Effects of team member psychological proximity on teamwork performance

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Abstract

Purpose – The aim of this paper is to examine whether team-members’ psychological proximity affects the degree of teamwork quality and therefore affecting the team performance.

Design/methodology/approach – A survey instrument was developed based on extant literature reviews, and administered among information technology professionals. Collected data were analysed using partial least square (PLS) method.

Findings – Team-members’ psychological proximity is found to be significantly related to teamwork quality. The magnitude of relational coefficients between sub-dimensions of psychological proximity and those of teamwork quality turned out to be different from each other.

Research limitations/implications – Psychological proximity is found to critically influence teamwork and performance in IT teams. Also, the four-factor model developed from previous literature is validated for further use. Snowball sampling using IT professionals is the major limitation of this study.

Originality/value – Studies on teamwork quality that employs psychological proximity are scarce. Socialising in workplaces is sometimes viewed as an unproductive activity, however, socialising decreases psychological proximity among team-members, increasing teamwork quality. In addition, examining the psychological proximity in team-members adds to the growing literature on teamwork quality.

Keywords Team performance, Psychological proximity, Team-member proximity, Teamwork quality

Paper type Research paper

1. Introduction

In modern corporate environment, team-members are dispersed across diverse locations for several reasons. First, corporations obtain professional techniques and knowledge needed to perform projects from various locations. Second, they need to co-operate with a wide range of stakeholders. Third, some team-members reside in client firms for certain durations of the project and fourth, innovative projects require specialists and they are often dispersed in diverse locations (Gassmann and Zedtwitz, 2003; Tallman et al., 2004). Being aware of this phenomenon, corporations rely on information and communication technology (ICT) to alleviate distance between team-members. So the new task for today’s corporations is to maximise their teamwork quality to improve team performance in an environment where team-members are dispersed across various locations.

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Whereas many companies successfully cope with this new task, others fail to do so. To understand the reasons behind companies’ success or failure of team projects, scholars have so far focused on the relationship between the physical distance among team-members and team performance, finding rather conflicting results. Kessler (2000), Sethi (2000), Sethi and Nicholson (2001) and Allen (1970) concluded that the failure of a project stems from work environment, where team-members are physically dispersed. In other words, as team-member proximity increases, the frequency and the quality of communication increase, thus resulting in better team performance. However, more recent studies have found that there is an insignificant or hardly any effect of team-member proximity on team performance. Carmel (1999) argued that such contradictory results from the past and the current studies are due to the advancement of ICT which makes physical proximity obsolete.

Recent studies are shedding light on these differences in results. For instance, Wilson et al. (2008) and Chong et al. (2012) summarised previous studies which examined the effect of team-member proximity on team performance. They claimed that the varying results appeared because psychological proximity was not taken into consideration. In support of such argument, some scholars found that the collaboration in a team is significantly affected by social norms, social values, and trust. These factors significantly influence the psychological teamwork mechanisms, such as knowledge transfer and perceived ability of a team, resulting in different degree of team performance (Kimmerle et al., 2008; Jong and Elfring, 2010; Kimmerle et al., 2011; Tan and Lim, 2009).

Psychological proximity bases its theory on the Construal Level Theory (CLT) of psychology. According to Wakslak (2012), CLT comprises of two levels of construals. The high-level construals are abstract in that general representations of an object such as its central and defining elements are captured. On the other hand, low-level construals are concrete in that captures the specific representations, including an emphasis on secondary item features. Thus, people with high-level construals focus more on the defining aspects of an item and make choices consistent with important and generalisable self-aspects such as their central values, ideologies and self-definitions. On the other hand, people with low-level construals focus more on the secondary and unimportant features resulting in decisions that do not strongly reflect attribute-importance (Wakslak, 2012). In other words, depending on the perceived distance between perceiver and the target, they interact differently.

This study examines the effect of the psychological proximity among team-members on teamwork quality and team performance, while taking into consideration the psychological aspect of team-member proximity, which has been largely untouched by previous studies. We extend the extant line of study which examines the effect of team-member proximity on team performance and empirically tests whether team work quality and team performance are affected by the psychological proximity among team-members.

