The data suggests IM can significantly contribute to communication performance in the workplace, where the benefits overwhelm the negative effects associated with work interruption. The theoretical and practical contribution and implications of the research are discussed.

1. Introduction

Social networking tools such as instant messaging (IM), blogs and wikis are widely adopted in society. IM is characterized by the immediate receipt of messages, allowing effective and efficient communication between interlocutors. Although the recent surge of social networking tools has aroused the interest of organizations, the use of IM in the workplace is controversial. The major deterrent to IM application at work is the widespread belief that IM leads to increased interruption and decreased productivity [23,37]. Deloitte [13] indicates that social networking tools are relatively under-utilized with only 41% of 750 responding companies indicating that these tools are used in the workplace. On the other hand, a recent study [19] suggests that IM users are no more interrupted than non-users. It appears that the consequences of IM use for individual employees and organizations are both controversial and as yet unquantified. The answer to the following practical question thus remains ambiguous: *Does IM actually provide value to organizations*? Given these conflicting and incomplete research results, the main objective of this study is to address selected consequences of IM use at work, viz.: interruptions, interactivity and communication quality, in a single research model, so as to empirically investigate the value of IM usage at work.

For many years, a core aspect of the discipline of information systems (IS) has been the design of collaborative tools that facilitate communication in organizations [43] and team work [32]. Communication is an essential activity for human beings, in which social interaction resembles a business transaction [47]. Therefore the parties involved in an exchange relationship seek, in their negotiations, to maximize their own interests. Various technologies (such as pervasive email, video conferencing and knowledge sharing forums) have been proposed to support communication in the online world so as to enhance work performance. However, it is rarely, if ever, the case that these technologies can facilitate the achievement of the same quality of social interaction that we are accustomed to in face-to-face encounters.

We argue that IM, as a popular communication tool that is widely used in daily life, has the distinctiveness of facilitating near-transparent communication among interaction partners. In principle, the same characteristic is applicable in the workplace where IM tools offer a way to address an inherent deficiency of other online computer-mediated communication (CMC) tools: the limited opportunity for team workers to signify their willingness to communicate with, as well as give instant responses to, each other, thereby developing mutual trust and social networks. Appropriate leveraging of IM tools enables interlocutors to bridge the communication gap between them and thus render teams that use IM high quality work results. However, the positive aspect of IM usage associated with its inherent interactivity is paralleled by the risk of work interruption, indicating that there is a dark side to IM use at work.

Grounded on Barnes's [4] idea of a social network, Rogers and Kincaid [45] characterized a communication network as consisting of "interconnected individuals who are linked by patterned communication flows". They described a communication network analysis that investigates "the interpersonal linkages created by the sharing of information in the interpersonal communication structure" [45], that is, the network. Past research has employed the social network analysis technique to outline social actors' linkages in a network

* Corresponding author. Tel.: +852 34427534.
E-mail addresses: carol.ou@uvt.nl (C.X.J. Ou), isrobert@cityu.edu.hk (R.M. Davison).
[1] Tel.: +31 13 466 3109.

0167-9236/$ – see front matter © 2011 Elsevier B.V. All rights reserved.
doi:10.1016/j.dss.2011.05.004

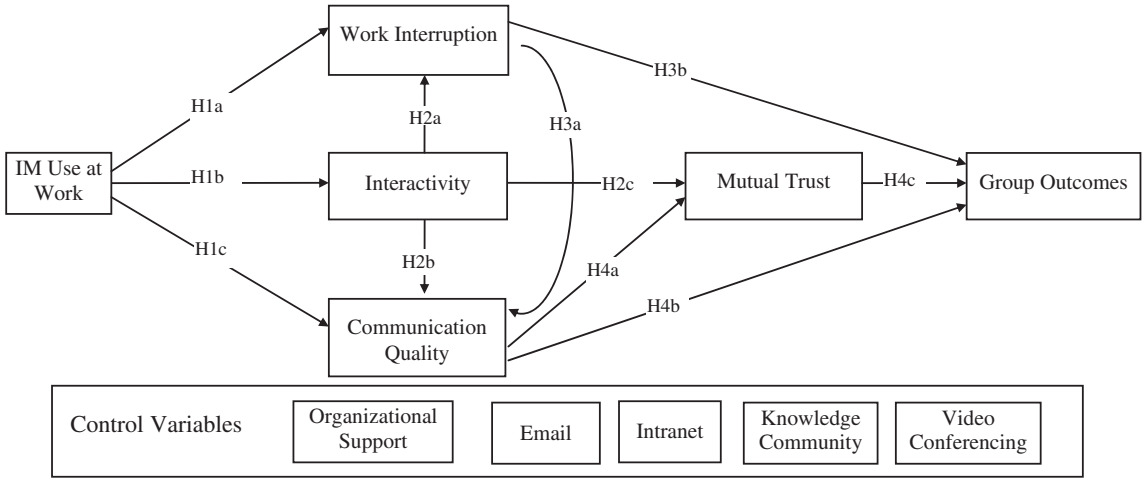

Fig. 1. Proposed research model.

[7,9,43,50]. The resulting network diagram is a powerful way of depicting the connectivity of network members, but the virtualization is inherently constrained to a limited number of actors inside the focal network. In this study, instead of using the social network analysis technique, we draw on the powerful suggestive metaphor of social network theory (SNT), which claims "*social networks are based on communication and trust*" [6, p. 262], to shape our conceptual model about IM, which we then verify with empirical data.

In parallel with social network research, an abundance of studies on CMC technology and media provides the current research with its theoretical foundations. Among them, two particular perspectives can be identified, viz.: the choice and the performance of technology and media. Research on CMC technology choice, such as media richness theory (MRT) [11], emphasizes using media characteristics (e.g., media richness and social presence) to predict the adoption or choice of CMC technology (i.e., adoption as the *dependent* variable). On the other hand, research on CMC technology performance, such as media synchronicity theory (MST) [14] and the CMC Interactivity Model [32], stresses how technologies influence communication and work performance (i.e., adoption as the *independent* variable). Most studies on CMC technologies have used MRT to predict media *choice*, but not *performance*. However, this study is concerned with whether and how the use of IM at work can improve group outcomes (i.e., perceived teamwork performance). Consequently we employ the second perspective of technology/media research, i.e., theories of communication performance, to quantify the major advantages and disadvantages of IM use at work, and investigate its impact on teamwork performance. Through this investigation we intend to contribute to CMC technology research because "few studies … have examined communication or task performance" of media [14, p.577].

Following this introduction, we explain the theoretical model and related research. We argue that given the highly interactive nature of IM, work interruptions may occur which may negatively influence both communication quality and the development of trust among colleagues. However, the interactive nature of IM may positively contribute to group outcomes through shaping communication quality and trust. Following a description of the survey method and data analysis, we discuss the findings and make suggestions for future research. We conclude the paper with implications and contributions.

2. Theoretical development

In prior research on CMC, theories of communication performance, such as the CMC Interactivity Model (CMCIM) [32] and Media Synchronicity Theory (MST) [14], have been applied to measure the impact of CMC tools on task performance. We adapt these theories to measure the significance of IM use at work on shaping group outcomes. The choice of mediators – interactivity and communication quality – is based on CMCIM [32] which proposes that they are influenced positively by CMC technologies. Meanwhile, SNT [6] claims that communication and trust form the base of a social network. We contend that IM is a powerful CMC tool that has the potential to enhance employees' social relationships at work where communication quality and mutual trust are fundamental and high quality group work that contributes to organizational success is the ultimate outcome. In addition to the positive effects of IM use at work, work interruption is a principal construct since we examine its negative influence on social networks. We control for the effects of other CMC tools on social networks, such as email, intranets and knowledge communities. Fig. 1 presents the research model. Definitions of the principal constructs are provided in Table 1.

2.1. The effects of using IM at work

Functioning primarily as a social networking tool, IM is widely used for the purpose of "being connected" [30] in both social and work environments [9]. IM allows users to maintain real-time contact with

Table 1
Principal constructs and definitions.

