PROJECT MANAGER CENTRALITY IN EFFECTING SOFTWARE DEVELOPMENT TEAM PERFORMANCE

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การเป็นศูนย์กลางของผู้จัดการโครงการที่มีต่อผลการดำเนินงานของทีมงานพัฒนาซอฟต์แวร์

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รัชดา นุตจรัส : การเป็นศูนย์กลางของผู้จัดการโครงการที่มีต่อผลการดำเนินงานของทีมงานพัฒนาซอฟต์แวร์ (PROJECT MANAGER CENTRALITY IN EFFECTING SOFTWARE DEVELOPMENT TEAM PERFORMANCE) อ.ที่ปรึกษาวิทยานิพนธ์หลัก: อ. ดร. วัชรา จันทาทับ, อ.ที่ปรึกษาวิทยานิพนธ์ร่วม: ศ. ดร. ประภาส จงสถิตย์วัฒนา, 174 หน้า.

วิทยานิพนธ์นี้นำเสนอและทดสอบสมมติฐานว่า ความเป็นศูนย์กลางของผู้จัดการโครงการเป็นตัวแปรปรับที่สามารถส่งผลต่อความสัมพันธ์ระหว่างความสามัคคีและผลการดำเนินงานของทีม มีการเก็บข้อมูลโดยการส่งแบบสอบถามแบบให้ตอบด้วยตนเองไปยังสมาชิกทั้งหมด 150 คนของโครงการพัฒนาซอฟแวร์ 8 โครงการ และมีผู้ตอบแบบสอบถามคิดเป็นร้อยละ 91 (136 คน) พบว่าทีมงานที่ผู้จัดการเป็นศูนย์กลางในการให้คำปรึกษาในด้านการทำงานสูงมีความสัมพันธ์ระหว่างความสามัคคีและผลการดำเนินงานของทีมสูงกว่าทีมงานที่มีผู้จัดการเป็นศูนย์กลางต่ำ นอกจากนี้งานวิจัยนี้ยังพบว่า ทีมที่สมาชิกมีความเป็นศูนย์กลางสูงและมีกลุ่มย่อยที่มีความสามัคคีมีประสิทธิภาพการดำเนินงานของทีมต่ำ แต่งานวิจัยไม่พบว่าความศูนย์กลางของผู้จัดการโครงการในการสนับสนุนด้านขวัญและกำลังใจมีผลต่อความสัมพันธ์ระหว่างความสามัคคีและผลการดำเนินงานของทีม

งานวิจัยนี้ขยายความรู้ในการศึกษาเครือข่ายสังคมภายในทีมโดยเสนอแนะว่าผู้จัดการที่มีความเป็นศูนย์กลางสูงจะส่งผลให้เกิดความสัมพันธ์สูงระหว่างความสามัคคีในทีมและประสิทธิภาพการดำเนินงานของทีม ผู้จัดการที่มีความเป็นศูนย์กลางสูงจะมีภาวะผู้นำเชิงงานซึ่งจะขับเคลื่อนการทำงานของทีม ลักษณะดังกล่าวแสดงให้เห็นว่าผู้จัดการโครงการสามารถเพิ่มการใช้ประโยชน์ของความสามัคคีภายในทีมในการบรรลุผลการดำเนินงานของทีม

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This dissertation proposed and tested a theoretical model that considered the project manager centrality as a moderator on the relationship between team cohesion and team performance. Self-administered questionnaires were sent to 150 members of 8 software development teams and yielded a response rate of 91% (136 members). It was found that the teams with a high centrality project manager in task-advice network had higher team cohesion-performance relationship than the teams with a low centrality project manager. The result also suggested that the managers whose teams with a high centrality members and cohesive subgroups had low team performance. However, the research did not find the effect of project manager centrality in friendship network on the relationship between team cohesion and team performance.

The findings from this research would extend the knowledge on team's social network studies by suggesting that the high centrality project manager enhances the team cohesion-performance relationship. The high centrality project manager shares task-oriented leader characteristic that focuses in driving the team's works. Such characteristic reveals that the project manager can maximize the utility of team cohesion in achieving team performance.

Field of Study:	Information Technology in Business	Student's Signature ....
		Advisor's Signature ....
Academic Year:	2014	Co-Advisor's Signature ....

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CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I – INTRODUCTION

1.1 Research Motivations

Software development is one of the large and high growth industries (Fernandes, Sales, Santos, & Webber, 2011; Maheshwari, Kumar, & Kumar, 2012; Sudhakar, Farooq, & Patnaik, 2011). Increasing software development team performance is important to ensure that both the software providers and the software users, gain benefits from the software quality and times to market. Recent research on team performance have highlighted a challenging role of project managers to shift their focus to develop interpersonal relations with the team, in contrast with traditional project managers who simply focus on planning, organizing, delegating, and controlling the well-structured team (Dyba & Dingsøyr, 2008; Wateridge, 1997). Research in software development teams to examine the project manager's interpersonal relations with the team and the team performance is necessary (Maheshwari et al., 2012; Sawyer, 2004).

Interpersonal relations between project managers and team members such as task-advice and friendship relations are important for motivating members' work collaboration, commitment to teams' tasks, and team performance (Casimir, 2001; R. Y. J. Chua, Ingram, & Morris, 2008). Managers who mainly develop task-advice relations with the team share the characteristic of a task-oriented leader who actively provides members with work-related information, sets up work processes in the team and directs the team how to complete the assigned work. A task-oriented leader generally focuses on managing work collaboration among members and driving team performance. From a different perspective, managers who mainly develop friendships with the team share a relationship-oriented leader characteristic. Such managers provide emotional support and also improve members' engagement and collaboration with the team. Both relations are important for the manager to drive team performance. Yet, there remains some question on how the project manager's interpersonal relations with the team influence the work collaboration in the team and the team's performance (Balkundi, Kilduff, & Harrison, 2011).

Social network research is an area of study to examine the pattern of interpersonal relations in the team[1]. Social network here refers to the web of interpersonal relations. In the books named "The Hidden Power of Social Networks" (Cross & Parker, 2004), and "Web of Inclusion" (Helgesen, 2005), the interpersonal relation can be modeled more like a web than a hierarchy of the team structure to explain the internal work collaboration in the team. The social network is drawn as a graph to show the manager and the members and their interpersonal relationships such as task-advice relations, i.e., who gives work-related information to whom, and friendship relations, i.e., who is a friend of whom. Analysis of the social network is useful to find a pattern of interpersonal relations that are important to deliver team results such as team performance.

To focus on the manager, one research area in social network studies in a team is the network centrality. Centrality is a network position to connect the flow and exchange of information resources in Information Exchange Perspective (Haythornthwaite, 1996). Centrality is also the position of leaders to influence others' ideas and perceptions in Social Influence Network Theories (Friedkin, 1993). As in Brass's paper on "Being in the Right Place" (1984), centrality is an important network position for influencing work results. The managers who centrally connect members in task-advice and friendship networks share a characteristic of task-oriented and relationship-oriented leaders that both aid in driving team performance (Casimir, 2001; R. Y. J. Chua et al., 2008). This leads to a desire to study the network patterns of software development teams by focusing on how the project manager centrality relates to and influences the team performance. As the project manager is an important person in leading team performance (Keil, Lee, & Deng, 2013), the findings

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[1]*Social network research is a field of study about the pattern of social relations among individual in a social context, e.g., workgroup, team and organization with a purpose to understand how the social structure has been formed and operated (Radcliffe-Brown, 1940; Wellman, 1983). Social network analysis "seeks to describe social structure in terms of networks and to interpret the behavior of actors in light of their varying positions within social structure" (Marsden, 1990, p.436).*

would provide an insight on what makes a high-performing team from the perspective of interpersonal relations between the manager and the team and the role of project manager centrality.

1.2 Problem Reviews

Literature reviews in the area of social network and team studies have suggested three research gaps to examine the effects of project manager centrality on team performance. First, there is a question on whether the project manager centrality provides positive or negative results to the team performance. Project manager centrality is the degree to which the manager is considered by the team members as a task advisor and a friend. A high centrality project manager is one having many members approach for work-related directions and emotional support which can foster work collaboration and improve team performance. It was found that teams with a high centrality project manager have a high performance (Balkundi & Harrison, 2006). However, some studies found negative results. "Trapped in your own net" refers to the situation where a manager is highly connected to the team yet results in a bottleneck on work collaboration (Gargiulo & Benassi, 2000). Teams with a high centrality project manager also have shown low performance (Kratzer, Holzle, & Gemunden, 2010; Kratzer, Leenders, & Van Engelen, 2008). The past research had examined the direct association between project manager centrality and team performance and found different results showing that the centrality provides both benefit and constraint (Kilduff & Brass, 2010).

Second, there remains a lack of study concerning the effect of project manager centrality on the relationship between team cohesion and team performance. In previous team research, they found that team cohesion is a direct predictor of team performance (Beal, Cohen, Burke, & McLendon, 2003; Gully, Devine, & Whitney, 1995; Mullen & Copper, 1994). It is suggested that team performance is a result of members' work collaboration and efforts (Kozlowski & Bell, 2003). However, these studies have focused on the members and lack the views of the project manager who had a formal role in managing the team. As the task advisor, a high centrality project

manager plays an important role to integrate team members' different capabilities to complete the tasks. As a friend to many members, the high centrality project manager might promote internal work collaboration in the team to better team performance. Team cohesion-performance relationship may differ between teams with a high centrality project manager and teams with a low centrality project manager, yet this remains a gap to study (Tabernero, Chambel, Curral, & Arana, 2009).

Third, in meta-analysis of teams' social network structures, project manager centrality can serve as a moderator on the team cohesion-performance relationship (Balkundi & Harrison, 2006). Yet, there remains a lack of empirical study in software development teams. As software development is a highly complex task, teams with a high centrality project manager who directs the teams' tasks and provides interpersonal support tend to have a stronger positive team cohesion-performance relationship than teams with a low centrality project manager. The empirical study of software development teams would contribute knowledge to fill the research gap and provide business implications to suggest how project managers can improve work collaboration and performance in their team.

1.3 Research Question

Overall, this dissertation is about the project manager centrality in the team's social networks. It is to find whether teams with a high centrality project manager have a different team cohesion-performance relationship from teams with a low centrality project manager, and in what networks, i.e., task-advice, friendship or both. It attempts to answer the main research question: ***How does project manager centrality effect team performance?*** There are two supporting research questions as follows:

1) To what extent do team cohesion-performance relationship differ between the teams with a high centrality project manager and the teams with a low centrality project manager?

2) In task-advice and friendship relations, what are the relations that make the difference in team cohesion-performance relationship in the teams with a high centrality project manager and the teams with a low centrality project manager?

1.4 Research Objectives

This research proposes and tests a conceptual model concerning how project manager centrality effects team performance in software development teams. It attempts to extend the knowledge of the social network and team research by focusing on the following research objectives:

1) To examine the effect of project manager centrality on the team cohesion-performance relationship.
2) To find out whether the effect of project manager centrality will foster or impede the team cohesion-performance relationship.
3) To determine the project manager centrality in the team's task-advice and friendship networks.

1.5 Research Assumptions

The assumption underlying this research is that the interpersonal relationships in a team exist in the view of the manager and team members, and it can use known methods, e.g., sociometric test and social network analysis, for data collection and analysis (Marsden, 1990, 2011). Task-advice and friendship relations are developed over time from social interactions such as in personal and team meetings between the manager and members. Although the relationships may not be mutually exclusive, it is also assumed from past research that task-advice and friendship relationships play a different role in relating to team performance (Lincoln & Miller, 1979). These two relations are as different as their theoretical differences.

The second assumption is that project manager centrality is a variable in team-level characteristics. Although the centrality is a quantitative measure of the manager's network position relative to the members in the team, there would be one centrality value per network per team as there is one manager presumed to have the formal role in charge of overall team performance. The different values of project manager centrality among teams would suggest a category of high centrality project manager vs. low centrality project manager of a team.

The third assumption is that project manager centrality and team cohesion are independent factors. Team cohesion is related to the members' characteristics as it was found in social selection and homophily theories that people select whether to develop interpersonal relations with someone who share personality, behavior and belief commonalities as themselves (McPherson, Smith-Lovin, & Cook, 2001).

1.6 Conceptual Model

A conceptual model is developed to answer the research question. It extends from the findings that team cohesion is a direct predictor of team performance (Beal et al., 2003; Gully et al., 1995; Mullen & Copper, 1994) to hypothesize that project manager centrality is a moderator on the team cohesion-performance relationship (Balkundi & Harrison, 2006) as shown in Figure 1.1.
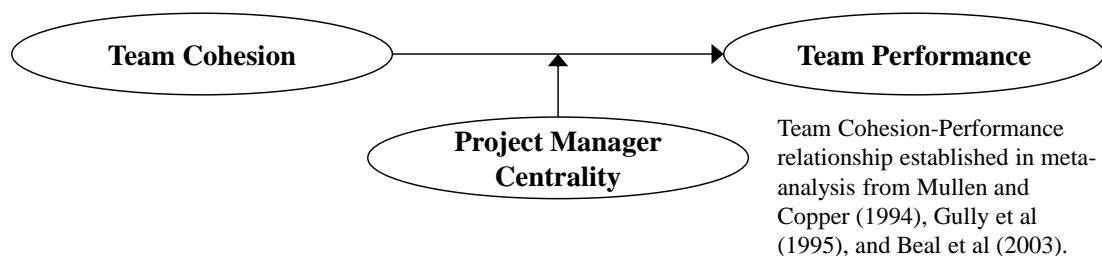
Figure 1.1 Conceptual Model

Project manager centrality is the degree to which the manager is considered by the team members as a task advisor and a friend. It is the ratio of

members in a team who nominate the manager to the total members following the Freeman's concept of in-degree centrality (1978). Team Cohesion is the extent to which the team members are committing to the team's tasks, feelings of interpersonal attractions in the team and pride to be part of the team (Mullen & Copper, 1994). Team performance is defined as the extent to which a team is able to meet established objectives in both work performance and work quality (Hoegl, Weinkauf, & Gemuenden, 2004).

Project manager centrality can be a positive moderator in the team cohesion-performance relationship. In information exchange perspectives (Haythornthwaite, 1996), high centrality project managers in the task-advice network have more access to work-related information and technical knowledge which helps the manager provide appropriate work solution and direction to minimize task difficulties and complete the team's tasks. High centrality project managers in friendship networks have more access to information on the team's attitudes towards work and the team's morale, which also helps the manager to take actions to motivate the team to deliver better. As team cohesion is an integrated effort to complete tasks, a high centrality project manager in both task-advice and friendship networks can enhance team cohesion to have a stronger positive effect on team performance.

In social influence network theory, the central actor is considered the prominent actor who can influence others' ideas and behavior (Friedkin, 1993; Friedkin & Johnsen, 2011). The high centrality project manager in a task-advice network shares task-oriented leader characteristic to focus and drive the work results by establishing well-defined work processes and channels of communication, scheduling work to be done, setting and emphasizing deadlines, and motivating subordinates to work hard (Casimir, 2001; DeLamater & Ward, 2013; Tabernero et al., 2009). As task advisor, the project manager gains cognitive-based trusts from the team on the manager's work competency, and can influence the team to follow the manager's direction to focus on accomplishing the task at hand (R. Y. J. Chua et al., 2008). This enhances the task commitment in the team to have a stronger positive effect on team performance. The high centrality project manager, being connected

with many members, can integrate team skills and knowledge through advising the team's work ideas to have one solution aligned with the team's overall target. This allows the team to work more efficiently and achieve higher performance. Thus, this provides the first hypothesis as follows.

Hypothesis 1 – Teams with a high centrality project manager in a task-advice network have a stronger positive effect on team cohesion-performance relationship than teams with a low centrality project manager.

The high centrality project manager in a friendship network shares relationship-oriented leader characteristic in concerning team members' attitudes and work satisfaction within the team (Casimir, 2001; DeLamater & Ward, 2013; Tabernero et al., 2009). As a friend to many members in a team, the high centrality project manager can be aware of the overall team's work atmosphere and morale, and take appropriate action to promote positive relations and minimize conflicts in the team. Unlike the high centrality project manager in a task-advice network who facilitates task completion, the high centrality project manager in a friendship network gains affect-based trust from the team which allows the manager to convince the team to form a consensus on work directions and encourage the members to put forth an effort to the team's performance goal (R. Y. J. Chua et al., 2008). This allows the team to work in more collaborative environment and achieve higher performance.

Hypothesis 2 – Teams with a high centrality project manager in friendship network have a stronger positive effect on team cohesion-performance relationship than teams with a low centrality project manager.

1.7 Research Methodology

Research Methods

This research uses a mix of quantitative and qualitative research approaches (Seale, 1999). It includes a survey and network study design to collect

quantitative data to test the hypotheses, and a semi-structured interview to collect qualitative data to provide supplemental results on the project manager's characteristics as a task-oriented and relationship-oriented leader to explain how the managers influence their team cohesion and performance.

Participants

The research invites a global software development company in Thailand to participate in this study. It has a large offshore software development center in Thailand that has many software development teams working under the same geographical boundaries, company culture and software development standards and procedures, e.g., to comply with the CMMI (Capability Maturity Model Integration) standard and software methodology such as the Agile method. By focusing on project manager centrality, the research requests the company to invite teams with each team has one project manager who is mainly responsible for team performance, and have team sizes ranging from 15 to 30 full-time members including the project manager. The manager is expected to work with the team for one to two years in the same working center. The participants are a project manager and the team members. Each participant is required to give consent before participating in the survey and they could opt out any time.

Data Collection

The research uses an online survey with identity verification and a semi-structured interview to collect data and follows the network study design approach in Marsden (1990, 2005, 2011). The online survey has standard questions adapted from past research to collect data on team cohesion and team performance and two sociometric questions to collect data on the team's task-advice and friendship networks. The research uses the members' ratings on team cohesion and team performance since the study relates to the members' perceptions and social influence network theories (Friedkin, 1993).

Concerning sociometric questions, the participants are requested to nominate unlimited names of team members as well as the manager who they consider their task advisor and friend and also provide their relationship strength, i.e., how close is the relation. The project manager centrality is a relative position of the project manager in the team's network. The research collects the whole network data. All team members and the team's project manager will receive the survey and reminders to respond until the response rate reaches a minimum of 80% (Sparrowe, Liden, Wayne, & Kraimer, 2001). The research tracks relationship direction, i.e., who rated whom, and measures the network reciprocation rate to validate the assumption on network data comparing with other studies (Brass, 1984; Ibarra, 1993a).

The research conducts a semi-structured interview with the project managers to collect qualitative data. It is used as supplemental results on the project manager's characteristics as a task-oriented and relationship-oriented leader to explain how the managers influence their team cohesion and performance. At the end of the interview sessions, the research provides a presentation on the collected network graphs of the manager's team, its interpretations and findings to the manager to review the collected network data and suggest alternative explanations.

Data Analysis

The research separates data analysis into three parts based on the characteristics of data which are: first, statistical analysis to analyse the quantitative data from all teams and test the hypotheses to determine whether the teams with a high centrality project manager have a stronger positive effect of team cohesion on team performance than teams with a low centrality project manager. The research follows the approach in Baron and Kenny (1986) to treat project manager centrality as dichotomy, team cohesion and team performance as continuous variables and use comparison group analysis to test the moderating effect. The context variables such as team size, team tenure, network density and network centralization are also analysed to ensure that they have no effect on team performance.

Second, the research uses social network analysis to examine the task-advice and friendship networks in each team. The research uses Node-level ANOVA, ANOVA density model and Relational Contingency-Table analysis following the standard social network methods (Borgatti, Everett, & Johnson, 2013; Hanneman & Riddle, 2005) to find how a high centrality project manager influences the team cohesion and team performance comparing to a low centrality project manager, and whether there is a subgroup of members in the team that prevents the project manager from influencing the team (Friedkin, 1993).

Third, the research uses content analysis to code the interview data and examine the project manager's characteristics according to the task-oriented and relationship-oriented leader characteristics following the standard behavioral definition by Yukl (2012). The project manager's responses in paragraphs are counted and reviewed with the quantitative classification on the low and the high centrality project managers to explain how the project manager influences team cohesion and team performance. Finally, the research summarizes the three data analyses to conclude the findings.

Validity, Reliability and Triangulation

The research adopts two forms of triangulation: data source and methodological in using a mix of qualitative and quantitative research approaches and data (Seale, 1999). For data source triangulation, the research requests the managers and management leader who has experience with all the teams in the study to review the collected social network graphs and integrated findings. To comply with data confidentiality and informant protections, the data is blinded as a code number and is presented to review with only the relevant parties, i.e., 1) each project manager is allowed to see and review the social network graphs of his/her team, and 2) the project managers' supervisor is requested to review the classification of project manager centrality and the manager's task-oriented and relationship-oriented leader characteristics, average rating of team cohesion and team performance, and integrated findings which are statistical analysis, social network analysis and interview results

across teams. For methodological triangulation, the research uses statistical analysis, social network analysis and interview results to cross-validate the findings and draw conclusions.

The research has limitations on its reliability since centrality is collected from the whole population in the team while each team has specific social network characteristics (Borgatti et al., 2013). Its generalization to the population remains limited. As individual team could be considered as specific cases in the study, the transferability to other contexts needs sufficient justification of its relevancy (Creswell, 2006). As the validity and reliability of social network research depend to a great extent on the methodology used (Marsden, 1990, 2011; Wasserman & Faust, 1994), this research closely followed the research design, data collection method, i.e., sociometric test, statistical and network analysis, as suggested in past studies.

1.8 Contributions and Business Implications

This research extends the knowledge to resolve the conflict theories on utility and constraint of the central network position in the team. The result suggests that the project manager centrality has an indirect positive effect on team performance. The high centrality project manager provides benefits in fostering work collaboration among members in the team and improving team performance.

The study also contributes knowledge to team research by considering the role of project manager on the relationship between team cohesion and team performance. The result suggests that team cohesion is a factor that contributes approximately 50% of the team's performance; however, the team also needs the project manager as the team's formal leader to drive team performance. The high centrality project manager plays an important role in connecting members and enhancing the information exchanges and internal work collaboration. As task advisor to many members, the project manager can influence the team to follow the manager's direction to focus on accomplishing the task at hand. The high centrality

project manager can improve the effect of team cohesion on team performance by 10% when compared with the low centrality manager.

The study provides an empirical result to support meta-analysis in social network research that shows project manager centrality is a moderator on the relationship between team cohesion and team performance. By studying software development teams, this study also contributes knowledge to information system research, particularly in software development team management. Software development is a complex socio-technical integration and managing human-work dependency is a key to achieving team performance (Sawyer, 2004). The project managers who have strong task-advice relations with members can help the team to integrate their knowledge and have a clear work direction. In addition, the managers can motivate work collaboration in the team to effectively improve team performance. These managers are highly central in task-advice networking, and the centrality has an effect because a high centrality project manager can fully integrate the team to make the messy platform orchestrated. The research also found that a high centrality project manager influences members' positive perceptions on team cohesion and team performance. These suggest that to manage a software development team to achieve a high performance, it is important to have a manager with strong technical expertise, not only to integrate the knowledge and work direction but also to develop task-advice relations, work motivation and trust in the team.

Business Implications

Research on the social network position has emphasized the importance of being in the right place (Brass, 1984). This study provides insight about the network position and interpersonal relations between the project manager and team members in a high-performing team. Given the prevalence of the constant change in software development teams from sequence and groups to network structure of knowledge software developers (Sawyer, 2004), the research is timely and relevant. It has been found that in a high-complex task such as software development, the project manager who is shifting from managing work effort based on a linear set of discrete tasks to

focusing on managing the task-advice relations benefits the team to strengthen the effect of team cohesion on team performance. The research results suggest that in order to develop a high-performing software development team, the project managers shall consider the following actions:

1) Setup and improve team cohesion as it contributes to approximately 50% of team performance. As team cohesion relates to members' shared characteristics and similarities (McPherson et al., 2001), it could be developed by setting up the team with similar personalities and conducting team building activities to minimize gaps among members.

2) Develop close interpersonal relations with the team by building a trust-based relationship and adopting some research studies such as the social style framework (Bolton & Bolton, 1984, 2009; Merrill & Reid, 1981). The manager may improve technical skills and task-advice relations with the team to provide effective work solutions and directions as it enhances internal work collaboration and team performance by approximately 10%.

3) Keep monitor and manage task-advice and friendship relations among members in the team. Relationship management is a secret weapon for a successful project manager to minimize subgroups, improve work collaboration and influence team performance (Brass & Krackhardt, 1999; R. Y. J. Chua et al., 2008).

4) It would be useful for the managers to adopt social network analysis as a tool to collect and analyze webs of interpersonal relations in the team. It may provide some insight, e.g., subgroups in the team, for the manager to find out and improve the team's internal collaborations, processes and structure.

1.9 Overview of Chapters

This dissertation has five chapters. Chapter 2 provides a review of related studies on centrality, task-advice and friendship relations, team cohesion and team performance, and proposes a conceptual model and hypotheses on the moderating effect of project manager centrality on team cohesion-performance relationship.

Chapter 3 details the research approach and methodology used in this dissertation, which are the network study design, measurements, data collection and analysis processes. The chapter ended with ethical in research and guidelines.

Chapter 4 presents the research results covering a summary of teams in study, context variables, the test results of all hypotheses, analysis of social network graph and interview results.

Finally, chapter 5 summarizes the dissertation on key findings and interpretations. It also discusses the theoretical implications of these results along with the limitations of the research and possible future research.

CHAPTER II – THEORETICAL BACKGROUND AND HYPOTHESIS DEVELOPMENT

2.1 Project Manager Centrality

Project manager centrality is the degree to which the project manager is considered by the team members to be a task advisor and a friend. It refers to the proportion of the members who nominate the manager in a team following the Freeman's concept of in-degree centrality (1978). The project manager is the team's formal leader who in charge of the completion of the project, i.e., a set of tasks to be delivered by a group of people working together as a workgroup or a team (Keil et al., 2013). A task-advice relationship is developed via a formal work-role relationship. Friendship is developed from emotional support and social-liking (Lincoln & Miller, 1979). Task-advice and friendship relations also reflect cognition-based trust or trust from the head, i.e., a judgment based on evidence of competency and reliability, and affect-based trust or trust from the heart, i.e., a bond that arises from emotions and feelings (R. Y. J. Chua et al., 2008). A high centrality project manager or the project manager who is considered by many members to be a task advisor and a friend is seen as a trustworthy manager. Social network research on team performance has reported an importance on project manager centrality in perspectives such as information exchange and work collaboration in team (Haythornthwaite, 1996), and social influence network theories (Friedkin, 1993) summarized as follows.