2. Literature review
2.1 Team-member psychological proximity
Psychological proximity is based on the CLT which suggests that an individual's perception of an object or an event is abstract or concrete depending on the psychological distance they perceive (Stephan et al., 2010).
Psychological proximity is researched from three perspectives (Lim et al., 2012). First, spatial distance refers to the perceived spatial distance between the person and the target. Fujita et al. (2006) found that individuals show considerable differences in the degree of their perception of other person according to the psychological distance they feel. In their experiment, two different groups of students were shown a video clip of a student studying. The first group was told that the video clip was shot at a local campus. On the other hand, the second group was told that the video clip was shot abroad. The result showed that the first group felt closer to the person on the video clip. Thus, perceived spatial distance has a considerable impact on the perception of the target. It seems psychological distance has a significant impact on the interaction between individuals, hence playing an important function in team activities including communication.

The second perspective is temporal distance which refers to the time difference between the perceiver and a certain event. Liberman and Trope (1998) and Liberman et al. (2007) showed that when people explained activities which would occur in the distant future, they gave an abstract explanation about why the activities were necessary. On the other hand, when explaining about the near future, they gave a more specific and clear explanation about how the activities would be performed.

The last perspective is social distance, which is the perceived distance in the importance of the relationship (Stephan et al., 2010; Lim et al., 2012). Lim et al. (2012) found the sample group, who watched baseball on-line, felt further psychological distance from the spectators at the stadium but among the three types of psychological proximity, the social distance was felt most highly.

These psychological effects, when applied to corporate environment, may render wrong cognitions and perceptions of team-members when they are far apart from each other and may negatively affect the performance of team-based tasks. Thus, one way of effectively operating a team and bringing out good performance is narrowing the psychological distance among team-members.

2.2 The components of teamwork quality
As the research scope and the definition of teamwork have caused confusion, recent studies have strived to conceptualise and redefine the concept. Salas et al. (2008) collected teamwork related literature from past 20 years to propose “The Big Five” referring to the defining factors of teamwork. Through the review of literature, they extracted most cited constructs: team leadership, team orientation, mutual performance monitoring, backup behaviour and adaptability.

In the project management field, Baiden and Price (2011) utilised “Effective Teamwork Assessment Matrix”, created by a company named Constructing-Excellence. It is widely used by the business field to assess corporate teamwork quality. The matrix consists of variables such as team identity, shared vision, communication, collaboration and participation, issue negotiation and resolution and reflection and self-assessment. Hatcher and Ross (1991) studied the relationship between teamwork and product quality. They viewed factors of teamwork as helpfulness, coordination of effort, open communication, and friendliness. Yang et al. (2011) proposed much simpler components of teamwork. They examined the impact of teamwork on project performance and how it is moderated by different variables. In
their study they used communication, collaboration and cohesiveness to measure teamwork.

Hoegl and Gemuenden (2001) created teamwork quality measurement tool called TWQ in an effort to identify factors of teamwork. The TWQ consists of six facets:

1. communication;
2. mutual support;
3. effort;
4. coordination of effort;
5. balance of member contribution; and
6. cohesion.

The TWQ was continuously used by Hoegl et al. (2003), Hoegl and Proserpio (2004), Hoegl et al. (2004), Hoegl and Parboteeah (2006), Hoegl et al. (2007), Hoegl and Parboteeah (2007) and has been proven of its validity as an effective measurement tool.

As discussed above, the concept of teamwork has been defined differently depending on the scope of the study. Therefore, to clarify the multidimensionality of the concept, as expressed by Salas et al. (2008), we found it necessary to deconstruct the existing definitions into their comprising components and reorganise them according to common characteristics. We first collected widely used teamwork quality measurement tools, then analysed the factors comprising those tools. We found that each factor fell under one of four characteristics:

1. communication;
2. collaboration;
3. coordination; and
4. cohesion.

