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The influence of ethical leadership and team learning on team performance in software development projects

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Abstract

Purpose – The purpose of this paper is to examine the effect of team learning processes (information acquisition, information processing and information storage and retrieval) on team performance in software development projects and to assess the effect of ethical leadership and its influence on these processes.

Design/methodology/approach – The authors examined 354 software development project teams in Thailand. A quantitative study was conducted through a Web-based survey, with structural equation modelling used to test the hypotheses.

Findings – The results of this study revealed that ethical leadership is positively correlated with the team learning processes of information acquisition, information processing and information storage and retrieval. However, only information processing and information storage and retrieval are positively related to team performance. The results indicate that ethical leadership has a positive direct effect on team performance. The results also show that the positive relationship between ethical leadership and team performance is partially mediated by team learning processes, namely, information processing and information storage and retrieval.

Research limitations/implications – This study highlights the importance of ethical leadership and guides managers towards considering the characteristics of both ethical leadership and team learning processes for enhancing team performance in software development projects.

Originality/value – This is the first study to the best of authors' knowledge to examine the role of team learning processes in mediating the relationship between ethical leadership and team performance, particularly concerning software development projects. The present research contributes to the literature on team performance management, emphasising the manner in which ethical leadership can result in team learning and team performance. The findings of this study can be used to encourage organisations to develop ethical leadership behaviours and team learning processes in software development projects.

Keywords Team performance, Team learning, Ethical leadership, Software development projects

Paper type Research paper

Introduction

In today's hypercompetitive business environment and with rapid changes in customer preferences (Liu *et al.*, 2011), software development has become a necessary part of supporting a firm's competitive advantage. Moreover, it is beyond the ability of any one individual due to time restrictions, technological challenges and changing requirements (Açıkgöz *et al.*, 2014). Thus, software development requires teamwork, bringing team members together to build the software (Sawyer and Guinan, 1998; Ebert and De Neve, 2001; Pee *et al.*, 2010). However,

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software development projects are notorious for their high failure rate (Liu *et al.*, 2011). According to the Standish Group's Chaos Report (Standish Group International, 2015), software projects only have a 29% success rate, with some 52% being delayed and 19% failing. The study of critical factors influencing performance in software development projects is ongoing (Liu *et al.*, 2011; Faraj and Sambamurthy, 2006) because task performance is an important issue for the survival of an organisation (Yang and Wei, 2017). Sudhakar (2011) proposed five critical success factors influencing software development performance, two of which are team leader behaviour and teamwork processes.

Recently, researchers have focussed on ethical leadership because this behaviour is instrumental in the effective functioning of organisations and also influences employee attitudes, behaviour and performance (Wadei *et al.*, 2020; Lin *et al.*, 2019; Liu *et al.*, 2019; Sosik *et al.*, 2019; Bavik *et al.*, 2018; Walumbwa *et al.*, 2017; Huang and Paterson, 2017). Ethical leadership refers to the presentation and encouragement of normatively appropriate behaviour (Brown *et al.*, 2005). Ethical leaders accept personal responsibility for team performance, signalling to followers the value and importance of the assigned task and the requirement for appropriate behaviour (Piccolo *et al.*, 2010). However, empirical research on how ethical leadership affects team performance is limited (Peng and Lin, 2017). To the best of our knowledge, no study has yet been conducted on the influence of ethical leadership on software development project teams. Therefore, the initial purpose of this study is to investigate the influence of team leaders'ethical leadership on team performance in software development projects.

Team learning is one of the five disciplines described by Peter Senge in his book *The Fifth Discipline: The Art and Practice of the Learning Organization* (Senge, 1990). Team learning is valuable because it is a key mechanism through which organisations become strategically and operationally adaptive and responsive (Edmondson, 1999), i.e. they become learning organisations. Previous research has shown that team learning processes can lead to better general team performance (Van Woerkom and Croon, 2009; Boon *et al.*, 2013), while Akgün *et al.* (2014) found that team learning enables members to meet their technical performance expectations in software development projects. Furthermore, leadership styles such as transformative and authentic leadership are found to be positively associated with team learning (Raes *et al.*, 2013; Bucic *et al.*, 2010; Edmondson, 1999). Although these leadership styles have an ethical component (Yang and Wei, 2017), not much is known about the direct influence of ethical leadership on team learning. One study indicates that ethical leaders can stimulate reflective team learning (Walumbwa *et al.*, 2017). Therefore, the second purpose of the present study is to examine the influence of ethical leadership on three distinct processes of team learning, namely, information acquisition, information processing and information storage and retrieval.

Leadership scholars emphasise that leaders can influence team functioning (Podsakoff *et al.*, 1996). However, very little is known about how ethical leadership affects team performance through the mediating role of team learning. Hence, the third purpose of this study is to investigate team learning as a linkage mechanism between ethical leadership and team performance.

The rest of this paper is organised as follows. In the next section, the theoretical context and the creation of hypotheses are discussed, while the research methodology is described in the subsequent section. Further ahead, the model is evaluated using structural equation modelling (SEM) techniques, with the findings discussed in the final section and the implications and limitations of the research summarised.