Principal constructs	Definitions	Source
IM Use at Work	The employee's use of IM as a work-related contact and communication tool to ask and answer questions, share files and engage in work-related socialization	[9,43]
Work Interruption	The employee's perception of disturbance from unscheduled IM interaction, or the discontinuity of current work activity because of IM interaction which is not initiated by the focal employee	[19,39]
Interactivity	The extent to which an IM user believes that the IM tool enables interlocutors to actively control interactions and message exchange as they interact with each other, and the degree to which the communication is synchronized	[25,32,46]
Communication Quality	The employee's perception of the quality of communication in terms of being timely, adequate, accurate, complete, interactive and effective	[35]
Mutual Trust	The extent to which trust is placed by the members of the focal network in each other	[29,38]
Group Outcomes	The employees' perceptions of group satisfaction, group outcome satisfaction, and outcome quality	[17]

colleagues, no matter where they are located. Although IM users can signify their online status as ('available', 'busy' or 'away'), most users indicate that they are 'available' and so leave themselves open to contact — and hence interruption [19]. Various studies have investigated the impacts of IM usage at work, while a core theme in this research is the direct effects of IM on work interruption levels (such as [37,44]). Several characteristics of IM are associated with the concept of work interruption (see Table 1), which is disruptive. For example, the pop-up and flashing screen of incoming messages demands the recipient's immediate attention, regardless of the work in hand. Meanwhile, since IM allows polychronic communication among interlocutors, it potentially contributes to the effectiveness of the work environment where employees are simultaneously engaged with multiple online conversations. Such polychronic communication practices can greatly reduce employees' concentration on the work in hand [19]. As a result, the use of IM at work may seriously influence employees' work focus and increase the level of work interruption.

Hypothesis 1a. The use of IM at work increases work interruption.

An IM also enables the creation of a two-way, near-synchronous and lifelike communication channel that is highly interactive [14,30,32] in both social and work environments. Firstly, the IM functionality offers a two-way private channel for team workers, similar to traditional face-to-face communication where work-related questions can readily be integrated into the interaction process. Secondly, during the course of the interaction, files can be transferred simultaneously. In the workplace context, IM tools provide employees with both an interactive process and an alternative way of asking for real-time help, thus enabling the exchange of task-related information and interactive problem-solving during the work process. Furthermore, IM offers interlocutors a fine degree of control since they can make use of the IM's flashing avatar to be "invisible" and so maintain control over the initiation of communication. Overall, the use of IM technology improves the perception of communication interactivity and control in the work environment.

Hypothesis 1b. The use of IM at work enhances interactivity.

When employees have the spatial capability for direct, personal interaction, quality communication is more likely to develop. The rich but informal set of communication functionalities built into IM tools, such as real-time interaction and the exchanging of messages and files, renders IM the capability of providing a quality communication channel. As a highly interactive tool, IM mimics face-to-face communication patterns and so has been considered to contribute to the perception that communication is accurate, complete, timely and effective [35]. Even without the physical presence in the same location, IM can be used for "quick questions and clarifications, coordination and scheduling, to discussions of complex work" [2, p. 505]. In such a quality communication process, emerging issues can be discussed and mutual understanding among colleagues can be developed [43]. IM in the workplace thus complements other forms of communication, especially when employees work in different locations or remotely. Consequently, we argue that IM use at work has the potential to improve communication quality in the work context.

Hypothesis 1c. The use of IM at work enhances communication quality.

2.2. The influence of interactivity

We argue that there are both advantages and disadvantages to IM's interactivity. Work interruptions occur when interactions are initiated by another party [39]. As Davison and his colleagues explain [12], these interruptions can be frequent and prolonged — they document the case of a knowledge worker actively engaged with 17 parallel IM chats. They also report how knowledge workers in the same firm had contact lists running into the hundreds — i.e. hundreds of known people who may get in contact at any time. Work interruption is caused not only by the frequency of IM use at work, but also by the interactive nature of IM, characterized by synchronicity and two-way communication. The interruption requires a response, even if the response is only to refuse the interaction. IM tools typically rely on spawned pop-up windows to enable communication, which are often automatically superimposed on top of all other application interfaces with flashing lights that are hard to ignore. The requirement for the message recipient to react immediately to the incoming call appears uniquely disruptive [19] and additional to interruptions caused by email and phone calls [37,44].

Hypothesis 2a. IM's interactivity increases work interruption.

Regardless of an IM's interruptive effects, we argue that the interactivity of an IM can bring users considerable benefits. Interactivity has long been a desired characteristic of CMCs in website design [25,46], virtual communities [27] and systems used for work-related tasks [32]. An IM's fine level of control (including initiating communications, archiving and transcript-searching capabilities) supports employees' complete and effective communication at work, even as it potentially causes interruption to others. We suggest that when two-way, synchronized communication enhances communication quality, employees will be more willing to be involved in IM interaction (cf. [32]).

Hypothesis 2b. IM's interactivity enhances communication quality.

Trust is a critical factor in accomplishing group work [28]. Collocation is considered to reinforce co-workers' mutual familiarity and consequently enhance mutual trust among colleagues; however, such trust is relatively difficult to achieve in distributed environments [24]. Contemporary, distributed work practices require working professionals to collaborate and communicate across multiple networks and locations. Deployment of IM in this distributed workspace has the potential to enhance employees' mutual trust by enabling synchronized, two-way conversations with a fine degree of control. Indeed, IM may enable a new form of work incorporating informal interaction, connecting working professionals, overcoming the limitations of space, time and even cost, and thus helping employees establish mutual trust. We thus hypothesize that:

Hypothesis 2c. IM's interactivity enhances mutual trust.

2.3. The Influence of work interruption

Work interruption resulting from IM use, and the consequent negative impact on productivity, has been considered the major barrier to company deployment of IM at work [23,37]. The primary concern relates to the perceived negative consequences of interruption: on average, a worker needs eleven minutes to return to a state of concentration on an interrupted task [33], though the delay will depend on many other factors including the depth and duration of interruption. Other consequences of interruption include errors, stress and reduced performance [16]. Computer users with constant on-screen interruptions from IM unrelated to ongoing work tasks may find it difficult to resume work tasks and consequently experience longer task completion times [10]. Such distractions are generally considered a hindrance to an employee under pressure, which consequently negatively influences communication quality and productivity. Unsurprisingly, work interruptions have been generally criticized as causing deteriorations in user effectiveness and efficiency, and increasing the number of errors [20].

More specifically, interruptions are commonly problematic due to the cognitive limitations of human beings. If the interruption is unrelated to the task at hand, yet cannot be ignored (e.g. if it comes

from a respected peer or superior) the message recipient may be reluctantly forced to mentally engage with a new topic that demands focused attention if quality communication is to be achieved. The interruption initiated by unexpected instant messages can influence employees by introducing multiple tasks that force task switching and alternating attention, and thus increase the cognitive burden on an employee's attention and memory. Research in cognitive psychology shows that even when the interruptive tasks are similar to those currently in hand, the requirement of switching cognitive attention from one task to another does not reduce the disruptiveness of the interruption [20]. If interruptions occur frequently, such as those induced by IM usage at work, work performance, i.e., perceived group outcomes in this study, can be significantly and negatively affected. We thus hypothesize that:

Hypothesis 3a. Work interruption reduces communication quality.

Hypothesis 3b. Work interruption has a negative impact on group outcomes.

2.4. The social network at work

As articulated by SNT [4], interaction is embedded in the social network. In companies, good teamwork requires frequent communication and mutual trust [24], consistent with SNT: "networks are based on communication and trust" [6, p.262]. Group work is collaborative by definition, with group members required to engage in various interlinked activities if high quality outcomes are to be achieved. Group members working together often develop a strong social network because of mutual understanding and shared values. Collective action, such as group work in this study, is easier to achieve in a social network where the members' ties are characterized by a high degree of goodwill, collective bonds, and expectations of pro-social behavior [48]. Meanwhile, trust is a critical ingredient of a social network, such as the one in the work context in this study, that involves collective action [48] and collaboration [34].

Similarly, employees' mutual trust has been regarded as one of the fundamental considerations for organizational arrangements, especially for those of a virtual nature [40]. Employees' mutual trust, even in a well-established social network, can be very fragile and temporary, and is further dependent upon the communication behavior of the team members [24]. Mutual trust does not develop in a single information exchange event, but through repeated interaction involving shared understandings and values [21]. As relationships mature after quality communication and the increase of familiarity, strong mutual trust among team workers can be established.

