How the Team Norm of Information Exchange and Team Information Processing Affects Team Performance in Software Development Projects?

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Abstract

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This study examines how the team norm of information exchange and team information processing affects team performance. Data were collected from 354 project teams from software development companies in Thailand. Structural Equation Modelling (SEM) was conducted to test the proposed hypotheses. The results of the study revealed that team norms of information exchange (TNM) has a significant relationship with team information processing (PRO). Team information processing positively influences team performance (TPM). Software development organisations could adopt such norms and this team process to improve software development projects performance and recognise team processes, which is essential for long-term sustainability and competitiveness.

Keywords: team norms of information exchange, team information processing, team performance, software development project
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Introduction

Software development is a human-centered process that involves a range of task uncertainty and teamwork challenges (Trendowicz et al., 2008). It involves a high degree of problem solving to arrive at a solution that satisfies the needs of the customer (Eid & Millham, 2013; Ahmed, Capretz, Bouktif, & Campbell, 2012). Team members must deal with the inevitable ambiguity of project goals (Faraj & Sambamurthy, 2006). Moreover, as described by Ebert and Neve (2001), software development requires a high level of teamwork and communication. Numerous software projects fail as systems that are not functioning as planned, not being used, or never completed (Wallace, Keil, & Rai, 2004). Therefore, it is critical to understand what is required to deliver high quality applications on time and within budget (Açıkgöz, Günsel, Bayyurt, & Kuzey, 2014).

The team process is linked to greater team innovation and adaptability, which future organizations expect (Curral, Forrester, Dawson, & West, 2001). Other software development studies highlighted the significance of team processes in software development project performance (Akgün, Lynn, Keskin, & Dogan, 2014; Srivastava, Bartol, & Locke, 2006; Yang & Tang, 2004; Guinan, Cooprider, & Faraj, 1998). Sawyer and Guinan (1998) discovered that team processes result in high-quality software development and are significantly predictive of team performance. Developing and sharing information within teams leads to better performance (Basaglia, Caporarello, Magni, & Pennarola, 2010). However, the link between information processing and software development team performance has been little studied.

Team norms may be significant determinants of team performance (Cohen & Bailey, 1997). When working on a software development project, team norms allow participants to use their information processing skills to produce high-quality software (Açıkgoez et al., 2014;Basaglia et al., 2010). However, teamwork problems can occur in a software development project if they have difficulty implementing the team norm (Maheshwari, Kumar, & Kumar, 2012). Software development is a dynamic process where teams from different experiences come together to create a software application (Sawyer et al., 2010; Guinan et al., 1998). Team norms reinforce devotion to tasks and guide team members' actions (Açıkgoez et al., 2014). However, little research has been undertaken to examine the relationship between team norm of information exchange and team information processing in software development projects.

This study's aim is: (1) to examine the relationship between the team norm of information exchange and team information processing (2) to examine team information processing and team performance.

Theoretical Background and Hypothesis development

The definitions of the variable

The team norm of information exchange refers to the collective willingness of team members to proactively provide each other with helpful information (Deeter-Schmelz & Ramsey, 2003). Team information processing refers to the exchange and analysis of information within the team (Van Offenbeek, 2001). Team performance was assessed for both product and process, with product performance being an indicator of software quality. Software development efficiency is measured by process performance (Liang, Liu, Lin, & Lin, 2007).

Influence of Team norm of information exchange

Lenberg and Feldt (2018) emphasize the great importance of team norms in software development programs and state that the clarity of team norms is a better indicator of team members' performance. According to the normative conduct theory of Cialdini, Kallgren, & Reno, (1991) the effect of team norms of information exchange on team information processing depends on the principle of injunctive norms. When an individual must decide whether to share or discuss information with team members, explicitly establishing team norms allows the individual to spend less time discussing what team activities are appropriate (Wageman, Hackman, & Lehman, 2005). Team norms also allow team members to participate in more interpersonal interactions and share essential information, which leads to new ideas for teamwork (Chatman & Flynn, 2001).

Deeter-Schmelz and Ramsey (2003) found that team norms of information exchange impact team information processing practices. Kim and Shin (2015) also found that cooperative norms encourage team members to be more engaged in sharing information and skills with their teammates, leading to increased team creativity. Based on the previous findings, we proposed that

H1. Team norm of information exchange is positively related to team information processing

Influence of Information processing and Team performance

Information processing in a team will positively influence team performance. According to the research of Faraj and Sproull (2000), coordination and integration of knowledge among team members can improve the performance of software projects. The results and data generated by sharing information within the team would likely take less time for each team member. It is more likely that team members can gain shared knowledge by this process and develop their ability to manage a project, contributing to higher team performance (Chamtitigul and Li, 2021; Chow, 2018).

Leicher and Mulder (2016) have already shown that knowledge sharing shows a significant effect on team performance. Team information processing was found to be a good predictor of team performance in software development projects by Chamtitigul and Li (2021). Thus, we proposed:

H2. Team Information processing is positively related to team performance.