Theoretical background and hypotheses development

Influence of ethical leadership on team learning

Ethical leadership, as defined by Brown *et al.* (2005), is "the demonstration of normatively appropriate conduct through personal actions and interpersonal relationships and the promotion of such conduct to followers through two-way communication, reinforcement and decision-making" (p. 120). Ethical leadership contains the following two essential aspects: the moral person and the moral manager. The moral person aspect of an ethical leader relates to individual personality traits such as honesty and trustworthiness, while the moral manager aspect concerns the communication of an ethics and values message and the use of rewards and discipline to hold followers accountable for ethical conduct (Brown and Treviño, 2006; Brown *et al.*, 2005).

Team learning refers to the social process of formal and informal interaction among individuals (Fisser and Browaeys, 2010). The definition of team learning falls into the following two camps: some researchers define team learning as an outcome of shared knowledge and experience building among team members (Ellis *et al.*, 2003); for others, team learning refers to behavioural processes that facilitate learning to adapt and improve team performance (Edmondson, 1999). However, learning does not always guarantee the optimum success of a team and better performance is not always a learning result (Wilson *et al.*, 2007). Team learning processes should be distinguished from team performance (Van Woerkom and Croon, 2009). Following Edmondson (1999), Huber (1991) and Van Woerkom and Croon (2009), team learning in the present study refers to the processes of learning by team members, namely, information acquisition, information processing and information storage and retrieval. Information acquisition represents the sharing of information by other teams and collecting information from people outside the team (Wong, 2004). Information processing means the sharing of information within the team and its interpretation (Van Offenbeek, 2001). Information storage and retrieval refers to the storing and retrieving of information for future use by the team (Van Offenbeek, 2001). These processes may be both sequential and iterative but are all important for teams (Gibson and Vermeulen, 2003).

According to social learning theory, Bandura and Walters (1977) and Bandura (1986) posit that individuals learn appropriate ways to behave by observing the behaviour of role models and those around them. This theory further suggests that they are likely to imitate credible and desirable role models. In the working environment, leaders serve as legitimate role models by demonstrating appropriate behaviours (Brown *et al.*, 2005). Ethical leaders demonstrate behaviours such as openness, honesty, reliability and truthfulness (Walumbwa and Schaubroeck, 2009), which are "hallmarks of conscientiousness" (Costa and MacCrae, 1992). According to Bakker *et al.* (2012), individuals with high conscientiousness are more likely to help their peers and engage in active learning behaviour. They also tend to encourage their peers to make suggestions beneficial to the organisation (Bowling, 2010). Besides, the role models of openness and benevolence used by ethical leaders provoke followers to express their opinions and report problem-related information without fear of negative feedback (Brown *et al.*, 2005; Dadhich and Bhal, 2008). Moreover, communication of ethical values and the use of rewards and punishments by ethical leaders can promote follower positive behaviour such as knowledge sharing (Liu *et al.*, 2019; Bavik *et al.*, 2018; Le and Lei, 2018). Moreover, they prevent follower unethical behaviour such as knowledge hiding (Anser *et al.*, 2020; Abdullah *et al.*, 2019). Behaviours displayed by ethical leaders can "trickle down" to their team members, encouraging those who witness such behaviours to behave similarly towards their team members (Mayer *et al.*, 2009). Thus, team members working with ethical leaders are more likely to engage in team learning behaviours too.

Prior research reveals that ethical leadership is associated with follower psychological empowerment (Qing *et al.*, 2019; Javed *et al.*, 2017; Kalshoven *et al.*, 2011). Zahrani (2012) also

found that psychological empowerment is positively related to learning in the workplace. Ethical leaders facilitate psychological empowerment in their team members, leading them to pay attention to team opinions and participate actively in decision-making activities among members (Kalshoven *et al.*, 2011; Resick *et al.*, 2011; De Hoogh and Den Hartog, 2008). Sharing power with team members helps them to be more responsible for their tasks (Yukl *et al.*, 2013). Participation in decision-making also boosts the free flow of ideas and collaboration among team members (Sarin and McDermott, 2003), eliciting individual tacit knowledge to develop team explicit knowledge (Madhavan and Grover, 1998). Such participation requires team members to retrieve previous team information and update it for future use. Moreover, when team members collaborate in decision-making, they are more likely to bring knowledge from people external to the team (Latham *et al.*, 1994).

Previous research reveals that ethical leadership is positively related to knowledge sharing and learning at the team level. According to Ling *et al.* (2020), the ethical leadership of founder-CEOs is positively associated with the advice-seeking behaviour of top management team members. Liu *et al.* (2019) found that ethical leadership is significantly related to team knowledge sharing through the mediating role of a team development competition, while Walumbwa *et al.* (2017) report that ethical leadership enhances group learning behaviour. Based on the previous discussion, the following hypotheses are proposed:

H1. Ethical leadership is positively related to team learning processes, namely, *a)* information acquisition, *b)* information processing and *c)* information storage and retrieval.

