

The Moderating Effect of Leader Centrality on Team Cohesion and Performance in Software Development Projects

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ABSTRACT

This study examined if the formal leader was centrally connected in team's social network, the team cohesion-performance effect in team was strengthen or weaken. From the data collected from 8 software development teams, 150 members in total in a branch of a global software development company in Thailand, the result suggested that teams with high-central leader in task-advice network had stronger team cohesion-performance effect than teams with low-central leader. The high-central leader in friendship network had less influence on team cohesion-performance effect. Using person-to-person relationships data collected from the questionnaire, a social network analysis of the leader influences in the team discovers that the connection between the leader and members has positive results to team cohesion and performance. The central leader played an important role in connecting many members and minimizing subgroups in team.

Keywords: project team; leader centrality; team cohesion; team performance; social networks

1. RESEARCH BACKGROUND AND PURPOSE

In researches of workgroup and team in organizations, one of the enduring questions we faced is why some teams outperform others in achieving work performance and quality. One answer was provided by a number of social network researches on the importance of leader centrality, i.e., an extent to which the team's formal leader has direct social relations from members in team, would provide benefits and constraints to the leader in driving team performance. It was found that teams with high-central leader tend to perform better [Balkundi and Harrison, 2006]; however, some studies found negative results [Kratzer, Holzle, and Gemunden, 2010; Kratzer, Leenders, and Van Engelen, 2008]. With these different findings, how the leader centrality relates to team performance remains a gap to study.

While social relation is important in team, another answer was provided in the researches of team cohesion as a key predictor of team performance [Beal, Cohen, Burke, and McLendon, 2003; Gully, Devine, and Whitney, 1995; Mullen and Copper, 1994]. Team cohesion refers to the members bonding to the team and its task in explaining how social relations among members motivated work collaborations in team [Kozłowski and Ilgen, 2006]. However, it was less mentioned about the team's formal leader. By adopting social network perspectives, the high-central leader, i.e., a leader who has social relations with many members, may play an important role in promoting work collaborations and integrating member's different capabilities which enhances the positive results of team cohesion on team performance. Yet, on the contrary, the high-central leader would be a bottleneck in work collaborations, i.e., all members are tied with the leader, which prevents the team cohesion to positively effect team performance [Kratzer et al., 2008]. These also suggested another research gap to examine whether teams with high-central leader have different team cohesion-performance from teams with low-central leader.

Thus, this study attempted to examine the moderating effect of leader centrality on team cohesion-performance relationship. Testing of moderating effect would address at least three existing lines of inquiry. First, how the leader centrality relates and influences team performance. Second, whether the

relationship of team cohesion-performance is stronger or weaker in teams with high-central leader as compared to teams with low-central leader. Third, as the leader is embedded in team's social network, in what social relation and network characteristic that the central leader has effect on team performance. To do this, we studied software development teams in a global software development company in Thailand, and used both the regression and the social network analysis to examine how the central leader influences the team cohesion and performance. The result would extend knowledge in two research areas: to study the role of leader centrality on team cohesion-performance relationship and to find whether the central leader benefits or constraints the performance of leader's team.

2. LITERATURE REVIEW

This section summarizes key literatures on leader centrality, team cohesion and team performance relationship.

2.1. Leader Centrality

Leader centrality within a team context is an extent to which the team's formal leader has direct connections from members in the team's social network of task-advice and friendship relations [Balkundi, Barsness, and Michael, 2009]. A formal team leader is the person in charge on the completion of a set of tasks assigned to the team [Keil, Lee, and Deng, 2013]. Task-advice relation is a conduit of work-related information, whereas friendship relation is related to intimacy and social-liking [Lincoln and Miller, 1979]. Centrality was studied in perspectives, such as information exchange and work collaboration in team [Haythornthwaite, 1996] and social influences network theories [Friedkin, 1993] in explaining the characteristics of central leader in influencing the team.

In information exchange perspectives, the social relations, i.e., task-advice and friendship relations, structure the flow of information among members in network. The central leader, as having many connections, benefits the team in integrating knowledge, work solution and direction to minimize task difficulties and complete the team works [Haythornthwaite, 1996]. As centrally connected,

the leader can enhance work collaborations among members by bridging the gaps of different members' capabilities. The leader can provide and integrate the knowledge among members to have one solution direction for the team [Cross and Cummings, 2004; Hossain, 2009a, 2009b; Hossain and Wu, 2009; Hossain, Wu, and Chung, 2006]. As for friendship relation, the central leader would have more accesses to the information on team specific situation, i.e., individual and team's morale so the leader can provide necessary emotional support to the team and motivate team performance as well as retain members with the team [Balkundi et al., 2009].