Work-related communication often combines both social and informational elements [15]. The more accurate, complete, timely, adequate and effective the interaction, the more information can be shared, mutual understanding and trust achieved, and so higher levels of teamwork accomplished. In contrast, a team lacking mutual trust will not share information or otherwise function effectively [40], leading to low-quality team work. In highly competitive business environments, group member coordination requires increased frequency of interaction with more rapid and direct access to information; this can be facilitated by IM technology. Such frequent and interactive communication nurtures the employees' mutual trust and consequently occasions an increase in both individual and team-based productivity and satisfaction. We thus hypothesize that:

Hypothesis 4a. Communication quality is positively related to mutual trust.

Hypothesis 4b. Communication quality is positively related to group outcomes.

Hypothesis 4c. Mutual trust is positively related to group outcomes.

2.5. Control variables

In addition to IM, we expect that other communication tools, such as email, intranet knowledge communities and video conferencing, may contribute to social networks. Theories of communication performance such as MST [14] suggest that the best medium for a given situation may involve a combination of CMC tools because an integrated communication environment can balance the strengths and weaknesses of individual tools. We thus account for the effects of other CMC tools on the research model. Considering that the research context involves information technology use in organizations, we also model the potential effects of organizational support on IM use.

3. Methodology

We used the survey method to verify the research model. This section briefly explains the development and validation of measures, and the data collection procedure.

3.1. Measurement development

We use existing measures from the literature to form the items used in this study. The independent variable, IM use at work, is operationalized based on the conceptual definitions of IM use at work from previous case study research on IM [9,43], as well as measurement items adapted from [26] about the frequency of knowledge management system use at work into IM usage for: contacts and communication; asking questions; answering questions; sharing files; and work-related socializations. The measures of work interruption are based on Garrett and Danziger's [19] single question on the rarity of completing tasks without interruption, as well as two additional items (to ensure scale robustness) covering work disturbance and concentration inhibition. Prior research has provided rich information on the operationalization of interactivity, where it was treated either as a first-order construct, e.g., [25] or, very recently, as a second-order construct, e.g., [32]. Although interactivity has been operationalized in these two different ways, there is a consensus that interactivity covers three dimensions, viz., two-way communication, synchronicity and control. In this study, we adapted the measures of interactivity from [25] in the context of IM use in the workplace, operationalizing it as a first-order construct, encompassing the items of two-way and synchronized IM conversations with a fine degree of control. Items about communication quality are taken from [35], covering timely, accurate, adequate, complete, effective and interactive communication, as well as being present when needed. Mutual trust is measured with items from [38] including "making decisions beneficial to each other; willingness to provide assistance to each without exception; counting on each other at all times and the level of trust existing between the participant and colleagues in general". Following [17], group outcomes constitute a second-order composite construct, measured by three separate, but correlated, individual constructs — group satisfaction, outcome satisfaction and outcome quality. Control variables (use of email, video conferencing, intranet and knowledge community) are measured by frequency of use at work on a never (1) to always (7) scale. We developed a new measure of organizational support, which reads "My company encourages its employees to use IM tools to contact colleagues for work purposes", with a scale from strongly disagree (1) to strongly agree (7). Appendix A lists all items for the principal constructs.

Considering that the measures came from different sources, we conducted card sorting exercises to test their reliability and validity [36], with one work professional, an academic scholar and a research student acting as judges. In the first round, where the judges were not provided with the construct names but asked to label each item, the correct hit ratio was 84%. We then revised some wordings found by the judges to be ambiguous and conducted a second card sorting

exercise with a new group of judges. Construct names were provided in this round and a 95% correct hit ratio was achieved, indicating sufficient item-construct reliability [36].

A pilot study of the survey was conducted with a sample of 30 ethnic Chinese postgraduate students from a major university in Hong Kong in order to collect feedback on the survey questions, enabling us to further revise the measures used in the subsequent large-scale data collection process.

3.2. Data collection

We collected survey data on a voluntary basis from working professionals in China who are also undertaking part-time postgraduate study at one of the following universities: Tsinghua University (Beijing), University of Science and Technology of China (Hefei), Xi'an Jiao Tong University (Xi'an) and Shenzhen University (Shenzhen). We decided to collect data using the survey method rather than an experiment because we wish, as far as possible, to ensure that our study captures the essence of the natural working environment, which few experiments can achieve. On the cover page of the survey, we specified our interest in CMC communication for team work. Survey respondents were asked to complete the survey in the context of the current or most recent team project. If respondents were involved in multiple projects, they were asked to answer questions based on their experience with the most important project (in their estimation).

Over a period of four weeks, we collected 253 valid data points (a 66% response rate). We determined that non-response bias was not a concern using the method described in [1], showing that: (1) the respondents' demographic characteristics were similar to those currently registered at the universities concerned; (2) a *t*-test of the demographic characteristics of respondents in the first two weeks and in the second two weeks did not significantly differ ($p > .10$). We also compared responses from the four cities based on their demographics. The ANOVA test results showed insignificant differences in all comparisons between groups. Therefore these 253 data points formed the data set for subsequent statistical analysis (see Table 2 for demographic characteristics).

4. Data analysis

Before analyzing the research model, we first validated measures at the construct level. The robustness of the research model was then confirmed by PLS analysis and several additional checks.

4.1. Validating the measures

We used SPSS and Partial Least Squares (PLS) to calculate construct validity and reliability. Convergent and discriminant validity were first confirmed with factor analysis: (1) the factor loading scores on their expected factors are all above 0.6. Moreover, the factor loading scores are much higher on their expected factors than on other factors; (2) all eigenvalues of the constructs are larger than 1.0; (3) the communality scores are all higher than 0.50. These results, summarized in Appendix B, indicate adequate reliability of the measures [22]. Second, since 'group outcomes' is an endogenous second-order construct represented in the research model, we validated this construct by two steps. For its three first-level constructs – group satisfaction, outcome satisfaction, and outcome quality – the reliability of the measures were 0.93, 0.93 and 0.95, respectively. For the second-level construct of group outcomes, the factor scores of three first-level constructs were taken as the composite dimensions of group outcomes in the PLS analysis, following the method of handling second-order constructs in PLS suggested by [41]. The loading of each composite dimension was significant as shown in Fig. 2. Third, construct reliability for all principal constructs was assessed by identifying the composite reliability scores, all of which are above 0.90 (Table 3), suggesting acceptable internal consistency. The square roots of the Average Variance Extracted (AVE) are all above 0.80, which is greater than all other cross correlations. This shows that all constructs capture more construct-related variance than error variance. In order to examine the deviation of the measures, we also conducted a Kurtosis test of measurement scores. As shown in Table 4, the low Kurtosis values suggest that the measures used in our study have frequent modestly sized deviations. Taken together, these results demonstrate adequate convergent and discriminant validity for all constructs used in this study.

Table 2
Demographic Characteristics (n = 253).

Categories	Items	%	Categories	Items	%
Gender	Male	62.9%	Position	Non-management employee	60%
	Female	37.1%		Manager	22%
				Senior or Executive manager	18%
Education level	Pre-college	3.6%	Age range	18–25	24.6%
	College	21.8%		26–35	64.3%
	Undergraduate	49.2%		36–45	9.9%
	Graduate/master or above	25.4%		46 and above	1.2%
Company location	Beijing (Northern China)	22.9%	Organization size	50 or below	24.5%
	Shenzhen (Southern China)	27.3%	(number of employees)	51–100	16.1%
	Hefei (Eastern China)	27.3%		101–500	30.5%
	Xi'an (Western China)	22.5%		501–1000	11.2%
				1001 or above	17.7%
Industry type	Public relations	4.2%	IM Contacts	None	1.8%
	Manufacturing	18.4%		1–10	23.6%
	IT	23.8%		11–20	20.1%
	Commerce	5.9%		21–50	29.7%
	Tourism & Entertainment	11.3%		51–99	15.7%
	Telecommunication	5.0%		100–200	7.8%
	Government Services	7.1%		201 or above	2.5%
	Logistics & Transportation	6.7%			
	Others	17.5%			
Number of different IM tools	None	1.6%	Work related IM contacts	None	1.8%
(such as MSN, QQ, ICQ, company	1	13.3%	as a% of total contacts	1%–20%	17.4%
owned IM) used at work	2	36.1%		21%–40%	23.8%
	3	36.5%		41%–60%	26.2%
	4	8.8%		61%–80%	23.3%
	5 or above	3.6%		80%–100%	10.8%