In information exchange perspectives, the interpersonal relations, i.e., task-advice and friendship relations, the structure allows the flow of information among members in network. A high centrality project manager, having many connections with the other team members, benefits the team by exchanging scarce resources (Haythornthwaite, 1996), which in a software development team, includes work-related information such as software specifications, technical knowledge and solution directions are necessary information in developing the software. A high centrality project manager would benefit the team by integrating such knowledge to minimize task difficulties and complete the team responsibilities. Also, as centrally connected,

the manager can enhance work collaboration among members by bridging the gaps of different members' capabilities. The manager can provide and integrate the knowledge among members to have one solution direction for the team (Cross & Cummings, 2004; Hossain, 2009a, 2009b; Hossain & Wu, 2009; Hossain, Wu, & Chung, 2006). For the friendship relation, a high centrality project manager would have access to the information on team specific situation, i.e., the individual and team's morale, so the manager can provide necessary emotional support to the team to motivate team performance as well as retain members within the team. As a result, the high centrality project manager is generally found to foster high team performance (Balkundi & Harrison, 2006).

In social influence network theories, the central actor is considered a prominent actor who can influence others' perceptions and behavior (Friedkin, 1993; Friedkin & Johnsen, 2011). The interpersonal relations provide channels for the flow of social influences and ideas among the members (Ahuja, Galletta, & Carley, 2003; Ibarra & Andrews, 1993). Under uncertainty, i.e., working on complex and unclear tasks, people tend to seek information from their social context to adapt their behavior to conform within the perceived norm. A high centrality project manager, as seen by more members than a low centrality project manager, could be more easily viewed as a role model capable of influencing the team's work results. As a task-advice relationship is established via a formal work-role relationship, the high centrality project manager in such networks would reflect the concentration of manager-member interactions in focusing the work, and thus the manager can influence the work direction and team behavior in driving work performance. As friendship is established via social support and liking, a high centrality project manager can get along well with the team and minimize conflicts among members to promote collaboration in the team and thus improve team performance. As a result, the high centrality project manager is seen as having charisma in motivating team performance (Balkundi, Barsness, & Michael, 2009; Balkundi et al., 2011).

As "influence is the essence of leadership" (Yukl, 1994, p.223) and the central argument of network research is that "centrality is the key component of

leadership in an organization" (Brass & Krackhardt, 1999, p.183), a high centrality project manager in task-advice and friendship networks is closely relating to the task-oriented and relationship-oriented leader. A 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 a relationship-oriented leader has behavior centering on 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 the team (Casimir, 2001; Tabernero et al., 2009). Task-advice and friendship relations also relate to the trustworthy leader as cognition-based trust, i.e., a judgment based on evidence of competency and reliability, and affective-based trust, i.e., a bond that arises from emotions and feelings (R. Y. J. Chua et al., 2008; Moran, 2005). Thus, a high centrality project manager in task-advice and friendship networks is seen as having high competency in working skills and relations buildings, which influences both team cohesion and team performance (Tabernero et al., 2009; Wendt, Euwema, & van Emmerik, 2009). Table 2.1 provides a summary of task-oriented and relationship-oriented leader characteristics (Yukl, 2012).

Table 2.1 Task-oriented and Relationship-oriented Leader Characteristics

Leader Behavioral Characteristics	Definitions
1. Task-oriented Leader	
Clarifying	Leaders use clarifying to ensure that people understand what to do, how to do it, and the expected results. Clarifying includes explaining work responsibilities; assigning tasks; communicating objectives, priorities, and deadlines; setting performance standards; and explaining any relevant rules, policies, and standard procedures.
Planning	This broadly defined behavior includes making decisions about objectives and priorities, organizing work, assigning responsibilities, scheduling activities, and allocating resources among different activities.
Monitoring operations	Leaders use monitoring to assess whether people are carrying out their assigned tasks,

Leader Behavioral Characteristics	Definitions
	the work is progressing as planned, and tasks are being performed adequately.
Problem solving	Leaders use problem solving to deal with disruptions of normal operations and member behavior that is illegal, destructive, or unsafe. Effective leaders try to quickly identify the cause of the problem, and they provide firm, confident direction to their team or work unit as they cope with the problem.
2. Relationship-oriented Leader	
Supporting	Leaders use supporting to show positive regard, build cooperative relationships, and help people cope with stressful situations.
Developing	Leaders use developing to increase the skills and confidence of work-unit members and to facilitate their career advancement.
Recognizing	Leaders use praise and other forms of recognition to show appreciation to others for effective performance, significant achievements, and important contributions to the team or organization.
Empowering	Leaders can empower subordinates by giving them more autonomy and influence over decisions about the work. One empowering decision procedure called consultation includes asking other people for ideas and suggestions and taking them into consideration when making a decision.

Centrality relates to behavior that benefits the team. With comprehensive tests (Klein, Lim, Saltz, & Mayer, 2004), it has been found that highly educated individuals with low neuroticism or a short-temper have high task-advice and friendship centrality. A high centrality person in a task-advice network also has activity preference characteristics, i.e., the person is hard-working, highly engaged in the team's tasks, is competent and presents values that benefit the team. A high centrality person in friendship network is agreeableness, i.e., a personality of being cooperative, compliant, sincere, gentle, and trustworthy (Klein et al., 2004). In addition, centrality also relates to the behavior such as self-monitoring, i.e., a high centrality person keeps monitor the interpersonal relations and adapt to changes (Mehra, Kilduff, & Brass, 2001; Zaccaro, Foti, & Kenny, 1991). A self-monitoring

manager is an emotional helper to the team (Toegel, Anand, & Kilduff, 2007). All these suggest that a high centrality project manager would share some behavior, e.g., activity preferences, agreeableness, and self-monitoring, that benefits the team.

2.2 Team Cohesion-Performance Relationship

Team cohesion is the extent to which team members bond to the team, commit to the team's tasks and are proud to be part of the team (Barrick, Bradley, Kristof-Brown, & Colbert, 2007). Team cohesion is a predictor of team performance in many research and meta-analysis (Beal et al., 2003; Chang & Bordia, 2001; Evans & Dion, 2012; Greer, 2012; Kozlowski & Ilgen, 2006; Mullen & Copper, 1994). Team cohesion has three facets: interpersonal attraction which facilitates the members in a team to collaborate with others, task commitment which increases individual efforts to complete the task, and group pride which facilitates members sharing affection 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 tasks which facilitates their work collaboration in the team. Team cohesion reflects dense interpersonal relations among members in a team to impact team performance. Team cohesion effects team performance when the team is working on complex interdependent tasks that require high work collaboration (Gully et al., 1995).

2.3 Development of Conceptual Model

Literature reviews provide two key reasons that project manager centrality should be a positive moderator on team cohesion-performance relationship. First, in the contrasting theory on the utility and constraint of centrality (Kilduff & Brass, 2010), many research have suggested that project manager centrality should provide positive rather than negative results to the team. The centrality provides benefit to the actor to have more information to integrate different members' capabilities to promote team performance (Haythornthwaite, 1996) and to influence members' perceptions and behaviors to direct the team towards the same performance target (Friedkin, 1993;

Friedkin & Johnsen, 2011), rather than the centrality reflecting constraint that the actor may have redundant information, being a bottle neck and discourage the team from findings novel solutions (Gargiulo & Benassi, 2000; Kratzer et al., 2008; Kratzer et al., 2010). It was found in the meta-analysis of 37 team network studies that the high centrality project managers have high-performing teams (Balkundi & Harrison, 2006). The different findings that centrality provides both benefit and constraint may simply be a result of past studies having examined the direct association between project manager centrality and team performance (Balkundi & Harrison, 2006).

Second, as team cohesion effects team performance when there is high task interdependency in the team, a high centrality project manager can benefit the team by interconnecting and managing the messy platform to organize and achieve a higher team performance. This can be explained by the fact that team cohesion reflects dense interpersonal relations among members in the team to effect team performance and one key moderator is task interdependent (Gully et al., 1995). Having high task interdependence means the team needs to be more cohesive and collaborative to achieve team performance, yet, this also means the team is in a messy platform of dense interpersonal relations among the members. To achieve a higher team performance, it will require some members to connect and manage the messy platform toward organization. This could be the high centrality project manager, having task-oriented and relationship-oriented leader characteristics, to influence members' motivations and integrate members' different capabilities to benefit the team. By bridging the connections among members and influencing the work results, the high centrality project manager can foster team cohesion to have a higher positive effect on team performance than the low centrality project manager. This suggests the conceptual model as shown in Figure 2.1. It is extended from meta-analysis of team cohesion-performance relationship (Mullen & Copper, 1994) and hypothesizes that the project manager centrality is a moderator for the relationship (Balkundi & Harrison, 2006).
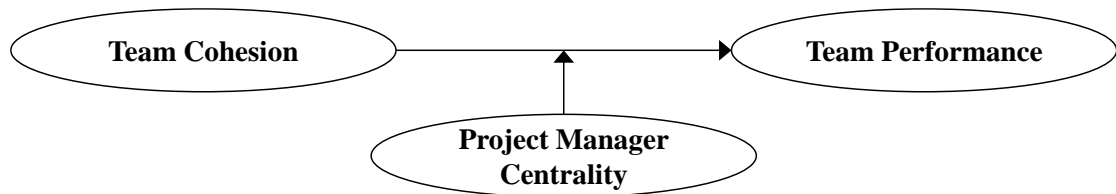
Figure 2.1 Conceptual Model

The utility of centrality is the core idea in this research. It suggests two hypotheses as follows. First, the teams with a high centrality project manager in task-advice networks should have a stronger positive team cohesion-performance relationship than the teams with a low centrality project manager. In information exchange perspectives, the centrality provides benefit to the actor to have more information and bridge information flows to enhance work collaboration among members in the team (Haythornthwaite, 1996). In task-advice networks of work-related information, i.e., work progress and technical knowledge, the high centrality project managers, as compared to the low centrality project managers, can have more information to guide the work direction in the team. Teams with high centrality project manager reported high internal work collaboration (Bono & Anderson, 2005; Zhang & Peterson, 2011), higher speed and efficiency of consensus decision making (Salk & Brannen, 2000), development of new ideas and strategic integration (Pappas & Wooldridge, 2007) and effective integration of team efforts and high performance (Balkundi et al., 2009).

In social influence network theories, the central position lays the actor who has high influence on others' perceptions and behavior (Friedkin, 1993; Friedkin & Johnsen, 2011). The central position found the leader of the group (Mullen, Johnson, & Salas, 1991; Neubert & Taggar, 2004; Sutanto, Tan, Battistini, & Phang, 2011), the prominent actor (Knoke & Burt, 1983) and opinion leader (Chen & Li, 2012) who is the key initiator on diffusing innovative ideas among members in the team. The high centrality project manager in task-advice network shares the task-oriented leader's characteristics that the manager influences the team to focus on accomplishing the task at hand (Tabernero et al., 2009). A task-oriented leader also influences team efficacy, i.e., the team's shared beliefs of its capability to achieve its performance

target, and task accomplishments. While developing software is a technical-related task, the high centrality project manager is seen as being powerful in influencing the uses of new problem-solving ideas and driving technical innovations in the team (Ibarra, 1993a).

As people generally seek advice from people they trust, task-advice relations are positively associated with cognition-based trust, i.e., trust based on competence and reliability (R. Y. J. Chua et al., 2008). The high centrality project managers, as nominated by others, share the similar characteristic of being trustworthy (R. Y. J. Chua et al., 2008; Moran, 2005; Wei-Li, Ryh-Song, & Hao-Kai, 2012), having high professional values (Gibbons, 2004), high work competence (Casciaro & Lobo, 2008), are hard-working and are highly engaged in the team's tasks (Klein et al., 2004). The high centrality project manager as compared to the low centrality project manager shares more of these characteristics and provides substantial benefits to the team. Hard-working and competent managers actively support the team with their extensive skills to achieve the team's task objectives (Offermann, Kennedy Jr, & Wirtz, 1994). These factors provide the following hypothesis.

Hypothesis 1 – Teams with a high centrality project manager in a task-advice network have a stronger positive effect on team cohesion-performance relationship than teams with a low centrality project manager.

For friendship networks, the teams with a high centrality project manager should also have a stronger positive team cohesion-performance relationship than the teams with a low centrality project manager. Friendship is developed from emotional support, intimacy and social liking (Lincoln & Miller, 1979). In information exchange perspectives, the centrality in the friendship network allows the manager to be aware of individual members' attitudes towards the work of the team (Haythornthwaite, 1996). A high centrality project manager can have an integrated picture on the team's work atmosphere and morale which helps the manager to motivate the team more appropriately than a low centrality project manager. A high centrality project manager

in a friendship network shares relationship-oriented leader characteristics that the manager is friendly and approachable, provides encouragement and looks out for the welfare of subordinates to keep interpersonal relations pleasant (Casimir, 2001; DeLamater & Ward, 2013; Tabernero et al., 2009). A high centrality project manager also has a good reputation and the necessary charisma to minimize conflicts among members and promote team performance (Balkundi et al., 2009; Balkundi et al., 2011; Mehra, Dixon, Brass, & Robertson, 2006). As people generally make friends with people they trust, friendship relations are related to affection-based trust, i.e., where trust arises from emotions and feelings (R. Y. J. Chua et al., 2008). A high centrality project manager reflects a trustful leader who develops cohesion in the team and influences team members to trust each other, motivate members' collaboration and improve integrated work performance (Mach, Dolan, & Tzafrir, 2010). This provides the following hypothesis.

Hypothesis 2 – Teams with a high centrality project manager in friendship network have a stronger positive effect on team cohesion-performance relationship than teams with a low centrality project manager.

In summary, the high centrality project managers have more knowledge of their team to manage the team's direction and integrate the team's efforts. The high centrality project manager shares leader characteristic to motivate cohesion in the team and the team's behavior to collaborate effectively. The high centrality project manager generally has high work competence and fully engages in the team's tasks to effectively drive team performance. In context team cohesion effects team performance, i.e., when there is a high task interdependence such as in software development teams, the high centrality project manager would foster the team cohesion to have a higher positive effect on team performance than the low centrality project manager. The high centrality project manager bridges the gaps among members, integrates different members' capabilities, promotes work collaboration and motivates positive work results to make a messy platform more orchestrated.

2.4 Summary

Project manager centrality is the extent to which the project manager, the formal leader of the team, has direct connections with members in the team serves as their task advisor and friend. By having many connections, the high centrality project manager can provide better support to the team for improving information exchanges and internal work collaboration as well as motivating the team to work toward the same target performance. The high centrality project manager is seen as a trustful and charismatic person who integrates the team's expertise and influences the team's behavior to harmonize and perform highly. The high centrality project manager shares task-oriented and relationship-oriented leader characteristics that benefit the team. The central position in the team's social network is hypothesized to be the right place for the manager to enhance the team cohesion-performance relationship (Brass, 1984; Brass & Krackhardt, 1999). As expertise integration is important for a software development team performance (Faraj & Sproull, 2000; Tiwana & Mclean, 2003), a conceptual model with two hypotheses has been developed to examine the moderating effect of project manager centrality on team cohesion-performance relationship (Balkundi & Harrison, 2006; Mullen & Copper, 1994).

CHAPTER III – METHODOLOGY

3.1 Research Paradigm and Epistemology

The research paradigm is "the fundamental models or frames of reference we use to organize our observations and reasoning" (Babbie, 2013, p.57-58). The research paradigm plays a critical role in guiding the social research in a scientific inquiry. There are commonly five broad paradigms in social science research studies (Babbie, 2013; Creswell, 2006).

1) Ontological refers to the nature of reality and its characteristics such as the definition and property of what is assumed to exist.

2) Epistemological refers to what counts as knowledge and how knowledge claims are justified.

3) Axiological refers to the role of values in which the researcher acknowledges that research is value-laden and that biases are present.

4) Methodological refers to the process of research.

5) Ethical refers to the process in conforming to the standards of conduct of a given profession or group, which include voluntary participation, no harm to participants, anonymity and confidentiality.

In elaborating the research paradigm, W. F. Chua (1986) and Orlikowski and Baroudi (1991) have classify research epistemologies into positivist, interpretive and critical as summarized in Table 3.1

Table 3.1 Epistemology: Positivist, Interpretive and Critical

	Positivist	**Interpretive**	**Critical**
1. Ontological: beliefs about physical and social reality	Social world exists independent of humans, and whose nature can be characterized and measured.	Social world are not 'given'. Rather, it is produced and reinforced by humans through their action and interaction.	Social reality is historically constituted. Things can never be treated as isolated elements (totality) but be shaped by historical and contextual conditions.
2. Epistemological: beliefs about knowledge	Hypothetic-deductive, search for universal laws. Theory is true only	Hypothetic-inductive, getting inside the world of those generating it.	Through the analysis of what it has been, what it is becoming, and what it

	Positivist	Interpretive	Critical
	if it is repeatedly not falsified by empirical events.		is not.
3. Primary concerns	Understand (Discover).	Explain (Interpret)	Evaluate and transform (Change)
4. Code of conduct	Test theory in an attempt to increase predictive understanding of phenomena.	Explain phenomena through accessing the meanings that participant assign to them, the intent is to understand the deeper structure of a phenomenon.	Critique the status quo and structural contradictions within social systems, and thereby to transform these alienating and restrictive social conditions.
5. Methodological: beliefs about which research methods and techniques are considered appropriate	Large-scale sample surveys and controlled laboratory experiments are suitable research methods. Inferential statistics is the data analysis method used to discover causal laws. Validity and reliability are crucial.	Field study with attempts to derive constructs from the field by in-depth examination of and exposure to the phenomenon of interest. The form of knowledge is constructed through the world view of researchers.	Critically analyse material conditions of domination through the particular theoretical framework.

Based on the definitions above, this research is neither pure positivist nor pure interpretive. Neither paradigm fits with the researcher's view of the team's social network structure that is socially constructed by human actors, i.e., the project manager and team members who interact to complete a set of predefined tasks. Their interpersonal relations have been formed and operated individually, i.e., in their world views, and collectively, i.e., integrated as a network.

In this study, the researcher attempts to show that the project manager's network position relates and influences the members' perceptions on team cohesion and team performance. In the positivist perspective, the researcher has the ontological assumption that project manager centrality is predictive and as such behaves in a deterministic manner, which allows the researcher to conduct an empirical deductive study to test the past findings that project manager centrality is a positive moderator on the team cohesion-performance relationship. The project manager centrality in the team is presumed to exist and the researcher can use known methods, e.g., sociometric questionnaires, social network graphs, and network analysis for data

collection and analysis. However, project manager centrality is a position in the team's social network that the interpersonal relations in the team is not given but produced by the project manager and team members, i.e., as the task advisor and a friend. Its interpretation, i.e., the meaning of project manager centrality and how it affects the team, is highly dependent on individual participant. Based on such awareness, the researcher seeks to adopt an interpretive view to explain the effect of project manager centrality through in-depth analysis of social network graphs and through shared meanings assigned by the participants in the field.

In epistemological beliefs, this research is most consistent with positivism. Four rationales support this choice. First, the research is mostly deductive. The researcher identified a set of hypotheses that was derived from existing theories and literature. The researcher attempts to test these hypotheses to fill the research gaps. Second, the researcher's primary concern is to understand the moderating effect of project manager centrality rather than to explain the meaning of project manager centrality. The researcher then seeks to use the meaning of project manager centrality as given by prior studies, i.e., the high centrality project manager in task-advice and friendship networks shares task-oriented and relationship-oriented leader characteristics, to examine the phenomena rather than to construct the meaning through the world view of the researcher and the participants. Third, with the belief that the knowledge of project manager centrality is consistent and transferable with regards to prior studies, the researcher is more focused on the positivist paradigm. Finally, the researcher recognizes that all research methods are fallible and hopes that the validity of findings is strengthened through a process of triangulation and mixed methods.

In the axiological paradigm, it is recognized that centrality is simply a relative position in the network as calculated from the data. The finding from this research is limited to explaining the data rather than creating a predictive theory or universal law. The finding can only place some knowledge pertaining to network theory to explain the benefits of network position and interpersonal relations in a team (Neuman, 2007).

3.2 Network Study Design

The purpose of network analysis is to examine interpersonal relations in terms of the network (Marsden, 1990). Based on comprehensive reviews on research design for social network studies comparing with other known standards, network analysis principles and assumptions are summarized in Table 3.2 (Carpenter, Li, & Jiang, 2012; Marsden, 1990, 2005, 2011; Rowley, 1997). The researcher also added the last column to summarize how the research design follows these categories of principles and assumptions.

Table 3.2 Network Study Design

Principles	Assumptions	Methodological Issues	Focus in this research
Social structure is conceived as a pattern of specifiable relations joining social units-including both individual actors and collectives.	Level of analysis draws a focus on how network analysis to be established between concepts and measures.	What is the level of analysis on the network under study?	**Level of analysis:** this research focuses on positional analysis in measuring the centrality of the project manager in team's social network.
Behavior is interpreted in terms of structural constraints on activity rather than in terms of inner forces within units.	Actors and their actions are viewed as interdependent units.	What are the boundaries of the network under study?	**Boundary specification and strategies:** this research focuses on whole-network of formal membership in team. Two types of nodes in representing the manager and the team members.
Existence of predetermined actor sets in the research settings.	Actors can be predefined with known characteristics or uncovered through network analysis of social structure.	What is the characteristic of actor sets in the network under study?	**Network sampling:** opportunity sampling based on information availability is used; the characteristics of managers and team members also collected to analyse homogeneity of data across team.
Analyses focus on the relations between units.	Relations between actors are channels for transfer of flow of resources.	What type(s) of relations will be measured? Do the relations measured represent the range of relevant components of the construct?	**Relation types:** task-advice and friendship relations are the primary relations under investigation.

Principles	Assumptions	Methodological Issues	Focus in this research
		What is appropriate instrument for measuring network under study?	**Instruments, Validity and Reliability**: Sociometric test administered with a roster of member's name is used. The respondent is allowed to list unlimited number of names in corresponding to two questions on task-advice and friendship relations.
		Will binary of value data be collected? Does the operationalization of the relations construct(s) require assessing the strength of the relations?	**Relationship strength and scale types:** strength of relations is an important aspect of this study. The value data will be collected.
		Are the relations directional or nondirectional? Are the relations reciprocal?	**Symmetrize and reciprocation:** the relations will be directional and the data analysis will determine the reciprocity of the relations.

This research focuses on position analysis of network centrality. As the relative position of an actor in the team, the whole-network data of the team is collected in this study. The boundary of the team is defined based on formal membership of the project manager and the members in the team. Team sizes range from 15 to 30 full-time members including the project manager to meet validity criteria of centrality calculation under 80% expected response rate and keep some dynamics management processes inherent in software development teams (Faraj & Sproull, 2000; Gould & Fernandez, 1989; Guinan, Cooprider, & Faraj, 1998; Sawyer & Guinan, 1998; Sparrowe et al., 2001).

The research uses opportunity sampling based on information availability and the reach of the researcher. Opportunity sampling is one of the common sampling methods used in the network study (Carpenter et al., 2012). It is conducted by inviting the project managers in the company and collected network data based on chances,

i.e., per availability and voluntary participations of the managers and their team members.

Sociometric test is a basic and general technique used in social network research (Marsden, 2011). The researcher has administered a sociometric test with a roster of member's names to aid the respondents' recall in providing data (Marsden, 2011). The respondent is allowed to list an unlimited number of names in corresponding to two questions: one for task-advice and another for friendship relations as the primary relations under investigation. The research also collects data on the strength of the relations based on 'closeness' or emotional distance. Such measure is free of contamination as compared to duration and frequency of interactions (Marsden, 1990). The researcher keeps relationhips direction, i.e., who rated whom, measures the network reciprocation rate to validate the assumption on network data comparing with other studies (Brass, 1984; Ibarra, 1993a). Following the reviews on survey methods for network data by Marsden (2011), the researcher considers only teams where the members and manager are working in the same geographical boundary to ensure that they have some regular interaction with each other and to provide data validity and reliability.

3.3 Measurement of Variables

This section summarizes the measurement of variables in the study which are dependent variables – team performance, independent variables – project manager centrality and team cohesion, and context variables – individual and team characteristics. Figure 3.1 shows a summary list of variables. Details of the questionnaires, scales and data coding are provided in Appendix B.
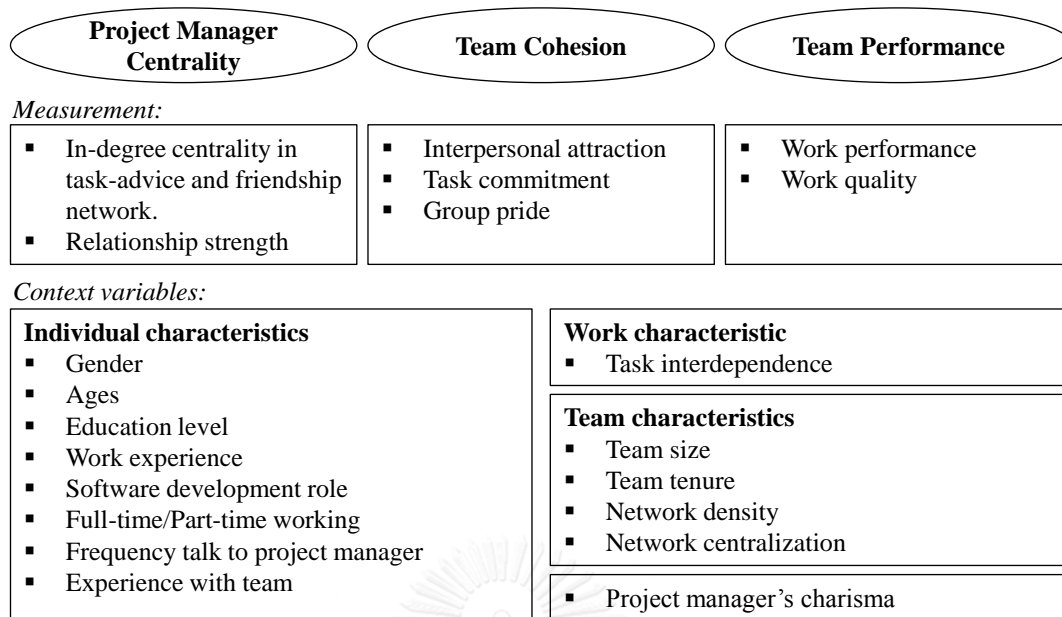
Figure 3.1 Measurement of Variables

3.3.1 Dependent Variable

Team Performance – is measured as in a five-point likert scale in work performance and work quality following the standard questions in Hoegl and Gemuenden's paper (2001). Team performance rating by members would show some different from actual performance; however, it is applicable because 1) based on meta-analysis by Beal et al. (2003), team cohesion is strongly related to performance behavior and how well the team works together rather than actual outcomes (Kozlowski & Ilgen, 2006), 2) the research studies interpersonal relations between the manager and the team, the rating would relate to how the members view the manager in terms of supporting their work (Faraj & Sproull, 2000), and 3) self-rating is appropriate when anonymity is guaranteed, i.e., when the measures are said to be obtained for research purposes and will not be used in assessing the teams for organizational purposes (Henttonen, Janhonen, & Johanson, 2013).