Influence of team learning on team performance

The performance of software development projects should be evaluated in the following two dimensions: product performance and process performance (Nidumolu, 1995). Product performance measures the output delivered by the project, whereas process performance measures the efficiency of software development (Liang *et al.*, 2007). Hence, these aspects are used as the criteria for software development project performance.

Previous research reveals that team learning increases the level of team performance. According to Edmondson (1999), team learning behaviours affect manufacturing team performance, while Van Woerkom and Croon (2009) found that team learning, particularly information processing, is a strong predictor of team performance. Boon *et al.* (2013) found team learning was positively related to police and firemen team effectiveness. Finally, Bui *et al.* (2016) found team learning to be positively associated with research performance in higher education teams. Hence, the following hypotheses are proposed:

H2. Team learning processes, namely, *a)* information acquisition, *b)* information processing and *c)* information storage and retrieval are positively related to team performance.

Influence of ethical leadership on team performance

Brown and colleagues posit that ethical leadership may affect team outcomes (Brown *et al.*, 2005). Social exchange theory by Blau (1964) suggests that individuals who are well-treated by others feel obliged to react positively or offer positive treatment in some way (Walumbwa *et al.*, 2011). Ethical leadership is associated with honesty, trustworthiness and fairness in decision-making (Brown *et al.*, 2005). High-quality social exchange between ethical leaders and team members may

encourage them to put extra effort into their work (Brown *et al.*, 2005). When ethical leaders exhibit such behaviour towards their team members, the latter may reciprocate through job dedication, leading to improved performance (Peng and Lin, 2017).

Previous research suggests a positive relationship between ethical leaders and team performance. According to Lin *et al.* (2019), ethical leadership can enhance team performance indirectly through leader–member exchange and capitalisation. Liu *et al.* (2019) found that ethical leadership is positively linked to team performance through a team development competition, while the findings of Peng and Lin (2017) reveal that ethical leadership is positively related to group in-role performance. According to Walumbwa *et al.* (2012), ethical leadership has a positive influence on task performance in nursing teams. Based on the previous discussion, the following hypothesis is proposed:

H3. Ethical leadership is positively related to team performance.

Mediating role of team learning

Previous studies reveal that team behavioural factors mediate the relationship between ethical leadership and team performance (E.g. Liu *et al.*, 2019; Walumbwa *et al.*, 2012). When considering tools for achieving competitive advantage, team learning is an important determinant in many firms (Chan *et al.*, 2003). Moreover, the development of high-quality software is influenced by team learning (Liang *et al.*, 2009). As discussed earlier in *H3*, it is suggested that ethical leadership has a direct positive influence on team performance. In this study, a positive relationship is proposed between ethical leadership and team performance, partially mediated by team learning processes.

Ethical leaders clarify performance goals and task expectations to help their team members know what is expected from them (Kalshoven *et al.*, 2011). Clarification of the goal provides a sense of belonging among employees by enabling them to concentrate on activities designed to achieve that goal (Leonard-Barton and Knowledge, 1995). It helps them to learn faster in a changing environment (Lynn and Kalay, 2016). According to Kim and Lee (2010), vision and goal clarification is positively related to employee knowledge acquisition and application capability. Furthermore, Taghavi and Woo (2017) reveal that role clarity helps information system development teams improve the identification of customers' business requirements. Team information acquisition, in turn, leads to higher team performance. Ancona and Caldwell (1992) suggest that teams are likely to perform their tasks better and boost long-term success when acquiring information from outside the team, while Akgün *et al.* (2014) reveal that team information acquisition has a positive effect on operational effectiveness in software implementation. In this present study, a positive relationship is proposed between ethical leadership and team performance, partially mediated by team information acquisition.

Ethical leaders tend to respect and listen to others (Brown *et al.*, 2005), and such behaviour may trickle down to their followers, encouraging them to behave similarly towards others (Mayer *et al.*, 2009). According to social learning theory (Bandura and Walters, 1977), team members are likely to let others express opinions without personally attacking them (Liu *et al.*, 2019) and seek information from other team members (Qian *et al.*, 2017). The findings of Walumbwa *et al.* (2017) reveal that ethical leadership enhances internal information processing within the team, while Tang *et al.* (2015) reveal ethical leadership to be positively related to knowledge sharing. Information sharing among the team may trigger other processes such as analysis, discussion and consideration of different perspectives (Rhee and Choi, 2017). Through these processes, team members are more likely to develop shared knowledge and enhance their ability to complete a task (Boon *et al.*, 2013), resulting in higher-quality solutions (Chow, 2018). Previous research by Leicher and Mulder (2016) reveals that knowledge sharing positively

influences the performance of nursing teams in caring for the elderly. Liang *et al.* (2009) found that team learning positively impacts on software quality. Thus, a positive relationship between ethical leadership and team performance is proposed in this present study, partially mediated by team information processing.