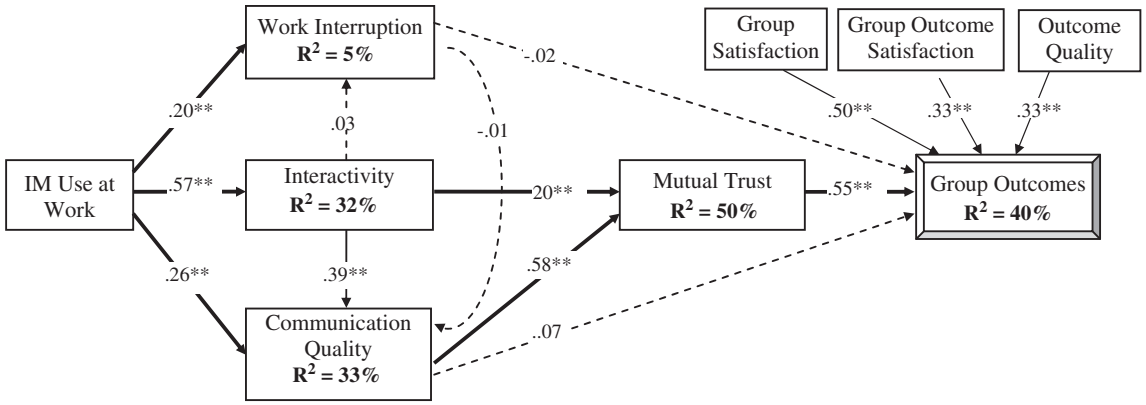

Fig. 2. PLS results of structural model without control variables. Note: Square boxes represent the first-order factors measured with reflective scales. Bevels represent second-order factor (group outcome) formatively measured by three first-order constructs (group satisfaction, group outcome satisfaction and outcome quality). Paths in solid lines are significant links (*0.01<p<0.05; **p<0.01). Paths in dotted lines are insignificant links. The formative models were analyzed in the PLS model simultaneously with the entire structural model.

We also tested for common method bias: one principal factor counting for the majority of the variance explained [42]. Our principal components factor analysis, summarized in Appendix B, indicates that each factor explains roughly equal variance (6.66%–17.29%), suggesting the lack of substantial common method bias. Furthermore, the correlation matrix (Table 3) shows that the highest inter-construct correlations are below 0.68, while common method bias is usually evidenced by extremely high correlations (r>.90) [3]. Finally, we included a marker variable [31], i.e. a conceptually un-related question, in the survey to adjust for common method bias. Three ex ante questions set for this marker variable were: "please indicate how satisfied you are (1) with your current study; (2) with your family; (3) with your life in general". The correlations of these items and the items used to measure the principal constructs were not significant (average r = 0.05; average p = 0.83), suggesting the lack of evidence for common method bias. Finally, to test for multicollinearity, collinearity diagnostics for constructs were also conducted. The analysis shows that the collinearity indicators – tolerance values and variance inflation factors – are all less than the acceptable cut-off points [22].

4.2. Analyzing the research model

The structural model was examined using PLS. We first analyzed the proposed research model without control variables so as to focus on the sole effects of IM used at work. We then included all the control variables and conducted various hierarchical regressions to compare the interplay of IM and other CMC tools in the next section where we describe the robustness tests. Results in Fig. 2 indicate that the research model is largely supported by the data, except hypotheses H2a, H3a, H3b and H4b. IM use at work has a significant impact on work interruption (b = 0.20, p<0.01), interactivity (b = 0.57, p<0.01) and communication quality (b = 0.26, p<0.01), supporting H1a, H1b and H1c. Interactivity is also found to significantly influence communication quality (b = 0.39 p<0.01) and mutual trust (b = 0.20, p<0.01), validating H2b and H2c. On the other hand, its influence on work interruption is only modest, rejecting H2a. The influence of IM on work interruption is not significant, rejecting H3a and H3b. The results demonstrate strong support for H4a (communication quality → mutual trust: b = 0.58, p<0.01) and H4c (mutual trust → group outcomes: b = 0.55, p<0.01). However, the direct effect of communication quality on group outcomes is not supported by the data (b = 0.07, p>0.10), rejecting H4b. The variance explained of interactivity, communication quality, mutual trust, and group outcomes is 32%, 33%, 50% and 40%, respectively. The R^2 scores for all dependent variables in this study, together with the factor loading, yield an excellent goodness-of-fit for the whole research model [8].

4.3. Robustness checks

Our research focuses on IM's effects on interactivity, interruption and communication quality. IM's sole contribution effects to the suggested outcomes in the research model are shown in Fig. 2. In order to capture IM's extra contribution effects, i.e. in addition to the four other CMC tools, to the research model, we conducted hierarchical regressions in SPSS so as to examine the individual variance of IM's outcome constructs explained by IM. As summarized

Table 3
Descriptive statistics, correlation matrix, and average variance extracted.

Principal constructs	Mean (STD)	Reliability	1	2	3	4	5	6
1. IM use at work	5.0 (1.3)	.91	.84					
2. Work interruption	3.8(1.5)	.90	.19**	.86				
3. Interactivity	5.3(1.2)	.90	.56**	.14*	.86			
4. Communication quality	5.0 (1.1)	.95	.47**	.07	.49**	.85		
5. Mutual trust	4.9 (1.2)	.93	.36**	.12*	.49**	.67**	.87	
6. Group outcomes	5.2 (1.2)	.90	.29**	.06	.39**	.50**	.64**	.86

**Correlation significant at p<0.01 level.
Diagonal elements are the square root of the AVE from their indicators.
Off-diagonal elements are correlations between constructs.

Table 4
Frequency table and the results of the kurtosis test.

Principal constructs	Kurtosis scores*	Frequency						
		1	2	3	4	5	6	7
1. IM use at work	0.23	1.6%	3.6%	6.3%	18.2%	27.7%	26.9%	15.8%
2. Work interruption	−0.42	5.9%	13.0%	21.7%	27.7%	19.0%	8.3%	4.3%
3. Interactivity	0.74	0.8%	0.8%	4.3%	14.6%	30.4%	32.0%	17.0%
4. Communication quality	0.27	0.0%	3.2%	4.8%	19.8%	36.9%	27.4%	7.9%
5. Mutual trust	0.14	0.0%	2.8%	4.7%	14.6%	32.0%	30.0%	15.8%
6. Group outcomes	−0.31	0.4%	0.8%	9.5%	18.6%	25.3%	33.6%	11.9%

* Note: Kurtosis is a measure of the peakedness of the probability distribution of a real-valued random variable. Higher kurtosis means more of the variance is the result of infrequent extreme deviations, as opposed to frequent modestly sized deviations.

Table 5
Hierarchical regression analysis.