3.3.2 Independent Variable

Project Manager Centrality – is the in-degree centrality of the project manager in the team's task-advice and friendship networks. The network is collected by using a sociometric test following the questions from Ibarra's paper (1993a). Respondents are requested to nominate an unlimited number of the team members' names in corresponding to task-advice and friendship relations and rate the strength of the relations based on 'closeness' or emotional distance as values from 1 (not close) to 5 (very close) in each input name (Moran, 2005). Following Freeman's concept (1978), centrality is calculated by the total number of members who rated the manager divided by the total number of members in the team.

Team Cohesion – is measured as a five-point likert scale in three facets which are interpersonal attraction, task commitment and group pride following the standard questions in Hoegl and Gemuenden's paper (2001).

3.3.3 Context Variables

Several variables in the research context are collected to test the homogeneity of the data in minimizing the effects on the main variables in the study. These are including individual and team characteristics.

Individual Characteristics – gender, ages, education level and experiences in software development are collected as demographical data (Carboni & Ehrlich, 2013; Mehra et al., 2001). The software development role as project manager, software developer, software tester, business analyst, system analyst, and other is collected and used to classify the team members and the manager. Also, the respondents were requested to indicate whether they are working full-time or part-time, the frequency to which they have talked to the project manager and their experiences with the team (Carboni & Ehrlich, 2013).

Work Characteristics – task interdependence is the extent to which team members have to depend on one another to accomplish their task. It is controlled by the research design that was selected for the software development teams that are performing similar to the set of tasks in a global software development company, and the respondents were requested to rate task interdependence in a five-point likert scale following a standard question to review the variance among teams (Gully et al., 1995).

Team Characteristics – team size is the total number of team members including the manager. Team tenure is the average members' experience with the team. Network density is the proportion of actual nominations among the total possible number of nominations. It measures overall level of relationships in the network, i.e., dense networks could ease team communications which benefits the team performance. Network centralization refers the extent to which relationships are concentrated in a small number of individuals rather than distributed equally among all members. These variables are collected and tested for statistical control of data variance across teams (Allen, Katz, Grady, & Slavin, 1988; Balkundi & Harrison, 2006; Carboni & Ehrlich, 2013; Sparrowe et al., 2001).

Project Manager's Charisma is measured as a five-point likert scale in seven questions from the Multifactor Leadership Questionnaire in Waldman, Ramirez, House and Puranam, (2001). As a leadership quality in motivating the team, charisma is used to test the association with the project manager centrality (Balkundi et al., 2011).

Other details of software development methodology and variables are omitted in order to keep the questionnaire length practical. It is based on the considerations that these variables have already been tested comprehensively in other studies, such as in Guinan et al. (1998), Faraj and Sproull (2000), Hoegl and Gemuenden (2001), Sawyer, Guinan and Cooprider (2010) and Balkundi et al. (2011).

3.4 Data Collection

This section summarizes the data collection processes which are include a highly detailed description of the software development teams and companies in study, the invitation process and the development of the questionnaire and interview protocol.

3.4.1   Software Development Teams and Organization in Study

A global software development company in Thailand was invited to participate in this research. It has a large offshore software development center that focuses on delivering financial software applications as their main product. The center has many software development teams. The teams are working according to the CMMI (Capability Maturity Model Integration) standard as well as software methodology such as the Agile method. All members, managers and project teams follow such standards to ensure software quality and achieving team performance are their key focus. The company was selected as it focuses on team performance. Teams are working in the same location and comply with the company's collaborative culture. Research on the company provides an appropriate context for the study.

With the focus on the project manager as the central actor in the team's internal social network, the teams that have one formal project manager were invited for this research. The following criteria from past research are used as a guideline for team characteristics in this study.

1) Teams have a range of 15 to 30 full-time members including the project manager. Teams with less than 80% participation will be excluded as the network analysis requires a high response rate (Sparrowe et al., 2001). Fifteen to 30 members are necessary to have some dynamics management processes inherent in the teams (Faraj & Sproull, 2000). A 30-member network is considered sufficiently large to enough to calculate the centrality score, and it is reasonable to

assume that test statistics have the standard normal distribution (Gould & Fernandez, 1989).

2) The team members and their manager have been working together for more than one year in the same working location and have established some interpersonal relations (Allen et al., 1988; Carboni & Ehrlich, 2013; Gallivan, Spitler, & Koufaris, 2005; Marsden, 2011).

3.4.2 Participant Invitation and Data Collection Process

The process for acquiring participants is summarized as follows:

1) Contact and invite the company to participate in the research. Provide background of the study and research process including the scope of the research and the data collection processes both through an online survey and a semi-structured interview as well as sample research results.

2) Send formal invitation letters from the IT in Business PhD program to the authorized persons in the company to obtain permission to conduct the research. Also, request permission to use the results of the online survey and interview content in research publications.

3) Request the company to select software development teams and invite the project managers and their team members to participate.

4) Send out an online survey to the managers and their team members to collect data, and send reminder mails to encourage responses until the response rate reaches 80%. Request the managers to help notify and remind their team members to provide responses.

5) Conduct a semi-structured interview with an individual project manager to collect qualitative data about the manager and the team's characteristics. After completing the interview, request the manager to review the social network graphs of his/her team and provide information how they interpret the graph. The graphs are presented after the interview to minimize the possibility that the managers may present themselves in favour to the research.

6) Conduct a review session with the managers' supervisor to obtain additional information such as how the teams are setup and to review the statistical and social network findings as well as interview results across the teams.

7) Summarize research results to the managers and their supervisor.

3.4.3   Development of Questionnaire

The questionnaire was developed by following the terms and wordings described in past papers on sociometric tests (Ibarra, 1993a) and studies of software development teams in organizations (Faraj & Sproull, 2000; Guinan et al., 1998; Hoegl & Gemuenden, 2001; Sawyer et al., 2010). The questionnaire was developed with a reordering of questions and used reverse scale when appropriated. Reordering the questions is necessary to facilitate the flow of questions. Using a reverse scale helps minimizi eacquiescence, i.e., the tendency of respondents to agree more than to disagree regardless of questionnaire content. To ensure that the wording is appropriate, the company's contact person also helped in reviewing and testing the questionnaire. As a result, the questionnaire has three sections which start with sociometric tests, followed by input regarding work and team characteristics, and ending with individual demographic information. It has 3-4 pages in length with 34 questions and 2 sociometric questions, as sample provided in Appendix C.

3.4.4   Development of Interview Protocol

A qualitative semi-structured interview was conducted with the project managers to gain in-depth data. The interview protocol was designed by asking about project managers' perceptions on interpersonal relations in the team, their relations with the team as well as their roles and experiences in managing team performance. As the researcher could not conduct an experiment to directly examine the effects of project manager centrality on the team cohesion-performance relationship, the interview data is used to provide supplemental data to 1) explore the key characteristics of the high centrality project manager, 2) find whether the team are

being cohesive, i.e., having close interpersonal relations and working collaboratively in the manager's perceptions, 3) explain how the manager's and team's characteristics relate to team performance, and 4) find alternative explanations in addition to the findings from statistical and network analysis. Table 3.3 provides a summary of interview protocol and questions. The questions on reviewing the collected social network graphs were at the end of the interview to request the manager to comment on the analysis and findings of their team.

As the interview provides benefits in allowing a flexible flow of questions, some questions were added during the interview to ask the managers to share personal beliefs and attitudes such as: How do you position yourself with a team? Do you think interpersonal relations benefit or hinder management of team performance? Should a manager have close relations with the team? How should you balance such relations? The focuses in asking these questions are to compare and contrast project manager centrality amongst different teams.

Table 3.3 Interview Protocol and Questions

Interview Topics	Interview Questions
▪ Team cohesion and Team performance	▪ Describe how the team was setup. Are they got to know each other in this project or since some projects in the past? ▪ In your opinion, how they worked with each other? ▪ In your opinion, are they having closed relations? Are they having subgroups in your team? ▪ In your opinion, what is key strength in your team? What make them differs from others in having high team performance?
▪ Project manager centrality and Team performance	▪ Describe how you lead this team. ▪ Describe the situation when the team was fallen behind the planned work schedule, what did you do? ▪ Describe the situation when the team was having low morale, i.e., due to work-related and personal issues, what did you do? ▪ Describe the situation when the team had conflicts, i.e., members having different opinions, what did you do? ▪ How do you know the situations?

Interview Topics	Interview Questions
	▪ In your opinion, what makes the team follows your suggestions? ▪ What is your secret ingredient in managing the team to achieve team performance? ▪ In your opinion, what is your personality and management styles? ▪ How these relate to team behavior and performance?
▪ Project manager centrality and Team Cohesion-Performance Relationship	▪ Are you having a close personal relation with the team? ▪ In this team, in what circumstances that you can let the team handle the situations by themselves and in what circumstances that you would closely involve? ▪ In your opinion, are they having close relations with you? In what way? ▪ In your opinion, would the team performance more relate to the interpersonal relations among members or their relations with you? Why?
▪ Social Network Graph	▪ This is the social network graph of your team. What do you think about the graph? ▪ Would it reflect the team's social network according to your perceptions? why? ▪ Based on our analysis, we would explain the graph as …. Do you think it makes senses? what could be wrong? ▪ Based on your experience with the team, how would you explain the graph in relating to team's work results?

3.5 Data Analysis Process

The data analysis is separated into three parts as shown in Figure 3.2, which include: 1) statistical analysis to analyse the quantitative data in all teams and test the hypotheses to determine whether the teams with a high centrality project manager have a stronger positive effect of team cohesion on team performance than teams with a low centrality project manager; 2) social network analysis to examine the task-advice and friendship networks in each team on how the project manager centrality effects team cohesion and team performance; and 3) qualitative data analysis to analyse the interview data as supplemental results on the project manager's

characteristic as a task-oriented and relationship-oriented leader following the standard behavioral definition by Yukl (2012). The project manager's responses in the paragraphs are counted and reviewed with quantitative classification on the low and the high centrality project managers to refer to past literature to explain how the project managers influence team cohesion and team performance in their teams. The research used SPSS and UCINET as statistical and social network analysis tools (Borgatti et al., 2013; Hanneman & Riddle, 2005).
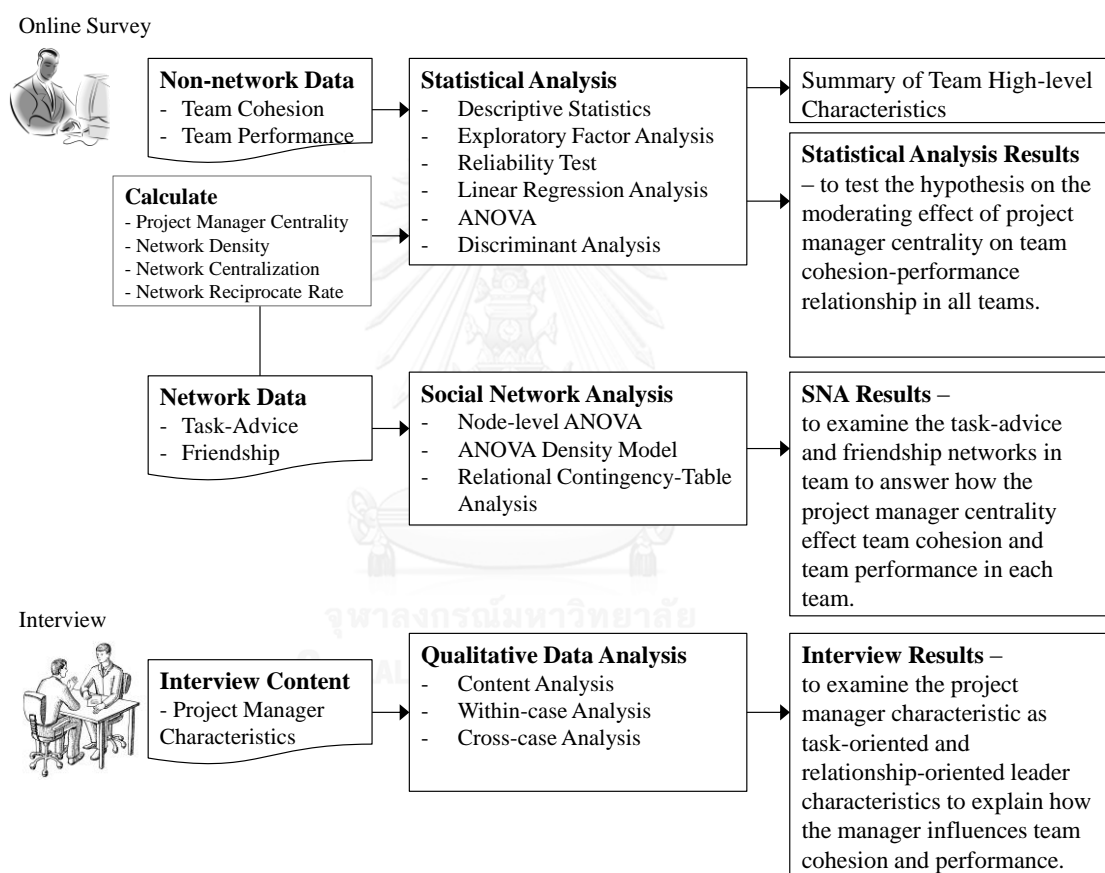
Figure 3.2 Data Analysis Process

3.5.1 Statistical Analysis

The research uses standard statistics to analyse data such as Exploratory Factor Analysis (EFA) which is used to calculate the composite score of team cohesion and team performance. To test the external validity of the scores, the

research tests the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy as value $\geq .6$ and the Bartlett's Test of Sphericity as statistically significant as $p \leq .05$ (Pallant, 2004). The component matrix is also tested with value $\geq .5$ to consider the factor loadings are significant and have internal validity (Hair, Black, Babin, & Anderson, 2010). Also, the research tests reliability coefficient or Cronbach's Alpha with value $\geq .70$ to accept the composite score as reliable (Hair et al., 2010).

Prior to testing the moderating effect, the research conducts a series of statistical tests to confirm that team characteristics have less effect on team performance, and the project manager centrality is independent from the project manager's charisma and team cohesion, as shown in Figure 3.3. First, the research uses linear regression analysis to check if the team characteristics such as team size, team tenure, network density and network centralization have effects on team performance. Then, for the second test, the research uses 1-way ANOVA to check if members' ratings of the project manager's charisma differ significantly among the low and the high centrality managers. The research also uses discriminant analysis to test whether charisma is a function of project manager centrality. If one or both the ANOVA and discriminant analysis is found significant, it could be that the project manager's charisma is a moderator rather than the project manager centrality. The third test also uses 1-way ANOVA and discriminant analysis to test if the team cohesion differs among teams with the low and the high centrality managers and if team cohesion is a factor of project manager centrality. All these analyses must not have statistical significances to allow further statistical test on moderating effects.
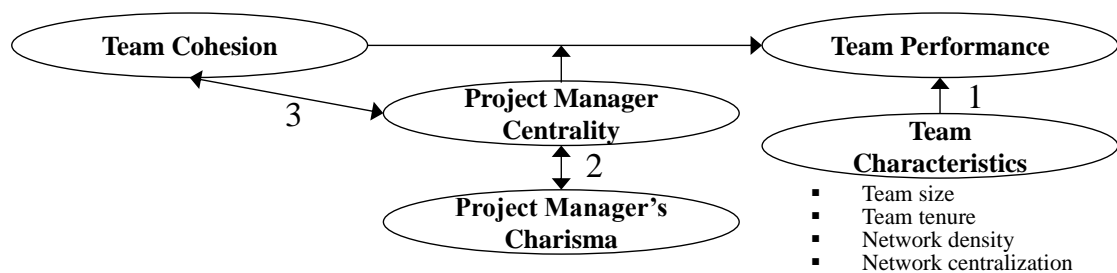
Figure 3.3 Context Variables

To test the moderating effect, the research uses the approach in Baron and Kenny (1986) to treat project manager centrality as dichotomy, team cohesion and team performance as continuous variables for analysis. First, we classify the project manager centrality into low, medium and high centrality project managers and use a dummy code with an order from 0 to 2 to allow the teams with the low centrality project manager (code 0) as the base group. Then, we use linear regression analysis to examine the team cohesion-performance relationship and compare the regression coefficient (slope) between teams with the low and the high centrality project managers to observe if the moderating effect is significant. The *Adjusted R^2* and ANOVA *F*-Test are examined to review the percentage of how much the data is explained by the relationship and to confirm the model fits with statistical significance as $p \leq .05$. The regression coefficient *B* is tested with statistical significance as $p \leq .05$ to confirm whether team cohesion is a predictor of team performance for all teams under low, medium and high centrality project managers. We also reviewed the scatter plot of the team cohesion-performance relationship to confirm the hypotheses.

3.5.2 Social Network Analysis

The research separates social network analysis from standard statistical analysis. Although the social network data was obtained from sociometric tests as part of the survey, the network data have different characteristics from non-network data which include: 1) the network data is in the form of relational matrix and vector rather than independent observation of individual respondent, i.e., a member's rating of relationship strength to another member would be recorded in the data as an interpersonal relation with direction from the respondent to the nominated person. Interpreting the relational data is done in two ways as A rated B and B got rated from A, which differs from a member's rating of team cohesion and has only the one score. 2) Since it is relational data, each value is not an independent observation using conventional statistical approaches as based on independent probability sampling. 3) The whole network data tends to be the population as all the members are part of the team, rather than a sample or a set of data for inferential statistics to predict characteristics of the population. Because of these, direct estimation of the sampling

distributions based on randomization and specific network analysis is needed (Hanneman & Riddle, 2005). Such analyses are Node-level ANOVA, ANOVA density model and Relational Contingency-Table analysis which its significant *p* value is permutation-based significance tests rather than probabilistic test. The value is significant if it is lower or higher than we can expect by chance rather than by testing the sample mean with the population mean. The research applies considerations and the data analysis process following the standard social network methods (Borgatti et al., 2013; Hanneman & Riddle, 2005) as follows.
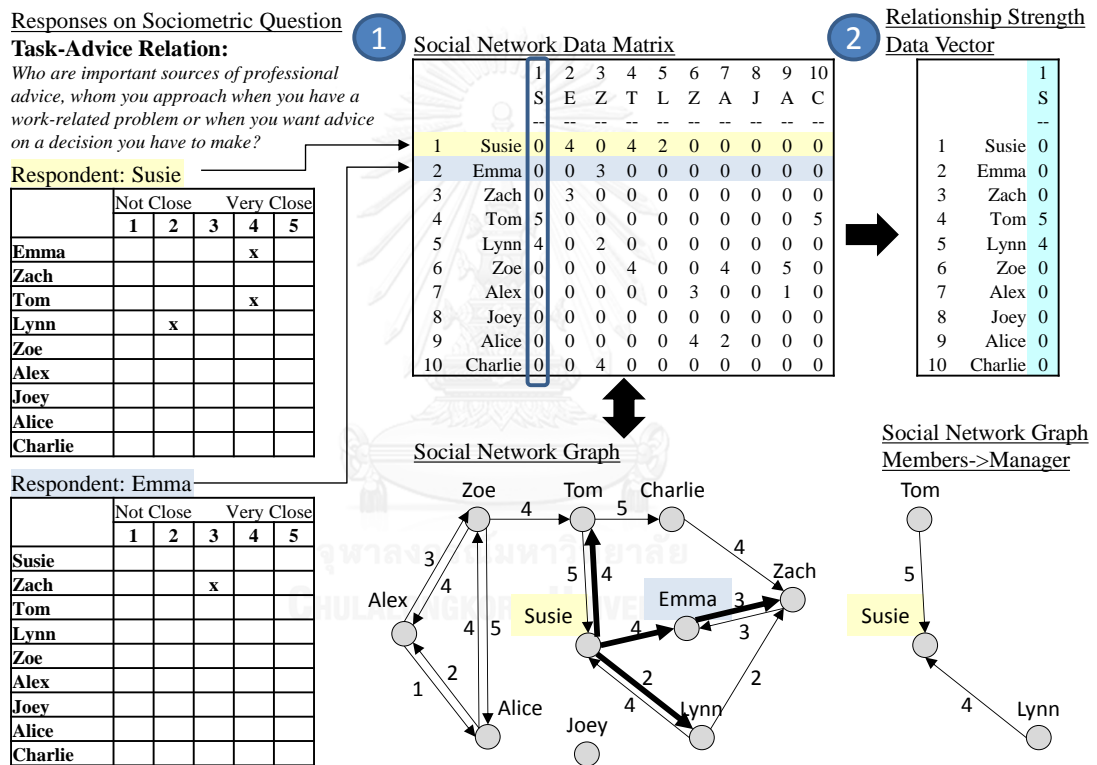
Figure 3.4 Social Network Data Matrix and Relationship Strength Data Vector – Sample

First, the research converts data from sociometric tests into the social network data matrix and relationship strength data vector covering relationship direction and strength, as shown in Figure 3.4. The matrix indicates who nominated whom as their task advisors and friends, with the row indicating the respondent, the column indicating the person who got nominated, and value indicating the strength of

relations with 0 as no relation and 5 as close relation. The matrix corresponds to the social network graph. The graph represents relations among members as direct lines connecting from the responded member to members who got nominated. The relationship strength data vector is extracted from the social network data matrix of each team by taking the column under project manager's name. It indicates how close the individual members feel to their manager.

The researcher uses NETDRAW function in UCINET to draw social network graphs of each team to make a visual comparison. As shown in Figure 3.5, the legend indicates 1) node colour represents the manager (black) and the members (grey), 2) the line style represents the relations between the members and the manager (solid) and between the members (dash), 3) the line arrow represents relation direction from the rating respondents to the nominated members, and the arrow size represents the strength of relations, and 4) the line thickness represents the average team cohesion of the team. The node size represents the in-degree centrality of each member and manager. The research puts the manager as having node number '1' and the members as different numbers. Based on Similarities and Iterative Metric MDS (Multidimensional Scaling) in Ordination and Scaling, the node represented the manager is positioned at the center of the graph, and, the nodes that have similar connections to others are shown as having close position. There is also a node called cut-point (white) which would be the node the graph will is disconnected into two sub-graphs.

Node	Members and Manager	Color	Black (Manager), Grey (Members), White (Cut-Point).
		Size	In-degree Centrality
		Number	1 (Manager), Other (Members)
Line	Social Relations	Line Styles	Solid (Members - Manager), Dash (Members - Members)
		Arrow Direction	Relation Direction
		Arrow Size	Relationship Strength
		Thickness	1 (Low-cohesive Team), 3 (High-cohesive Team)
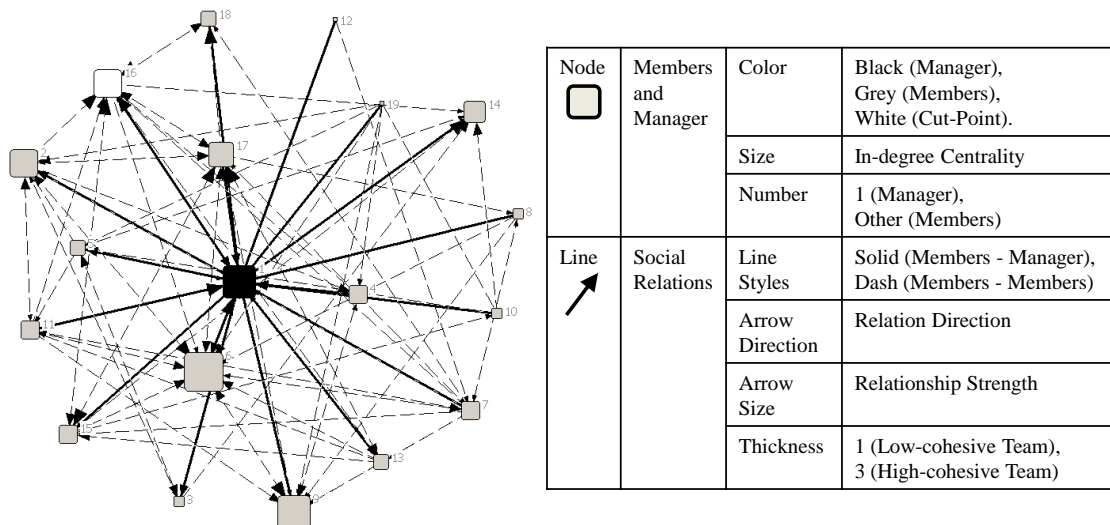
Figure 3.5 Social Network Graph – Sample

To examine the effect of project manager centrality, the research has adopted social network analysis as shown in Figure 3.6. First, the research uses Node-level ANOVA to check the correlations between members' ratings of relationship strength with the manager and their rating of team cohesion and team performance. This is to examine whether the members who are closer to the manager have rated higher team cohesion and team performance. Following the social influence network theory that relationship strength determines interpersonal influences on attitudes and perceptions (Friedkin, 1991), the significant ANOVA F-Test indicates that project manager centrality influences the stronger positive effect of team cohesion on team performance.