In social influence network theories, the central actor is referred as prominence actor who can influence others' perceptions and behavior [Friedkin, 1993; Friedkin and Johnsen, 2011]. The social relations provide channels for the flow of social influence and ideas among the members [Ahuja, Galletta, and Carley, 2003; Ibarra and Andrews, 1993]. Under uncertainty, i.e., working on complex and unclear tasks, people tend to seek information from their social context to adapt their works and behaviors. The high-central leader, one as seen by more members than the low-central leader, could be more easily in seeing as a role model in influencing team's work results. As task-advice relation is established via formal work-role relation, the high-central leader in such network would reflect the concentration of leader-member interactions in focusing the work, and thus the leader can influence the work direction and team behavior in driving work performance. As friendship relation is established via social supports and likings, the high-central leader can get along well with the team and minimize conflicts among members to promote collaborations in team and thus improving team performance. As a result, the team performance would associate with the high-central leader, i.e., the central leader was found having high charisma in motivating team performance [Balkundi et al., 2009; Balkundi, Kilduff, and Harrison, 2011].

According to "influence is the essence of leadership" [Yukl, 1994, p. 223] and the central argument of network research, "centrality is the key component of leadership in organization" [Brass and Krackhardt, 1999, p.183], the central leader in task-advice and friendship networks were found closely related to the

task-oriented and relationship-oriented leader. Task-oriented leader has behavior in focusing and driving the work results, such as establishing well-defined work processes and channels of communication, scheduling work to be done, setting and emphasizing meeting deadlines, and pressuring subordinates to work hard, whereas relationship-oriented leader has behavior in being friendly and approachable, providing encouragement and keeping interpersonal relations pleasant as well as looking out for the welfare of subordinates and minimizing conflicts in team [Casimir, 2001; Tabernero, Chambel, Curral, and Arana, 2009]. Task-advice and friendship relations were also related to the trustful leader as cognition-based trust, i.e., a judgment based on evident of competency and reliability, and affective-based trust, i.e., a bond that arises from emotions and feelings [Chua, Ingram, and Morris, 2008; Moran, 2005]. As the central leader in task-advice and friendship network was found having high competent in working skills and relationship buildings [Tabernero et al., 2009; Wendt, Euwema, and van Emmerik, 2009], both could influence team cohesion and performance.

2.2. Team Cohesion and Team Performance Relationship

Team cohesion is an extent to which the team members are bonding to the team, committing to the team's tasks and being pride to be part of the team [Barrick, Bradley, Kristof-Brown, and Colbert, 2007]. Team cohesion is a predictor of team performance in many researches and meta-analysis [Beal et al., 2003; Chang and Bordia, 2001; Evans and Dion, 2012; Greer, 2012; Kozlowski and Ilgen, 2006; Mullen and Copper, 1994]. Team cohesion has three facets: interpersonal attraction which facilitates the members in team to collaborate with others, task commitment which increases individual efforts on completing the task, and group pride which facilitates the members to share attraction to the group task or goal. Integrating these three facets provides an explanation that, after the team members had an opportunity to work together or at least to become acquainted with each other, they may develop bonding to the team and its task which facilitates their work collaboration in team. Team cohesion has stronger effect on team performance when team is working on interdependent tasks that required high work collaboration [Gully et al., 1995].

3. HYPOTHESIS DEVELOPMENT

Figure 1 shows the conceptual model proposed in this study. It was extended from Mullen and Copper's [1994] meta-analysis of team cohesion-performance relationship and hypothesized that the leader centrality could be a moderator for the relationship [Balkundi and Harrison, 2006].

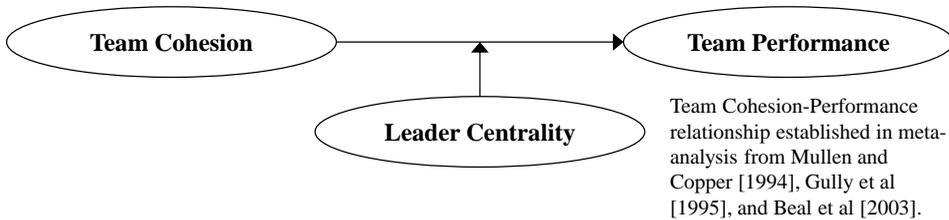


Figure 1. Conceptual Model

The model was developed to examine whether the teams with high-central leader have team cohesion-performance relationship differ from teams with low-central leader. As centrality was explained in terms of connection, relation and strength of relations between an actor and others in the same network, theoretical backgrounds on the utility and constraint of centrality were discussed in developing research hypotheses as follows.

3.1 Utility of Centrality

Utility of centrality is the core idea that the central location within a connected group benefits the individual actor to have more resources to influence the work outcome of the group.

In information exchange perspectives, centrality provides benefit to the leader in having more information and ability to integrate different capabilities in team via social connections. The central position benefits the leader to integrate the work flows and interpersonal supports in enhancing the team cohesion to have a higher positive effect on team performance. In task-advice network of work-related information, i.e., work progress and technical knowledge, the high-central leader, as compared to the low-central leader, can have more information to guide the work direction in team to align with the performance target. As

related to intimacy, friendship relations allow the leader to aware of individual members' attitudes towards the works in team. The high-central leader can have more integrated picture on the team's work atmosphere and morale for motivating the team than the low-central leader. As found in prior studies, teams with high-central leader reported a high internal work collaboration [Bono and Anderson, 2005; Zhang and Peterson, 2011], a speed and efficiency of consensus decision making [Salk and Brannen, 2000], a development of new ideas and strategic integration [Pappas and Wooldridge, 2007] and an effective integration of team efforts and high performance [Balkundi et al., 2009]. These suggest teams with high-central leader tend to have stronger team cohesion-performance relationship than teams with low-central leader.