Independent variables in the regression	Dependent variables/analysis results											
	Use of IM at work	Work interruption		Communication quality			Mutual trust				Group outcomes	
	Model 1	Model 2A	Model 2B	Model 3A	Model 3B	Model 3C	Model 4A	Model 4B	Model 4C	Model 4D	Model 5A	Model 5B
Organizational support	0.468**											
Knowledge sharing community		0.125*	0.106	0.154**	0.107	0.116	0.216**	0.185*	0.196**	0.134*		
Intranet		−0.259**	−0.229**	−0.026	0.051	−0.009	0.040	0.091	0.018	0.022		
Email		0.007	−0.031	0.283**	0.185**	0.156**	0.356**	0.292**	0.257**	0.173**		
Video conferencing		0.264**	0.231**	0.119	0.035	0.070	−0.034	−0.090	−0.047	−0.084		
Instant messenger			0.155**		0.398**	0.235**		0.264**	0.065	−.0.060		
Interactivity						0.306**			0.373**	0.209**	0.162**	0.050
Communication quality										0.535**	0.390**	0.070
Mutual trust												0.551**
Model F	70.532	3.555		11.529	20.949	23.096	15.645	17.672	22.672	40.867	39.698	53.764
Sig.	0.000	0.008	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
R^2	0.219	0.054	0.076	0.157	0.299	0.361	0.202	0.264	0.357	0.540	0.242	0.394
Adjusted R^2	0.216	0.039	0.057	0.144	0.284	0.346	0.189	0.249	0.341	0.526	0.394	0.387
Change of R^2	0.219	0.054	0.018	0.157	0.141	0.063	0.202	0.062	0.093	0.183	0.242	0.152
F Change	70.532	3.555	5.689	11.529	49.565	24.027	15.645	20.770	35.337	96.832	39.698	62.337

** $p<0.01$.
* $0.01<p<0.05$.

in Table 5, Model 2A indicates that an intranet decreases work interruption ($b=-0.259$, $p<0.01$), but video conferencing is considered to increase work interruption ($b=0.264$, $p<0.01$). When integrating all the other four CMC tools together in Model 2B, IM is found to significantly lead to work interruption ($b=0.155$, $p<0.01$). IM's contributing effects on improving communication quality are worth noticing (an increasing R2 of 14.1% when comparing Model 3A and Model 3B), with an overwhelming impact when compared with knowledge sharing community ($b_{Model\ 3A}=0.154$ to $b_{Model\ 3b}=0.107$). These results suggest that employees find IM to be the most effective CMC tool for improving communication quality.

Our premise in the current research model is that IM use at work contributes to group outcomes through enhancing communication quality and mutual trust. We conducted a classical mediation test to validate this premise according to the procedure suggested by [5]. The hierarchical regressions against mutual trust also provide support for this premise. The direct impact of IM on shaping employees' mutual trust is found to be significant ($b=0.264$, $p<0.01$) in Model 4B. On the other hand, IM's direct effect on mutual trust ($b=-0.065$, $p>0.10$) is overwhelmed by interactivity ($b=0.209$, $p<0.01$) and communication quality ($b=0.535$, $p<0.01$), as indicated in Model 4D. Combining the results of Fig. 2, Model 4B and Model 4C, we observe the full mediating effect of interactivity and communication quality on the path from IM use at work to employees' mutual trust.

We use the same method [5] to test the mediating role of trust in the model. When mutual trust is excluded from the regression against group outcome, the direct impacts of interactivity ($b=0.162$, $p<0.05$) and communication quality ($b=0.390$, $p<0.01$) on group outcomes are both found to be significant in Model 5A. Together with the results shown in Model 5B and Fig. 2, our data confirm that mutual trust fully mediates the influence of interactivity and communication quality on group outcomes. This result also provides a convincing explanation for the insignificant path between communication quality and group outcomes.

The survey responses were collected from part-time postgraduate students. These students, as working professionals, may be expert multitaskers who routinely handle many simultaneous activities. Such a potential for multitasking may influence their perception of IM interruption and effectiveness. In order to examine this issue, we conducted a Kurtosis test in SPSS to check whether their responses to IM use and their perceptions of work interruption are concentrated at the extremes (high or low) of the scales. The Kurtosis scores of the IM use and the perception of work interruption (Table 4) are close to zero, suggesting that survey participants' responses vary. The frequent modestly sized deviations of our measures (IM use and work interruption) guarantee that the dataset is distributed normally near the mean, indicating that uniform distribution in measures is not a serious problem in this study.

It is notable that the control variable, organizational support, significantly influences the use of IM tools at work, with a path coefficient of $b=0.47$ ($p<0.01$), as shown in Model 1 in Table 5. The variance of IM use at work explained by organizational support is 22%, highlighting the significant impact of organizational influence on individual employees' choice of using IM at work. In order to explore the influence of respondents' demographic information on the principal constructs used in this study, we also conducted various ANOVA tests. The results of these tests (summarized in Table 6) indicate that both the use of IM at work ($F=2.799$, $p<0.05$) and communication quality ($F=3.500$, $p<0.05$) vary across different age groups, with people aged 36–45 (25 participants) residing at the high end of the scales. The use of IM at work ($F=1.398$, $0.05<p<0.10$) and interactivity ($F=1.636$, $p<0.01$) are significantly higher when the

Table 6
ANOVA test results based on respondents' demographic data.

Dependent list	Grouping factors/analysis results							
	Sex (*T*-test)		Age		Job position		Work related IM contacts (%)	
	F	Sig	F	Sig	F	Sig	F	Sig
Use of IM at work	.006	.941	2.799	.041**	.409	.665	1.398	.051*
Interactivity	.346	.557	1.080	.358	.139	.870	1.636	.008***
Work interruption	.723	.396	.160	.923	2.271	.105	1.020	.450
Communication quality	.170	.680	3.500	.016**	.109	.897	1.279	.115
Mutual trust	1.226	.270	.644	.587	1.055	.350	1.255	.132
Group outcomes	1.288	.258	1.126	.339	.068	.934	1.128	.274

* $0.05<p<0.10$.
** $0.01<p<0.05$.
*** $p<0.01$.

employees have higher percentage of work related contacts in their IM tools. Except for these four significant ANOVA results, other demographic items only exert modest effects on the principal constructs, suggesting that different groups have created natural variance across the data set. The implications of these results are discussed in the following section.

5. Discussion, implications, and future research

This research has several key findings and implications, with a number of future research directions indicated, as explained below.

5.1. Key findings

Firstly, although IM use is a significant predictor of work interruption, this interruption does not have a significant effect on group outcomes. This can be explained by the overwhelmingly positive effects of IM on shaping communication quality and trust in team work, highlighting the benefits of IM used at work. Secondly, IM use and interactivity only explain 5% of work interruptions, suggesting that work interruptions occur for all employees and IM use does not make the situation worse. Work interruption can be induced by telephone calls, email, face-to-face communication or meetings. Furthermore, this study shows that IM is not the major source of work interruption. Thirdly, IM use has a significant impact on interactivity, which in turn is a critical mediating variable for the development of mutual trust and communication quality. This result suggests an important design principle for CMC tools – interactivity – which highlights the significance of two-way, synchronized communication with a fine level of control for designing CMC tools. This study suggests that synchronicity is one of the important characteristics of quality communication. However, in addition to synchronicity, two-way interaction and interaction controllability are two fundamental characteristics of CMC tools that deserve equal attention by both researchers and CMC tool designers. Fourthly, organizational members' mutual trust fully mediates the effects of IM interactivity and communication quality on team outcomes. This finding suggests that employees' mutual trust is a fundamental driver for team work quality, consistent with [24]. IM use can contribute to this trust when mediated by interactivity and communication quality. The current study provides empirical evidence for the relevance of the suggestive metaphor of SNT [6] in the workplace. Last, but not least, the encouragement and support from the organization on using IM at work directly influence the usage frequency of IM tools. Taken together, the influence of IM use at work is now better understood, comparing positive and negative effects, and evidencing its significance for work performance.

It is worth noticing the changing contributive roles of four other CMC tools (knowledge sharing community, Intranet, email, and video conferencing) when IM is introduced in the hierarchical regression tests. Specifically, our data suggest that IM appears to be most effective in facilitating quality communication ($b = 0.398$, $p < 0.01$) when compared to the downstream effects of knowledge sharing community ($b = 0.107$, $p > 0.10$) and email ($b = 0.185$, $p < 0.01$) on communication quality. Interestingly, model 3B suggests that intranet can significantly reduce work interruption ($b = -0.229$, $p < 0.01$), while video conferencing can significantly increase work interruption ($b = 0.231$, $b < 0.01$).

With respect to the influence from demographic information, our data suggests that professionals aged from 36 to 45 use IM at work the most. This group of professionals also has the highest level of communication quality compared to other age groups. When more work-related contacts are contained in an IM, it is more likely that they will use IM at work, and this IM will lead to higher levels of interactivity, subsequently contributing to better teamwork performance.