Methodology

Sample and procedure

The study's participants are software development project teams from Thai software and IT consulting firms. We collect the list of companies from the database of the Agency for the Promotion of Digital Economy (DEPA) and then contacted HR managers and addressed the objectives of this research. The project selection requirements were told once they confirmed their participation. The first criterion, the team must have consisted of at least two members. The second, the project must only be finished within the last 12 months. HR managers chose the teams and the questionnaires were completed using an online survey program. Additional, one respondent per project was asked to complete the questionnaire based on his or her observations from the behavior of the team members rather than personal preferences. Twenty questionnaires were removed due to the halo effect and 56 questionnaires were removed due to team leader self-assessment. The final sample thus comprised 354 valid responses. Table 1 provides an overview of the sample in terms of demographic and project information.

Table 1: Description of the final sample

Variables	Categories	Frequency	Percent
1. Gender	Male	211	59.6%
	Female	143	40.4%
2. Age	Less than 30	212	59.9%
	30-40	111	31.4%
	41-50	24	6.8%
	≥51	7	2%
3. IT year experience	0-5 years	221	62.4%
	6-10 years	81	22.9%
	11-15 years	35	9.9%
	>15 years	17	4.8%
4. Avg. team size	2-3 team members	108	30.5%
	4-7 team members	152	42.9%
	>7 team members	94	26.6%
5. Avg. project duration	<1year	296	83.6%
	1-2 years	43	12.2%
	>2 years	15	4.2%

Measures

The measurements were established based on previous research. All constructs were evaluated using a five-point Likert scale. Project duration and team size were controlled for the proposed model. Table 2. shows the list of constructs and sources.

Table 2. List of constructs and sources

Construct	Number of questions	Source

Team norm of information exchange	3	Deeter-Schmelz and Ramsey, (2003)
Team information processing	4	Van Offenbeek, 2001; Islam, Doshi, Mahtab and Ahmad (2009);
Team performance	7	Maheshwari et al. (2012)

Results

Descriptive statistics

Table 3 shows the construct means, standard deviations, and the intercorrelations between the constructs. Intercorrelations between constructs ranged between - 0.210 and 0.561. We found the positive correlation between 1) Team norm of information exchange and information processing, 2) Team norm of information exchange and performance, 3) Team information processing and performance, and 4) team size and project duration.

Table 3: Construct Means, Standard Deviations, and Correlations

Variable	Mean	S.D.	Correlations			
			TNM	PRO	TPM	TMS
1. Team norm of information exchange	4.29	.67				
2. Team information processing	4.09	.65	.561**			
3. Team performance	3.96	.65	.438**	.488**		
4. Team size	6.23	4.97	-.074	-.025	-.095	
5. Project duration	9.34	8.51	-.085	-.084	-.210**	.207**

**. Correlation is significant at the 0.01 level (2-tailed).

Confirmatory factor analysis of measurement model

We conduct confirmatory factor analyses (CFA) to assess the fit between the observed data before testing the hypotheses. Table 4 shows that all Cronbach's alpha values are greater than 0.70, demonstrating high internal consistency for the measurements (Nunnaly, 1978). This study then examined convergent validity. Convergent validity is a term that refers to the extent to which the new scale correlates with other variables and measures of the same construct. All factor loadings were significantly higher than the acceptable standard of 0.5 (p <0.01) proposed by Hair, Black and Babin (1998). All composite reliability scores (CR) exceeded the reliability threshold of 0.7 (Hair, Black, Babin, Anderson, & Tatham, 2006; Fornell & Larcker, 1981). Also, the average variance extracted (AVE) values were more significant than 0.50, indicating acceptability (Hair et al., 2006). Thus, all values of the structures are convergent valid.

Table 4: Confirmatory factor analysis of the measurement model

Construct	Factor loading	α	CR	AVE
ENM		0.898	0.903	0.756
ENM1	0.904			
ENM2	0.891			
ENM3	0.810			
PRO		0.882	0.873	0.631
PRO1	0.818			
PRO2	0.871			
PRO3	0.771			
PRO4	0.771			

Team performance		0.892	0.922	0.558
TPM1	0.752			
TPM2	0.733			
TPM3	0.779			
TPM4	0.711			
TPM5	0.757			
TPM6	0.720			
TPM7	0.728			

Note: All t-values are significant at 0.001 level. TNM = team norm of information exchange; PRO = Team information processing; TPM = Team performance.

We also examined discriminant validity. The square root of AVE and squared correlation coefficients were presented in the validity. From the results in Table 5, it can be concluded that the square root of AVE for each construct is above 0.5 and greater than the squared correlation coefficients for each construct (Fornell & Larcker, 1981), which confirms discriminant validity.