In social influence network theories, the central position lays the actor who has a higher influence on others' perception and behavior [Friedkin, 1993; Friedkin and Johnsen, 2011]. Leader central in task-advice network found task-oriented leader who influences the team to focus on accomplishing the task at hand, and leader central in friendship network found relationship-oriented leader who improves team cohesion [Taberner et al., 2009]. Task-oriented leader influences team efficacy, i.e., team's shared beliefs of its capability to achieve its performance target, and task accomplishment; and relationship-oriented leader induces team cohesion to have positive effects on team performance [Taberner et al., 2009]. As people develop task advice and friendship relations with person whom they trust [Chua et al., 2008], the high-central leader is a trustful leader who develops trust in team and improves integrated work performance [Mach, Dolan, and Tzafir, 2010]. Past studies also found that the central leader had high reputation and was a charismatic leader who minimizes conflicts among members and promotes team performance [Balkundi et al., 2009; Balkundi et al., 2011; Mehra, Dixon, Brass, and Robertson, 2006]. Thus, the central leader has a leader characteristic which motivates the members to collaborate effectively and this enhances team cohesion-performance relationship.

In summary, the central leaders have more knowledge of their team to manage team's direction and integrate team's effort. The central leader also possesses a leader characteristic in motivating cohesion in team and team's behavior to collaborate effectively. While integrating team direction, work

collaboration and skills are important factors in enhancing team cohesion-performance relationship [Faraj and Sproull, 2000; Hoegl and Gemuenden, 2001]; the central leader would strengthen team cohesion-performance relationship. This provides hypotheses as follows.

Hypothesis 1a: Teams with high-central leader in task-advice network have stronger team cohesion-performance relationship than teams with low-central leader.

Hypothesis 1b: Teams with high-central leader in friendship network have stronger team cohesion-performance relationship than teams with low-central leader.

3.2 Constraint of Centrality

Constraint of centrality is a contrasting idea on the ability to exercise the resources as constraint by the network location. The idea of embeddedness was evolved to encompass the inertial tendency to exercise benefits of connections [Granovetter, 1985; Uzzi, 1996].

In information exchange perspectives, the central leader tends to have a redundancy and overload of information from many members which may lower the leader's ability in using information to enhance team performance. Also the central leader may have a high workload in maintaining many connections and as the team is highly depending on the leader, the leader may be a bottleneck of work collaboration in team. The central leader had high coordination failures, i.e., fail to pass along critical information in ways that help team members to effectively complete tasks at hand [Gargiulo and Benassi, 2000]. The central leader in friendship network may spend too much time in monitoring and managing team's morale and interpersonal issues rather than having a management focus in aligning the team cohesion to achieve performance target. In problem of embeddedness, the central leader could be influenced by the redundant information which preventing the leader to innovatively manage the work direction in team. As a result, teams with high-central leader reported low internal work collaboration as all depending on the leader and having low team performance [Kratzer et al., 2008; Wendt et al., 2009].

In social influence network theories, the high-central leader as very influential may discourage the team from finding novel solutions and lower team creative performance [Kratzer et al., 2010]. The high-central leader may overly participate in team's tasks which preventing the team to have alternative way to increase team performance. In problem of embeddedness, the central leader is embedded within a network to the extent that they show a preference for developing social relations with team rather than focusing on work target. Being friend was said to be a dilemma that to be likeable the leader would need to spend times in taking cares the team, however, doing so may distract both leader and team from focusing on work performance [Taylor, Hanlon, and Boyd, 1992]. As friendship relations need time to develop and have different aspects for individually, the central leader may weaken cohesion-performance relationship due to the fact that most of social interactions between leader and members are mainly for getting like from many members rather than promoting cohesion in team and for achieving task performance. Also, as friend, the leader may be influenced by the team to an extent that both leader and team think alike; therefore, the leader may be unable to discern poor performance [Dobbins and Russell, 1986].

In summary, although having task-advice and friendship relations with many members would benefit the leaders and their team on work collaborations; the central leader may be a bottleneck in having high workload and too much redundant information. The central leader may have too much involvement in team and spend times in developing relations which deviates the leader and team to focus on team performance. As being embedded in the central, the leader would weaken team cohesion-performance relationship. This provides hypotheses as follows.

Hypothesis 2a: Teams with high-central leader in task-advice network have weaker team cohesion-performance relationship than teams with low-central leader.

Hypothesis 2b: Teams with high-central leader in friendship network have weaker team cohesion-performance relationship than teams with low-central leader.