5.2. Implications and contributions

This research contributes to theories of communication performance by identifying the most important positive and negative effects of CMC tools. Theories of communication performance conceptualize the logic that links CMC technology with task performance. We advance the appreciation of communication performance theories by formally defining the roles of technological elements, such as IM, in shaping work performance. Meanwhile, we also provide theoretical explanations for the effective deployment of CMC tools at work by including the concept of social networks in the study of communication performance at work. The integration of social network and communication performance theories provides a new theoretical lens to investigate the application of other social networking tools, such as blogs and wikis, in the workplace. Social networks not only serve socialization purposes. The key ingredients of a social network, like quality communication and mutual trust among network actors, are also the fundamental elements required for effective organizational work. By quantifying the contributions of IM tools on interactivity, communication quality and mutual trust in a work-based social network, this research adds a cornerstone to the research on CMC technology and complements previous research that focused on media richness.

This study is not only grounded in the theories of CMCIM [32] and MST [14], but also provides additional theoretical contributions beyond these two theories. First, compared to the focus of CMCIM on interactivity, the current study incorporates work interruption in measuring the advantages and disadvantages associated with IM use at work. Second, mutual trust in the work context, though overlooked in CMCIM, is another key concept that should receive theoretical attention. Its full mediation effect on the path from communication efficiency and group performance suggests that the fundamental purpose of communication in the workplace is to establish mutual understanding and trustworthiness among employees. The critical role of employees' mutual trust therefore can't be overlooked in improving performance. Last, but not least, CMCIM was originally tested [32] with a socially lean CMC medium (an audience response system — ARS). Instead of a single medium, we utilized the theoretical logic of MST [14] and thereby incorporated IM, email, intranet, knowledge sharing platform and video conference in a single model to examine the interplay of different CMC tools in the workplace. Such an incorporation provides both a starting point and a compelling rationale to further examine the integration effect of different CMC technologies in the workplace.

Apart from the above theoretical contributions, we also provide empirical evidence that IM is a double-edged sword. While it facilitates online connectedness it also contributes to work interruptions. However, by helping to shape a social network, enabling quality communication and trust, the negative effects are negligible — and no more serious than those that occur as a result of other interruptions such as phone calls and impromptu conversations. Indeed, we suggest that IM can usefully supplement other CMC tools and help create an effective and comprehensive CMC environment in the workplace, leading to better work performance.

Regardless of the positive effects of IM on work performance, we should not simply overlook the downside of IM usage in causing work interruption. In order to address the distracting effect of IM at work, both organizations and working professionals can consider scheduling IM work according to a pre-arranged scheme, whereby specific time slots in a day are allocated to focused and interactive IM communication opportunities. Such a scheme can help to ensure that those employees who always need to concentrate without interruption on their work can do so without the fear of undesired disruption. Naturally, each organization will wish to prioritize different kinds of communication at different times and for different purposes. Consequently, the precise amount of time allocated

to scheduled IM communication will vary from organization to organization.

In addition to the main effects of IM use at work, the empirical results with respect to the impacts of several other CMC tools in this study (viz., email, intranet, knowledge sharing platform and video conference) are worthy of practitioner attention. CMCIM [32] indicates that even a socially lean CMC tool such as an ARS can significantly enhance communication quality. The contribution effects of other CMC technologies (such as email and knowledge sharing platform) shown in this study, however, offer additional empirical insights beyond CMCIM. The integrated use of different CMC technologies, even though some are less synchronized and interactive (e.g., email and knowledge sharing platform) than IM, has the potential to create much more substantial effects on communication performance than the use of a single CMC tool. Such results meanwhile provide a first attempt to empirically verify the theoretical logic of MST [14] that "the best medium for a given situation may be a combination of media (p.588)".

At the same time, the significant impact of organizational support on IM usage frequency is worth noting. Although we have studied voluntary IM use, organizational encouragement exerts a considerable influence (22%) on employees' actual use of IM. This encouragement is significant. Those employees who are already familiar with IM will often choose to continue to use the tool in this context. However, those employees who are less certain of its benefits or are more concerned about possible reductions in productivity and increases in interruption and who have so far not adopted may now be encouraged to do so. As we have seen in this study, the net benefits of IM use are certainly more significant than the net losses — and therefore IM use is a behavior that can usefully be encouraged. Both employees and the organization as a whole can be expected to benefit from IM use, with enhancements to communication quality and interpersonal trust. By comprehensively discussing and empirically verifying the pros and cons of using IM at work, this research provides compelling reasons for organizational managers to encourage the effective usage of social networking tools, such as IM and others. Organizations should not only establish internal social networks in order to facilitate team work, but also extend social networks to engage their external customers and collaborations. Through the informal, social network-based interactions, a better understanding of needs and values is easier to achieve. As shown by this research, social actors are greatly influenced by the quality communication and mutual trust established in the interaction process. Thus, with the enhancement of communication quality and trust via the employment of social networking tools, sales performance and organizational collaborative performance are likely to be improved.

The practical implications about the significance of the impact of age group on our findings are numerous. The results suggest that mature working professionals (aged from 35–46) in China are the most zealous IM users at work. This finding is perhaps surprising, but we speculate that the expected knowledge and work experience of this group of professionals means that they are intensively connected by IM with a wide range of colleagues. This is an important practical implication for those companies that would like to establish a knowledge network in the workplace. These experienced working professionals appear to have the capacity to forge ahead with social and knowledge networks, given their high levels of IM connectivity, and so provide their colleagues with both answers to questions and quality communication with a high degree of efficiency. Thus, actively enabling social network tools, such as IM, to maintain connectivity with this group of experienced working professionals is significant for organizations that wish to assemble expert knowledge in the workplace.

Our data also suggests that on average, work-related contacts count for slightly less than half of the total number of contacts for working professionals in China. This implies that IM is generally used at work to communicate with coworkers. Although the use of IM can be conceded to be a distraction, generally people who use IM at work are convinced by its interactivity. The high number of work-related contacts in IM tools provides organizations with another compelling rationale to support and encourage using IM to improve the quality of work.

5.3. Limitations and future research

A key limitation of this study is its reliance on perception data. Future studies could usefully include objective data related to the precise nature of the group outcomes, such as productivity measures, sales volumes and other performance indicators. The combination of perception and objective data can provides more compelling evidence for the contributions of social networking tools in the organizational context. It would also be useful to investigate the impact of additional variables, notably those germane to the Chinese context such as guanxi. Specifically, guanxi refers to connections and relationships in China, describing the basic dynamic in personalized networks of influence in both business and social life [49]. It may be reasonably expected that such specific social-network related Chinese contextual variables would exert a significant influence on employees engaged in collaborative team work.

Meanwhile, the participants of this study are professional adults from various organizations in China. Although the generalizability of the research model is thus enhanced, the focus on a single organizational context with the social network analysis technique can clearly depict organizational members' inter-connections in their work-based social networks. Outlining the centrality and picturing the network structure in one single organizational context can specifically benefit the focal organization in terms of enabling the critical mass of the social network and strengthening the social ties by establishing new connections among network actors.

In this study, we examined only one specific social networking tool — IM. Other types of social networking tools such as blogs, wikis, and the recent popular networking sites, such as FaceBook, SecondLife, YouTube and Slashdot [18], open up new opportunities for the investigations of social networks in organizational business practices. Compared to IM, these tools have different characteristics, but they also potentially bring both positive and negative influences to organizational performance. These different underlying social technologies that can support and extend organizations' territories constitute interesting avenues for studying CMC tools and online social networks.

6. Concluding remarks

Social networking technologies such as IM have demonstrated their enormous influence in our daily lives, but their potential in business deployment has barely been investigated. IM appears to have the potential to play an instrumental role in group work because it strengthens the intercommunication and interconnectivity of work professionals, both of which are necessary for collaboration. As we demonstrate in this study, although IM tools do contribute to work interruptions, the actual effect is minimal and no greater than the regular interruption of work from other sources. However, IM tools also enable higher levels of interactivity and communication quality, enhancing team member trust and so contributing significantly to productivity. In many respects, IM tools constitute a hidden advantage for those organizations that dare to sanction their use — and so may contribute to a competitive advantage. This constitutes a compelling rationale to include social networking tools such as IM in the workplace and we look forward to more research that conceptualizes, operationalizes and empirically tests the significance of social network technology in the workplace.