First, the ‘coordination’ factor refers to “the degree of common understanding regarding the interrelatedness and current status of individual contributions…” (Hoegl and Gemuenden, 2001). Second, the ‘collaboration’ factor indicates the ability to understand the task of each other and collaborate through information exchange. Third, the ‘communication’ factor indicates the frequency of information exchange. Last, the ‘cohesion’ factor refers to the degree of mutual interaction between team-members to create unity within the team. The extracted four factors are used as the basis for this study. Table I shows the detailed organisation of the four factors.

3. Research model and hypotheses

3.1 Research model

The purpose of this study is to empirically test the effect of team-member proximity on teamwork quality and team performance. Based on the discussions so far, the research model has been designed, as shown in Figure 1. The research model consists of eight variables. Psychological proximity is divided into three sub-variables: spatial distance, temporal distance and social distance. Teamwork quality consists of communication, coordination, collaboration and cohesion. Last, team performance is the dependent variable of the model.
<table>
<thead>
<tr>
<th>Study</th>
<th>Communication</th>
<th>Collaboration</th>
<th>Coordination</th>
<th>Cohesion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hatcher and Ross (1991)</td>
<td>Communication</td>
<td>Helpfulness</td>
<td>Coordination of effort</td>
<td>Friendliness</td>
</tr>
<tr>
<td>Hoegl and Gemuenden (2001); Hoegl et al. (2003); Hoegl and Proserpio (2004); Hoegl and Parboteeah (2006, 2007), Hoegl et al. (2007)</td>
<td>Communication</td>
<td>Mutual support</td>
<td>Coordination of effort</td>
<td>Cohesion</td>
</tr>
<tr>
<td>Salas et al. (2008)</td>
<td>–</td>
<td>Mutual support</td>
<td>Constructive conflict</td>
<td>–</td>
</tr>
<tr>
<td>Van den Bossche et al. (2006)</td>
<td>–</td>
<td>Mutual support</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Baiden and Price (2011)</td>
<td>–</td>
<td>Issue negotiation and resolution</td>
<td>–</td>
<td>Shared vision</td>
</tr>
<tr>
<td>Hsu et al. (2012)</td>
<td>Communication</td>
<td>–</td>
<td>Coordination</td>
<td>–</td>
</tr>
<tr>
<td>Yang et al. (2011)</td>
<td>Communication</td>
<td>Collaboration</td>
<td>–</td>
<td>Cohesiveness</td>
</tr>
</tbody>
</table>

Table I. The four factors of teamwork
3.2 Spatial distance and teamwork quality

Generally, team-member proximity is perceived as one of the important factors that affect team performance (Hoegl et al. 2007). According to the proximity theory, an increase in distance interferes with communication by decreasing unofficial interaction and the chances of contact (Cummings, 2004; Salas et al., 2008). Therefore, in project teams where the distance between team-memgers is far, the possibility of involvement in unofficial socialisation, personal relationship and trust building is relatively low and it takes longer time than in traditional teams which work together in the small vicinity (Kraut et al., 2002; Lim et al., 2012; Olson et al., 2002). However, this is the effect that comes from situations where only physical proximity is considered. Torre and Rallett (2005) argued that the determining factor for team-member proximity is not only physical proximity but also the perceptions of distance by team-members.

Interestingly, in the study by Wilson (2001), even when team-members were working in the same locations, the perceived spatial distance was found to be far. Therefore, the frequency of communication was low and the team-members were not able to socialise with each other. Ultimately, team-members felt low team identity. On the other hand, Kogut and Metiu (2001) found that open-source software development teams were feeling close spatial distance even when they were dispersed around the globe. More than 1,000 developers worked together to achieve high performance such as developing the Linux OS. The authors interpreted that these performances were achieved because of the workers' common identities as a 'Hacker' and their passionate willingness to communicate. This resulted in decreased perception of spatial distance. These results show that spatial distance has a close relationship with qualities of teamwork and eventually with team performance as well. We propose our first set of hypotheses as follows:

H1a. A decrease in spatial distance will positively affect communication.