4. DATA COLLECTION AND ANALYSIS

Data were collected from the Thailand branch of a global software development company. This company has many branches in many countries including Thailand. The Thailand branch was considered as the key strategic development center of financial software applications and had approximately 200 software developers spitted into around 10 teams. Out of which, 8 software development teams, 150 members in total, were selected through convenience sampling technique. The teams were selected based on their availability and voluntary. These teams were working in the same location and company's collaborative culture.

The online survey with identity verification to collect team cohesion, team performance and team's social network data was administered. As the research concerns social relations and influences in team, team cohesion and performance were rated by the team members in standard questions for software development teams from Hoegl and Gemuenden [2001]. Items were rated using a 5-point scale (1 = strongly disagree to 5 = strongly agree). Task-advice and friendship relations and relation strengths were measured by using sociometric questions [Ibarra, 1993a]. The name list of team members and leader were provided. Each respondent was asked to specify unlimited number of names who he/she considered important for his/her work in their project team in order to draw the social network within the team [Marsden, 2011]. Relation strength was rated using 5-point scale (1 = not at all close to 5 = very close). The online survey questionnaire used in this study is provided in Appendix A.

The data analysis was conducted in two parts. First, regression analysis of team cohesion-performance relationship was analyzed and compared between teams with high- and low-central leader. We treated leader centrality as dichotomy (i.e. as a high- or low-central leader), team cohesion as the independent variable, and tested moderating effect following the approach in Baron and Kenny [1986]. High- and low-central leader was classified based on the mean score plus and minus one standard deviation of the standardized in-degree centrality of the team's formal leader [Freeman, 1978]. To significantly observe the moderating effect, only teams with high- and low-central leader were

used in examining the team cohesion-performance relationship.

Second, social network analysis was used to find how the central leader influences team cohesion and performance [Friedkin, 1993; Friedkin and Johnsen, 2011]. We started by examining the connection between the leader and members in each project, and used Node-level ANOVA to test whether members who connected with the central leader have rated a high team cohesion and performance or not. Teams with significant Node-level ANOVA results would indicate that the central leader strengthen team cohesion-performance relationship. Then, we examined the connection among members by using Relational Contingency-Table analysis to test whether there was a subgroup of highly-connected members in teams. We tested the subgroups by classifying the members based on their relation strength with the leader. Teams with subgroups of members who were not closed to the leader would explain why we were unable to find the effect of leader centrality on team cohesion-performance relationship. The study used UCINET as social network analysis tools [Borgatti, Everett, and Johnson, 2013; Hanneman and Riddle, 2005].

5. RESULTS

We received a response rate of 91%, 136 out of 150 members in 8 software development teams. Each team had one project manager as the team formal leader in charge of work delivery and team performance. The team size was ranging from 14 to 27 members. 50% of respondents were females. The average age of the respondents was 31.25 years ($SD = 3.28$). Concerning the education, 51% had bachelor degree and 49% had master degree. They had average of seven years experiences in software development ($SD = 1.19$) and 1.6 years with the current team ($SD = 0.46$). 89% of members were working full-time and had a daily talk to the leader. 67% of members were developers, 15% were testers, 13% were product designers, and 5% were business analysts and system analysts.

Every team was performing similar set of software development tasks. They had reported a high task interdependent and work collaboration in team. They had reported a high correlation between team cohesion and performance as $r = .674$, $p = .000$. We also noted on using exploratory factor analysis (EFA) to generate the reliable standardized score with Cronbach's Alpha value .902 for

team cohesion and .926 for team performance. Both scores also had KMO Measure of Sampling Adequacy as .865, $p = .000$ and .864, $p = .000$, which suggested that the sampling data was appropriate. With 63% of members reported that they had talked with the leader as daily basis, and the collected network data have reciprocate rate as 52% and 55% in task-advice and friendship networks which similar to other studies [Brass, 1984; Ibarra, 1993b], the data would appropriate for analysis [Marsden, 1990, 2011]. There was an equivalent of 2 teams with high- and low-central leader classified for the test with descriptive statistics summary of team cohesion and performance was reported in Table 1.

Table 1
Descriptive Statistics

Team	Leader Centrality		Team Size	<i>n</i>	Team Cohesion		Team Performance	
	Task-Advice Network	Friendship Network			<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
A	Low	Low	19	19	-.40	.80	-.52	.82
B	Medium	Low	27	22	.21	.83	.09	.82
C	High	Medium	14	13	-.36	1.34	.37	1.08
D	Medium	Medium	18	16	.05	1.06	.20	1.18
E	Medium	Medium	20	19	.34	1.06	.19	1.02
F	Low	Medium	14	11	.13	1.01	-.13	.88
G	High	High	14	14	.37	.96	.44	.86
H	Medium	High	24	22	-.29	.88	-.39	1.06

Note: $N = 136$

5.1 Regression Analysis Results

In testing hypothesis 1a and 2a on leader centrality in task-advice network, Table 2 reported the results and Figure 2 shown the scatter plot of team cohesion-performance regression lines of teams with high- and low-central leader. We found that teams with high-central leader had team cohesion-performance stronger than teams with low-central leader, with a significant regression coefficient as $B = .616$, $p = .000$ higher than $B = .532$, $p = .001$. The scatter plot also supported that team cohesion has a higher effect on team performance in teams with high-central leader over teams with low-central leader along the range of team cohesion values. This supported the hypothesis 1a and failed to support the hypothesis 2a. The high-central leader in task-advice network would play an important role in enhancing rather than constraining the direct effect of team

cohesion on team performance.