Focused Questions	Social Network Analysis		
1 How the project manager centrality relates to team cohesion and performance?	**Node-level ANOVA** to examine *whether members who are more "closed" with the manager tend to rate a higher team cohesion and team performance?*	[Network Data] **Relationship Strength Data Vector [Member->Manager]**	[Non-Network Data] **Members' Rating of Team Cohesion and Team Performance**
2 What different are the network structure of high vs. low performing teams? ▪ was there any subgroup in the network?	**ANOVA Density Model** to examine *whether there were dense interpersonal relations in group of members who had different relationship strength with their manager?*	Test the distribution of relations <u>within and between</u> subgroups of a network if the subgroup has dense relations.	Density of vs. between Grp1, 2, ..., m in SNA-Matrix **Social Network Data Matrix - Relationship Strength**
▪ what was that subgroup?	**Relational Contingency-Table Analysis** to examine *which groups of members who had different relationship strength with their manager were "highly dense" than we could expected by chance?*	Test the distribution of relations <u>within</u> subgroups of a network if it has density higher than the density of randomized network with same size.	Density of Grp1, 2, ..., m in SNA-Matrix vs. Randomized Network **Social Network Data Matrix - Relationship Strength**

Figure 3.6 Social Network Analyses – Focused Question

Then, the research uses the ANOVA density model to test the distribution of interpersonal relations in the network. This is to examine if there any subgroups, i.e., the group of members who have dense relations among them. The *Adjusted R^2* with statistical significance as $p \leq .05$ indicates a possibility of having subgroups within the team; based on the social influence network theory, the subgroup may prevent the project manager from influencing the whole team. Then, to find the subgroup, the researcher uses Relational Contingency-Table analysis to test the density of the subgroups of members who are more and less close to their manager. Relational Contingency-Table Analysis is different from ANOVA density model that tests the density of the subgroups by compared with a randomized network with the same size rather than directly comparing the density between the subgroups. So, in addition to determining if the network has any subgroups as in the ANOVA density model, the chi-square χ^2 with statistical significance as $p \leq .05$ in Relational Contingency-Table Analysis indicates that the project manager is unable to influence the team due to the manager being less close to the other members in the team.

3.5.3 Qualitative Content Analysis

The researcher uses content analysis to analyse the interview data. A qualitative data analysis technique is employed to identify the objective and quantitative description of the manifest content of communication in order to make an inference. It has key processes as follows: 1) unitizing to produce a section of the interview transcript as the unit of analysis, 2) categorizing to map the content in the unit into a set of codes that helps interpret the overall results, and 3) inference to draw the analysis results.

First, for unitizing, the researcher uses paragraphs under the same topic that the manager answered to each interview question as a unit of analysis. This provides a meaningful representation of the communication as the managers may provide answers with examples. Then, the researcher categorizes the interview results into three groups of codes which are 1) the task-oriented and relationship-oriented leader characteristics following the standard behavioral definition by Yukl (2012), 2) the team characteristics including team background, software functions developed by the team and cohesion and work collaboration in the team in the project manager's perceptions, and 3) the project manager's reviews on the collected network graphs and social network analysis results of the manager's team. Categorizing the project manager's characteristics following standards allows the researcher to have an analytical framework and minimize misconception.

Then, to draw the conclusion, the researcher counts and reviews the paragraphs on the project manager's characteristics as a task-oriented and relationship-oriented leader with the quantitative classification on the low and the high centrality project managers to refer to past literature to explain how the project manager influences team cohesion and team performance. For the second and third groups, the researcher summarizes the content in the section on team characteristics and social network graph reviews.

3.6 Ethical in Research

Participation of this research is voluntary, confidential and with authorized by the company, the project manager and the team. The researcher follows the ethical guidelines for network research in organizations according to Borgatti and Molina (2005) to protect data confidentiality and respondents from the potential of being harmed, i.e., receive managerial action against poor measurement of performance as collected by the survey and summarized as below.

1) Individual responses, project and company summaries will be blinded as code numbers. The respondent's code number, name sequence in the questionnaire and node number will be blinded with different coding logic to protect against any guessing of who is who in the network graph.

2) Social network graphs of the team with less than 12 respondents will not be presented to protect the information on individual respondents' interpersonal relations.

3) Relationship strength will not be presented.

4) Only the top two ranking members' centrality values and the project manager's centrality values will be presented in the social network graphs of the team. Members with asymmetries relations with the manager, i.e., the manager rated the member but the member did not rate the manager, will not be presented.

5) Data on rating the team performance will be used for statistical analysis to test the hypotheses of this research only; there will be no report on the individual team.

6) Research findings of individual teams will be presented only to the project manager.

7) Research findings of all the teams will be presented to only the project manager's supervisor and upper management in the company.

The research also summarizes the findings with following information to protect the uses of the results to evaluate the managers and their teams: 1) the project manager's centrality values do not justify whether the project manager performed good or bad in managing the team as past research always suggested two contrasting views of benefits and constraints of being central to the team; 2) the ratings of team performance are a summary of how the members see the team rather than the actual performance, although it may related to motivation and it is time-dependent; and 3) the data and findings are for research purposes and not for discriminating or classifying people as high or low performers, therefore, the interpretation is focused on learning. The presentation to the company covers mainly a statistical analysis and social network analysis results across the teams, and a summary of project managers' characteristics.

3.7 Validity, Reliability and Triangulation

The issues of the research's validity and reliability are important because the objectivity of research is at stake (Silverman, 2001). Validity involves assessing the extent to which the assessment actually measures what is intended (Wasserman & Faust, 1994). Validity is created in this study by two forms of triangulation: data source and methodological in using a mix of qualitative and quantitative research approaches and data (Seale, 1999). Data source triangulation includes collecting multiple data from the same team. Observations and findings are reviewed from the perspective of the researcher, the managers and management leader who has experience with all the teams in this study, which include: 1) each project manager was requested to review the social network graph in representing the social network data; and 2) the project managers' supervisor was requested to review the classification of project manager centrality and the manager's task-oriented and relationship-oriented leader characteristics, average rating of team cohesion and team performance, and integrated findings which include statistical analysis, social network analysis and interview results across the teams. Methodological triangulation involved using the quantitative survey method and qualitative interview method in collecting data and cross-validating the results. It involved a systematic process of using the

quantitative data in testing the conceptual model and analyzing the social network characteristics inherent in each team, and to use the qualitative data to examine the explanations and validate the findings.

The reliability of the research concerns the degree to which the finding is independent of accidental circumstances of the research. Although this research used statistical analysis in testing the effect of project manager centrality on the team cohesion-performance relationship, its generalization to the population remains limited as centrality is collected from the whole population in the team while each team also has specific social network characteristics (Borgatti et al., 2013). An individual team could be considered a specific case in the study to which reliability would be examined as transferability provided through sufficiently rich analysis and thick description for a reader to be able to judge the relevancy of the conclusions to another context (Creswell, 2006). As the validity and reliability of social network research depends to a great extent on the methodology used (Marsden, 1990, 2011; Wasserman & Faust, 1994), this research closely followed the research design, data collection method, i.e., sociometric test, statistical and network analysis, as suggested in past studies.

CHAPTER IV – RESULTS

Human resource representatives in the company provided the researcher with a sample of eight software development teams totalling 150 members in an offshore delivery center to study. We coordinated with the human resource representative during March and April 2014 to invite the managers and their teams to participate in the online survey. Prior to setting up the survey, the human resource representative conducted a meeting session to brief the managers and their supervisor on the research background to gain support for the research and to clarify the necessity of getting a minimum of 80% response rate to draw the social network graph as well as discuss some concerns on ethical guidelines. The managers were invited to participate with the research voluntarily by providing the team members' name list and email contacts to setup the survey. The researcher also asked the managers to help notify their teams prior to sending out the survey and later to remind the team to respond to the survey. The researcher sent out the survey with an invitation by email to each participant. Each participant was required to give consent prior to beginning the survey and they could opt out any time by replying to the mail directly to the researcher.

The online survey was conducted from May to June 2014 with a reminder every two weeks for total of three times. We received a 91% response rate (136 members) from the survey. Then, we conducted an interview with the managers and their supervisor from July to August 2014, and performed data analysis in September 2014. Finally we presented the research results to the managers and their supervisor in October 2014.

4.1 Team Characteristics

Figure 4.1 shows the high-level team structure of the eight software development teams in this study.
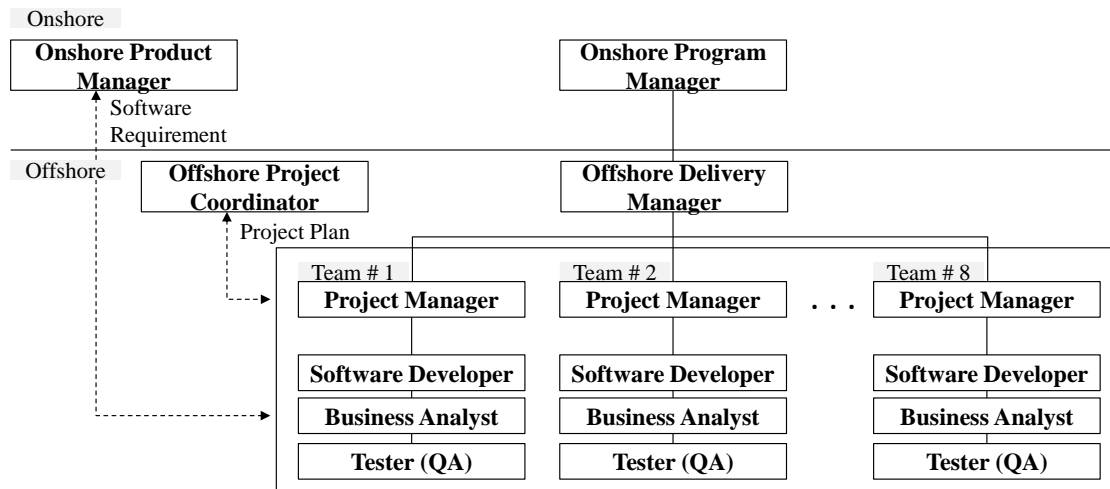
Figure 4.1 High-level Team Structure

Each team is composed of one manager who led software developers, business analysts and testers. The managers are in charge of managing the team to deliver the software according to the software requirements given by an onshore product manager, and the project plan is set up by an offshore project coordinator. All teams work to deliver financial software. Their tasks are separated by the software functions: R01 develops software administrative functions, i.e., users' profiles and authorization setup, R03 develops data interface functions, R04 develops financial accounting functions, R05 develops front-end screens as well as handling users' reports on software issues, R06 develops business reporting functions, R07 develops and integrates core financial functions, R08 develops financial KPIs for specific business industries, and R09 develops managerial accounting functions. The manager and team background is provided in Table 4.1.

Table 4.1 Manager and Team Background

Team	Manager Background	Team Background
R01	Female manager with background as software support analyst.	Team was setup by transitioning the members from another software support team. The manager is planning to take maternity leave and transitioning her role to one senior member in team.
R03	Female manager with strong technical skills and experiences.	Team was setup by a prior manager and transitioned to this manager for few years. The manager was recruited to the company to run and manage the team.

Team	Manager Background	Team Background
R04	Male manager who is recently promoted from technical specialist.	Team was setup by splitting the financial accounting functions from core financial functions in team R07. The team is setup for few months with three senior developers and new joiners and transitioned to this new manager.
R05	Female manager with strong experiences in software supports and people handlings.	Team was setup and built by the manager. As this team is working on front-end screens that used different technologies, i.e., java and mobile platforms, the members are recruited based on their different skills. The manager prefers team diversity and mixed of males and females.
R06	Female manager with background as business analyst.	Team was setup by a prior manager and transitioned to this manager for few years. Team is composed of two working groups: one develops reports for old software platform and another one for new platform.
R07	Male manager with strong technical skills and experiences.	Team was setup and built by the manager. As this team is working on the complex mathematic calculations and logics, the members are recruited based on their technical skills and strong thinking logics. All members are male.
R08	Female manager with strong technical skills and experiences.	Team was setup by a prior manager and transitioned to this manager for few months. Team is composed of senior developers who worked on separated set of financial KPIs and business industries.
R09	Male manager with strong technical skills and experiences.	Team was setup by a prior manager and transitioned to this manager for few years. The manager was recruited to the company to run and manage the team.

In these teams, the R03, R07, R08 and R09 managers have a strong technical background. The R01 and R05 managers have work experience in software support. The R06 manager has experience in business analysis. The R04 manager has been promoted recently and has some background in software. They were appointed to lead the teams that were setup by the prior manager and the offshore delivery manager except for the R05 and R07 managers who were set up to build their own teams. The R05 team is composed of team members with diversity skills to handle the different screen interfaces. The manager has strong experience in software support and people management skills to handle team diversity. The R07 team is composed of members who have strong analytical and coding skills. The manager has a strong technical background. This capability is important for the team to develop core

financial functions which are a complex mathematical model. Similar to the R07 team, the the R08 team is working on financial KPIs which includes many complex KPIs as per their industries. The team members have strong technical skills, high tenure and work individually for each set of KPIs. However, the R08 manager has just joined the team for a few months and is similar to the R04 manager. As for the manager and team's work situation, it is important to note that the R01 manager is transitioning her project managerial role to a senior developer in the team, and the R06 manager is managing two working groups separated by the software platform.

Teams are working on multiple projects. The project is a set of software requirements requested by the users of the software through the onshore product manager. It is broken into tasks or work items and the plan is set up before assigned to each team by the offshore project coordinator who works closely with the project managers. The assignment is based on the software function designed by each team. The project managers are in charge of the completion of the project tasks assigned to their team, and keep the offshore delivery manager appraised of the work progress and any issues. The objective team performance is measured based on how well the teams deliver the software quality and meet the project plan. However, as the teams are working on multiple projects and the company tracks their work progress based on the software project plan, the team performance is assessed based on members' perceptions towards average work performance and validated by the offshore delivery manager who compares the performance across teams.

Table 4.2 Team Demographic Data

No. of Teams	8 teams
No. of Members	150
No. of Respondents	136 (91%)
Gender	Female = 45 (33%)
	Male = 91 (67%)
Avg. Ages	31 years
Education Level	Master's degree = 67 (49%)
	Bachelor's degree = 68 (50%)
	Lower than Bachelor's degree = 1 (1%)
Avg. Work Experience	7.5 years
Avg. Experience with Team	1.6 years
Full-time / Part-time Working	Full-time = 121 (89%)

	Part-time = 15 (11%)
Software Development Role	Project Manager = 8 (6%)
	Developer = 82 (60%)
	Business Analyst = 6 (4%)
	Tester = 21 (16%)
	System Analyst = 1 (1%)
	Other = 18 (13%)
Task Interdependence	4.0 in 5-likert scales
Frequency Talk to Project Manager	Daily = 86 (63%)
	Once a week = 6 (4%)
	Once a month = 39 (29%)
	Seldom or never = 5 (4%)

The team sizes range from 14 to 27 members. As shown in Table 4.2, one third of the respondents are female. The average age of the respondents is 31 years ($SD = 3.28$). Most respondents are highly educated with approximately half of them having a Bachelor's degree and another half have a Master's degree. They have an average of 7.5 years experience in software development ($SD = 1.19$) and 1.6 years with the current team ($SD = 0.46$). Almost all members are working full-time and have talk daily with their project manager. 60% of the members are developers, 16% are testers, 5% are business analysts and system analysts, and 13% hold other positions such as database administrators. All teams in the study reported a high average of task interdependence as 4.0 in 5-likert scales ($SD = 0.20$). This implies that the teams have to be cohesive to gain a higher performance (Gully et al., 1995). Detail demographic data of each team are provided in Appendix D.

High-level network analysis results show that almost all managers have high centrality in task-advice networks. As shown in Table 4.3, project manager centrality values range from 0.500 to 1.000 in task-advice networks and higher than 0.385 to 0.652 in friendship networks indicating that they have stronger task-advice relations with the teams than friendship relations. As centrality is calculated by the total number of members who rated the manager divided by the total number of members in the team, we can see that in the R07 team, the project manager has a centrality value of 1.000 which means all members (100%) have nominated the manager as their task advisor. Teams also have a higher average network density and centralization in the task-advice network higher than in the friendship network. This

indicates that the interpersonal relations in the team are mainly related to work rather than being friends.

The network reciprocation rate is calculated as a percentage of reciprocal relations, i.e., A and B nominated each other, by the total number of relations in the network. The collected network data have a network reciprocation rate as 52% and 55% in task-advice and friendship networks which is similar to other studies, i.e., 32% and 46% (Ibarra, 1993b) and 50% (Brass, 1984). With 63% of members reporting that they have talked with the project manager on a daily basis, the data is appropriate for analysing the interpersonal relations in team (Marsden, 1990, 2011).

Table 4.3 Project Manager Centrality and Team Network Characteristics

Team	Project Manager Centrality		Team Network Characteristics					
	Task-Advice Network	Friendship Network	Task-Advice Network			Friendship Network		
			Density	Central-ization	Reciproca-tion Rate	Density	Central-ization	Reciproca-tion Rate
R01	0.500	0.389	0.295	10.805	0.515	0.178	10.283	0.459
R03	0.923	0.538	0.495	8.668	0.533	0.346	8.161	0.635
R04	0.824	0.471	0.382	12.270	0.496	0.356	8.810	0.532
R05	0.789	0.579	0.463	8.257	0.534	0.395	6.366	0.520
R06	0.538	0.462	0.346	8.551	0.413	0.357	5.868	0.554
R07	1.000	0.615	0.538	10.504	0.551	0.489	6.167	0.629
R08	0.826	0.652	0.663	6.707	0.787	0.522	5.533	0.639
R09	0.654	0.385	0.239	17.121	0.333	0.236	16.820	0.422
		Average	**0.428**	**10.360**	**0.520**	**0.360**	**8.501**	**0.549**

4.2 Statistical Analysis Results

We used standard statistics and group comparison to test the moderating effect following the approach in Baron and Kenny (1986). First, we used exploratory factor analysis (EFA) to calculate the team cohesion and team performance standardized composite scores, and analysed the reliability coefficient or Cronbach's Alpha to test the validity of the score. It is found that 1) team cohesion has a KMO Measure of Sampling Adequacy as .865 ($p = .000 < .05$), total variance explained as 59.781% and Cronbach's Alpha value .902, which indicates that the sampling data is

appropriate and the score is reliable, and 2) team performance has a KMO Measure of Sampling Adequacy as .864 (p = .000 < .05), total variance explained as 66.428% and Cronbach's Alpha value .926, which indicates that the sampling data is appropriate and the score is reliable. Table 4.4 summarizes the average team cohesion and team performance by team. The result shows that three teams, i.e., R01, R06 and R08, have average standardized team performance scores lower than the others, and also three teams, i.e., R01, R03 and R08, have average standardized team cohesion scores lower than others.

Table 4.4 Average Team Cohesion and Team Performance by Team

Team	Team Size	n	Team Cohesion		Team Performance	
			M	SD	M	SD
R01	19	19	-.40	.80	-.52	.82
R03	14	13	-.36	1.34	.37	1.08
R04	18	16	.05	1.06	.20	1.18
R05	20	19	.34	1.06	.19	1.02
R06	14	11	.13	1.01	-.13	.88
R07	14	14	.37	.96	.44	.86
R08	24	22	-.29	.88	-.39	1.06
R09	27	22	.21	.83	.09	.82

Then, we used linear regression analysis, 1-way ANOVA and discriminant analysis to examine the effect of context variables in the study, i.e., to confirm that team characteristics have less effect on team performance, and the project manager centrality is independent from project manager's charisma and team cohesion. Next, we used linear regression analysis to test the team cohesion-performance relationship and review past studies. Finally, we used group comparison to test the hypothesis if the teams with a high centrality project manager have a stronger positive effect of team cohesion on team performance than teams with a low centrality project manager. The results are reported in the following subsections.

4.2.1 Context Variables

The researcher has conducted statistical tests to review the effects from team characteristics on team performance, as shown in Figure 4.2.
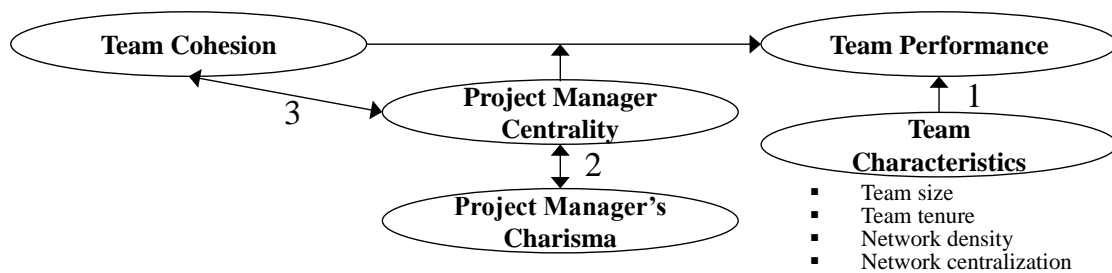
Figure 4.2 Context Variables

The result from the first test is reported in Table 4.5. It is found that team characteristics such as team size, team tenure, network density and network centrality have no effect on team performance. The *Adjusted R^2* found the regression models for the team characteristics-performance relationship are -.012 and -.009 in task-advice network and friendship network which means the models do not fit (*Adjusted R^2* < .000). The *F*-values are also not significant with *F*-value as $F(4, 131) = .598$ ($p = .665$) and $F(4, 131) = .691$ ($p = .599$) in the task-advice network and the friendship network. The regression coefficients of all team characteristic variables are not significant ($p \geq .05$). This suggests the homogeneity of the data that it has less effect from context variables.

Table 4.5 Linear Regression Analysis of Team Characteristics and Team Performance

Model Summary			Coefficients				
Adj. R^2	*F*(df_{REG},df_{RES})	*Sig.*		*B*	*SE*	*β*	*Sig.*
Task-Advice Network							
-.012	.598 (4, 131)	.598	Constant	.000	.086		1.000
			Team Size	-.004	.089	-.004	.961
			Team Tenure	.058	.103	.058	.575
			Density	-.010	.106	-.010	.923
			Centralization	.128	.091	.128	.164
Friendship Network							
-.009	.691 (4, 131)	.599	Constant	.000	.086		1.000
			Team Size	.008	.105	.008	.940
			Team Tenure	-.079	.118	-.079	.503
			Density	-.078	.103	-.078	.448
			Centralization	.119	.092	.119	.198

Note: Dependent Variable: Team Performance, $N = 136$

For the second test, we used exploratory factor analysis (EFA) to calculate the project manager's charisma standardized score. It has a KMO Measure of

Sampling Adequacy as .906 ($p = .000 < .05$), total variance explained as 69.696% and Cronbach's Alpha value .926, which indicates that the sampling data is appropriate and the score is reliable. Table 4.6 reports the test result on the relationship between project manager centrality and charisma. The ANOVA result shows that charisma is not related to project manager centrality, with F-test statistic having a value as $F(2, 133) = .438$ ($p = .646$) and 1.166 ($p = .315$) in task-advice and friendship networks. The discriminant analysis result also shows that charisma is not a function of project manager centrality. The Box's M and Wilk's Lamda statistics to test equal population covariance matrices and equality of the group mean are not significant ($p \geq .05$).

Table 4.6 ANOVA and Discriminant Analysis of Project Manager Centrality and Charisma

ANOVA (to test if Centrality → Charisma)		Discriminant Analysis (to test if Charisma → Centrality)			
F(df$_B$, df$_W$)	*Sig.*	Box's M	*Sig.*	Wilk's Lambda	*Sig.*
Task-advice Network					
.438 (2, 133)	.646	1.314	.523	.993	.646
Friendship Network					
1.166 (2, 133)	.315	5.133	.079	.983	.315

Note: $N = 136$

For the third test, Table 4.7 reports the test result on the relationship between project manager centrality and team cohesion. The ANOVA result shows that team cohesion is not related to project manager centrality, with F-test statistic having a value as $F(2, 133) = .833$ ($p = .437$) and .256 ($p = .775$) in task-advice and friendship networks. The discriminant analysis result also shows that team cohesion is not a function of project manager centrality. The Box's M and Wilk's Lamda statistics to test equal population covariance matrices and equality of the group mean are not significant ($p \geq .05$).

Table 4.7 ANOVA and Discriminant Analysis of Project Manager Centrality and Team Cohesion

ANOVA (to test if Centrality → Cohesion)		Discriminant Analysis (to test if Cohesion → Centrality)			
$F(df_B, df_W)$	*Sig.*	Box's M	*Sig.*	Wilk's Lambda	*Sig.*
Task-advice Network					
.833 (2, 133)	.437	2.616	.275	.988	.437
Friendship Network					
.256 (2, 133)	.775	3.214	.204	.996	.775

Note: $N = 136$

4.2.2 Team Cohesion-Performance Relationship

Table 4.8 reports the linear regression analysis of team cohesion and team performance relationships. It is found that team cohesion is a predictor of team performance, with the significant F-value as $F(1, 134) = 111.619$ ($p = .000 < .05$) and the *Adjusted R^2* as .450 which indicates the model fit in explaining 45% of data. Team cohesion has positive effects on team performance with the significant regression coefficient $B = .674$ ($p = .000 < .05$). This means if we improve the team cohesion 1 unit, it will contribute to improving team performance 67.4% in total. The coefficient is quite high when compared with past studies that found the cohesion-performance effect as .228 (Kozlowski & Ilgen, 2006). This may be because all teams in the study have a high average of task interdependence which implies that team cohesion is important for team performance (Gully et al., 1995).

Table 4.8 Linear Regression Analysis of Team Cohesion and Team Performance

Model Summary				Coefficients			
Adj. R^2	$F(df_{REG}, df_{RES})$	*Sig.*		*B*	*SE*	*β*	*Sig.*
.450	111.619 (1, 134)	.000	Constant	.000	.064		1.000
			Team Cohesion	.674	.064	.674	.000

Note: Dependent Variable: Team Performance, $N = 136$

4.2.3 Project Manager Centrality Effects on Team Cohesion-Performance Relationship

Statistical analysis based on group comparison was used to test the moderating effect of project manager centrality on the team cohesion-performance

relationship (Baron & Kenny, 1986). First, we classified project manager centrality into low, medium and high centrality project managers with a dummy code from 0 to 2. Then, we analysed the linear regression coefficient (slope) and the scatter plot of the team cohesion-performance relationship and compared the teams with the low and the high centrality project managers to confirm the moderating effect.

Classification of Project Manager Centrality

As the project manager centrality raw scores were generally high and had a positive skew, a standardized score of centrality was used for classification as 1) the high centrality project manager was the manager with a centrality z-score higher than the mean plus one standard deviation, or *Mean+1SD*, 2) and the low centrality project manager was the manager with a centrality z-score lower than mean minus one standard deviation, or *Mean-1SD*. This classification was based on the justification that it clearly distinguished the teams for testing the moderating effect without making a difference on team cohesion. As a result, there were 2 teams with high centrality project manager, 2 teams with low centrality project manager and the remaining 4 teams with medium centrality project manager, as summarized Table 4.9.