Ethical leaders communicate ethical values to create an inclusive learning environment in the workplace (Walumbwa *et al.*, 2017). A system of ethical values in an organisation can encourage members to store and apply collective knowledge due to their sense of moral obligation and shared interest (Luo and Lee, 2013). Tseng and Fan (2011) found that an ethical organisational climate can significantly influence employee engagement in knowledge management. Ethical leadership is likely to be an important factor for team information storage and retrieval process. According to Walz *et al.* (1993), the recording and capturing of team information and customers' ideas benefit software development. These processes are important for improving team practices (Timmermans *et al.*, 2013). They help to reduce ambiguities (Gibson and Vermeulen, 2003) and may provide teams with a starting point for generating new ideas in task performance (Widmann and Mulder, 2018). Van Woerkom and Croon (2009) found team information storage and retrieval to be positively related to the rating of team efficiency by managers. Thus, a positive relationship is proposed in this study between ethical leadership and team performance, partially mediated by team information storage and retrieval.

In light of the previously discussed arguments, team learning processes are considered to partially mediate the relationship between ethical leadership and team performance as described in the following hypotheses:

H4. The positive relationship between team leaders'ethical leadership and team performance is partially mediated by *a)* team information acquisition, *b)* team information processing and *c)* team information storage and retrieval.

Methodology

Data collection procedures

The survey was conducted in Thailand during a three-month period from October to December 2018. Firms were identified from software and IT consulting companies registered with the Thailand Digital Economy Promotion Agency and personal contacts. Convenience sampling was selected for the present study. Each selected firm had a software development team as part of the information technology department, comprising full-time software developers engaged in related projects.

To collect the data, a key person (Human Resources Manager) in each organisation was contacted via telephone and email to explain the objective of the research. After agreeing to participate in this research, these persons were asked to select at least one software development project using the following criteria: the project has been completed within the previous 12 months and the development team comprised at least two members. One team member whose main job function was software development was then randomly selected from each team to complete the questionnaire.

To address personal privacy concerns, before sending the questionnaire, the respondents were informed that the data collected would be used for this research only with no other information required that could potentially identify them, their employer or project. To obtain accurate data, participants were encouraged to respond honestly – there are no right or wrong answers. In particular, participants were asked to provide information based on an overview of team member behaviour rather than their own. After confirming their

willingness to participate in the research, the Web-based questionnaire was distributed via email.

From the 990 internet-based questionnaires sent out, 430 responses were obtained, yielding a response rate of 43%. Of these 430 responses, 20 exhibiting halo effect bias were checked using reversed questions and eliminated from further analysis. To avoid bias in answering self-rated leadership questions, 56 responses from team leaders were removed. This resulted in 354 valid responses, with approximately 59.3% of respondents being male. The mean age was approximately 30 years (SD = 6.8), with participants having six years of mean information technology experience (SD = 5.14). Participants were mainly employed as programmers on the project. The team size varied between 2 and 36 members (M = 6.2, SD = 4.93), and they had worked together in their project team for at least a month (up to 58 months) (M = 9.3, SD = 8.5 months).

Common method variance analysis

This study relies on a self-reported single-source data. Harman's single-factor test (Harman, 1960) was conducted to assess the effect of common method variance (Podsakoff *et al.*, 2003; Podsakoff and Organ, 1986). A total of 30 items from 5 constructs were considered (ethical leadership, team information acquisition, team information processing, team information storage and retrieval and team performance) for exploratory factor analysis.

Unrotated principal component analysis was performed to ascertain whether one single factor accounted for the majority of variance between scales. Eichhorn (2014) suggests that if a newly introduced common latent factor explains more than 50% of the variance, then common method bias (CMB) may be present. Table 1 presents the results of common method variance analysis. Five factors with eigenvalues greater than 1.0 were identified, together explaining 69.476% of the total variance. The first factor explained 39.288% of the variance. Because the calculated variance (39.288%) is below the threshold of 50%, it may not be a serious concern about CMB in this study.

Measures

This research was conducted in Thailand. To operationalise the questionnaire designed in English, a back-translation technique suggested by Reynolds *et al.* (1993) was used, whereby versions of the questionnaire in English and Thai were reviewed simultaneously. A five-point Likert-style format was used for the question design, ranging from (1) strongly disagree to (5) strongly agree.

Ethical leadership. A ten-indicator measure developed by Brown *et al.* (2005) was used according to the sample item, "My leader listens to what team members have to say".

Team learning. In this research, team learning processes are conceptualised and based on previous empirical research (Van Woerkom and Croon, 2009; Islam *et al.*, 2009; Wong, 2004; Van Offenbeek, 2001), with 13 items for evaluating team learning processes. Factor analysis using principal component extraction and varimax rotation extracted the following three factors: information acquisition, information processing and information storage and retrieval, accounting for 72.231% of the variance in responses (eigenvalue first component 5.499; second 2.439 and third 1.453). All factor loadings were above the recommended value (>0.5). The first and second factors consisted of four items and the last five items. These findings are unidimensional, and each has internal consistency. Table 2 shows the factors and items.

Team performance. The seven-item scale for product performance and process performance was developed from Maheshwari *et al.* (2012), adapted from the research of Nidumolu (1995), according to the sample item "Software development is reliable".