Table 2
Regression Analysis of Team Cohesion-Performance in Teams with High- and Low-central Leader in Task-Advice Network

	Model Summary			Coefficients		
	R^2	F		B	SE	β
High-central Leader	.598	37.165***	Constant	.394***	.118	
			Team Cohesion	0.616***	.101	.773***
Medium-central Leader	.474	69.376***	Constant	-.048	.084	
			Team Cohesion	0.731***	.088	.688***
Low-central Leader	.320	13.165***	Constant	-.267	.134	
			Team Cohesion	0.532***	.147	.566***

Note: Dependent Variable: Team Performance, $N = 136$, * $p < .05$, ** $p < .01$, *** $p < .001$

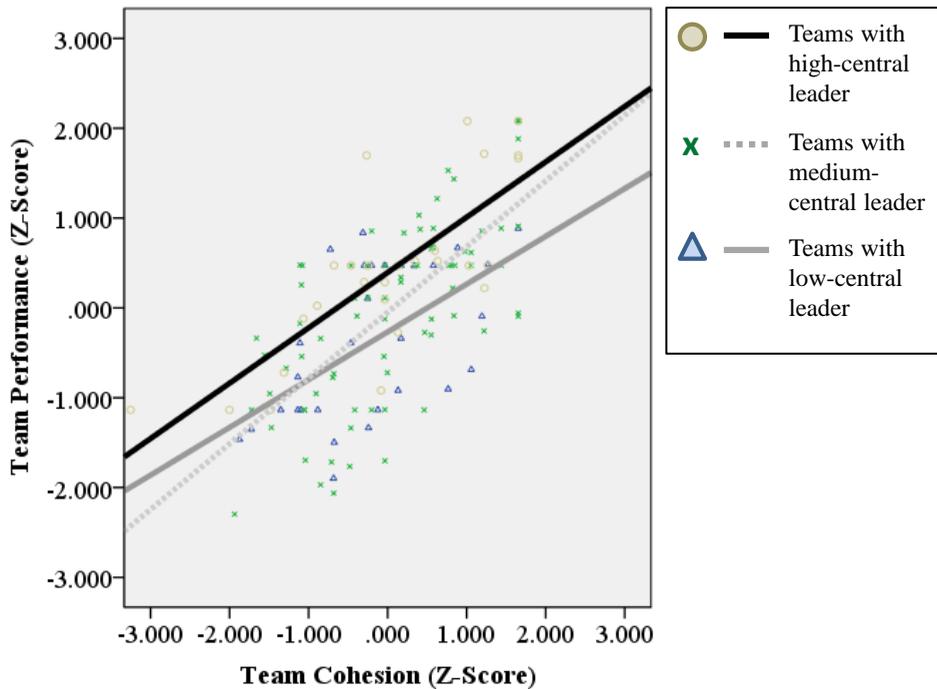


Figure 2. Scatter Plots of Team Cohesion-Performance in Teams with High- and Low-Central Leader in Task-Advice Network

In testing hypothesis 1b and 2b on leader centrality in friendship network, Table 3 and Figure 3 reported the results. The scatter plot show that teams with high-central leader do not have a higher effect of team cohesion on team performance than teams with low-central leader for the range of team cohesion values. Although the regression analysis reported the significant regression

coefficient as $B = .810$, $p = .000$ higher than $B = .546$, $p = .000$, the cross regression lines would indicate that the high-central leader not always strengthen or weaken the team cohesion-performance effect in team. Both hypothesis 1b and 2b are not supported. We could not find the moderating effect of leader centrality in friendship network on team cohesion-performance relationship.

Table 3
Regression Analysis of Team Cohesion-Performance in Teams with High- and Low-central Leader in Friendship Network

	Model Summary			Coefficients		
	R^2	F		B	SE	β
High-central Leader	.535	39.130***	Constant	-.039	.122	
			Team Cohesion	.810***	.129	.731***
Medium-central Leader	.496	56.165***	Constant	.128	.097	
			Team Cohesion	.654***	.087	.704***
Low-central Leader	.299	16.628***	Constant	-.153	.115	
			Team Cohesion	.546***	.134	.547***

Note: Dependent Variable: Team Performance, $N = 136$, * $p < .05$, ** $p < .01$, *** $p < .001$