Appendix A. Construct measures

Code	Constructs and measurements
IMUW	IM Usage at Work, Scale: Strongly disagree (1)–Strongly agree (7)
IMUW1	(1) I often use IM tools to contact other people for my work.
IMUW2	(2) I regularly use IM tools to communicate with colleagues or customers in my daily work.
	The frequency of usage of IM tools to do the following things in my daily work is …
	Scale: Not at all (1)–Frequently (7)
IMUW3	(3) Ask questions.
IMUW4	(4) Answer questions.
IMUW5	(5) Share files.
IMUW6	(6) Work-related socialization.
INT	Interactivity, Scale: Strongly disagree (1)–Strongly agree (7)
INT1	(1) I am able to control my communication at IM tools.
INT2	(2) Via IM tools, the other parties can respond to my communication quickly.
INT3	(3) Using IM tools allows me to acquire information in an interactive way.
WI	Work interruption, Scale: Strongly disagree (1)–Strongly agree (7)
WI1	(1) My work is always interrupted by IM messages.
WI2	(2) I felt IM messages are quite disturbing.
WI3	(3) Using IM tools inhibits my concentration on work.
CQ	Communication quality
	I feel that my communication with colleagues at work is …
CQ1	(1) 1. Untimely–7. Timely.
CQ2	(2) 1. Inaccurate–7. Accurate.
CQ3	(3) 1. Inadequate–7. Adequate.
CQ4	(4) 1. Incomplete–7. Complete.
CQ5	(5) 1. Ineffective–7. Effective.
CQ6	(6) 1. Non-interactive–5. Interactive.
CQ7	(7) I feel that the colleagues with whom I communicate at work are always: 1. absent when needed–7. Present when needed.
MT	Mutual trust, Scale: Strongly disagree (1)–Strongly agree (7)
	Considering my colleagues…
MT1	(1) We make decisions beneficial to each other under any circumstances.
MT2	(2) We are willing to provide assistance to each other without exception.
MT3	(3) We can count on each other at all times.
MT4	(4) The level of trust that exists between us is in general 1 (low)–7 (high).
OS	Outcome satisfaction, Scale: Strongly disagree (1)–Strongly agree (7)
OS1	(1) I am satisfied with the project outcomes produced by my team.
OS2	(2) I am pleased with the quality of work we did in my team.
OS3	(3) I am satisfied with the final project deliverable submitted by my team.
GS	Group satisfaction, Scale: Strongly disagree (1)–Strongly agree (7)
GS1	(1) I am satisfied with my group members.
GS2	(2) I was pleased with the way my teammates and I worked together.
GS3	(3) Grpsat3 I was very satisfied working with this team.
OQ	Outcome quality, Scale: Strongly disagree (1)–Strongly agree (7)
OQ1	(1) The work produced by my team is of a high quality.
OQ2	(2) The project outcome produced by my team was excellent.
OQ3	(3) The deliverables of my team were outstanding.

* Own loading scores are listed in this table, which are all higher than cross loading scores.
Cross loading scores are omitted here for brevity due to space limits.

Appendix B. Results of factor analysis

Items	Components								Communalities
	1	2	3	4	5	6	7	8	
IMUW1	.097	**.674**	−.081	.276	.127	.253	.076	.093	.640
IMUW2	.159	**.727**	.018	.155	.075	.294	.150	.158	.717
IMUW3	.142	**.821**	.094	.119	.092	−.112	.108	−.058	.753
IMUW4	.207	**.855**	.166	.060	.064	−.069	.078	−.051	.822
IMUW5	.245	**.681**	.056	−.046	.071	.050	.193	.132	.592
IMUW6	.272	**.692**	.045	−.026	.010	.118	.239	.097	.637
INT1	.121	.166	.048	.110	.158	.080	**.810**	.103	.754
INT2	.279	.365	.156	.150	−.023	.001	**.725**	.024	.785
INT3	.249	.427	.126	.173	−.024	.088	**.677**	.000	.758
WI1	.015	.225	−.057	.043	**.825**	.009	.046	.067	.744
WI2	.084	.073	.004	.031	**.906**	−.032	.059	−.027	.840
WI3	−.030	−.003	.110	.002	**.875**	.080	.013	−.079	.792

Appendix B (*continued*)

Items	Components								Communalities
	1	2	3	4	5	6	7	8	
CQ1	**.728**	.183	.180	.276	.015	.035	.117	.039	.689
CQ2	**.775**	.180	.181	.249	.077	.052	.237	.051	.795
CQ3	**.839**	.151	.158	.150	.025	.113	.093	.106	.807
CQ4	**.803**	.235	.099	.126	−.003	.277	.099	.073	.818
CQ5	**.756**	.258	.097	.106	.027	.123	.110	.124	.701
CQ6	**.778**	.167	.005	.152	−.049	.105	.183	.238	.759
CQ7	**.658**	.175	.275	.283	.054	−.032	−.031	.059	.627
MT1	.405	.140	.240	**.700**	.091	.126	.168	.109	.795
MT2	.370	.157	.222	**.719**	.014	.159	.202	.146	.815
MT3	.409	.089	.047	**.649**	.020	.189	.058	.288	.721
MT4	.425	.146	.298	**.654**	.013	.130	.160	.055	.765
OS1	.171	.145	.434	.189	.058	**.678**	.090	.263	.814
OS2	.250	.118	.435	.241	.014	**.664**	.068	.227	.821
OS3	.215	.130	.451	.151	.029	**.747**	.067	.096	.861
GS1	.256	.086	.437	.242	−.054	.175	.068	**.704**	.855
GS2	.219	.125	.535	.146	−.023	.132	.073	**.692**	.873
GS3	.230	.124	.421	.192	−.028	.290	.077	**.686**	.844
OQ1	.181	.087	**.863**	.171	.012	.137	.098	.174	.872
OQ2	.182	.071	**.855**	.145	.027	.192	.079	.200	.875
OQ3	.174	.023	**.804**	.100	.050	.313	.085	.192	.832
Eigenvalues	5.532	4.174	3.846	2.629	2.367	2.165	2.075	1.986	
% of variance	17.288	13.045	12.019	8.217	7.398	6.766	6.484	6.206	Total variance = 77.42%

Extraction method: Principal component analysis.
Rotation method: Varimax with Kaiser Normalization.