H1b. A decrease in spatial distance will positively affect collaboration.
3.3 Temporal distance and teamwork quality

According to Liberman et al.’s (2007) three perspectives of psychological proximity, the second component is temporal distance, which is the time difference between the perceiver and a certain event. Liberman and Trope (1998) show that an individual is interpreting the same event differently depending on the perceived temporal distance. For example, when people perceived an event of ‘moving to a new place’, under the condition of ‘in the next year’, they interpreted as ‘life’s new beginning’. However, when the condition was in near future such as ‘tomorrow’, they made more precise interpretation of an event as ‘packing things and moving them’. Temporal distance can occur when tasks require time difference. Such temporal distance can disturb synchronous communication and cause a negative effect on teams that are dispersed. Therefore, we propose the following set of hypotheses:

\[
\begin{align*}
H2a & \text{. A decrease in temporal distance will positively affect communication.} \\
H2b & \text{. A decrease in temporal distance will positively affect collaboration.} \\
H2c & \text{. A decrease in temporal distance will positively affect coordination.} \\
H2d & \text{. A decrease in temporal distance will positively affect cohesion.}
\end{align*}
\]

3.4 Social distance and teamwork quality

Social distance is based on the social capital theory. The social capital theory states that an individual or a group contains potential resources which are linked by networks (Bourdieu, 1985; Nahapiet and Ghoshal, 1998). Therefore, in teams where the social ties are strong, the formation of social network can greatly benefit the team. Herbsleb and Mockus (2003) argued that teams with dispersed team-members have relatively smaller social network than teams working in single space. Also, this phenomenon reduces communication frequency and creates difficulties in finding the member with information in need. Furthermore, dispersed team-members have much harder time recognising themselves as part of the team. Kotlarsky and Oshiri (2005) argued that creating social tie among team-members is critical in effective knowledge sharing and collaboration (Kotlarsky and Oshiri, 2005). Therefore, we propose the following set of hypotheses:

\[
\begin{align*}
H3a & \text{. A decrease in social distance will positively affect communication.} \\
H3b & \text{. A decrease in social distance will positively affect collaboration.} \\
H3c & \text{. A decrease in social distance will positively affect coordination.} \\
H3d & \text{. A decrease in social distance will positively affect cohesion.}
\end{align*}
\]

3.5 Teamwork quality and team performance

Teamwork refers to a process of interaction between individuals in reaching for a common goal (Hoegl and Parboteeah, 2006; Hsu et al., 2012; Salas et al., 2001; Salas et al., 2008; West, 2012), which means that teamwork quality and team performance are
inseparable. In Dayan and Di Benedetto (2008), team performance was used as the dependent variable for the study of relationship between teamwork quality and team performance. Our last set of hypotheses is:

- **H4a.** An increase in communication will positively affect team performance.
- **H4b.** An increase in collaboration will positively affect team performance.
- **H4c.** An increase in coordination will positively affect team performance.
- **H4d.** An increase in cohesion will positively affect team performance.

### 4. Methodology

#### 4.1 Collecting data

To collect the data, we targeted IT professionals who have experience in IT projects. The survey was conducted using ‘snowball sampling’, in which we contacted an IT professional in a team, then asked the other team-members to fill out the form. All constructs considered in this study were based on items, which have already been proven of their reliability and validity in prior studies. A total of 28 questions were measured using a seven-point Likert scale (1 = strongly disagree, 7 = strongly agree). The survey started in September of 2012 and ended in October the same year. A total of 223 data sets were collected and 207 sets were used for the analysis of the data.

The demographic characteristics are analysed and shown in Table II. The most observed work tenure period was 11 years and more 41.55 per cent (86). Among the respondents of the survey, project managers were 25.12 per cent (52) and project
leaders were 22.22 per cent (46). Most of the teams were made up of less than 10 team-members (48.79 per cent; 101). In addition, the most observed project duration was 3 to 6 month (48.79 per cent).