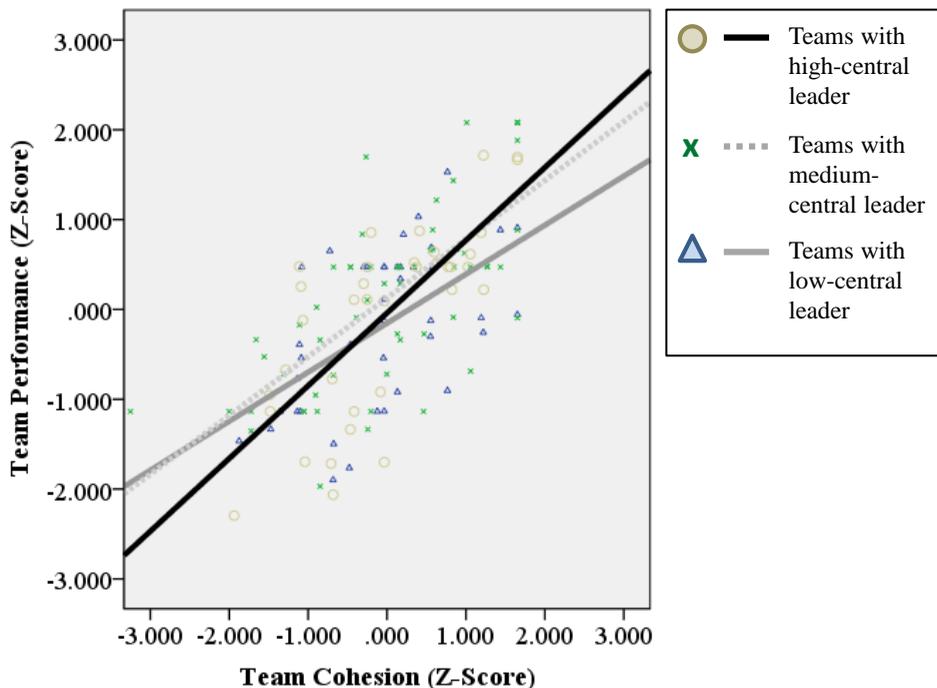


Figure 3. Scatter Plots of Team Cohesion-Performance in Teams with High- and Low-Central Leader in Friendship Network

5.2 Social Network Analysis Results

For task-advice network, Table 4 and 5 reported the results. We found that the connection between the leader and members has positive results to members' rating of team cohesion and performance. The members who are closed to the high-central leader had reported a high team cohesion and performance, with a significant F -value as $F(4, 9) = 4.436, p = .029$ and $F(4, 9) = 3.931, p = .038$ in team C, and $F(3, 10) = 9.451, p = .002$ and $F(3, 10) = 3.439, p = .049$ in team G. We found significant F -value in teams with high-central leader and not in teams with low-central leader. This would explain the results in supporting hypothesis 1a. The high-central leader in task-advice network would have a high team cohesion and performance.

Table 4
Node-level ANOVA Results on the Effect of Leader Centrality in Task-Advice Network on Team Cohesion-Performance Relationship reported by Team

Team		Team Cohesion			Team Performance		
		Sum of squares	df	F	Sum of squares	df	F
A – Low-central Leader	Between-group	0.83	3	.385	1.24	3	.567
	Within-group	10.81	15		10.90	15	
	Total	11.65	18		12.14	18	
B – Medium-central Leader	Between-group	7.32	4	5.412*	4.56	4	2.653
	Within-group	7.44	22		9.45	22	
	Total	14.76	26		14.00	26	
C – High-central Leader	Between-group	14.37	4	4.436*	8.93	4	3.931*
	Within-group	7.29	9		5.11	9	
	Total	21.66	13		14.05	13	
D – Medium-central Leader	Between-group	2.16	3	.691	2.34	3	.591
	Within-group	14.60	14		18.50	14	
	Total	16.76	17		20.84	17	
E – Medium-central Leader	Between-group	2.72	3	.820	8.74	3	4.664*
	Within-group	17.68	16		10.00	16	
	Total	20.40	19		18.74	19	
F – Low-central Leader	Between-group	4.10	3	.735	2.42	3	1.517
	Within-group	7.88	10		5.33	10	
	Total	11.98	13		7.75	13	
G – High-central Leader	Between-group	7.50	3	9.451*	7.13	3	3.439*
	Within-group	2.64	10		6.91	10	
	Total	10.14	13		14.05	13	
H – Medium-central Leader	Between-group	0.66	3	.282	2.16	3	.663
	Within-group	15.66	20		21.71	20	
	Total	16.32	23		23.87	23	

Note: $N = 136$, * $p < .05$

Table 5
Relational Contingency-Table Analysis Results of Task-Advice Network by Team

Team	df	χ^2	Relation Strength					
			0	1	2	3	4	5
A – Low-central Leader	19	15.239	.600	-	-	.560	.850	1.690
B – Medium-central Leader	22	57.690	.280	-	-	-	1.520	2.090
C – High-central Leader	13	36.310	1.010	-	-	.300	1.350	1.690
D – Medium-central Leader	16	27.703	.000	-	-	1.310	1.100	-
E – Medium-central Leader	19	23.266	.540	-	-	.720	1.080	1.260
F – Low-central Leader	11	49.034*	.280	-	-	1.440	-	-
G – High-central Leader	14	19.807	-	-	-	.310	.900	1.860
H – Medium-central Leader	22	46.461*	.300	-	-	1.260	1.190	1.280