Factor	Initial eigenvalues			Extraction sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	11.787	39.288	39.288	11.787	39.288	39.288
2	3.234	10.780	50.069			
3	2.352	7.841	57.910			
4	2.019	6.731	64.641			
5	1.451	4.835	69.476			
6	0.793	2.643	72.119			
7	0.674	2.245	74.365			
8	0.581	1.937	76.302			
9	0.575	1.917	78.219			
10	0.515	1.715	79.934			
11	0.510	1.701	81.635			
12	0.461	1.537	83.172			
13	0.442	1.474	84.646			
14	0.407	1.358	86.004			
15	0.401	1.337	87.341			
16	0.373	1.244	88.585			
17	0.365	1.215	89.801			
18	0.347	1.155	90.956			
19	0.315	1.049	92.005			
20	0.298	0.992	92.997			
21	0.272	0.906	93.902			
22	0.258	0.860	94.762			
23	0.243	0.811	95.573			
24	0.227	0.758	96.331			
25	0.222	0.739	97.070			
26	0.208	0.693	97.763			
27	0.196	0.653	98.416			
28	0.187	0.623	99.038			
29	0.162	0.539	99.578			
30	0.127	0.422	100.000			

Table 1.
Results of common method variance analysis

Control variables. Two variables were selected to control the following proposed research model:

(1) *Group size*. Previous research suggests that group size has an impact on team performance (Barry and Stewart, 1997). Thus, in this study, team size was obtained by asking respondents how many team members were in each project.

(2) *Project duration.* Outcomes of a project may also be influenced by project duration (Jiang *et al.*, 2009). To control for this, project durations ranging from 1 to 36 months were used.

Results

Descriptive statistics

Table 3 presents the means, standard deviations and inter-scale correlations of variables. The results reveal that ethical leadership is positively correlated with the three team learning processes ($r = 0.167$, $p < 0.01$; $r = 0.532$, $p < 0.01$; $r = 0.457$, $p < 0.01$). Moreover, ethical leadership and the three team learning processes are positively correlated with team performance ($r = 0.517$, $p < 0.01$; $r = 0.235$, $p < 0.01$; $r = 0.488$, $p < 0.01$; $r = 0.499$, $p < 0.01$).

Item	Factor 1	Factor 2	Factor 3	Communality
Factor 1: information acquisition				
ACQ1: we seek ideas/expertise from people external the team	*0.779*	0.179	0.162	0.665
ACQ2: we seek feedback about the team's work from people external to the team	*0.876*	0.091	0.112	0.787
ACQ3: we review the team's work with people external to the team	*0.889*	0.076	0.104	0.807
ACQ4: we obtain help or advice from people external to the team	*0.822*	−0.013	0.091	0.685
Factor 2: information processing				
PRO1: in this team, we share project-relevant know-how	0.137	*0.820*	0.204	0.733
PRO2: we take time to analyse and discuss with other team members about software development	0.099	*0.855*	0.221	0.789
PRO3: we usually consider different perspective of various team members when deciding how to develop software	0.009	*0.806*	0.269	0.721
PRO4: we take time to develop a shared understanding of the software developing	0.095	*0.804*	0.237	0.711
Factor 3: information store and retrieval				
STR1: we use team document	0.083	0.413	*0.638*	0.585
STR2: we store our knowledge in an archive	0.114	0.181	*0.847*	0.762
STR3: we use team document created by the team for the team	0.130	0.307	*0.766*	0.699
STR4: we store in minutes	0.121	0.227	*0.794*	0.697
STR5: we store team document in a common archive	0.145	0.127	*0.844*	0.749

Note: Italicized values represent the variable with higher factor loading which turn these variables into the representative of the factor

Table 2.
Factor loadings and communality estimates from principal component analysis for team learning processes

Variable	Mean	SD	Correlations 1	2	3	4	5	6	7
1. Tms	6.230	4.965	1	–	–	–	–	–	–
2. Projdu	9.340	8.510	0.207**	1	–	–	–	–	–
3. ELS	4.203	0.655	0.031	−0.043	1	–	–	–	–
4. ACQ	3.384	0.901	0.016	0.006	0.167**	1	–	–	–
5. PRO	4.091	0.649	−0.025	−0.084	0.532**	0.227**	1	–	–
6. STR	3.857	0.746	−0.035	−0.093	0.457**	0.299**	0.545**	1	–
7. TPM	3.959	0.650	−0.095	−0.210**	0.517**	0.235**	0.488**	0.499**	1

Notes: Tms = Team size; Projdu = Project duration; ELS = Ethical leadership; ACQ = Information acquisition; PRO = Information processing; STR = Information storage and retrieval; TPM = Team performance; $n = 354$ teams; $^{**}p < 0.01$ (two tailed)

Table 3.
Means, standard deviations and correlations

Although the results are consistent with our assumptions, the nested nature of the data has not been taken into account. Hence, Mplus software is used to test the hypotheses.