4.2 Operational definitions
The definition of team-member proximity is based on psychological proximity, defined by Lim et al. (2012) as the spatial, temporal and social distance the team-member feels towards other team-members. The ten measurement items for team-member psychological proximity are adopted from Lim et al. (2012). Teamwork is defined as “the interdependent components of performance required to effectively coordinate the performance of multiple individuals” by Salas et al. (2008). For the measurement items, we adopted various teamwork quality measurement tools such as TWQ by Hoegl et al. (2004) to the four factors of teamwork quality previously elicited. Last, team performance is defined as perceived team performance by team-members, following Hoegl and Gemuenden (2001).

5. Methodology and data analysis
We employed partial least squares (PLS) path modelling to analyse the data. We used SmartPLS 2.0 M3 software to run the analysis (Ringle et al., 2005). PLS is a statistical method which, unlike the LISERL and AMOS which are based on the covariance analysis, is based on the principal component analysis. The reasons for using PLS are twofold. First, PLS has an advantage in its relatively small sample size requirement. Second, it is well known for its flexibility in modelling higher-order constructs and direct, indirect and interaction effects (David et al., 2000). The PLS analysis consists of two steps. In the first step, all measurement models were examined for proper psychometric properties. The second step focused on testing the research model and hypotheses-structural model.

5.1 Measurement model
It is a widely accepted view that the reliability is acceptable when the composite reliability value is above 0.7 and Cronbach’s $\alpha$ is above 0.7 (Hair et al., 1995). As shown in Table III, both are above 0.7. Furthermore, the AVE values are above the threshold of 0.5, indicating the reliability between constructs is also reliable. Convergent validity refers to the degree of relationship between constructs that are supposed to be related, and discriminant validity refers to the degree of relationship between constructs that are not supposed to be related. Convergent validity can be evaluated using the composite reliability, Cronbach’s $\alpha$ and the average variance extracted (AVE) values. According to Fornell and Larcker (1981), the comparison between the correlation between variables and the square root of AVE can determine the discriminant validity. Table III presents the results of these comparisons.

Hair et al. (1995) suggests that convergent validity can be achieved when the AVE value is above 0.5, the composite reliability value above 0.8 and the Cronbach’s $\alpha$ value above 0.7. As shown in Table III, all the variables’ AVE values, composite reliability values and Cronbach’s $\alpha$ satisfy these criteria. Also, each of the square roots of AVE is greater than the neighbouring correlation values, which indicates the measurement items used in this study satisfy discriminant validity. In addition, communality is another indicator of the quality of the measurement model, which shows the reliability
<table>
<thead>
<tr>
<th>Variable</th>
<th>AVE</th>
<th>Composite reliability</th>
<th>Cronbach’s $\alpha$</th>
<th>$R^2$</th>
<th>Spatial</th>
<th>Temporal</th>
<th>Social</th>
<th>Communication</th>
<th>Collaboration</th>
<th>Coordination</th>
<th>Cohesion</th>
<th>Team performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spatial</td>
<td>0.721</td>
<td>0.885</td>
<td>0.809</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temporal</td>
<td>0.737</td>
<td>0.893</td>
<td>0.821</td>
<td>0.696</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social</td>
<td>0.683</td>
<td>0.865</td>
<td>0.764</td>
<td>0.544</td>
<td>0.572</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communication</td>
<td>0.641</td>
<td>0.899</td>
<td>0.859</td>
<td>0.426</td>
<td>0.576</td>
<td>0.558</td>
<td>0.543</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collaboration</td>
<td>0.809</td>
<td>0.927</td>
<td>0.882</td>
<td>0.302</td>
<td>0.315</td>
<td>0.373</td>
<td>0.419</td>
<td>0.417</td>
<td>1.000</td>
<td></td>
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</tr>
<tr>
<td>Coordination</td>
<td>0.718</td>
<td>0.884</td>
<td>0.805</td>
<td>0.462</td>
<td>0.459</td>
<td>0.497</td>
<td>0.691</td>
<td>0.526</td>
<td>1.000</td>
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</tr>
<tr>
<td>Cohesion</td>
<td>0.841</td>
<td>0.914</td>
<td>0.812</td>
<td>0.484</td>
<td>0.592</td>
<td>0.614</td>
<td>0.653</td>
<td>0.562</td>
<td>1.000</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Team performance</td>
<td>0.709</td>
<td>0.924</td>
<td>0.898</td>
<td>0.597</td>
<td>0.403</td>
<td>0.471</td>
<td>0.451</td>
<td>0.616</td>
<td>0.595</td>
<td>0.681</td>
<td>0.641</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Table III. Results of the CFA and Correlations (with AVEs in the diagonal)
of indicators. In this study, the communality values are above the threshold of 0.5, signalling the acceptable quality of the measurement model. The result of the analysis shows that both convergent validity and discriminant validity are achieved.