Table 4.9 Project Manager Centrality, Team Cohesion and Team Performance

Team	Project Manager Centrality		Team Cohesion		Team Performance	
	Task-Advice Network	Friendship Network	*M*	*SD*	*M*	*SD*
R01	Low	Low	-.40	.80	-.52	.82
R03	High	Medium	-.36	1.34	.37	1.08
R04	Medium	Medium	.05	1.06	.20	1.18
R05	Medium	Medium	.34	1.06	.19	1.02
R06	Low	Medium	.13	1.01	-.13	.88
R07	High	High	.37	.96	.44	.86
R08	Medium	High	-.29	.88	-.39	1.06
R09	Medium	Low	.21	.83	.09	.82

Team Cohesion-Performance Relationship Comparison between Teams with High and Low Centrality Project Manager

Table 4.10 and Figure 4.3 report the results of linear regression analysis and scatter plot of team cohesion-performance relationship comparing between teams with the low and the high centrality project managers in task-advice networks.

Table 4.10 Linear Regression Analysis of Team Cohesion-Performance Relationship in Teams with High and Low Centrality Project Manager in Task-Advice Network

Model Summary			Coefficients				
Adj. R^2	$F(df_{REG}, df_{RES})$	Sig.		B	SE	β	Sig.
High Centrality Project Manager							
.582	37.165 (1, 25)	.000	Constant	.394	.118		.003
			Team Cohesion	.616	.101	.773	.000
Medium Centrality Project Manager							
.467	69.376 (1, 77)	.000	Constant	-.048	.084		.567
			Team Cohesion	.731	.088	.688	.000
Low Centrality Project Manager							
.296	13.165 (1, 28)	.001	Constant	-.267	.134		.056
			Team Cohesion	.532	.147	.566	.001

Note: Dependent Variable: Team Performance, $N = 136$
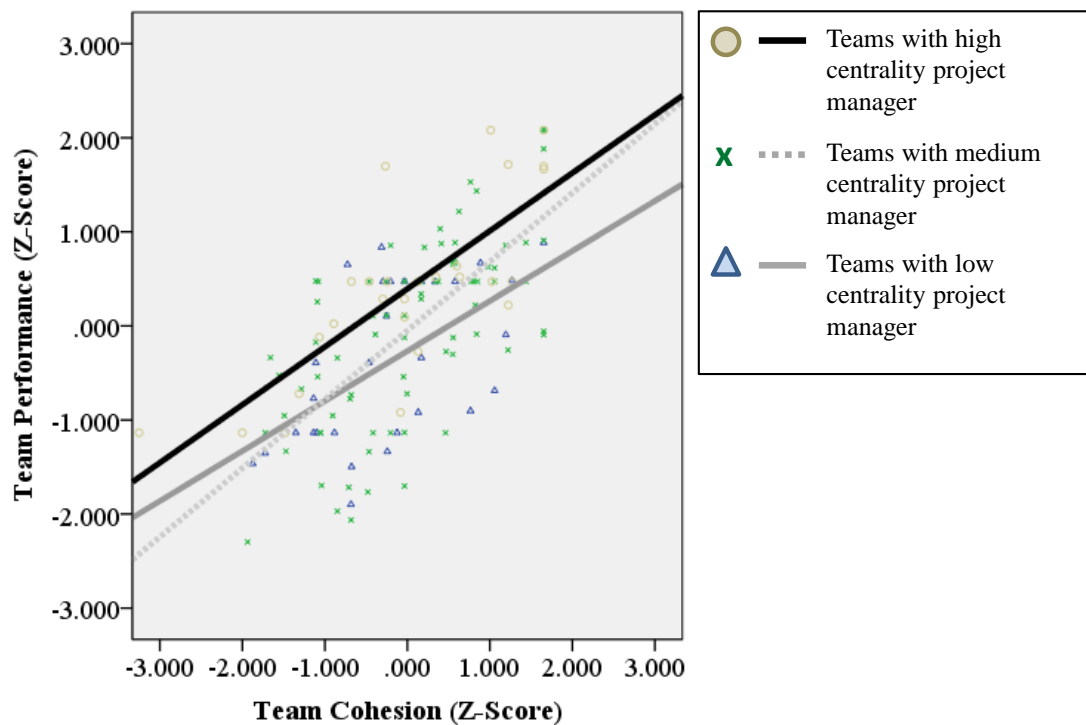
Figure 4.3 Scatter Plots of Team Cohesion-Performance Relationship comparing between Teams with High and Low Centrality Project Manager in Task-Advice Network

It is found that team cohesion has an effect on team performance in teams with all three levels of project manager centrality. With the significant F-value as $F(1, 25) = 37.165$ ($p = .000 < .05$) and the *Adjusted R^2* as .582 in teams with high centrality project manager, the significant F-value as $F(1, 77) = 69.376$ ($p = .000 < .05$) and the *Adjusted R^2* as .467 in teams with medium centrality project manager and the significant F-value as $F(1, 28) = 13.165$ ($p = .001 < .05$) and the *Adjusted R^2* as .296 in teams with low centrality project manager, we found the model fit to explain the data. Regression coefficients of team cohesion-performance relationship are all significant as $B = .616$ ($p = .000 < .05$) in teams with high centrality project manager, $B = .731$ ($p = .000 < .05$) in teams with medium centrality project manager and $B = .532$ ($p = .001 < .05$) in teams with low centrality project manager. This means in teams with high centrality project manager, improving team cohesion for 1 unit will contribute to improve team performance at 61.6% while in teams with low centrality project manager, improving team cohesion 1 unit will contribute only 53.2%. With

high centrality project manager, we can increase the effect of team cohesion on team performance approximately 8.4%.

The scatter plot also supports that for the range of team cohesion, increasing the standardized score of team cohesion from -3.000 to 3.000 in teams with high centrality project manager will result in a higher team performance than increasing cohesion in teams with low centrality project manager. This confirmed Hypothesis 1. Teams with high centrality project manager in a task-advice network have a stronger positive effect on team cohesion-performance relationship than teams with low centrality project manager. The project manager who has connections to many more team members in task-advice networks provides benefits to the team to promote work collaboration among the members, and foster team cohesion to have a stronger positive effect on team performance.

For friendship networks, Table 4.11 and Figure 4.4 report the results of linear regression analysis and scatter plots of team cohesion-performance relationship comparing between teams with the low and the high centrality project managers.

Table 4.11 Linear Regression Analysis of Team Cohesion-Performance Relationship in Teams with High and Low Centrality Project Manager in Friendship Network

Model Summary			Coefficients				
$Adj.\ R^2$	$F(df_{REG}, df_{RES})$	$Sig.$		B	SE	β	$Sig.$
High Centrality Project Manager							
.521	39.130 (1, 34)	.000	Constant	-.039	.122		.749
			Team Cohesion	.810	.129	.731	.000
Medium Centrality Project Manager							
.487	56.165 (1, 57)	.000	Constant	.128	.097		.191
			Team Cohesion	.654	.087	.704	.000
Low Centrality Project Manager							
.281	16.628 (1, 39)	.000	Constant	-.153	.115		.191
			Team Cohesion	.546	.134	.547	.000

Note: Dependent Variable: Team Performance, $N = 136$
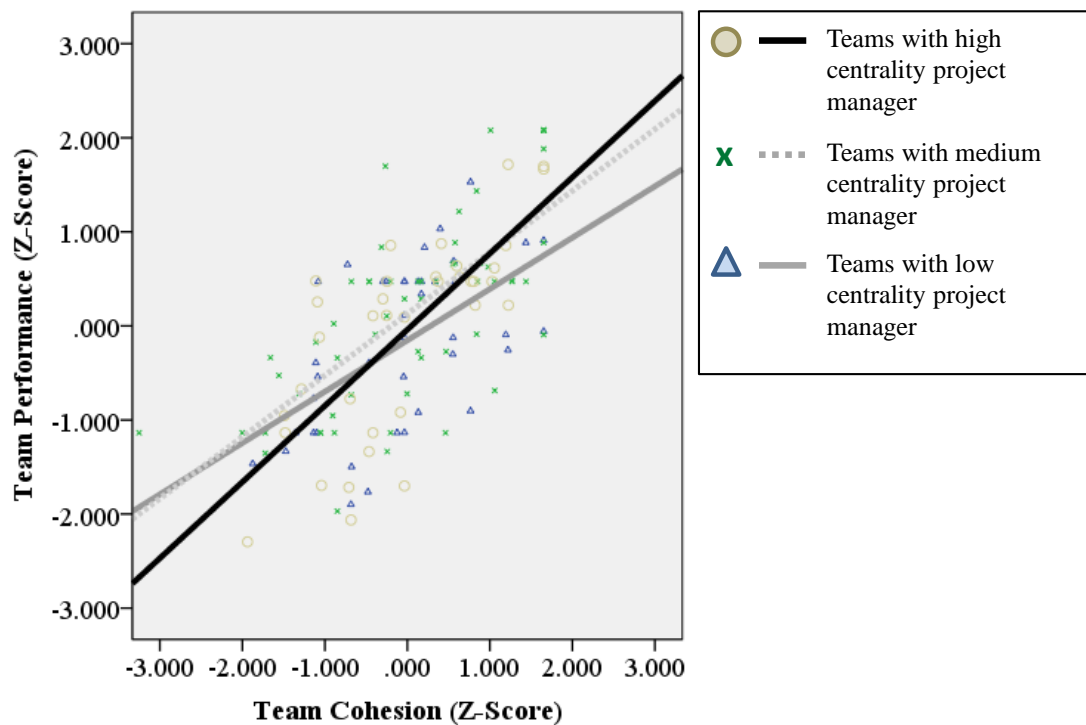
Figure 4.4 Scatter Plots of Team Cohesion-Performance Relationship comparing between Teams with High and Low Centrality Project Manager in Friendship Network

For friendship networks, it is found that team cohesion has an effect on team performance in teams with all three levels of project manager centrality. With the significant F-value as $F(1, 34) = 39.130$ ($p = .000 < .05$) and the *Adjusted R^2* as .521 in teams with high centrality project manager, the significant F-value as $F(1, 57) = 56.165$ ($p = .000 < .05$) and the *Adjusted R^2* as .487 in teams with medium centrality project manager and the significant F-value as $F(1, 39) = 16.628$ ($p = .000 < .05$) and the *Adjusted R^2* as .281 in teams with low centrality project manager, we find the model fit to explain the data. Regression coefficients of team cohesion-performance relationship are all significant as $B = .810$ ($p = .000 < .05$) in teams with high centrality project manager, $B = .654$ ($p = .000 < .05$) in teams with medium centrality project manager and $B = .546$ ($p = .000 < .05$) in teams with low centrality project manager. This means in teams with high centrality project manager, improving team cohesion for 1 unit will contribute to improving team performance at 81.0% while in teams with low centrality project manager, improving team cohesion 1 unit will

contribute only 54.6%. This means, with high centrality project manager, we could increase the effect of team cohesion on team performance approximately 26.4%.

However, the scatter plot shows that increasing team cohesion in teams with high centrality project manager not always contributes to a high team performance over teams with low centrality project manager. This rejected Hypothesis 2. Teams with high centrality project manager in friendship network do not have a stronger positive effect on team cohesion-performance relationship than teams with low centrality project manager. The graph shows that the high centrality project manager may have positive results on the team cohesion-performance relationship in the teams that have team cohesion, i.e., the team has team cohesion standardized scores higher than .000; on the contrary, the high centrality project manager may have negative results in teams that have negative team cohesion, i.e., have conflicts among members. This may imply that the project manager centrality in friendship network in team that has conflicts in team cannot effectively promote work collaboration in the team and foster an effect of team cohesion on team performance.

4.2.4 Additional Statistical Analysis

Since we cannot find the effect of project manager centrality in the friendship network, we have conducted an additional analysis to examine if project manager centrality moderates the internal three factors of team cohesion, i.e., interpersonal attraction, task commitment and group pride, to effect team performance. Table 4.12, 4.13 and 4.14 show the results.

Table 4.12 Linear Regression Analysis of Team Cohesion [separated as Interpersonal Attraction, Task Commitment and Group Pride] on Team Performance

Model Summary			Coefficients				
Adj. R^2	$F(\text{df}_{REG},\text{df}_{RES})$	Sig.		B	SE	β	Sig.
.454	38.449 (3, 132)	.000	Constant	.000	.063		1.000
			Interp. Attraction	.187	.096	.187	.054
			Task commitment	.220	.102	.220	.033
			Group pride	.349	.102	.349	.001

Note: Dependent Variable: Team Performance, $N = 136$

Table 4.13 Linear Regression Analysis of Team Cohesion [separated as Interpersonal Attraction, Task Commitment and Group Pride] on Team Performance in Teams with High and Low Centrality Project Manager in Task-Advice Network

Model Summary			Coefficients				
Adj. R^2	$F(df_{REG}, df_{RES})$	Sig.		B	SE	β	Sig.
High Centrality Project Manager							
.595	13. 727 (3, 23)	.000	Constant	.310	.132		.028
			Interp. Attraction	.181	.212	.233	.403
			Task commitment	.067	.217	.079	.761
			Group pride	.490	.206	.531	.026
Medium Centrality Project Manager							
.468	23.886 (3, 75)	.000	Constant	-.011	.088		.901
			Interp. Attraction	.165	.133	.148	.218
			Task commitment	.232	.139	.232	.100
			Group pride	.402	.145	.387	.007
Low Centrality Project Manager							
.286	4.867 (3, 26)	.008	Constant	-.241	.147		.113
			Interp. Attraction	.364	.225	.391	.117
			Task commitment	.351	.209	.348	.105
			Group pride	-.070	.206	-.083	.736

Note: Dependent Variable: Team Performance, $N = 136$

Table 4.14 Linear Regression Analysis of Team Cohesion [separated as Interpersonal Attraction, Task Commitment and Group Pride] on Team Performance in Teams with High and Low Centrality Project Manager in Friendship Network

Model Summary			Coefficients				
Adj. R^2	$F(df_{REG}, df_{RES})$	Sig.		B	SE	β	Sig.
High Centrality Project Manager							
.511	13.185 (3, 32)	.000	Constant	-.031	.124		.803
			Interp. Attraction	.403	.236	.330	.097
			Task commitment	.115	.183	.111	.533
			Group pride	.383	.184	.377	.046
Medium Centrality Project Manager							
.590	28.833 (3, 55)	.000	Constant	.220	.090		.018
			Interp. Attraction	-.173	.123	-.191	.165
			Task commitment	.522	.144	.563	.001
			Group pride	.431	.157	.408	.008
Low Centrality Project Manager							
.286	6.343 (3, 37)	.001	Constant	-.070	.132		.601
			Interp. Attraction	.459	.204	.441	.030
			Task commitment	-.124	.226	-.114	.586
			Group pride	.236	.186	.276	.212

Note: Dependent Variable: Team Performance, $N = 136$

After testing the three factors of team cohesion separately, the linear regression analysis in Table 4.12 found only task commitment and group pride are significant predictors for team performance, with the significant regression coefficient $B = .220$ ($p = .033 < .05$) and $B = .349$ ($p = .001 < .05$). However, there are some multicollinearity issues among the three factors with a high variance inflation factor (VIF) in interpersonal attraction as -2.270, in task commitment as 2.586 and in group pride as 2.568. This may be because the respondents consider all three factors to be the team cohesion concept. The result of testing the moderating effect in Table 4.13 and 4.14 also shows that all three factors are not significant for all three levels of project manager centrality and we cannot examine the moderating effects. We found only group pride has an effect on team performance in teams with the medium and the high centrality project managers with $B = .402$ ($p = .007 < .05$) and $B = .490$ ($p = .026 < .05$) in task-advice and $B = .431$ ($p = .008 < .05$) and $B = .383$ ($p = .046 < .05$) in friendship networks. Since the scree plot in exploratory factor analysis (EFA) of team cohesion in Figure 4.5 shows that there is only one composite score for team cohesion, the prior analysis of team cohesion-performance relationship is relevant.
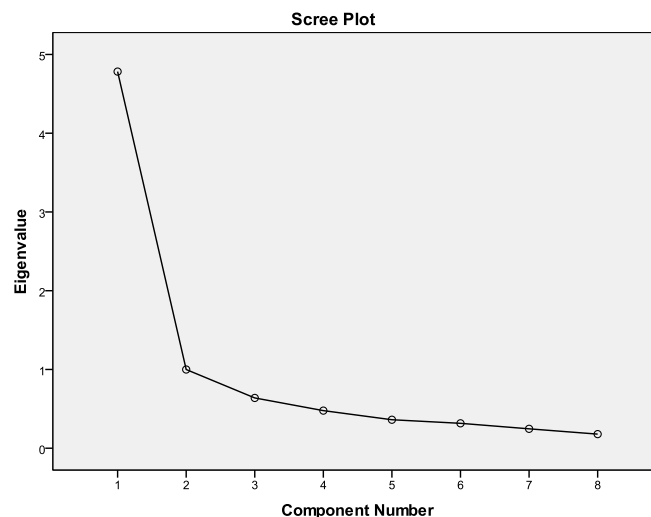
Figure 4.5 Exploratory Factor Analysis – Scree Plot of Team Cohesion

4.2.5   Summary of Statistical Analysis Results

The results found the moderating effect of project manager centrality on the team cohesion-performance relationship in task-advice networks, and confirmed Hypothesis 1. With the model fit at 58.2% and 29.6%, the finding is relevant. Teams with high centrality project manager have team cohesion-performance relationships as $B = .616$ ($p = .000 < .05$) which was higher than $B = .532$ ($p = .001 < .05$) in teams with low centrality project manager. This means, with the high centrality project manager, we could increase the effect of team cohesion on team performance approximately 8.4% from 53.2% to 61.6%.

However, the results failed to support Hypothesis 2. We cannot find the moderating effect of the project manager centrality in the friendship network on the team cohesion-performance relationship. In this statistical test, the project manager centrality and team cohesion were tested to ensure that they are independent factors. The team characteristics are also tested to ensure that they have no effect on team performance and provided homogeneity of the data. Also, it was found that the project manager's charisma is not directly related to the project manager's centrality in the context of the software development teams in the study.

4.3 Social Network Analysis Results

We used social network analysis to examine how project manager centrality effects the team cohesion-performance relationship in each team (Borgatti et al., 2013; Hanneman & Riddle, 2005). First, we examined whether the strength of the task-advice and friendship relations that were rated by the members to their manager is associated with the project manager centrality in each team. Then, we classified the teams into two groups based on the team performance's standardized score, and presented the social network graph of each team. Then, we used Node-level ANOVA to examine whether the members who are closer to their manager also rated higher team cohesion and team performance. It is to test if the high centrality project

managers influence team cohesion and team performance in the team. Then, we used the ANOVA density model to test if there are any subgroups of members in the team. Finally, we used Relational Contingency-Table analysis to test if the subgroup is formed among members who are less close to their manager. Based on social influence network theory (Friedkin, 1993; Friedkin & Johnsen, 2011), the subgroup may prevent the manager from connecting and influencing the team.

4.3.1 Project Manager Centrality and Strength of Task-Advice and Friendship Relations

Figure 4.6 shows an average of relationship strength rated by team members to their manager and the z-score of the project manager centrality in each team. It is found that the graphs on project manager centrality and average relationship strength from the members to the manager are similar, so the social network analysis to examine the effect of project manager centrality can be conducted by analysing the relationship strength vector. This was supported by the social influence network theory that centrality reflects the center of influences and the direction and strength of relations describe how persons' attitudes on an issue are affected by their own and others (Friedkin, 1993; Friedkin & Johnsen, 2011). Although some past studies suggested that the frequency of talking to the project manager may be related to project manager centrality, we examined the graph on the proportion of members who reported a daily talk with their manager. As shown in Figure 4.7, the graphs are less similar.

Task-Advice Network

Friendship Network

Project Manager Centrality – Z-Score
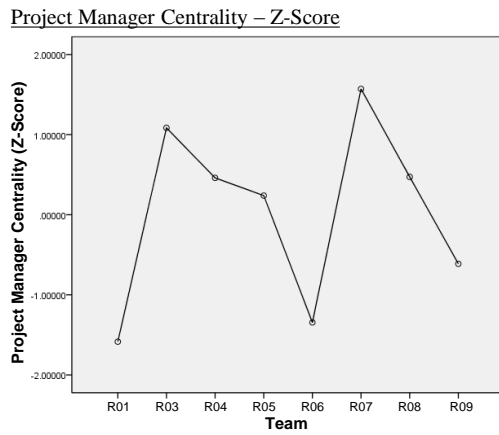
Project Manager Centrality – Z-Score
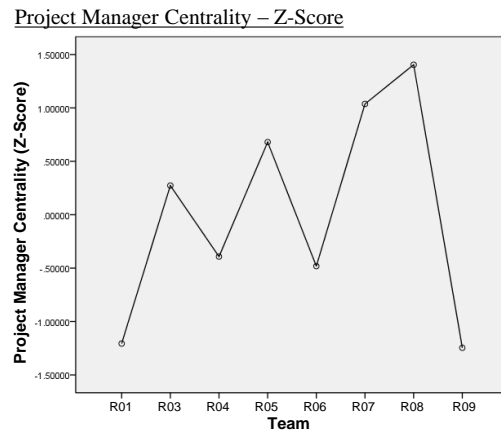
Relationship Strength–Members to Manager (Avg.by Team)
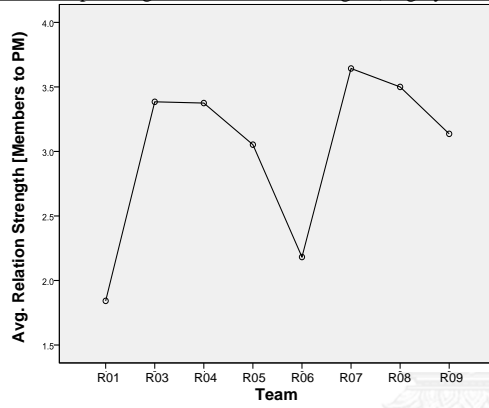
Relationship Strength–Members to Manager (Avg.by Team)
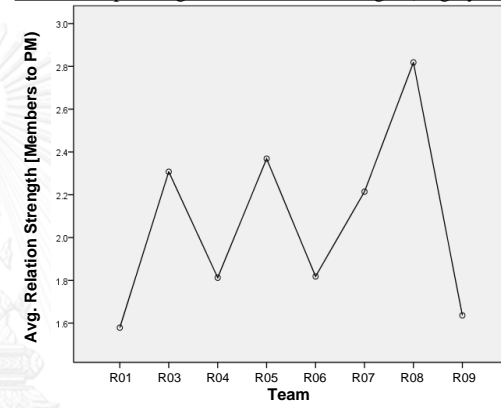
Figure 4.6 Project Manager Centrality and Relationship Strength [Members to Manager]

Task-Advice Network

Project Manager Centrality – Z-Score

Friendship Network

Project Manager Centrality – Z-Score

Proportion of Members who reported Daily-Talk with Manager
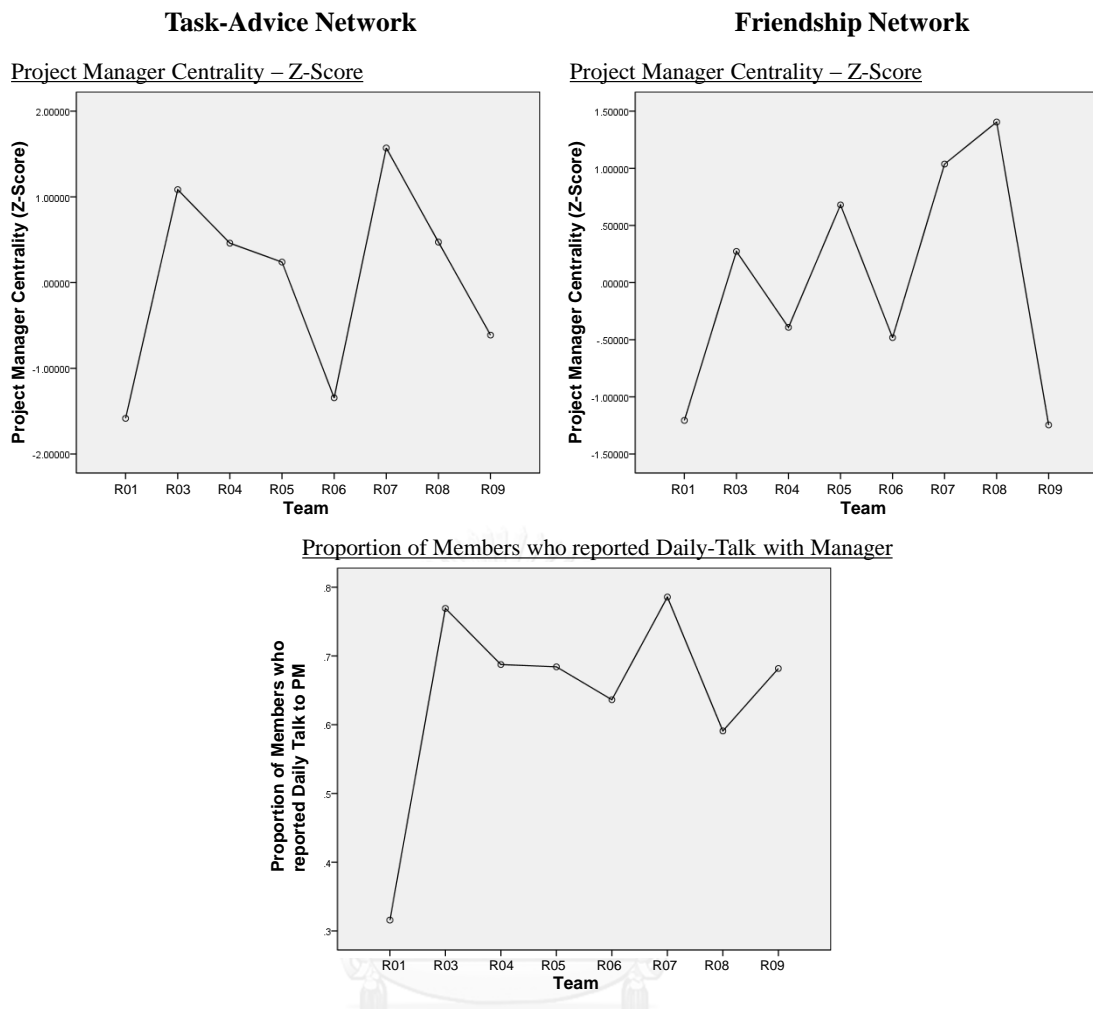
Figure 4.7 Project Manager Centrality and Daily Talk with Manager

4.3.2 Classification of Teams into Groups

Teams are classified into two groups based on the mean of the team performance standardized scores. Figure 4.8 and 4.9 show the results. There are 1) high-performing teams: R03, R04, R05, R07 and R09 and 2) low-performing teams: R01, R06 and R08. The project manager centrality values and rank in the team are also reported for explaining the node size. It is found that in general, the managers' node sizes in task-advice networks are bigger than in friendship networks which suggested that the managers mainly have task-advice relations with the team rather than friendship relations. For task-advice networks, almost all project managers are the 1st ranked centrality in the team, except the R01, R06 and R08 managers.