Results of confirmatory factor analysis for the measurement model

Before testing the research hypotheses, confirmatory factor analysis was used to establish convergent and discriminant validities and confirm the stability of the measurement model. As shown in Table 4, Cronbach's alpha values were above 0.70, showing good reliability and

Construct	Item	Cronbach's alpha	Factor loading	CR	AVE
Ethical leadership	ELS1	0.952	0.753	0.949	0.650
	ELS2		0.695		
	ELS3		0.858		
	ELS4		0.864		
	ELS5		0.859		
	ELS6		0.854		
	ELS7		0.744		
	ELS8		0.858		
	ELS9		0.787		
	ELS10		0.767		
Information acquisition	ACQ1	0.876	0.687	0.873	0.635
	ACQ2		0.828		
	ACQ3		0.907		
	ACQ4		0.747		
Information processing	PRO1	0.882	0.827	0.873	0.634
	PRO2		0.898		
	PRO3		0.730		
	PRO4		0.716		
Information storage and retrieval	STR1	0.883	0.665	0.881	0.598
	STR2		0.835		
	STR3		0.750		
	STR4		0.781		
	STR5		0.822		
Team performance	SWQUA1	0.892	0.745	0.890	0.537
	SWQUA2		0.722		
	SWQUA3		0.774		
	SWQUA4		0.701		
	SWQUA5		0.752		
	PROCEP1		0.712		
	PROCEP2		0.719		

Note: All *t*-values are significant at 0.001 level

Table 4. Results of confirmatory factor analysis for the measurement model

acceptability (Nunnaly, 1978). Hair *et al.* (1998) noted that indicator loadings must exceed 0.5 to indicate acceptability. All standard factor loadings were above the minimum acceptable threshold of 0.5 and highly significant ($p < 0.01$). All the composite reliability (CR) values also exceeded 0.7. Bagozzi and Yi (1988) indicated a threshold of 0.7 for CR. Additionally, the average variance extracted value (AVE) was calculated to assess convergent validity. Fornell and Larcker (1981) noted that indicator AVE scores exceeding 0.5 indicate acceptability, and from the Table 4, all the AVE exceeded 0.5, indicating convergent validity. Thus, all values for the constructs in this study exceed the acceptability thresholds.

To further explore the discriminant validity of these scales, Table 5 shows the results using the square root of AVE (shown as bold on the diagonal) (Fornell and Larcker, 1981) and squared correlation coefficients. The square root of AVE for each construct is greater than its correlation with another (Fornell and Larcker, 1981), indicating that the discriminant validity criterion is satisfied.

Comparison of alternative models and hypothesised model

To evaluate the hypothesised model, Mplus 7 software was used to compare alternative models of causal relationships. Standard fit indicators and cut-off criteria were used to

determine the validity of alternative and hypothesised models, with the RMSEA < 0.07, CFI > 0.90, TLI > 0.90 and SRMR < 0.08 (Hair *et al.*, 2006). The goodness-of-fit statistics of the hypothesised model (whereby outcomes were forced to depend on the constructs of ethical leadership, information acquisition, information processing, information storage and retrieval and team performance) were compared with those of a series of alternative models. The results of the analysis are presented in Table 6. Based on the fit index recommended by Hair *et al.* (2006), the results of this present study suggest that the hypothesised model (Model 6) is a good fit with the data and broadly better than all other alternative models. Accordingly, the hypothesised structural model was considered good enough to proceed with hypothesis testing.

Hypotheses testing

Figure 1 presents the results of SEM, used to examine the influence of ethical leadership on team learning and team performance. As indicated, ethical leadership has a positive impact on information acquisition ($\beta = 0.168$, $p < 0.01$), information processing ($\beta = 0.590$, $p < 0.01$) and information storage and retrieval ($\beta = 0.480$, $p < 0.01$). Hence, hypotheses *H1a*, *H1b* and *H1c* are supported.

Information processing and its storage and retrieval were found to be significant predictors of team performance ($\beta = 0.217$, $p < 0.01$; $\beta = 0.274$, $p < 0.01$), providing support for *H2b* and *H2c*. However, *H2a* was rejected because information acquisition was not a significant predictor of team performance ($\beta = 0.081$, $p = 0.109$). The direct relationship between ethical leadership and team performance was found to be significant ($\beta = 0.294$ $p < 0.01$), providing support for *H3*. These results were obtained while checking the team size and duration of the project to account for any possible confounding effect.

Construct	1	2	3	4	5
1. ELS	*0.806*	–	–	–	–
2. ACQ	0.028	*0.797*	–	–	–
3. PRO	0.283	0.052	*0.796*	–	–
4. STR	0.209	0.089	0.297	*0.773*	–
5. TPM	0.267	0.055	0.238	0.249	0.733

Table 5.
Discriminant validity of the construct

Note: Diagonals represent the square root of the average variance extracted, while the other entries represent the squared correlations coefficients **(r^2)**