5.2 The structural model
To analyse the structural relationships of the model, we used PLS's bootstrap routine with 500 iterations. Bootstrap recalculates the sample collected through the survey to estimate the measured value that holds a similar sampling distribution. This is used to evaluate the path coefficient’s significance (Temme et al., 2006; Tenenhaus et al., 2005).

The result of bootstrapping using the 207 data collected through the survey is shown in Table IV. The path coefficient result shows that all hypotheses are supported except H1b, H1d, H2a and H2c. Structural models are evaluated on the basis of the predictive relevance of the latent variables. This is done by analysing the multiple $R^2$ and the Stone-Geisser’s $Q^2$ coefficients, which are cross verified redundancy values. They are statistical estimates which represent the quality of the structural model and positive values support that observed values are well reconstructed (Tenenhaus et al., 2005). These statistical values of all the variables, with the exception of the three factors of the psychological proximity (spatial, temporal and social distance), are found to be positive. This indicates that the quality of the structural model is sound.

The quality of a PLS structural model can also be assessed using the $R^2$ of each variable. Normally, there are three $R^2$ thresholds that are used for interpretation: if the value is greater than 0.26, the variable is significant; if it is between 0.13 and 0.26, the variable is tangent; if it is between 0.02 and 0.13, the variable is not significant (Cohen, 1977). The $R^2$ of this study suggests all the variables are significant except collaboration, which is tangent.

Last, the goodness-of-fit is defined as the square root of the average $R^2$ of all endogenous variables times the average value of communality (Tenenhaus et al., 2005). The resulting value must be greater than 0.1 and there are three thresholds that are

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Structural relations</th>
<th>Path coefficient</th>
<th>$T$-statistics</th>
<th>Verification</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1-a</td>
<td>Spatial → Communication</td>
<td>0.287***</td>
<td>3.317</td>
<td>Supported</td>
</tr>
<tr>
<td>H1-b</td>
<td>Spatial → Collaboration</td>
<td>0.022</td>
<td>0.251</td>
<td>Rejected</td>
</tr>
<tr>
<td>H1-c</td>
<td>Spatial → Coordination</td>
<td>0.189*</td>
<td>2.432</td>
<td>Supported</td>
</tr>
<tr>
<td>H1-d</td>
<td>Spatial → Cohesion</td>
<td>0.024</td>
<td>0.297</td>
<td>Rejected</td>
</tr>
<tr>
<td>H2-a</td>
<td>Time → Communication</td>
<td>0.203</td>
<td>1.761</td>
<td>Rejected</td>
</tr>
<tr>
<td>H2-b</td>
<td>Time → Collaboration</td>
<td>0.186</td>
<td>1.79</td>
<td>Rejected</td>
</tr>
<tr>
<td>H2-c</td>
<td>Time → Coordination</td>
<td>0.15</td>
<td>1.41</td>
<td>Rejected</td>
</tr>
<tr>
<td>H2-d</td>
<td>Time → Cohesion</td>
<td>0.345***</td>
<td>3.751</td>
<td>Supported</td>
</tr>
<tr>
<td>H3-a</td>
<td>Social → Communication</td>
<td>0.271**</td>
<td>2.799</td>
<td>Supported</td>
</tr>
<tr>
<td>H3-b</td>
<td>Social → Collaboration</td>
<td>0.301**</td>
<td>3.26</td>
<td>Supported</td>
</tr>
<tr>
<td>H3-c</td>
<td>Social → Coordination</td>
<td>0.308**</td>
<td>2.813</td>
<td>Supported</td>
</tr>
<tr>
<td>H3-d</td>
<td>Social → Cohesion</td>
<td>0.404***</td>
<td>4.134</td>
<td>Supported</td>
</tr>
<tr>
<td>H4-a</td>
<td>Communication → Team performance</td>
<td>0.185</td>
<td>2.413</td>
<td>Supported</td>
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<tr>
<td>H4-b</td>
<td>Collaboration → Team performance</td>
<td>0.201*</td>
<td>2.337</td>
<td>Supported</td>
</tr>
<tr>
<td>H4-c</td>
<td>Coordination → Team performance</td>
<td>0.320***</td>
<td>4.043</td>
<td>Supported</td>
</tr>
<tr>
<td>H4-d</td>
<td>Cohesion → Team performance</td>
<td>0.227*</td>
<td>2.977</td>
<td>Supported</td>
</tr>
</tbody>
</table>