Note: $N = 136$, * $p < .05$

Table 5 reported that in team with low-central leader, team F, members who are less closed to the leader had formed their own subgroups with significant chi-square value, $\chi^2(11) = 49.034$, $p = .005$. The members who rated the leader as neutral ('3') had dense connections among themselves as 1.440 times higher than random network of the same size. As having fewer connections with the members, the low-central leader may have subgroup in team which prevented the leader to influence the team as we found low team cohesion and performance in this team. In contrast, teams with high-central leader were not found subgroups. This would partly support hypothesis 1a by explaining that the low-central leader may has subgroup in team which prevent the leader to enhance team cohesion-performance.

For friendship network, Table 6 and 7 reported the results. We could not find that the members who have connections to the leader had rated a high team cohesion and performance. The F -values in Node-level ANOVA result in Table 6 were not significant in both team cohesion and performance. The Relational Contingency-Table Analysis results in Table 7 also reported that teams such as team A, B, D, F, G and H have subgroups with significant chi-square values. This would explain why we could not find the moderating effect of leader centrality in friendship network to support both hypothesis 1b and 2b. With subgroups in team, the central leader in friendship network would less influence team cohesion-performance relationship.

Table 6
Node-level ANOVA Results on the Effect of Leader Centrality in Friendship Network on Team Cohesion-Performance Relationship reported by Team

Team		Team Cohesion			Team Performance		
		Sum of squares	df	F	Sum of squares	df	F
A – Low-central Leader	Between-group	3.91	3	2.529	3.12	3	1.731
	Within-group	7.73	15		9.02	15	
	Total	11.65	18		12.14	18	
B – Low-central Leader	Between-group	6.34	4	4.139*	1.94	4	.885
	Within-group	8.42	22		12.06	22	
	Total	14.76	26		14.00	26	
C – Medium-central Leader	Between-group	8.91	3	2.329	7.13	3	3.439*
	Within-group	12.75	10		6.91	10	
	Total	21.66	13		14.05	13	
D – Medium-central Leader	Between-group	2.46	4	.558	1.07	4	.176
	Within-group	14.31	13		19.77	13	
	Total	16.76	17		20.84	17	
E – Medium-central Leader	Between-group	5.74	3	2.088	6.88	3	3.092*
	Within-group	14.66	16		11.86	16	
	Total	20.40	19		18.74	19	
F – Medium-central Leader	Between-group	2.41	2	1.714	1.52	2	1.338
	Within-group	7.73	11		6.24	11	
	Total	10.14	13		7.75	13	
G – High-central Leader	Between-group	3.38	3	1.311	2.17	3	.973
	Within-group	8.60	10		7.43	10	
	Total	11.98	13		9.60	13	
H – High-central Leader	Between-group	1.34	3	.597	1.92	3	.583
	Within-group	14.98	20		21.95	20	
	Total	16.32	23		23.87	23	

Note: $N = 136$, * $p < .05$

Table 7
Relational Contingency-Table Analysis Results of Friendship Network by Team

Team	df	χ^2	Relation Strength					
			0	1	2	3	4	5
A – Low-central Leader	19	33.193*	.720	-	-	-	.000	2.800
B – Low-central Leader	22	150.467*	.360	-	-	1.410	.630	-
C – Medium-central Leader	13	17.362	.550	-	-	-	1.440	.960
D – Medium-central Leader	16	68.198*	.250	-	-	1.400	1.640	-
E – Medium-central Leader	19	45.686	.530	-	-	1.060	.000	1.650
F – Medium-central Leader	11	34.308*	.600	-	-	1.870	2.800	-
G – High-central Leader	14	32.833*	.480	-	-	2.040	.680	2.040
H – High-central Leader	22	91.195*	.240	-	-	1.920	1.250	1.600

Note: $N = 136$, * $p < .05$

6. DISCUSSION

Our findings suggested that teams with high-central leader in task-advice network had a stronger team cohesion-performance relationship than teams with low-central leader, with the significant regression coefficient as $B = .616, p = .000$ higher than $B = .532, p = .001$. As task-advice is a conduit of work related information, in software development teams that highly concentrated in work-role relations, the central leader would benefit the team in providing work-relevant knowledge to many members in team [Cross and Cummings, 2004]. The results can be explained by adopting information exchange perspectives that: the high-central leader, as having more connections than the low-central leader, would play an important role as the central connector of information and knowledge exchange among members [Haythornthwaite, 1996]. The high-central leader could promote work collaborations and integrate members' different capabilities to enhance the positive results of team cohesion on team performance.