Table 5: The construct's discriminant validity

Construct	1	2	3	4	5
1. ENM	*0.869*	-	-	-	-
2. PRO	0.315	*0.795*	-	-	-
3. TPM	0.192	0.238	*0.747*	-	-

Note: The diagonals describe the square root of the extracted average variance (AVE), and the other items are the squared correlation coefficients (r^2)

Hypothesis testing

We run Structural Equation Modelling (SEM) to answer the research questions. Figure 1 shows the results (x^2=254.334; df=99; *p*=0.0; x^2/df=2.57; RMSEA=0.067; CFI =0.95; TLI=0.94; SRMR=0.055). As indicated, we found that the TNM-PRO relationship was significant (β= 0.641, $p < 0.01$), indicating that *H1* was supported. The PRO - TPM relationship was also significant (β = 0.556, $p < 0.01$), supporting *H2*. Team size (TMS) and project duration (PRJ) were added when testing the model to address a possible confounding effect. We also found PRJ had a positive effect on TPM.

Figure 1. Hypothesis proposed model
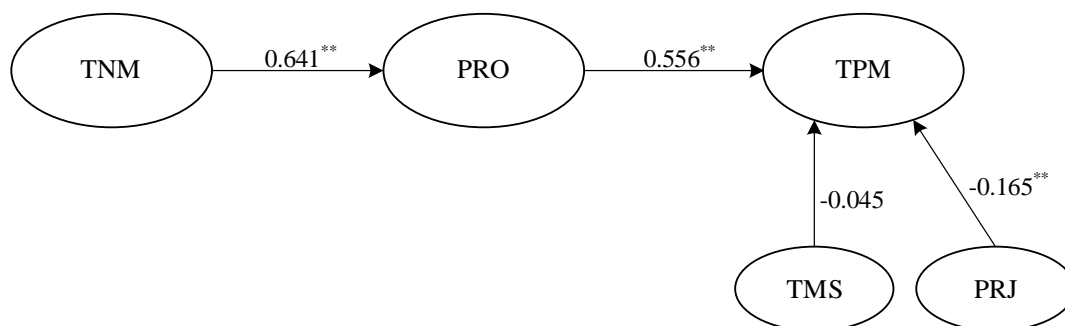
Discussion

Theoretical implications

The aim of this study to examine the influence of team norm information exchange and information processing on team performance. First, we found that team norm of information exchange is positively related to team information processing. Consistent with normative conduct theory (Cialdini et al., 1991), the influence of team norm of information exchange on team information processing is due to

the principle of injunctive norms. Established group norms allow members to collectively process input according to agreed-upon rules. Our results are consistent with previous studies, i.e., team norm has an impact on team processes (Taggar & Ellis, 2007; Shin & Eom, 2014). Second, we also found that team information processing positively predicted team performance. Information processing in a team contributes to the creation of high-quality software applications. Processing information in a team increases productivity because it takes less time and therefore software can be produced faster. Our results are consistent with previous studies, i.e., team process influences team performance (Chamtitigul & Li, 2021; Lee, Gillespie, Mann, & Wearing, 2010; Liu, Keller, & Shih, 2011; Mathieu & Schulze, 2006; Schippers, Homan, & Van Knippenberg, 2003). Appropriate team norms enable team members to move in the same direction and function positively, and promote interactions among team members and team performance (Wang, 2010).

Practical implications

This study provides practical implications for organizations that desire to building teamwork. First, as our results showed, the team norm facilitates the team process that enables the team to develop the task strategically. Therefore, it may be effective for organizations to encourage teams to create a norm of information exchange when the project is in its initial stages. To promote the team norm of information exchange, managers should support and encourage open and transparent communication to continuously maintain effective information sharing and discussions. Maintaining communication behavior in teamwork then becomes a pattern of information exchange behavior and establishes such norm among team members to work together respectfully. Second, we found that team information processing positively predicts team performance. Organizations should recognize the need for team processes (e.g., team information processing) in software development projects. Team information processing promotes social interaction among team members. It also provides an opportunity to share relevant knowledge, which leads to new ideas for higher team performance. Due to the greater complexity of today's businesses and the growing demand for accurate information, managers should emphasise the value of team processes, which are a strategic management tool for long-term success and competitive advantage.

Limitation and future research

This study has limitations that should be taken into account in future studies. First, the results of this study were based on a survey of workers from Thailand. Thus, we are unable to generalize our findings for the workers of other societies. Second, this study was conducted using self-reported information from single respondents. The use of single-response data likely produces the effect of common method bias (CMB), which tend to produce non-causal relationship. Third, this study's survey was limited to a single industry.

For future research, we suggest to investigate the different types of team processes (e.g., team reflexivity) in the relationship between such norms and team performance. In addition, to confirm our findings, researchers could examine team norms of information exchange and information processing on other types of performance.

Conclusion

This study provides a theoretical evidence-based framework for managing teamwork. The results show that team norms of information exchange significantly influence team information processing. Team information processing positively influences team performance. Our findings will help software development organisations establish team norms and team processes that improve software development project performance.

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