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

Table IV. Summary of the hypothesis tests
6. Discussion and conclusion

An analysis of the survey data shows that the three factors of psychological proximity have an impact on teamwork quality, thereby affecting team performance. The first finding is that decreasing spatial distance positively affects the communication and the coordination factors of teamwork quality. The second finding is that temporal distance has the least impact on teamwork quality out of the three psychological proximity components. It is found to affect only the cohesion factor of teamwork quality. The third finding is that social distance affects all four factors of teamwork quality. Ultimately, psychological proximity positively affects teamwork quality, thus bolstering team performance.

The main theoretical implications are threefold. First, the findings are consistent with previous study suggesting that psychological proximity affects teamwork (Chong et al., 2012; Wilson et al., 2008). This indicates that to enhance the teamwork quality and the team performance of teams with dispersed team-members, psychological proximity must be considered. Second, each of the three psychological proximity factors (spatial, temporal and social distance) has a different effect on the teamwork quality factors. Among these factors, social distance has the strongest influence and has an effect on all of the four factors of teamwork quality. This implies that spatial distance and temporal distance can be conquered by creating strong social ties among team-members. Third, the four factors of teamwork quality proposed further extend the teamwork quality literature. These findings support the results presented in previous studies such as works by Hoegl and Gemuenden (2001), Hoegl et al. (2003), Hoegl and Proserpio (2004), Hoegl et al. (2004), Hoegl and Parboteeah (2006), Hoegl et al. (2007), Hoegl and Parboteeah (2007). The congruency with prior studies confirms that the qualities of teamwork we reconstructed through the four factors of teamwork quality provide a useful framework that enriches the extant literature.

Our findings also have implications at the managerial level. First, the results of this study suggest that reducing social distance helps overcome spatial and temporal distance. In other words, project teams with dispersed team-members can reduce their psychological distance by getting close to one another personally. Thus, it is recommendable for corporations to devise ways to enhance social ties among team-members. Second, spatial distance affects the communication and the coordination factors of teamwork quality. In order to prevent the distortion of knowledge and information during transfer, corporations should set strict standards for documentation. Third, although the effect of temporal distance is diminishing due to technologies such as e-mail, peer-to-peer file sharing and cloud computing, our results suggest that it has a clear impact on cohesion. This means that for mutual interaction and solidarity, synchronous interaction and unofficial contacts are still crucial for team identity. Companies may provide opportunities for team-members to get together periodically holding workshops and seminars.

The limitations of this study are as follows. In the field of teamwork performance, there are diverse views on the defining dimensions such as governance (autonomy) and technical (organising/job design) (Muller et al., 2000; Rasmussen and Jeppesen, 2006;
Thompson and Wallace, 1996). However, this study employed dimensions of teamwork quality that are best related to psychological aspects of a team. Thus, this study left other defining dimensions untouched.

In conclusion, for the future studies, it would be significant and interesting to consider other defining dimensions as the conceptualisation of teamwork quality is a social nature. Also, by expending the data sets to world-wide samples from different cultures, it can better explain the causality.

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