Although the R08 manager has a high centrality value as 0.826, the manager is surrounded by members who also had high centrality. For friendship networks, we can notice that almost all managers are not the 1st ranked centrality in team. We also found cut-point nodes, i.e., members who are important in the team that taking them out will cause the network to be disconnected, in both high- and low-performing teams and in both task-advice and friendship networks, i.e., in task-advice networks of R01, R04, and R06 teams and in friendship networks of R04, R05 and R06 teams. The research seeks more explanation on the role of cut-points and provides results in the interview section. Social network graphs of each team are provided in Appendix E.

1. High-Performing Teams – R03, R04, R05, R07 and R09	R03 PMCtr = 0.923 (r#1)	R04 PMCtr = 0.824 (r#1)	R05 PMCtr = 0.789 (r#1)
	R07 PMCtr = 1.000 (r#1)	R09 PMCtr = 0.654 (r#1)	
2. Low-Performing Teams – R01, R06 and R08.	R01 PMCtr = 0.500 (r#2)	R06 PMCtr = 0.538 (r#2)	R08 PMCtr = 0.826 (r#2)
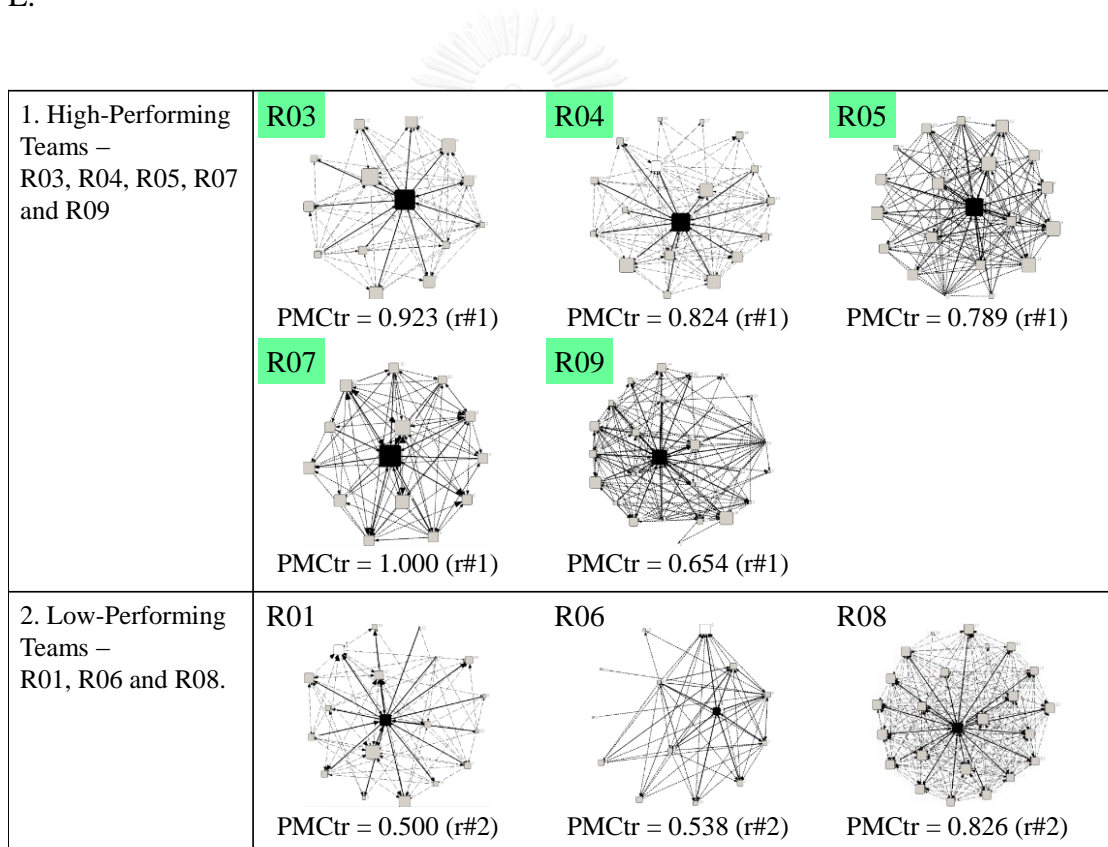
Figure 4.8 Task-Advice Network Graphs of High- and Low-Performing Teams

1. High-Performing Teams – R03, R04, R05, R07 and R09	R03 PMCtr = 0.538 (r#2)	R04 PMCtr = 0.471 (r#2)	R05 PMCtr = 0.579 (r#1)
	R07 PMCtr = 0.615 (r#2)	R09 PMCtr = 0.385 (r#2)	
2. Low-Performing Teams – R01, R06 and R08.	R01 PMCtr = 0.389 (r#1)	R06 PMCtr = 0.462 (r#5)	R08 PMCtr = 0.652 (r#1)
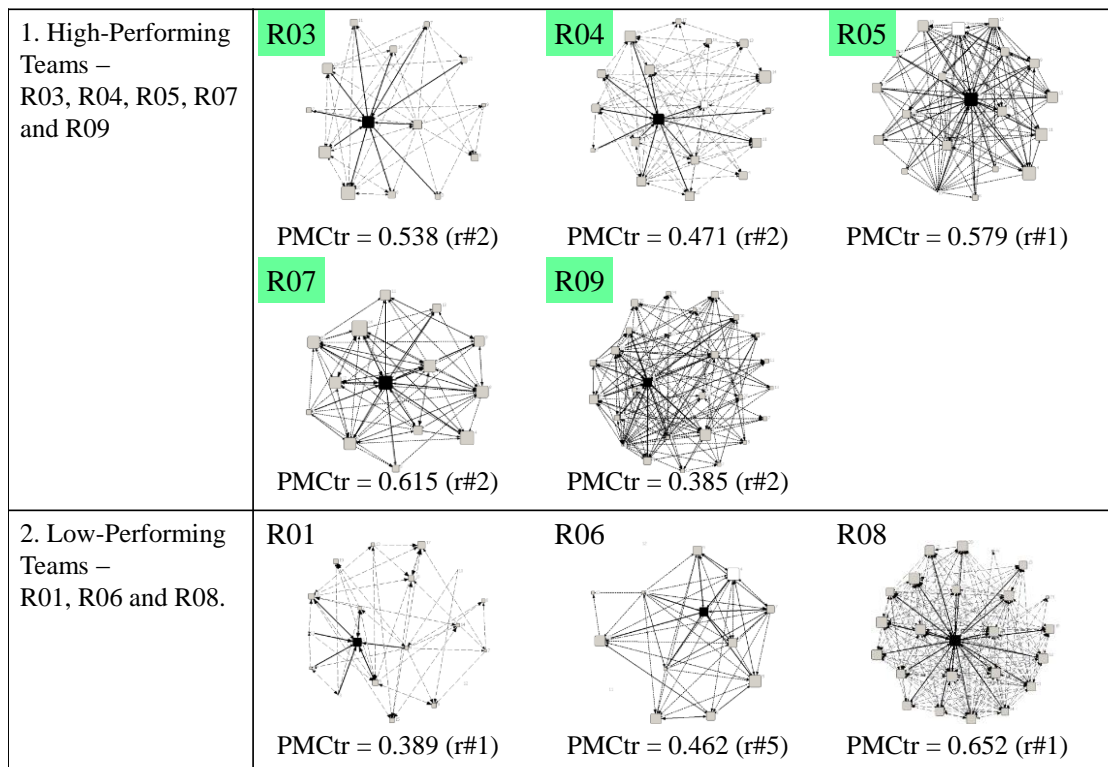
Figure 4.9 Friendship Network Graphs of High- and Low-Performing Teams

4.3.3 Node-level ANOVA

We analysed Node-level ANOVA in each team to test whether relationship strength of members to the manager relates to their rating of team cohesion and team performance. The results are summarized in Table 4.15 and 4.16.

Table 4.15 Node-level ANOVA of Task-Advice Relationship Strength [Members to Manager] on Team Cohesion and Team Performance

Team-Project Manager Centrality		Team Cohesion			Team Performance		
		Sum of squares	df	F	Sum of squares	df	F
R01-Low centrality project manager	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	
R03-High centrality project manager	Between-group	14.37	3	4.436*	8.93	3	3.931*
	Within-group	7.29	10		5.11	10	
	Total	21.66	13		14.05	13	
R04-Medium centrality project manager	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	
R05-Medium centrality project manager	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	
R06-Low centrality project manager	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	
R07-High centrality project manager	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	
R08-Medium centrality project manager	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	
R09-Medium centrality project manager	Between-group	7.32	3	5.412*	4.56	3	2.653
	Within-group	7.44	23		9.45	23	
	Total	14.76	26		14.00	26	

Note: *$p < .05$.

In task-advice networks, the results show that in the R03 team, members who are closer to the project manager have rated high team cohesion and team performance, with F-Statistic values as $F(3, 10) = 4.436$ ($p = .029 < .05$) and $F(3, 10) = 3.931$ ($p = .038 < .05$). The R07 team also has a similar result with F-Statistic values as $F(3, 10) = 9.451$ ($p = .002 < .05$) and $F(3, 10) = 3.439$ ($p = .049 < .05$). These suggest that the relationship strength, i.e., the degree to which members rate the manager as their close task advisor, relates to the members' rating of team cohesion and team performance in these two teams.

Table 4.16 Node-level ANOVA of Friendship Relationship Strength [Members to Manager] on Team Cohesion and Team Performance

Team-Project Manager Centrality		Team Cohesion			Team Performance		
		Sum of squares	*df*	*F*	Sum of squares	*df*	*F*
R01-Low centrality project manager	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	
R03-Medium centrality project manager	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	
R04-Medium centrality project manager	Between-group	2.46	3	.558	1.07	3	.176
	Within-group	14.31	14		19.77	14	
	Total	16.76	17		20.84	17	
R05-Medium centrality project manager	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	
R06-Medium centrality project manager	Between-group	2.41	3	1.714	1.52	3	1.338
	Within-group	7.73	10		6.24	10	
	Total	10.14	13		7.75	13	
R07-High centrality project manager	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	
R08-High centrality project manager	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	
R09-Low centrality project manager	Between-group	6.34	3	4.139*	1.94	3	.885
	Within-group	8.42	23		12.06	23	
	Total	14.76	26		14.00	26	

Note: *$p < .05$.

In friendship networks, we could not find that the members who were close to the manager having rated high team cohesion and team performance. The *F*-values in the Node-level ANOVA result in Table 4.16 are not significant in both team cohesion and team performance. These suggest that the relationship strength in the friendship network, i.e., the degree to which members see the manager as their close friend, is not related to the members' rating of team cohesion and team performance.

Integrated results on team cohesion and team performance in task-advice and friendship networks found importance of the high centrality project managers. It is found that in the R03 and R07 teams which are the top two high-performing teams (R03 team has team performance $M = .37$, $SD = 1.08$, and R07 team has team performance $M = .44$, $SD = .86$), the members who closer to the manager in task-advice networks have rated both team cohesion and team performance higher than members who were less close to the manager with significant F-value in Node-level ANOVA. The strength of task-advice relations to which the high centrality project manager connected members plays an important role to influence the members' perceptions and ratings. Figure 4.10 highlights the results.

1. High-Performing Teams – R03, R04, R05, R07 and R09	R03	R04	R05
	PMCtr = 0.923 (r#1) ✓- Cohe: $F(3,10) = 4.436*$ ✓- Perf: $F(3,10) = 3.931*$	PMCtr = 0.824 (r#1) - Cohe: $F(3,14) = .691$ - Perf: $F(3,14) = .591$	PMCtr = 0.789 (r#1) - Cohe: $F(3,16) = .820$ ✓- Perf: $F(3,16) = 4.664*$
	R07	R09	
	PMCtr = 1.000 (r#1) ✓- Cohe: $F(3,10) = 9.451*$ ✓- Perf: $F(3,10) = 3.439*$	PMCtr = 0.654 (r#1) ✓- Cohe: $F(3,23) = 5.412*$ - Perf: $F(3,23) = 2.653$	
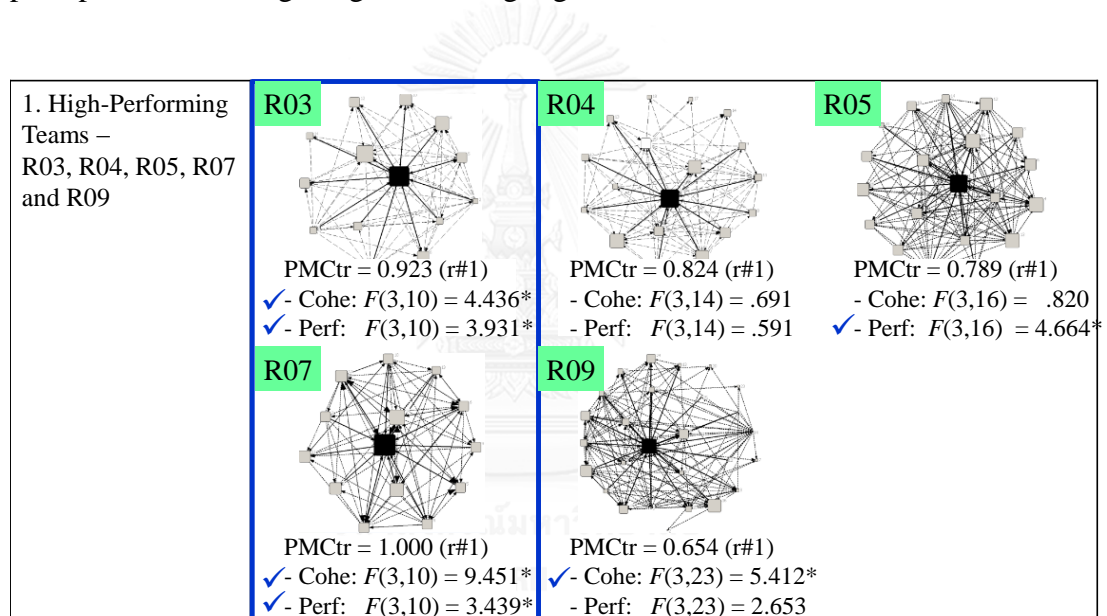
Figure 4.10 Task-Advice Network Graphs – Node-level ANOVA Results of the R03 and R07 teams

4.3.4 ANOVA Density Model and Relational Contingency-Table Analysis

The ANOVA density model is a process of testing if there is a subgroup in team that has internal relations closer than external relations. The structural block model was used to partition the team into subgroups based on relationship strength from members to the manager, and test whether the members in each subgroup have dense relations among them higher than relations between the subgroups. The

findings will suggest whether the members who are more and less close to their managers have formed their own subgroups. The result is shown in table 4.17.

Table 4.17 ANOVA Density Model Analysis of Task-Advice and Friendship Networks in Team

Team	Task-Advice Network			Friendship Network		
	R^2	Adj. R^2	p	R^2	Adj. R^2	p
R01	.064	.024	.600	-.528	-.593	.900
R03	-.064	-.219	.533	-.166	-.264	.483
R04	.147	.106	.284	.360	.307	.001
R05	.109	.074	.463	.210	.180	.066
R06	.441	.394	.001	.321	.294	.001
R07	-.470	-.594	.878	.247	.184	.061
R08	.222	.202	.029	.298	.279	.001
R09	-.804	-.865	.963	.268	.244	.000

In task-advice networks, it is found that the R06 team and the R08 team have subgroups of members with significant *Adjusted R²* = .394 (*p* = .001 < .05), and *Adjusted R²* = .202 (*p* = .029 < .05). This means that the R06 team and the R08 team have 39.4% and 20.2% possibility to find subgroups of task advisors in the team. As in-degree centrality measures the number of connections from members to the manager, having a subgroup of members who have dense relations among them may suggest a reason why the manager has low centrality in the team. Dense relations meant the members had relations with their own kind, having such connections would count among them and let some or all of them have high centrality. As it was found, this may explain why the R06 manager and the R08 manager are the 2nd ranked centrality in the task-advice network in their teams.

In friendship networks, it is found that almost half of the teams in the study have subgroups of members who are friends. There are significant *Adjusted R²* in the teams as follows: the R04 team has *Adjusted R²* = .307 (*p* = .001 < .05), the R06 team has *Adjusted R²* = .294 (*p* = .001 < .05), the R08 team has *Adjusted R²* = .279 (*p* = .001 < .05) and the R09 team has *Adjusted R²* = .244 (*p* = .000 < .05). This may explain why the managers are not the 1st ranked centrality in team.

To analyse further, we used Relational Contingency-Table Analysis to test if the subgroup is formed between members who less close to the manager. Table 4.18 reports the results.

Table 4.18 Relational Contingency-Table Analysis of Task-Advice and Friendship Networks in Team

Team-Project Manager Centrality	df	χ^2	p	Relationship Strength					
				0	1	2	3	4	5
Task-Advice Network									
R01-Low	19	15.239	.653	0.600	-	-	0.560	0.850	1.690
R03-High	13	36.310	.056	1.010	-	-	0.300	1.350	1.690
R04-Medium	16	27.703	.334	0.000	-	-	1.310	1.100	-
R05-Medium	19	23.266	.405	0.540	-	-	0.720	1.080	1.260
R06-Low	11	49.034	.005	0.280	-	-	1.440	-	-
R07-High	14	19.807	.160	-	-	-	0.310	0.900	1.860
R08-Medium	22	46.461	.025	0.300	-	-	1.260	1.190	1.280
R09-Medium	22	57.690	.277	0.280	-	-	-	1.520	2.090
Friendship Network									
R01-Low	19	33.193	.022	0.720	-	-	-	0.000	2.800
R03-Medium	13	17.362	.414	0.550	-	-	-	1.440	0.960
R04-Medium	16	68.198	.002	0.250	-	-	1.400	1.640	-
R05-Medium	19	45.686	.093	0.530	-	-	1.060	0.000	1.650
R06-Medium	11	34.308	.005	0.600	-	-	1.870	2.800	-
R07-High	14	32.833	.021	0.480	-	-	2.040	0.680	2.040
R08-High	22	91.195	.003	0.240	-	-	1.920	1.250	1.600
R09-Low	22	150.467	.000	0.360	-	-	1.410	0.630	-

Note: **-** : There is no member rated the manager with that relationship strength.

In task-advice networks, it is found that in the R06 team and the R08 team, members who are less close to the manager have formed their own subgroups with significant chi-square $\chi^2(11) = 49.034$, ($p = .005 < .05$) and $\chi^2(22) = 46.461$ ($p = .025 < .05$). The members who rated the manager as neutral ('3') have dense relations among themselves at 1.440 times and 1.260 times higher than we could expect by chance. As there is a subgroup of members, it would be hard for the project manager to connect all of them. Based on the social influence network theory that relationship strength determines interpersonal influences on attitudes and perceptions (Friedkin, 1991), the neutral score means the manager has less influence on the team, i.e., to motivate the members' rating on team cohesion and team performance. This may

explain why the R06 team and the R08 team are in the low-performing group. Figure 4.11 highlights the results.

2. Low-Performing Teams – R01, R06 and R08.	R01 PMCtr = 0.500 (r#2) - $\chi^2(19) = 15.239$	R06 PMCtr = 0.538 (r#2) ✓- $\chi^2(11) = 49.034*$ **Have Cohesive Subgroup Density as 1.440 times higher than we can expected by chance**	R08 PMCtr = 0.826 (r#2) ✓- $\chi^2(22) = 46.461*$ **Have Cohesive Subgroup Density as 1.260 times higher than we can expected by chance**
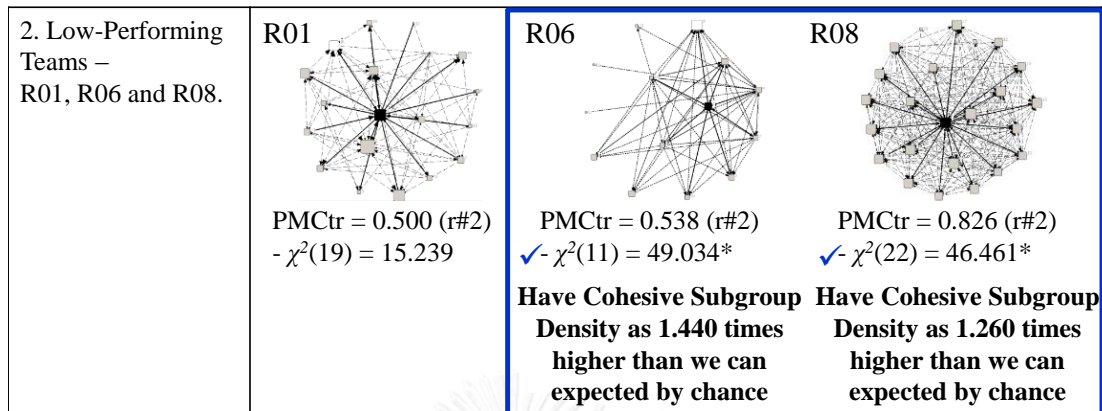
Figure 4.11 Task-Advice Network Graphs – Relational Contingency-Table Analysis
Results of the R06 and R08 teams

In friendship networks, it is found that almost all teams in the study except the R03 team and the R05 team have subgroups of members who are less close to the manager as a friend. There is a significant chi-square in the teams as follows: the R01 team has $\chi^2(19) = 33.193$, ($p = .022 < .05$), the R04 team has $\chi^2(16) = 68.198$, ($p = .002 < .05$), the R06 team has $\chi^2(11) = 34.308$, ($p = .005 < .05$), the R07 team has $\chi^2(14) = 32.833$, ($p = .021 < .05$), the R08 team has $\chi^2(22) = 91.195$, ($p = .003 < .05$), and the R09 team has $\chi^2(22) = 150.467$, ($p = .000 < .05$). Based on the social influence network theory (Friedkin, 1991), this may explain why we were unable to find the effect of project manager centrality in friendship network. Figure 4.12 highlights the results.

1. High-Performing Teams – R03, R04, R05, R07 and R09	R03 PMCtr = 0.538 (r#2) - χ2(13) = 17.362	R04 PMCtr = 0.471 (r#2) ✓- χ2(16) = 68.198*	R05 PMCtr = 0.579 (r#1) - χ2(19) = 45.686
	R07 PMCtr = 0.615 (r#2) ✓- χ2(14) = 32.833*	R09 PMCtr = 0.385 (r#2) ✓- χ2(22) = 150.467*	
2. Low-Performing Teams – R01, R06 and R08.	R01 PMCtr = 0.389 (r#1) ✓- χ2(19) = 33.193*	R06 PMCtr = 0.462 (r#5) ✓- χ2(11) = 34.308*	R08 PMCtr = 0.652 (r#1) ✓- χ2(22) = 91.195*
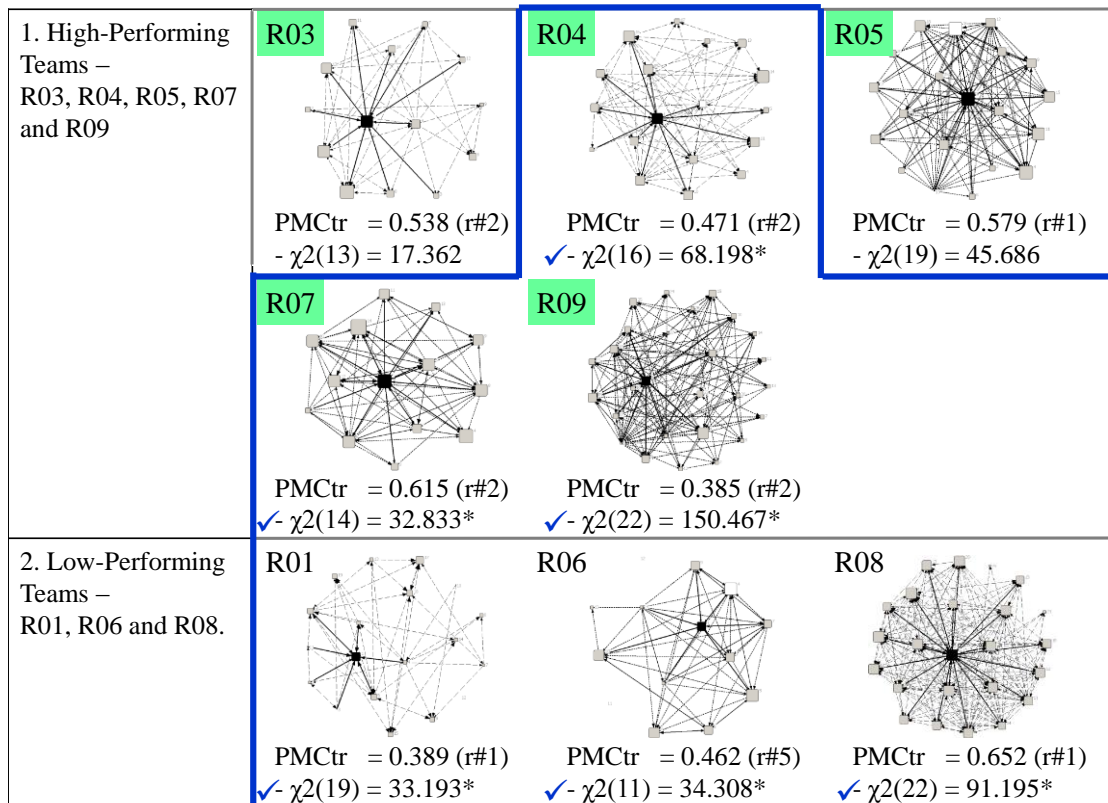
Figure 4.12 Friendship Network Graphs – Relational Contingency-Table Analysis
Results of the R01, R04, R06, R07, R08 and R09 teams

4.3.5 Summary of Social Network Analysis Results

The findings from the social network analysis are more observations and explanations rather than statistical confirmations on the research model. The Node-level ANOVA result found that relationship strength of the members to their manager relate and explain their rating of team cohesion and team performance. For all eight teams in the study, it is found that in the top two high-performing teams, the R03 team and the R07 team, the team members who were close to their manager in task-advice networks have rated high team cohesion and team performance. The R03 manager, as having high centrality as the R07 manager, would closely connect many members and foster team cohesion to have a stronger positive effect on team performance. Based on the social influence network theory that relationship strength determines interpersonal influences on attitudes and perceptions (Friedkin, 1991), the result explains the

important role of high centrality project managers as task advisors to motivate high team cohesion and team performance in the team.