In social influence network perspective [Friedkin and Johnsen, 2011], we found that the high-central leaders have influence their connected members to rate a high team cohesion and performance, with the significant F-values reported in Node-level ANOVA results. The high-central leader would connect many members and minimize a chance in having subgroup in team. The low-central leaders would less benefit the team in connecting the different members, as we found subgroup in their teams with the significant chi-square values reported in Relational Contingency-Table Analysis. The subgroup may form their own opinions which prevent the leader to influence the work processes and solution directions for the whole team [Friedkin and Johnsen, 2011]. The leader who had more connections with members would occupy prominence position as being a task-oriented and competent leader who motivates all members in having a strong team cohesion and performance [Casimir, 2001; Chua et al., 2008; Taberner et al., 2009].

Friendship relation is also important in attracting members to the team [Lincoln and Miller, 1979]. However, in context of software development teams in our study, we could not detect that the central leaders in friendship network

strengthen or weaken team cohesion-performance relationship in their teams. This may be due to the fact that friendship relation is inherent in working teams when compared to task-advice relation that is highly related to work-role performance [Brass, 1984; Lincoln and Miller, 1979; Saint-Charles and Mongeau, 2009]. The affectionate leader may minimize conflicts among members in team [Balkundi et al., 2009]; however, to promote team cohesion to have a stronger effect on team performance, it would need the leader to motivate the members to focus more on the team's tasks. Team cohesion-performance relationship is due primarily to task commitment among members rather than interpersonal attraction and group pride [Mullen and Copper, 1994]. The relationship would be more influenced by task-advice relations than friendship relations that developed from personal intimacy and social-liking [Chang and Bordia, 2001; Lincoln and Miller, 1979; Taberner et al., 2009]. Thus, in work context such as software development, we found only leader centrality in task-advice relations has a moderating effect. Friendship relation between the formal leader and members is not a strong moderator as the results also suggested that many teams have subgroups of members rather than have connections with the leader.

7. RESEARCH LIMITATIONS

As with any study, this research has limitations. First, the study context focused on the software development teams in a business company and only eight software development teams participated in the online survey. The findings were limited since regression analysis compared between teams with high- and low-central leader rather than directly benchmark the leader centrality. Thus, future research may consider using other study contexts to have a wider range of leader centrality values.

Second, the lack of findings on the leader centrality in friendship network (Hypothesis 1b and 2b) might be due to the fact that the teams in this study were in a business organization that collaboration is based on work-role structure rather than relationship-based structure such as charity and volunteer works. While these teams focused on formal work arrangements, the social relations govern the team would be mainly a task-oriented rather than a friendship-oriented which may

be found in other types of software development, i.e., open source software project teams that have no pre-designed organizational structure [Colazo, 2010; Jungpil, Jae Yun, and Chen, 2008; Liu and Iyer, 2007]. Although the open source software project teams may have no formal leader, i.e., project manager, future researches may examine the effect of centrality of informal leader on team cohesion-performance relationship.

8. CONCLUSIONS AND BUSINESS IMPLICATIONS

This study provided insights about network position of formal leader in team's social network and team performance. The findings also addressed two key ideas in team management. First, there has been a long debate about whether the formal leader shall be centralized or decentralized in team to lead team performance. The findings suggested that being at the central in team's social network provided benefit in enhancing the effect of team cohesion on team performance. However, it also depended on the network of social relations that also inherent in each team, i.e., having subgroups in team which may prevent the central leader to influence the team. This supported the second idea that managing social relation is a weapon for the leader in driving team performance [Brass and Krackhardt, 1999]. Relationship management would not only to have an effective social relation and trust, but also to reduce the potential gaps among the subgroups for team work collaborations [Chua et al., 2008].

APPENDIX A

Online Survey Questionnaire

Part 1. Respondent was asked to specify the team's members who he/she considered important for his/her work in this project, and rated how close is the relationship using a 5-point Likert scale ranging from 1 (not at all close) to 5 (very close).

Task-advice Relation

1. Who are important sources of professional advice, whom you approach when you have a work-related problem or when you want advice on a decision you have to make?

Friendship Relation

1. Who are very good friends of yours, people whom you see socially outside of work?

Part 2. Respondent was asked to respond to the following 18 statements using a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) to evaluate the team cohesion and team performance.

Team Cohesion

1. All members are fully incorporated in our team
2. There are many personal conflicts in our team [reverse score]
3. There is cohesion between the members of our team.
4. Our team sticks together.
5. It is important to the members of our team to be part of this project.
6. The team did not see anything special in this project [reverse score].
7. The team members are strongly attached.
8. The project is important to our team.
9. The members of our team felt proud to be part of the team.
10. Every team members felt responsible for maintaining and protecting the team.

Team Performance

1. The team has completed the project in a cost-efficient way.
2. The team has completed the project in a time-efficient way.
3. The team has completed the project within schedule.
4. The team has completed the project within budget.
5. The team has delivered project result in high quality.
6. The team was satisfied with the project result.
7. The delivered product (software) proved to be stable in operation
8. The delivered product (software) proved to be robust in operation.

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