References

[1] J.S. Armstrong, T.S. Overton, Estimating non-response bias in mail surveys, Journal of Marketing Research 14 (1977) 396–402.
[2] D. Avrahami, S.E. Hudson, Communication characteristics of instant messaging: effects and predictions of interpersonal relationships, Proceedings of the 2006 20th Anniversary Conference on Computer Supported Cooperative Work. CSCW '06, ACM, New York, NY, 2006, pp. 505–514.
[3] R.P. Bagozzi, Y. Yi, L.W. Phillips, Assessing construct validity in organizational research, Administrative Science Quarterly 36 (1991) 421–458.
[4] J. Barnes, Class and committees in a Norwegian island parish, Human Relations 7 (1954) 39–58.
[5] R.M. Baron, D.A. Kenny, The moderator–mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations, Journal of Personality and Social Psychology 51 (1986) 1173–1182.
[6] T.A. Börzel, Organizing Babylon on the different conceptions of policy networks, Public Administration 76 (1998) 253–273.
[7] K.M. Carley, J. Diesner, J. Reminga, M. Tsvetovat, Toward an interoperable dynamic network analysis toolkit, Decision Support Systems 43 (2007) 1324–1347.
[8] W.W. Chin, Issues and opinion on structural equation modeling, MIS Quarterly 22 (1998) vii–xvi.
[9] H.K. Cho, M. Trier, E. Kim, The use of instant messaging in working relationship development: a case study, Journal of Computer-Mediated Communication 10 (4) (2005) http://jcmc.indiana.edu/vol10/issue4/cho.html (Available January 19th, 2011).
[10] E. Cutrell, M. Czerwinski, E. Horvitz, Effects of instant messaging interruptions on computing tasks, Extended Abstracts of CHI '2000, Human Factors in Computing Systems, ACM Press, New York, 2000, pp. 99–100.
[11] R.L. Daft, R.H. Lengel, Information richness: A new approach to managerial behavior and organizational design, in: L.L. Cummings, B.M. Staw (Eds.), Research in Organizational Behavior, JAI Press Inc., Connecticut, 1984, pp. 191–233.
[12] R.M. Davison, C.X.J. Ou, Y. Li, J. Björkstén, Eastwei: a knowledge-based value shop, Proceedings of 13th Pacific Asia Conference on Information Systems, Hyderabad, India, 2009.
[13] Deloitte, Resistance to Change, Budget Constraints and Cost-Cutting Delay New Technologies into the Workplace: Deloitte Poll, http://www.deloitte.com/view/en_US/us/press/Press-Releases/press-release/8696c52c23d85210VgnVCM100000ba42f00aRCRD.htm 2009 (Available January 19th, 2011).
[14] A.R. Dennis, R.M. Fuller, J.S. Valacich, Media, tasks, and communication processes: a theory of media synchronicity, MIS Quarterly 32 (2008) 575–600.
[15] D.G. Dologite, M.Q. Fang, Y. Chen, R.J. Mockler, An information systems view of Chinese state enterprises, Journal of Strategic Information Systems 7 (1998) 113–129.
[16] H. Eyrolle, J.M. Cellier, The effects of interruptions in work activity: field and laboratory results, Applied Ergonomics 31 (2000) 537–543.
[17] M.A. Fuller, A.M. Hardin, R.M. Davison, Efficacy in technology-mediated distributed teams, Journal of Management Information Systems 23 (2006) 209–235.
[18] D. Ganley, C. Lampe, The ties that bind: social network principles in online communities, Decision Support Systems 47 (2009) 266–274.
[19] R.K. Garrett, J.N. Danziger, IM=Interruption management? Instant messaging and disruption in the workplace, Journal of Computer-Mediated Communication 13 (1) (2007) http://jcmc.indiana.edu/vol13/issue1/garrett.html Available January 19th, 2011.
[20] T. Gillie, D. Broadbent, What makes interruptions disruptive? A study of length, similarity and complexity, Psychological Research 50 (1989) 243–250.
[21] T. Gössling, Proximity, trust and morality in networks, European Planning Studies 15 (2) (2004) 675–689.
[22] J.F. Hair, R.E. Anderson, R.L. Tatham, W.C. Black, Multivariate Data Analysis with Readings, 4th ed. Prentice Hall, Englewood Cliffs, NJ, 1995.
[23] E. Isaacs, A. Walendowski, S. Whittaker, D. Schiano, C. Kamm, The character, functions, and styles of instant messaging in the workplace, Proceedings of the 2002 ACM Conference on Computer Supported Cooperative Work, New Orleans, Louisiana, USA, 2002, pp. 11–20.
[24] S.L. Jarvenpaa, D.E. Leidner, Communication and trust in global virtual teams, Organization Science 10 (1999) 791–815.
[25] Z. Jiang, I. Benbasat, Investigating the influence of the functional mechanisms of online product presentations, Information Systems Research 18 (2) (2007) 1–17.
[26] A. Kankanhalli, B.C.Y. Tan, K.K. Wei, Contributing knowledge to electronic knowledge repositories: an empirical investigation, MIS Quarterly 29 (2005) 113–143.
[27] M. Khalifa, N. Shen, System design effects on social presence and telepresence in virtual communities, Proceedings of the 24th International Conference on Information Systems, Washington, DC, USA, 2004, pp. 547–558.
[28] R.M. Kramer, K.S. Cook, Trust and Distrust in Organizations, Russell Sage Foundation, New York, 2004.
[29] J.N. Lee, M.Q. Huynh, R. Hirschheim, An integrative model of trust on IT outsourcing: examining a bilateral perspective, Information Systems Frontiers 10 (2008) 145–163.
[30] D. Li, P.Y.K. Chau, H. Lou, Understanding individual adoption of instant messaging: an empirical investigation, The Journal of the Association for Information Systems 6 (2005) 102–129.
[31] M.K. Lindell, D.J. Whitney, Accounting for common method variance in cross-sectional research designs, Journal of Applied Psychology 86 (2001) 114–121.
[32] P.B. Lowry, N. Romano, J.L. Jenkins, R.W. Guthrie, The CMC interactivity model: how interactivity enhances communication quality and process satisfaction in lean-media groups, Journal of Management Information Systems 26 (2009) 159–200.
[33] G. Mark, V.M. González, J. Harris, No task left behind?: Examining the nature of fragmented work, Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, Portland, Oregon, USA, 2005, pp. 321–330.
[34] D.J. McAllister, Affect- and cognition-based trust as foundations for interpersonal cooperation in organizations, Academy of Management Journal 38 (1995) 24–59.
[35] J.J. Mohr, R.S. Sohi, Communication flows in distribution channels: Impact on assessments of communication quality and satisfaction, Journal of Retailing 71 (1995) 393–415.
[36] G.C. Moore, I. Benbasat, Development of an instrument to measure the perceptions of adopting an information technology innovation, Information Systems Research 2 (1991) 192–222.
[37] B. Nardi, S. Whittaker, E. Bradner, Interaction and outeraction: instant messaging in action, Proceedings of the 2000 ACM Conference on Computer Supported Cooperative Work, Philadelphia, USA, 2000, pp. 79–88.
[38] K.N. Nelson, J.G. Cooprider, The contribution of shared knowledge to IS group performance, MIS Quarterly 20 (1996) 409–432.
[39] B. O'Conaill, D. Frohlich, Timespace in the workplace: dealing with interruptions, Proceedings of CHI, New York, USA, 1995, pp. 262–263.
[40] N. Panteli, S. Sockalingam, Trust and conflict within virtual inter-organizational alliances: a framework for facilitating knowledge sharing, Decision Support Systems 39 (2005) 599–617.

[41] S. Petter, D.W. Straub, A. Rai, Specifying formative constructs in information systems research, MIS Quarterly 31 (4) (2007) 623–656.
[42] P.M. Podsakoff, D.W. Organ, Self-reports in organizational research: problems and prospects, Journal of Management Information Systems 12 (1986) 531–544.
[43] A. Quan-Haase, J. Cothrel, B. Wellman, Instant messaging for collaboration: a case study of a high-tech firm, Journal of Computer-Mediated Communication 10 (4) (2005) http://jcmc.indiana.edu/vol10/issue4/quan-haase.html Available January 19th, 2011.
[44] J. Renneker, L. Godwin, Theorizing the unintended consequences of instant messaging (IM) for worker productivity, Sprouts 3 (14) (2003) 137–168.
[45] E.M. Rogers, D.L. Kincaid, Communication Networks: Toward a New Paradigm for Research, Free Press, New York, 1981.
[46] H.H. Teo, L.B. Oh, C.H. Liu, K.K. Wei, An empirical study of the effects of interactivity on Web user attitude, International Journal of Human-Computer Studies 58 (2003) 281–305.
[47] J.W. Thibaut, H.H. Kelley, The Social Psychology of Groups, Wiley, New York, 1959.
[48] M.M. Wasko, R. Teigland, S. Faraj, The provision of online public goods: examining social structure in an electronic network of practice, Decision Support Systems 47 (2009) 254–265.
[49] K.R. Xin, J.L. Pearce, Guanxi: connections as substitutes for formal institutional support, Academy of Management Journal 39 (1996) 1641–1658.
[50] B. Zhu, S. Watts, H. Chen, Visualizing social network concepts, Decision Support Systems 49 (2010) 151–161.

Carol X.J. Ou is an Assistant Professor of Information Management at Tilburg University. Her research interests include social networks, computer-mediated communication, electronic commerce, website design, and knowledge management in organizations. Her publications have appeared in such journals as Communications of the ACM, Journal of AIS, the International Journal of Human–Computer Studies, Information Technology & People, the Journal of IT Management, and Chinese Management Studies, among others. Carol is also serving as a Senior Editor of journals in the IS field. She is a Certified IS Auditor, an Academic Advocate of IS Audit and Control Association, as well as a Committee Member of various conferences on information systems and technologies.

Robert Davison is an Associate Professor of Information Systems at the City University of Hong Kong. He has published over 50 articles in a variety of journals such as the *Information Systems Journal, IT&People, IEEE Transactions on Engineering Management, Decision Support Systems, Journal of the AIS, Communications of the AIS, Communications of the ACM* and *MIS Quarterly*. Robert is the Editor-in-Chief of the *Electronic Journal of Information Systems in Developing Countries*, a Senior Editor for the *Information Systems Journal,* Co-editor of *Information Technology & People and* Associate Editor of *MIS Quarterly*.