Model	X^2	DF	RMSEA	CFI	TLI	SRMR
1. Model 1: ELS →TPM	160.344	133	0.024	0.994	0.992	0.035
2. Model 2: ELS →TLN	340.486	209	0.042	0.978	0.973	0.053
3. Model 3: TLN →TPM	342.019	196	0.046	0.965	0.959	0.052
4. Model 4: ELS →TPM and TLN →TPM	655.79	436	0.038	0.97	0.966	0.052
5. Model 5: ELS →TLN →TPM	657.925	437	0.038	0.970	0.966	0.053
6. Model 6: hypothesised model	812.263	439	0.049	0.95	0.943	0.077

Table 6.
Comparison of alternative models and hypothesised model

Notes: ELS = ethical leadership; TLN = team learning; TPM = team performance; $n = 354$

Mediation hypothesis testing

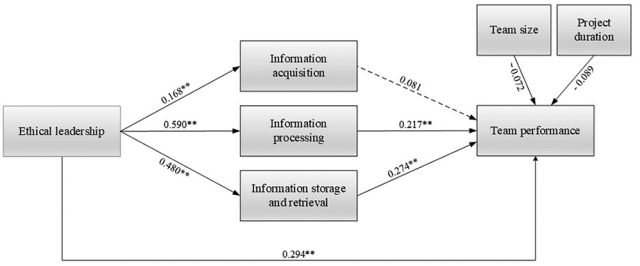
The indirect and direct total effects and their 95% confidence intervals (CIs) were calculated using the bootstrapping method in Mplus (Muthén and Muthen, 2017) to test the three mediation hypotheses (*H4a–H4c*). Bootstrap CIs were computed using 5,000 bootstrap samples.

Table 7 reports mixed results. Model 2 shows that ethical leadership has a positive and direct relationship with team performance (estimate = 0.369, 95% CI = 0.177–0.562), while its indirect effect through information processing is also significant (estimate = 0.192, 95% CI = 0.073–0.311). Similarly, Model 3 shows that ethical leadership has a positive and direct relationship with team performance (estimate =0.392, 95% CI = 0.238–0.545), while its indirect effect through information storage and retrieval is also significant (estimate = 0.171, 95% CI = 0.072–0.270). The 95% CIs shown in Models 2 and 3 do not include zero, evidencing support for *H4b* and *H4c*. Finally, Model 1 shows that ethical leadership has a positively and direct relationship with performance (estimate = 0.537, 95% CI = 0.405–0.668). However, no significant result was found for the indirect influence of ethical leadership on team performance via team information acquisition because its 95% CI includes zero (estimate = 0.027, 95% CI = −0.013–0.067). *H4a*, therefore, is rejected.

Discussion

Theoretical implications

This study provides five contributions. Firstly, it focusses on the impact of ethical leadership, which is relatively poorly investigated in the context of software development projects. Moreover, in the previous research on software development projects, team



Notes: *$p < 0.05$, **$p < 0.01$, X2 = 812.263, $df = 439$, RMSEA = 0.049, CFI = 0.950, TLI = 0.943, SRMR = 0.077

Figure 1. Hypothesis proposed model

Model	Indirect effect Estimate (95% CI)	Direct effect Estimate (95% CI)	Total effect Estimate (95% CI)
1. ELS–ACQ–TPM	0.027 (−0.013–0.067)	0.537 (0.405–0.668)	0.564 (0.437–0.690)
2. ELS–PRO–TPM	0.192 (0.073–0.311)	0.369 (0.177–0.562)	0.561 (0.434–0.689)
3. ELS–STR–TPM	0.171 (0.072–0.270)	0.392 (0.238–0.545)	0.563 (0.437–0.688)

Notes: $n = 354$ teams; bootstrap $n = 5{,}000$; ELS = ethical leadership; ACQ = information acquisition; PRO = information processing; STR = information storage and retrieval; TPM = team performance

Table 7. Results of mediation hypothesis testing

learning is generally considered as an outcome of project performance rather than an input to teamwork processes (Liang *et al.*, 2007; Nidumolu, 1995). Team learning in this study is newly defined as a behavioural learning process by team members, including information acquisition, information processing and information storage and retrieval. Therefore, this study suggests a way for increasing team performance in software development projects through ethical leadership and team learning processes.

Secondly, the findings in this study support the previous research in that two team learning processes enhance team performance, namely, information processing and information storage and retrieval (Boon *et al.*, 2013; Van Woerkom and Croon, 2009; Van Woerkom and Van Engen, 2009; Van den Bossche *et al.*, 2006; Gibson and Vermeulen, 2003; Edmondson, 1999). Team information processing allows each member's information to be combined, leading to the discovery of new insights beneficial to the quality of software development processes. The results of this study support those of Akgün *et al.* (2014) in that software development success depends not only on technical issues but also teamwork processes (e.g. team learning). Moreover, team information storage and retrieval decrease ambiguities (Van Woerkom and Croon, 2009; Gibson and Vermeulen, 2003), enabling the team to reach shared knowledge faster; this may help teams to deliver their software development projects on time and on budget.