As relationship strength determines interpersonal influences, we also used the ANOVA Density Model and Relational Contingency-Table Analysis to examine if there is a subgroup of members who developed relations among themselves and influenced others in their own group. For all eight teams in the study, it is found that in the two low-performing teams, the R06 team and the R08 team have subgroups formed between members who are less close to their manager. As members in the subgroup have dense interpersonal relations within the group rather than with others, the finding would explain why the R06 manager and the R08 manager have 2nd ranked centrality in the teams. These imply some difficulties faced by the managers to connect different subgroups in the team to promote team cohesion to have positive effects on team performance.

The social network analysis results also found a lack of support for the project manager centrality in friendship networks. The Node-level ANOVA results in all eight teams are not significant for both team cohesion and team performance. It may be because the friendship relation is less inherent in the team, i.e., teams in the study have less friendship network density than task-advice network density, and the members and manager are not as friendly, i.e., the managers have low centrality values and not the 1st ranked centrality in the team. Also, the ANOVA Density Model and Relational Contingency-Table Analysis results show that almost all teams have subgroups of members who are friends with others. As a subgroup is a group of members who has dense relations among themselves, this may explain why the managers have low centrality and why we are unable to detect the moderating effect of project manager centrality on team cohesion-performance relationship. The friendship relationship strength of the members to their manager does not explicitly relate and explain the members' rating of team cohesion and team performance. As a result, we are unable to confirm that the high centrality project managers as friends provide an obvious benefit to influence high team cohesion and team performance in team.

4.4 Qualitative Content Analysis Results

We used content analysis to analyse the interview data. From the eight teams in the study, we interviewed six project managers from teams R01, R03, R04, R05, R06 and R07. We could not approach the manager in teams R08 and R09 due to the fact that the R08 manager was leaving the company during the study while the R09 manager was too busy in managing the large team. The interview session with each manager was approximately one and a half hours and in Thai with a tape recorder. The interview content had been transcribed by the researcher and reviewed with the project manager prior the analysis and publication of the research results.

The content analysis results produced a total of 332 paragraphs and 273 paragraphs (82%) and were extracted and categorized as follows: 1) 94 paragraphs are the project manager's characteristics categorized as task-oriented and relationship-oriented leader characteristics, 2) 154 paragraphs are the team characteristics and 3) 25 paragraphs are the project manager's reviews on social network analysis results of his/her team. Table 4.19 shows the standard behavioral definition that is used in this research and examples of paragraphs in each definition. The paragraphs on the project managers' characteristics are provided in Appendix F. Team characteristics and social network graph reviews are summarized in corresponding sections.

Table 4.19 Selected Examples of Interview Paragraphs and Behavioral Definition of Task-oriented and Relationship-oriented Leader Characteristics

Leader Behavioral Characteristics	Examples of Paragraphs
1. Task-oriented Leader	
Clarifying	I have given feedback on their work performance every three months. The key point is they are clear on their responsibilities and the target so they will be able to focus and perform in the right direction. I always make this clear.
Planning	This project is initially very critical. The initial estimation is un-realistic. Although we did many re-estimate, it remains delay in months. I break down work details, impacts and dependency and re-plan. It is quite better now.
Monitoring operations	For this kind of cases, I have to aware, although I have assigned the work, I will monitor if they are ok.
Problem solving	I think it is my experience in making decisions on solving

Leader Behavioral Characteristics	Examples of Paragraphs
	technical issues. It is quite fast and we are able to deliver the software product as the product manager would like to have…I would be the one who thinks about new workflow and solutions.
2. Relationship-oriented Leader	
Supporting	We are so concerns about issues in production. Actually I am quite stress; but I always tell them that it is just the fault, the issues that we need to solve. Not to worry and just move on to solve them. They may feel safe to talk to me.
Developing	I have encouraged Mr.A to speak out his opinions since I started leading this team. He talked to me and told me that sometimes he does not agree with the senior members; however, it is ok to just simply follow. I have suggested that he not do this, even to me.
Recognizing	I let them get involved in the work to learn and I recognize them. I acknowledge their work to relevant parties such as product managers, as well as if there is a chance I point out to our boss that he/she is delivering this good work.
Empowering	I like to have different ideas and opinions so I want everyone to share and discuss their ideas. I always encourage them to let share idea first. Whether it will be accepted or not would depend on the situation and others, but if everyone contributes idea would bring different perspectives and a good solution. Although it is not the best, it is always good to move on.

4.4.1 Project Manager's Characteristic Categorized as Task-oriented and Relationship-oriented Leader Characteristics

Table 4.20 reports the number of paragraphs on the project manager's characteristics that can be categorized as task-oriented and relationship-oriented leader characteristics. It is found that almost all managers share task-oriented leader characteristics than relationship-oriented leader characteristics, except the R05 manager. By comparing the managers and considering the 1st and 2nd rank, we found the R03 and R07 managers highly share task-oriented leader characteristics, and the R03, R05 and R07 managers highly share relationship-oriented leader characteristics. Although the number of paragraphs is slightly different, the result agrees with past studies that the project manager centrality reflects the manager's task-oriented and relationship-oriented leader characteristics (Casimir, 2001; R. Y. J. Chua et al., 2008).

Table 4.20 Project Manager's Characteristic Categorized as Task-oriented and Relationship-oriented Leader Characteristics and Project Manager Centrality

Project Manager	Project Manager's Characteristic		Project Manager Centrality	
	Task-oriented Leader	Relationship-oriented Leader	Task-Advice Network	Friendship Network
R01	4	2	0.500	0.389
R03	11	8	0.923	0.538
R04	9	7	0.824	0.471
R05	8	9	0.789	0.579
R06	5	2	0.538	0.462
R07	21	8	1.000	0.615
Total	**58**	**36**	**-**	**-**

The detailed interview results on the project manager's characteristics as task-oriented and relationship-oriented are summarized as follows.

Task-oriented Leader Characteristic

The R03 and R07 managers highly share task-oriented leader characteristics. They mainly focused on completing the team's tasks and setting standards to the team to do the same. The R03 manager suggested that "*we focused on our work and did it to our best* [33:00-34:00]" and "*if we put all our efforts to the work we will achieve the result. Not to worry about others* [40:00-42:00]." The R07 manager clarified the performance standard to the team. "*I have given feedback on their work performance every three months. The key point is they are clear on their responsibilities and the target so they will be able to focus and perform in the right direction. I always make this clear* [36:15-37:45]."

The R07 manager also emphasized the planning and monitoring work progress according to the target that "*I tried to relocate their work to let them work with each other and align their goals* [09:53-10:17]." "*I also set up a pair-programming for them to talk and set goals together. Those who are not so strong could share and set goals with the stronger person. The goal would be 'to deliver this component by this timeframe' so the person who lacks skills would speed up while the stronger person would provide some help* [07:00-09:53]." "*My role is to drive team performance. I track issues, help them on finding solutions, and act as a connector,*

i.e., to find and allocate team members to help other [51:24-53:22]" and "*I swop and assign the work for them to get to know and work on the same objective and direction* [54:00-01:01:05]*.*"

Both the R03 and R07 managers emphasized the importance of problem solving and made efforts to make it faster. The R03 manager suggested that "*I think it is my experience in making decisions on solving technical issues. It is quite fast and we are able to deliver the software product as the product manager would like to have…I would be the one who thinks about new workflow and solutions* [20:40-22:00]*"* and "*the team capability is not defined by how many issues; rather, it is defined by how well we can handle the issues and move forward. We may have handled three issues but we can solve it in three hours which is better than in three days* [42:30-46:00]." The R07 manager also said that "*when they have arguments, I focus on what is practical for work solutions rather than who will win. I focus on work and I am fully dedicated* [40:43-42:43]*.*", "*what to do is to solve issues and find preventions* [32:48-35:22]" and "*I rather see it is as a team to work together to resolve it fast* [35:22-36:15]*.*"

Relationship-oriented Leader Characteristic

The relationship-oriented leader motivates team performance by supporting, developing, recognizing and empowering their team members (Yukl, 2012). Here we found the R03, R05 and R07 highly share relationship-oriented leader characteristic, and the R05 manager shares more relationship-oriented leader characteristics than task-oriented leader characteristics. They paid attention to members' attitudes and provided emotional supports to the team. The R07 manager suggested that "*I think being empathetic and kind are also important as a leader. Although the work is urgent, I think we can always manage. I trust them. I would find if they have issues so I can help…I also participated in their personal events, i.e., housewarming, weddings, to let them know that I also care about them as a person* [22:18-25:03]." Also, the R05 manager added that "*in my view, team members' attitudes are the most important* [52:15-01:01:50]" and "*I believe in balancing the*

joyful and work-focused modes; so I will select the way in approaching and following up their work. I am a bit stressed and want to get work done, but the way I go about it is not to drive and push them but to see and help them out… I believe that pushing them would make them stressed and would serve no benefit [44:39-47:35]." The R03 manager suggested that "*I have one-on-one sessions with individual team members, approximately half an hour or more per month. I ask about their lives if it remains joyful or if there are any issues or problems* [18:30-20:50]."

Besides simply assigning the work to a team, all three managers also suggested that it is important to develop and empower their teams to gain new skills and confidence. The R03 manager said that "*as a leader, I try to let my team think and work by themselves to let them learn. My responsibility is to support them to grow* [23:40-25:10]." "*I have encouraged N#10 to speak out his opinions since I started leading this team. He talked to me and told me that sometimes he does not agree with the senior members; however, it is ok to just simply follow. I have suggested that he not do this, even to me…If you are unable to think and work by yourself, you are still a follower. Actually I encourage everyone* [14:00-14:40]." and "*I talk to them in our one-on-one meetings and guide them to seeing and following the good example* [34:00-35:15]." The R07 manager added that "*I provided full support to them, i.e., train their English communication skills. Although they are junior members, they can run demonstrations with foreign product managers via teleconference and be proud* [30:19-31:47]."

As demonstrating skills to outsiders is also important for career advancement, the R05 manager provided support to her team that "*in depth, I looked at them not only for how they acted to me but also how they treated others, and plan carefully who they should work with and learn from, as this is important for their career development* [47:35-49:00]." The R03 manager keeps recognizing and motivating her team that "*I let them get involved in the work to learn and I recognize them. I acknowledge their work to relevant parties such as product managers, as well as if there is a chance I point out to our boss that he/she is delivering this good work* [22:00-23:20]." The R07 manager suggested that all these are important for improving

the team to deliver the team performance that "*they will follow although they need to adjust and speed up their skills, even though it is quite challenging for them. It would be fun and challenging works rather than boring with a fixed formula [30:19-31:47].*"

4.4.2 Project Manager's Characteristic Categorized as Task-oriented and Relationship-oriented Leader Characteristics and Team Cohesion-Performance Relationship

How do the managers enhance the team cohesion-performance relationship in their teams? It was suggested by the R03 and R07 managers who highly share task-oriented leader characteristics that the work collaboration is a performance standard in the teams, and as task advisor, they are the connector who integrates members' different capabilities to effectively deliver the work.

The R03 manager said that "*I will always emphasize to the team that to complete the work is not simply just to finish your own job but to finish the team's work. If we finish our work, we should not just sit, playing and waiting for the next task. We should consider contributing to the team.* [16:45-18:30]." Also, to make it happen, the R07 manager suggested that "*I set their work environment as knowledge sharing and work collaboration, i.e., helping each other. I tried to make it tangible rather than abstract by doing things like giving rewards to the person who helped out others, volunteering and sharing knowledge. I keep providing feedback to ensure they are doing as I expect, i.e., to have a shared environment [05:20-07:00]*" and "*I always emphasize that everyone wants to achieve and complete the work and go home to rest. So we should help each other out as well as share the issues so others can help. We work together [51:24-53:22].*" He added that "*my role is to drive team performance. I track issues, help them on finding solutions, and act as a connector, i.e., to find and allocate team members to help others. I played the role as advisor, i.e., I connected persons who have capability and ideas to help others who may be stuck on some tasks. As leader, I see and know their experience and skills so I can connect each of them to deliver the best work [51:24-53:22].*"

For friendship relations, the R05 manager who shares more relationship-oriented leader characteristics suggested that, as a friend of many members, she is the connector to minimize conflicts and encourage work collaboration in the team. She said that "*my team members have different personalities. Seniors compromise quite a bit. They have their own opinion but they will not take sides in suggesting solutions. Juniors are good in technical skills however they have high confidence. They are biased and so intense in discussions. So I have to step in to slow the arguments down [8:50-11:40]*" and "*I always tell them we should discuss and have alternative ideas but we should have a best conclusion without fighting with each other [01:06:10-01:13:00].*"

Although sharing different opinions, all three managers suggested that having task-advice and friendship relations with the team would provide benefits. The high centrality project manager played an important role as the central connector to integrate many members' different capabilities and minimize conflicts in the team, which fosters team cohesion to have a stronger positive effect on team performance.

4.4.3 Additional Analysis

Since we found the R01 and R06 managers have a low number of paragraphs on the project manager's characteristics that are categorized as task-oriented and relationship-oriented leader characteristics, we have re-examined their interview transcripts. It is found that the R01 manager was planning to take maternity leave and she was transitioning her management roles to N#6, a senior member who has the highest centrality in the task-advice network in the team.

"*N#6 is the lead here, who I transitioned to coordinate tasks when I take maternity leave in the next two months [16:10-16:20].*", "*I did not work closely with the team recently compared to the past when I always worked late with them. Since getting married and now planning to have a baby, I cannot socialize with them as much like having lunch far from office the, having parties or hanging out. As manager, I have many meetings. I have to focus on the meetings to clear outside*

issues and transition internal management to N#6 [21:29-22:15].", and *"I trusted many people, first, N#6, definitely. He is the key person in my team. When there are issues, I will talk with N#6 first. I will ask his opinion and provide my suggestions [27:00-27:42]."*

For the R06 team, we found that the team is composed of two working groups: one develops reports for old software platforms and another one for new platforms. The manager appointed N#9, a senior member who has the highest centrality in the task-advice network in the team, to be responsible for work integration and informally leads the team. Also, the manager has interpersonal relations with the team but not so close.

"Now the team is separated into two parts: to develop applications for the old and new platforms. We have two seniors responsible for each part. N#6 is in charge of the old platform to set up the server and maintenance. N#9 is in charge of the new platform. Most developments are in the new platform, so junior members can approach N#9 on any technical-related questions [07:38-10:03]." "Each team member has their work items and works individually. We have meetings every Monday to plan and synchronize our progress and plan delivery. I put N#9 to be responsible for work integrations and informally lead N#6 and coach the junior developers [12:37-16:02]" and *"I think my personality would not fully motivate the team as I expected. It may be because I rarely interact with them, i.e., walking to their desks and talking with them on how their work is during the day. Most of the time I am working at my desk and juniors would come to consult me. I have good relationships with them but not so close. I do not have lunch with them as I have my friends in other groups. My team and I are not so close but we have some chitchat. We have some trips and parties together. We have some conversations but not so close or too personal [28:25-30:09]."*

4.4.4   Summary of Interview Results

A qualitative interview was conducted to elaborate some characteristics of high centrality project managers and seek some explanation of why such characteristics would relate to team cohesion-performance relationship. The findings suggested that the high centrality project managers in task-advice networks, i.e., the R03 and R07 managers, share task-oriented leader characteristics. They focused on driving the work in the team by planning, monitoring, clarifying and solving work-related challenges. The high centrality project managers in the friendship network, i.e., the R03, R05 and R07 managers, share relationship-oriented leader characteristics. They focused on developing relations with the team by paying attentions to members' attitudes, supporting and empowering the members to learn new skills as well as recognize the members on their work performance. Both leader characteristics can enhance the team cohesion-performance relationship because being a task advisor and a friend to many members allows the managers to minimize conflicts among members, and integrate team efforts, knowledge and capabilities to deliver the team's work results.

The findings also suggested that low centrality project managers have less influence on the team. It may be due to the work arrangements in the team that the managers have transitioned their management role to a member to informally lead the team or the team is composed of different working groups.

4.5 Social Network Graph Reviews and Other Findings

The research reviewed the social network graph interpretation with each project manager to find characteristics of the members who have high centrality in task-advice and friendship networks, and the role of cut-point and isolate nodes. The results are summarized as follows.

First, the members who have high centrality in task-advice networks are strong in the technical background and many members approach them for work

solutions. The R01 manager suggested that "*N#6 is an information expert on workflow, work processes and solutions. He knows well about the work* [41:06-41:55]" and "*the 2nd highest centrality is N#9. He is who I told you the specialist in Java Applet. We use Java Applet. Many members have to approach him for technical advice* [39:34-39:55]." The R03 manager added that "*N#13... I think this reflects his knowledge of software products. As this information is important to work delivery, besides the members approaching the project manager for work direction, they will also approach QA for product-related information to complete their tasks at hand. I also worked closely with the product manager* [49:00-01:03:00]." The R05 manager also suggested that "*the 2nd rank centrality in the task-advice network is N#16. This would be related to the software requirement. She knows a lot about the software products. I think team members approach N#16 to get details on software requirements and they approach me for finding and making final decisions on software solutions* [01:27:10-01:28:20]."

Second, the members who have high centrality in the friendship network are joyful people who can make other laughs and have fun. The R01 manager suggested that "*N#17 is a nice person. Everyone loves her. N#18 came back to re-join the company and the team because she prefers to work with her.* [43:30-44:00]." The R04 manager suggested that "*N#14 is a joyful person, quite talkative and easy-going with others* [#2: 31:30-32:56]." The R06 manager suggested that "*N#4 has a good sense of humour, easy to talk and is friendly with everyone. He is not the joker in team, however, he always posts / shares some new things on his facebook and we liked it so much. It is because his personality that makes us laugh sometimes and everyone is happy to talk to him. He is funny and approachable* [01:56:22-01:59:40]." The R03 manager suggested something different: "*I think it is N#10's personality in making him to have a high centrality in the friendship network. He is a good listener. He is not a funny person, actually. He is polite.* [01:05:00-01:07:00]." The R07 manager suggested that "*I agree that N#14 is 1st rank in friendship centrality. She is only one tester in my team and in that role she has to work with every team member...so she has to join and talk with every developer to ensure all development work is of high quality. The SNA result does not surprise to me. I think the result is*

good. QA role would need friendship relations so if she does not have good relations with developers, it would not be so good in the overall work delivery [01:07:15-01:08:29]."

Third, the cut-point node is the member who connects the core work process in the team. The R01 manager suggested that "*N#16 is cut-point because he is the key person who integrates software codes to build the software version. If we don't have him we will be unable to progress key process in the work* [40:45-41:06]." The R04 manager suggested that "*N#15 is a main proxy of the overall work as well as provides relevant information from outsiders to the team. She has worked with the team for quite a long time and quite active in sharing information with the team. She is so important that if we did not have her, the workflow would be disconnected* [#2: 16:58-17:26]." The R06 manager suggested that "*N#9 is the person who the members in team depend on. He has a big workload* [01:38:30-01:43:37]." The managers' supervisor suggested that having a cut-point in R04 would be a concern that the work transition process remains under progress. "*I think it actually reflects the fact but it is quite a surprise to me…Before this, we were transforming the team to have QA as a quality owner to developers to also take ownership. We don't want everything tied on the QA. We already tried transforming this for almost a year to move away from this model (this kind of network pattern – having QA as cut-point), so I think it should already be done. Now the findings found this yellow, so when I look back, it would be possible as this person is very strong in the level and that the manager is new to the role – he may not confront with the cut-point and would follow it quite a bit…this finding is good…This mean we still have not reached the goal…so we need to continue doing it (transitioning the cut-point)* [01:16:10-01:17:05]."

As for the friendship network, the R04 manager suggested that the cut-points share some similar characteristics as the high centrality node; however, the cut-point would be the target to laugh at. "*N#7 is generally a target that everyone would tease. He is a joyful person who makes others both enjoy and have fun in teasing him* [#2: 31:30-32:56]. *He is the guy everyone plays with. It is not only that he always plays with others but also everyone goes to tease him even he is just sitting. Teasing*

him is fun and he also funny. He is more of a victim than an initiator. If he was not in the team, we would have fewer funny moments [#2: 39:00-39:43]." Also, the R05 manager suggested that "*N#16 is a funny person and always has a sense of humour. Everyone could make fun around her. She added a cheerful atmosphere in team* [01:34:30-01:35:00]".

Fourth, the interview with the R01 manager found that the isolate node is the member who worked independently from others in the team. "*N#12 is the one that prefers to work alone such as doing research work. He likes to work individually* [45:15-45:42]".

The researcher also reviewed the social network graph interpretation and interview results with the managers' supervisor. He suggested that the graph closely reflects the team and manager characteristics as follows.

First, the task-advice network reflects the centrality as an extent to which the actor is important in the team. The managers' supervisor suggested that besides the manager who is at the center, he can guess that the high centrality node next to the manager node is the key tester and business analyst who shares an important role as project manager in team. "*This would be possible that nodes close to others would share similar characteristics. In the R07 team, N#14 played a tester role, N#1, the manager, he drives work delivery and is central for team development, and N#14 would be central for quality assurance (QA). QA by role would be able to provide information on the software requirement and design as the manager. Both are similar in their software knowledge* [51:00-52:00]." "*In my opinion, R05 and R07 quite closely represents what is happening. Especially R05 that you said highly dense graph represent closed interpersonal relations in the team…if seeing from interpersonal relations, I see the pattern of R05 and R07 are really reflecting what happened here: these teams are social. Also the nodes besides the managers that have high centrality, I see these reflect their specific roles, i.e., N#16 in R05 and N#14 in R07are QA that team members have to approach. I saw the position of both nodes also lies in the center as the manager as they are important in team. I am not*

surprised; the result presents the reality here [55:00-59:00]." The reason is that they have to know well about the work process and detail software functions as the manager. "*I see they are central as go-to guy for their specific role* [01:06:24-01:08:50]." In addition, the managers' supervisor suggested that the distance between nodes reflects closeness of interpersonal relations among members in the team. "*I am seeing the N#4 in R05 that has a big size but is a bit far from the manager's node. This also reflects the fact. In task-advice, this node can be central for some team members (this node is Business Analyst). But in terms of relation, this node and the manager are quite distant. This reflects things that really happened here* [01:01:30-01:02:30]."

Second, the managers' supervisor suggested that the high centrality project manager in task-advice networks is the manager who highly focuses on work and influences the team direction. He commented that the R07 manager was an experienced manager. "*Let me see; I think R07 has the highest project manager centrality, team cohesion and team performance* [28:00-29:00]. *He has high experience in software development and takes a leading role* [32:00-33:00]. *He drives work delivery and is central for team development* [51:00-52:00]. *At first, I reviewed R07. I think it makes sense that PM has high centrality, this is the pattern that really reflects the team* [01:02:30-01:04:30]." As for R03, he suggested that "*I am surprised that team R03 has less cohesion than other teams because actually the team has such situations. Project manager centrality is really like this as many members also have to approach and depend on the project manager…This team has fewer activities as members are quite individual, i.e., they have their own interests. So in task-advice, I think the manager is a quite high influencer* [01:34:39-01:35:39]." As for the high centrality project manager in the friendship network, we only have the input that "*I think the R05 manager would have the 1st rank in friendship centrality among the managers* [01:07:15-01:08:29]." The R05 manager has reflected her personality as "*I am quite a joyful person especially with my peers and friends. The juniors can talk to me openly, making jokes and fun, and also respect me* [44:20-44:39]." and "*I think it would be my personality and I would be their older sister rather than a leader such as being open to talk. I am quite a joyful and cheerful person, and like to see different*

opinions. I believe that juniors may not want to have a leader all the time; they want someone to talk to. I believe that having fewer gaps or no gaps would be good in working with them. Open and frank discussion would let us understand each other, i.e., they also stop arguing when seeing my concerns. I also have a lot of friends and I want to have friends even in the work environment [01:29:53-01:32:10]."

Third, the managers' supervisor suggested that the subgroup in team R06 is due to the work arrangement in the team, and the subgroup in team R08 may relate to some management concerns. "*I think R06 would be ok. Actually, they are having sub teams inside [01:15:44-01:16:10].*" and "*the R08 network also reflects what really happens…they have subgroups and not like the subprojects in R06. These are subgroups of non-collaborative team members. The manager already left and I have moved in to oversee this team, and yes, there have quite many issues and major issues are that they have small groups in team…the team can work independently, they are self-organized; however, they lack a strong leader or a manager in leading their work direction…In the graph, they have high centrality which would mean all of them are strong in their role but may lose the high-level picture, i.e., to align with team strategy [01:45:09-01:52:40].*"

Lastly, as seen by the managers' supervisor, team cohesion reflects positive a work atmosphere, i.e., the team members are cheerful, always laugh and have lots of fun with others. He reviewed that "*In comparing team cohesion, R04's result also make sense as actually they are quite more cohesive than R03. Also, both are also quite loose if compared with R05 and R07. It is quite obvious as the team is so quiet. Members in R05 and R07 always talk loudly, chitchat and have fun in the team during the work. These teams are sitting nearby and at the same floor. I can see and compare. R04 is quiet. It would be because R04 is quite new for both the manager and team. They may need time to build relations. Not like R03 where members have experience but differing interests [01:38:42-01:40:16].*"

In summary, the high centrality members in the friendship network are joyful people who can make others laugh and have fun. The cut-point node is

important as being the core function of the team, i.e., if moving out will impact the work processes. The isolate node is the member who works independently based on their job function or personality. Teams with high team cohesion have a cheerful work atmosphere.

4.6 Summary

The researcher conducted three different analyses to examine the moderating effect of project manager centrality on team cohesion-performance relationship, which are 1) statistical analysis to test the hypothesis on the moderating effect of project manager centrality on the team cohesion-performance relationship in all teams, 2) social network analysis to examine the task-advice and friendship networks in the team to answer how the project manager centrality effects team cohesion and team performance in each team, and 3) qualitative content analysis on the interview data to examine the project manager characteristics as task-oriented and relationship-oriented leader characteristics to explain how the manager influences team cohesion and performance. Table 4.21 summarized the results.

Table 4.21 Summarized Results from Statistical Analysis, Social Network Analysis and Qualitative Content Analysis

	Project Manager Centrality in Task-Advice Network	Project Manager Centrality in Friendship Network
1. Statistical Analysis Results		
	Confirm Hypothesis 1. We found the moderating effect of the project manager centrality in task-advice network. With high centrality project manager, we could increase the effect of team cohesion on team performance approximately 8.4% from 53.2% to 61.6%.	Reject Hypothesis 2. We cannot find the moderating effect of the project manager centrality in friendship network on team cohesion-performance relationship.
2. Social Network Analysis Results		
	We found that, in high-performing teams, i.e., R03 and R07, the team members who are closed to their managers have rated high team cohesion and team performance. In low-performing teams, i.e., R06 and R08, there have subgroups formed	We cannot find that the members who are closed to the manager have rated high team cohesion and team performance. All teams in study except R03 and R05 team have subgroups of members who are less closed to the manager as friend.