Thirdly, the results of this study in relation to software development projects align with previous empirical research in that ethical leadership has a positive direct impact on team performance (Lin *et al.*, 2019; Liu *et al.*, 2019; Peng and Lin, 2017; Walumbwa *et al.*, 2012; De Hoogh and Den Hartog, 2008). Moreover, the findings accord with the theory of social exchange proposed by Blau (1964) in that when leaders exhibit ethical behaviours, team members are more likely to reciprocate them and contribute positively to team performance.

Fourthly, the findings of this study confirm that ethical leadership has a positive and direct effect on all three team learning processes. Drawing on social learning theory, the results in this study agree with the previous research in that ethical leaders act as role models and provide foundations such as team learning to facilitate team development (Walumbwa *et al.*, 2017; Liu *et al.*, 2019). Furthermore, in accordance with Lee *et al.* (2013), the results of this present study show that leaders who demonstrate behaviours such as openness and concern for others are more likely to promote knowledge creation and exchange among members of software development teams.

Finally, the results of this study reveal that team learning processes, namely, team information processing and team information storage and retrieval play a partial mediating role in the relationship between ethical leadership and team performance. Ethical leaders communicate ethical values and listen to others (Brown *et al.*, 2005), arousing team members to learn together. Through team learning, team members share knowledge and develop, thereby contributing to better team performance. The findings of this study are in line with previous research in that ethical leadership can be seen as a crucial factor in enhancing teamwork processes **(**e.g. team learning**)**, thereby improving team performance **(**Ling *et al.*, 2020; Peng and Lin, 2017; Qian *et al.*, 2017; Walumbwa *et al.*, 2012**)**.

Practical implications

The findings of this study highlight the importance of team learning for improving team performance in software development projects. Success in software development requires an enormous amount of collective knowledge and skills. Because individuals cannot possibly possess all the required expertise, teams with a high degree of collective learning behaviours have greater potential for successful software development. As a result, managers should consider team learning as an important teamwork process for developing high-quality

software and delivering projects on time and on budget. An organisation should invest in a programme to promote team learning for long-term benefit and success.

Team leaders are typically chosen because of their technical abilities rather than leadership skills (Elkins and Keller, 2003). The results of the current study indicate that the ethical leadership skills of team leaders are a critical factor in fostering team learning and team performance. To promote active learning among software development teams, organisations should do as follows: firstly, cultivate ethical leadership by providing a variety of training to improve the ethical behaviour of team leaders. Such training may be provided through the communication of ethical values and development of an ethical code (i.e. business ethics) to help team leaders conduct themselves with integrity. Moreover, organisations should encourage team leaders to act as role models of ethical behaviour. By observing the ethical behaviour of team leaders such as respect and listening to the opinions of others, team members can learn about ethical business practices and imitate them. These ethical behaviours facilitate collective learning, potentially contributing to higher team performance.

Secondly, team leaders should strengthen team learning through the discussion of business ethics. They should use rewards to promote ethical behaviour and punishment to prevent unethical behaviour. Thus, team members will become more committed to their work and have a greater willingness to learn together as a team, ultimately leading to better team performance.

Limitations and future research

The study is not without its limitations. Firstly, we relied on self-reported, single-respondent data. This may create CMB (Podsakoff *et al.*, 2003), which becomes the second limitation in this study. Previous researchers suggest that consistency motif bias may arise when participants are asked to provide a retrospective report of their perceptions and behaviours because they try to maintain consistency in responses to questions (Johns, 1994; Podsakoff *et al.*, 2003). Furthermore, employees are prone to giving socially desirable responses when rating themselves on their job performance, leading to social desirability bias (Donaldson and Grant-Vallone, 2002; Crowne and Marlowe, 1964). In addition, close relations between supervisor and subordinates may cause self-reporting bias (Ahmad and Gao, 2018) or leniency bias (Guilford, 1954). Consequently, CMB could inflate non-causal relationships between variables in this study (Donaldson and Grant-Vallone, 2002). This is because when using single-respondent data and the effect of CMB, the likelihood is that the results are also contaminated by non-causal associations, which in turn becomes the third limitation. Future research should consider using data from multiple sources to minimise CMB.

Fourthly, the survey in this study was conducted in a single industry (the software industry). Fifthly, the survey was based solely on the views of software development teams. Future studies should consider data from other project stakeholders to broaden the perception of software development projects. Sixthly, this study collected data from software development teams in Thailand. There would be value in future research investigating whether the study results are generalisable to other cultural contexts. Finally, this study did not assess the potential moderating effects on the causal relationship between ethical leadership and team learning. The findings of this study could be extended in future to include the investigation of contextual moderators (such as ethical climate) and their effect on the relationship between ethical leadership and team learning processes.

Conclusion

This study proposes a theoretical model by empirically assessing the effect of ethical leadership on team learning and team performance. As the results show, ethical leadership

was found to have a direct positive effect on three team learning processes and team performance in software development projects. Two team learning processes, namely, information processing and information storage and retrieval have a positive impact on team performance. Team information processing and information storage and retrieval were also found to partially mediate the relationship between ethical leadership and team performance. Thus, the results extend the existing literature on team performance management by demonstrating the influence of the ethical leadership behaviour of team leaders on team performance through the medium of team learning processes in software development projects.

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