	Project Manager Centrality in Task-Advice Network	Project Manager Centrality in Friendship Network
	between members who less closed to the manager and this prevents the managers to promote team cohesion to have positive effects on team performance.	
3. Qualitative Content Analysis Results		
	The high centrality project managers, i.e., R03 and R07 managers, share task-oriented leader characteristic. They focused on driving the works in team by planning, monitoring, clarifying and solving work-related operations. The managers suggested that as task advisor to many members, they are the connector who integrates members' different capabilities to effectively deliver the works. This allows them to promote work collaboration as a performance standard in team.	The high centrality project managers, i.e., R03, R05 and R07 managers, share relationship-oriented leader characteristic. They focused on developing relations with team by paying attentions to members' attitudes, supporting and empowering the members to learn new skills as well as recognizing the members on their work performance. The managers suggested that as a friend of many members, they are the connector to minimize conflicts and encourage work collaboration in team.

In summary, it is found that the project manager centrality in the task-advice network is a positive moderator on the team cohesion-performance relationship. The statistical analysis results support Hypothesis 1 that teams with high centrality project manager in task-advice network have a stronger positive effect of team cohesion-performance relationship than teams with low centrality project manager. The social network analysis results of each team also supports that, in high-performing teams, the high centrality project managers influence their close team members to rate high team cohesion and team performance. In contrast, in low-performing team, there are subgroups of members who have dense relations among them rather than with the manager. The subgroup is found in groups whose members rated the manager with a neutral score. Based on social influence theory, this explains why the manager has 2nd rank centrality in the team and has less influence on the team. The interview results also support that the high centrality project managers share task-oriented leader characteristics that focus on driving team performance. They focused on clarifying team performance standards, planning and monitoring

operations, and solving problems that block the team from achieving performance. As for the low centrality project managers, they participate less in the team due to work arrangements in the team.

The researcher cannot find the moderating effect of the project manager centrality in the friendship network on team the cohesion-performance relationship. Hypothesis 2 is rejected. The social network analysis also reports that almost all teams in the study have subgroups of members who are less close to the manager as a friend. It is only the interview results that the high centrality project managers share relationship-oriented leader characteristics. They paid attention to members' attitudes and provided support to their members to learn new skills to improve team performance. They focused on minimizing conflicts and encouraging work collaboration in the team.

The findings provided an understanding of how the high centrality project manager influences team cohesion-performance relationship as follows. First, the high centrality project manager in a task-advice network shares task-oriented leader characteristic that has behavior in focusing and driving the work results of the team (Casimir, 2001; DeLamater & Ward, 2013; Tabernero et al., 2009). Second, based on the social influence network theory (Friedkin, 1993; Friedkin & Johnsen, 2011), the high centrality project manager has a high influence on the members' perceptions and behavior. As found in the network analysis result that members who were closed to the manager has rated high team cohesion and team performance, the high centrality project manager, as having task-oriented leader characteristics, can influence the team's behavior to work actively and focus on team performance as the manager. Third, the high centrality project manager provides benefits to the team to integrate knowledge and expertise in the team to enhance the result of team collaborative effort, i.e., as measuring by team cohesion, to effect team performance. This is supported by the theoretical explanation from the information exchange perspective that the central actor benefits for internal work collaboration, knowledge integration and work direction (Bono & Anderson, 2005; Cross & Cummings, 2004; Salk & Brannen, 2000; Zhang & Peterson, 2011). Fourth, as trust is gained by many members as their

task advisor, the high centrality project manager can promote work collaboration as the performance standard in the team. The high centrality project manager in a task-advice network or task-oriented leader is more related to team performance than the high centrality project manager in the friendship network or relationship-oriented leader who builds interpersonal relations for the team to function over time (Balkundi & Harrison, 2006; Moran, 2005).

As a result, the high centrality project manager in a task-advice network plays an important role to motivate high team cohesion and team performance in the team. Being task advisor to many members provides benefits to the manager to promote work collaboration in the team. Centrality has an effect because the high centrality project manager can fully connect and integrate the team efforts, knowledge and capabilities to make the messy platform orchestrated.

CHAPTER V – FINDING AND CONCLUSION

5.1 Research Results and Key Findings

The research invited eight software development teams of 150 members in the offshore delivery center to be the subjects of the study, and conducted online surveys from May to June 2014 with three reminders at intervals of every two weeks. The research received responses from 136 members (91% response rate) from the survey, and interviewed six project managers and their supervisor from July to August 2014. The research completed data analysis in September 2014 and presented the research results to the company in October 2014.

The statistical analysis results support the 1st hypothesis. Teams with a high centrality project manager in task-advice network have a team cohesion-performance relationship as regression coefficient $B = .616$ ($p = .000 < .05$) stronger than $B = .532$ ($p = .000 < .05$) in teams with a low centrality project manager. This suggests that with a high centrality project manager, the team can increase the effect of team cohesion on team performance approximately 8.4% from 53.2% to 61.6%. However, the results do not provide support for the 2nd hypothesis on the project manager centrality in a friendship network.

For social network analysis, the results show that in teams with a high centrality project manager, team members who were close to the manager in a task-advice network rate high team cohesion and team performance with significant F-statistic values in Node-level ANOVA. Teams with a low centrality project manager have subgroups of members with significant chi-square χ^2 in ANOVA density model and Relational Contingency-Table analysis. The results support the 1st hypothesis by providing an explanation that the task-advice relationship strength between the project manager and members is associated with the team cohesion-performance relationship. The high centrality project manager in a task-advice network has a high influence on team cohesion and team performance. The low centrality project manager is embedded in the teams that have subgroups that prevent the manager from influencing

the team. In a friendship network, it was found that almost all teams have subgroups of members who are not close friends with the manager. The relationship strength between the manager and members does not relate to team cohesion and team performance. This suggests that the friendship relation is less explicit in teams to find support for the 2nd hypothesis.

The interview results provide explanations to the findings in both hypotheses. It reveals that the high centrality project managers in task-advice networks share task-oriented leader characteristics. They focus on clarifying team performance standards, planning and monitoring operations, and solving problems that block the team from achieving performance. They suggested that as task advisor to many members, they are the connector who integrates members' different capabilities to effectively deliver the task results. This allows them to promote work collaboration as a performance standard in the team. The low centrality project managers participate less in the teams due to work structures such as having transitioned their management role to another member to informally lead the team and the team is composed of different working groups.

For friendship networks, it is found that the high centrality project managers share relationship-oriented leader characteristics. They focus on developing relations with the team by paying attention to members' attitudes, supporting and empowering members to learn new skills as well as recognizing members on their work performance. They suggested that as a friend of many members, they are the moderator to minimize conflicts in the team. A high centrality project manager in a task-advice network or task-oriented leader is more connected to team performance than the high centrality project manager in a friendship network or relationship-oriented leader who builds interpersonal relationships for the team to function over time (Balkundi & Harrison, 2006; Moran, 2005).

By integrating the three analytical results, the study provides an answer to the research questions. First, the project manager centrality in a task-advice network has a moderating effect on the team cohesion-performance relationship. The teams

with a high centrality project manager as a task advisor, i.e., the manager had a high proportion of members who sought out for work-related advice, experienced a stronger team cohesion-performance relationship than the teams with a low centrality project manager. This may be because software development tasks are highly complex tasks that information exchanges and work collaboration among members are important. The high centrality project manager as a task advisor can help the teams to exchange work-related information and integrate their knowledge to have a clear work direction (Haythornthwaite, 1996). The high centrality project managers also share task-oriented leader characteristics to focus on work completion by establishing well-defined work processes and channels of communication, scheduling work to be done, setting and emphasizing deadlines, and motivating the teams to focus on work results (Casimir, 2001; DeLamater & Ward, 2013; Tabernero et al., 2009). Generally people seek advice from people they trust. The high centrality project manager gains trust from the team on the manager's work competency (R. Y. J. Chua et al., 2008). As the center of social influence (Friedkin, 1993), all these help the manager to influence the team to follow the manager's work direction to focus on accomplishing the task at hand and foster team cohesion to have a stronger positive effect on team performance.

Second, the moderating effect of project manager centrality in a task-advice network is more explicit. The research cannot find the effect of project manager centrality in a friendship network. Teams with a high centrality project manager in a friendship network not have different levels of team cohesion-performance relationship than teams with a low centrality project manager. This may be due to the fact that the research studies software development teams in the company that focuses on work delivery. It is found that the project manager centrality in a task-advice network is higher than in a friendship network. Also, the teams have higher network density in a task-advice network than in a friendship network. These suggest that the relations between the manager and the other members are mainly based on work, and the teams are formed and developed based on their work-related focus. As there are fewer friendship relationships in the team, the project manager centrality in the friendship network may be less detectable in this study.

Key Findings

There are three conclusions to be drawn from the results. First, the centrality of the project manager in the team's social network has an indirect effect on the team performance. Second, the teams with high centrality project manager in task-advice networks have a stronger positive team cohesion-performance relationship than the teams with low centrality project manager. Third, as generally people seek advice from people they trust, the high centrality project managers influence members' positive perceptions on team cohesion and team performance. The high centrality project managers in task-advice networks share task-oriented leader characteristics. A task-oriented leader focuses on work completion by establishing well-defined work processes and channels of communication, scheduling work to be done, setting and emphasizing deadlines, and motivating the teams to focus on work results (Casimir, 2001; Tabernero et al., 2009). In highly complex interdependent tasks such as software development where internal work collaboration is a key factor of team performance, the high centrality project manager plays an important role to fully integrate the team to make the messy platform orchestrated. As a result, the high centrality project manager in a task-advice network can foster team cohesion to have a stronger positive effect on team performance.

However, the research cannot find an effect of project manager centrality in the friendship network. Teams with high centrality project manager in friendship networks do not have different levels of team cohesion-performance relationship from teams with low centrality project manager. The high centrality project managers did not significantly influence members' perceptions on team cohesion and team performance. This may be because the software development teams in the study are mainly focused on delivering the work. The teams have higher network density in task-advice networks than in friendship networks. Also, all project managers have higher centrality in task-advice networks than in friendship networks, and it is found that almost all teams have subgroups of members who are not close friends with the manager. These suggest that the relations between the manager and members are mainly based on the work. The managers have less friendship relation with the team

to detect the effect of project manager centrality in the friendship network in this study. The rest of this chapter will discuss the theoretical contributions, implications and limitations of the research.

Theoretical Contributions

A key contribution of this dissertation is to extend the knowledge of the network centrality of the formal leader in the team and the team cohesion-performance relationship research. Specifically, the research provides knowledge to answer the research gaps summarized as follows.

First, in social network research on utility and constraint of network centrality (Kilduff & Brass, 2010), the dissertation attempts to resolve the opposite views on whether project manager centrality will provide positive or negative results to team performance. While past research had examined the association between the project manager centrality and team performance and found different results, the present research examines the indirect effect of project manager centrality and suggests that project manager centrality benefits the team in enhancing the effect of team cohesion on team performance. The findings extend the knowledge on utility of network centrality that project manager centrality also provides indirect benefit to the team.

Second, in team research on team cohesion-performance relationship (Mullen & Copper, 1994), past research had studied team members and their interpersonal relations as a key predictor of team performance. The present research considers the project manager who is the formal leader in charge of team performance and examines the effect of the project manager's interpersonal relationship with the team. Unlike other studies, the research in this dissertation adopts social network analysis to provide knowledge that the task-advice relation between the manager and team is important. The project manager who has a close relationship with many members as the task advisor can influence the members' positive perception on team cohesion and team performance. The findings extend the knowledge in the team

research that the project manager centrality in the task-advice network is a positive moderator on the team cohesion-performance relationship. Teams with high centrality project manager as task advisor have stronger team cohesion-performance relationship than teams with low centrality project manager.

Third, in research on the team's social network structures, there remains a lack of empirical study to explain the moderating effect of project manager centrality on the team's cohesion-performance relationship since the model was proposed based on meta-analysis (Balkundi & Harrison, 2006). The dissertation conducts an empirical study in software development teams and adopts knowledge from the information exchange perspective (Haythornthwaite, 1996), social influence network theories (Friedkin, 1993) and task-oriented and relationship-oriented leader characteristics (Casimir, 2001; Tabernero et al., 2009). The research results provide an integrated knowledge that: in teams that worked on highly complex interdependent tasks such as software development, the formal team leader such as project manager who develops task-advice relations with many members plays an important role in connecting and integrating different members' capabilities and makes the messy platform orchestrated. The centrality has an effect because 1) the high centrality project manager can have more accesses to work-related information and technical knowledge from different members which helps the manager to provide appropriate work solutions and directions to minimize task difficulties, 2) the high centrality project manager in a task-advice network shares task-oriented leader characteristics to motivate the team to focus on work completion, and 3) gains trust from many members as the high centrality project manager can fully influence the team to work more collaboratively although the members are different, e.g., in work capabilities and personalities.

To conclude, the dissertation contributes knowledge that the centrality of the project manager in the team's task-advice network is a performance-linking pin to integrate different members to enhance team cohesion to have a stronger positive effect on team performance. The high centrality project manager benefits the team in

managing the messy platform of highly complex interdependent tasks and interpersonal relations in the team to gain higher team performance.

Originality of Study

A long range of social network research and team research has provided a general prediction of team performance concerning interpersonal relations among team members such as team cohesion (Kozlowski & Bell, 2003; Mullen & Copper, 1994) and between the team leader and team members such as the leader's network centrality (Balkundi et al., 2011; Brass & Krackhardt, 1999; Kilduff & Brass, 2010; Mehra, Dixon, et al., 2006). What was neglected until now would be the intersection of the two research areas, specifically whether the network position of the formal team leader, i.e., the project manager, relates and influences team cohesion-performance relationship in the team. This dissertation initiates the idea to examine the effect of project manager centrality by building on the core social network concept of utility of network centrality (Kilduff & Brass, 2010): first, the research retains the key network idea of in-degree centrality, i.e., the proportion of team members who nominated the project manager as their task advisor and friend, relates to how the manager gains more knowledge and trust from the team and is a prominent actor to motivate the team to work collaboratively and attain the team performance target. The project manager centrality tends to benefit the team. Second, the research examines the project manager centrality in task-advice and friendship networks which are two common interpersonal networks in teams that are used to explain the team outcomes.

However, there are key differences between the past research and the study in this dissertation. First, whereas past studies examined the centrality values in association with team performance, the present research applies panel analysis to examine the effect of project manager centrality on whether the team under the high centrality project manager has different perceptions from the team under the low centrality project manager in the rating of their personal bonding to the team and team performance. As project manager centrality relates to leader influence, the separation of the low and the high centrality project managers allows the researcher to apply a

quantitative study with a social network analysis and a qualitative interview to explain the effect of project manager centrality both in the integrated picture and in-depth, i.e., inside the specific case of each team. The research design increases our confidence in the findings. The data and findings came from different sources and reviewed with different perspectives, i.e., from managers and their supervisor who had different but intensive experiences with the teams, to avoid biases from single-source data and researcher's perceptions to interpret the data with personal beliefs. As in many social network research, the collection of the network data with the higher response rates provided more in-depth information of the interpersonal relations in the team.

Second, the software development teams in this study are unique and different from other teams and organizations. Research in software development teams is important as the teams and work processes are changing rapidly from a common team-task structure of a waterfall model to a network structure of socio-technical integration, i.e., integrating social and technical aspects into a network of knowledge workers, as in agile method (Sawyer, 2004). The team performance highly depends on the network performance of interpersonal relations that bonds the team (Churchville, 2008; Sawyer, 2004). Indeed, software development is a knowledge-driven business that relies on expertise integration to create the finished product (Faraj & Sproull, 2000; Ryan & O'Connor, 2013; Tiwana & Mclean, 2003). Given the importance of social network analysis that is required of team studies, the dissertation and findings are aligned with the current trend and are appropriate (Quintane, Pattison, Robins, & Mol, 2013; Sudhakar et al., 2011).

Third, as "most people can articulate an intuitive notion of centrality. They might suggest that the leader is at the center of the group, have access to all the other positions, or that the other positions are dependent on the leader" (Brass & Krackhardt, 1999, p.183). Recent research have attempted to integrate the centrality of the formal leader to the leadership behavior and team performance (Balkundi et al., 2009; Balkundi et al., 2011; Bono & Anderson, 2005; Mehra, Dixon, et al., 2006); however, they remain limited in integrating the social network and team research.

This dissertation acknowledges and extends this literature by examining the effect of the project manager centrality to enhance team cohesion-performance effect in the manager's team (Balkundi & Harrison, 2006).

Business Implications

The findings in this dissertation also address four key ideas in team management. First, there has been a long debate on whether the manager should be centralized or decentralized in the team to manage team performance. The findings in this research suggest that being at the center in the team's social network provides benefits to the extent that the manager does not get overly involved and discourage the team. This is due to the fact that there is a concept difference between interpersonal relation and social interaction in that social interaction is a temporal element in the definition of interpersonal relation (Marsden, 1990). Having effective social interaction builds trust and creates positive interpersonal relations (R. Y. J. Chua et al., 2008). The high centrality project manager in a task-advice network shares task-oriented leader characteristic to focus on work and is strong in technical skills to develop cognitive-based trust on the manager's work competency, rather than being the person who simply has intensive participation with team. Broadly speaking, the high centrality project manager is the person who gains trust from the team to seek advices and follow the work direction. To be involved everywhere rather than in everything is the responsibility of the manager; the manager presents a valued benefit to the team. A trustful manager lies in the center to manage effective information exchanges and work collaboration which enables a cohesive team to result in higher team performance.

The second idea rests on the question whether the manager should be friends or purely task advisors. This research cannot find support for project manager centrality in friendship networks on whether it could foster a team cohesion-performance relationship. The result is similar to other studies that as having a formal role and authority, the project manager has high centrality in the task-advice network and it is able to detect the effect of the project manager centrality on team

performance (Salk & Brannen, 2000). However, it shall not directly conclude that the high centrality project manager in a friendship network has no effect on team performance and the manager should not develop friendship relation with the team, i.e., as suggested in some literature (Dobbins & Russell, 1986; Taylor, Hanlon, & Boyd, 1992). It may simply be because the team rarely sees the manager as a friend, and the friendship relation is less inherent and it is harder to detect the effect in the work-related context (Saint-Charles & Mongeau, 2009). However, one interesting finding is the characteristic of the R05 manager who has friendship centrality as the 1st rank in her team. She shares the relationship-oriented leader characteristic. She paid attention to the interpersonal relations between members in her team and managed the conflicts among the members. She may have some effects on team cohesion-performance relationship (Mehra, Dixon, et al., 2006).

The third idea is that based on the formal role and authority, generally the manager should have high centrality comparing to members in the team. However, the finding suggested that not all managers have centrality as the 1st rank in their team, and in some condition the high centrality project manager may not have a high-performing team. There would be other factors controlling the effect of project manager centrality such as in the social network analysis results in the R01, R06 and R08 teams that when the team has other members with high centrality and cohesive subgroups, it is hard for the manager to influence team performance. As explained by the social influence network theories (Friedkin, 1993), teams in such situations have other prominent actors and subgroups that also influence work directions in the team. The interview results also found that the R01 and R06 managers have transitioned their management role to a member to informally lead the team, i.e., N#6 and N#9 who have the highest centrality in the task-advice network in the team. The result would only imply that the low centrality project manager has less influence to motivate team performance (Friedkin & Johnsen, 2011; Salk & Brannen, 2000).

The fourth idea rests on the question of what aspect and priority that the managers shall be concerned with to improve interpersonal relations in the team to

have major effects on team performance. The research results would suggest the following actions for the managers to consider:

1) Develop team cohesion by improving interpersonal relations among team members as it contributes to approximately 50% of team performance. As team cohesion relates to members' shared characteristics and similarity (McPherson et al., 2001), the manager shall set up the team with similar personalities and conduct team building activities to minimize gaps among members.

2) Develop interpersonal relations with teams through providing task-advice and improve technical skills to provide effective work solutions and directions as it enhances internal work collaboration and team performance by approximately 10%. The manager may develop close relations with the team by building trust-based relationships and adopting some research studies such as the social style framework (Bolton & Bolton, 1984, 2009; Merrill & Reid, 1981).

3) Keep monitor of and manage task-advice and friendship relations among members in the team. Relationship management is the secret weapon for the successful project manager to minimize subgroups, improve work collaboration and influence team performance (Brass & Krackhardt, 1999; R. Y. J. Chua et al., 2008).

4) It would be useful for managers to adopt social network analysis as a tool to collect and analyze webs of interpersonal relations in the team. It may provide some insight, e.g., subgroups in the team, for the manager to find out and improve the team's internal collaborations, process and structure.

5.2 Limitations and Future Research

Clearly this dissertation has limitations. First, the lack of findings on the effects of project manager centrality in friendship networks (Hypothesis 2). It may be due to the fact that the teams and organization in the study are a business organization

where collaborations are based on a work-role structure rather than friendship-based structure such as in charity and volunteer work. These teams focus on formal work arrangements. Although they have adaptive structure, i.e., from adopting an agile method, the interpersonal relations that govern the team remain task-oriented rather than friendship-oriented. The friendship relation 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, & Chen, 2008; Liu & Iyer, 2007). Although the open source software project teams may have no formal leader, i.e., a project manager, future research may consider the effect of centrality of informal leaders on the team cohesion-performance relationship.

The second limitation is that the study is focused on software development teams in a business company. The data is limited to only eight teams and has project manager centrality in task-advice network more than .500 rather than a full range as .000 to 1.000. The finding is limited in its data to use comparison group analysis to classify the low and the high centrality project managers rather than to use benchmark values of project manager centrality. Future research may consider other study contexts to have a full range of project manager centrality values to find what centrality value the manager does to effect the team as well as its predictive power.

The third limitation is the lack of information on the team members' personal characteristics to consider whether they are similar to their manager. Although the dissertation is developed based on the assumption that the homophily and social selection theories are the key theories to explain the cohesion in the team, i.e., members who share similar characteristics such as beliefs and personalities tend to develop relations with each other as well as the partner of relations tend to develop similarities (McPherson et al., 2001), there remains a lack of findings as to whether the high centrality project managers select members to their team based on their similarities, and if similarity is a predictor for the manager to be central in the team and links the member to behave like the manager. It is possible that in fact the manager has high centrality in the team of members who are hard-working as the manager, and with hard-working similarity, team are cohesive and have high

performance. As "similarity breeds connections" (McPherson et al., 2001, p.415), future research may measure personality trait factors as a control factor on team cohesion and project manager centrality to re-examine the effect. This may extend the past research, e.g., to link the five-factor model of personality as an antecedent of individual centrality (Klein et al., 2004).

As a wise man says one research generates only small knowledge and many interesting questions, this research shares the same dilemma. Although it is found that the high centrality project manager has a strong effect of team cohesion on team performance, the challenging question is: how to develop interpersonal relations in the team and whether other study context shares the similar findings. As we are developing a theory that explains a project manager's network position and their implications, it is also important to understand why some managers are in the central position whereas others remain less central in the team. Are there a process and methodology for the manager to build interpersonal relations in team? Are there some leadership development tools and training for the manager to develop interpersonal relations in team and manage team results more effectively? Also, as team structure changes rapidly to a network of knowledge workers, how to study the dynamic network of team performance? In distributed and larger teams, certainly the manager is less central and is allocating the management role to groups of senior members or informal leaders who shall have more closed relations with the team, whether the in-degree centrality of the informal leader and another centrality, e.g., in-between centrality in measuring the bridging connection of the manager, interact with one another to predict team performance? Previous research has found a distributed-coordinated team structure (Mehra, Smith, Dixon, & Robertson, 2006); however, these remain unanswered questions to study.

5.3 Conclusion

This study provides insight about the network position of the project manager in a team's social network and team performance. It provides a theoretical explanation and findings that the high centrality project manager enhances the effect

of team cohesion on team performance. Given a long range of research on team cohesion and social network in the team, with emphasis on team performance, the study is timely and relevant. Unlike other studies, this dissertation seeks to integrate the findings in the social network and the team research to suggest that as interpersonal relations become prevalent in today's management, the manager needs to capitalize on the benefits of the relations to improve the team process and performance. The study here takes the first step in understanding these processes.

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APPENDIX

Appendix A – Summary List of Key Literatures

A-1 – Centrality and Performance

The literature summary is ordered by the publication year.

Author (s)	Findings	Effects/ Relation-ships	Independent Variables	Dependent Variables	Context Variables
Brass, 1984	<u>Centrality provides structural sources of power</u> - Centrality in workflow, communication, and friendship networks related to power (perceptions of influence and to get promoted). - Excepts liaison and communicator roles, which are not considered influential.	Association	Ind.Centra-lity	Ind.Power	-
Mullen et al., 1991	<u>Centrality indicates Leader</u> - Central actor in communication network is seen as leader of the group.	Association	Ind.Centra-lity	Perceived as a Leader	Channel of Communi-cation, Information Type
Brass & Burkhar dt, 1993	<u>Centrality and influence strategies each mediated the other in relation to power</u> - In-degree centrality in workflow network has strong independent effects on power (perception of influence). - Betweenness centrality not relates to power in team, but has interaction effects on power through upward org.position. - Closeness centrality has indirect effects on Power through the use of behavioral tactics.	Direct effect, Interac-tion, Media-tion	Ind.Centra-lity (in Team and with Upward Org. Position)	Ind.Power	-

Author (s)	Findings	Effects/ Relation-ships	Independent Variables	Dependent Variables	Context Variables
Ibarra, 1993a	<u>Centrality mediates relationships between Ind.Charateristics and Innovation Involvement</u> - Central in five networks (communication, advice, support, influence, and friendship) mediates the effects of individual attributes and formal position on innovation involvement. - Central in task-advice network is found related to innovation involvement than central in friendship network.	Media-tion	Ind.Charac-teristics (Formal Position in Org)	Innovation Involvement	Professional Activity, Prestige, Tenure, Education
Gargiulo & Benassi, 2000	<u>Central Leader has more failures in managing coordination, communication and workloads</u> - Centrality has negative effect on project manager's ability in managing the team. - Centrality incurred negative performance results; the effect remains strong although the effect of strength/ weakness relations was statistically controlled.	Associa-tion (Negative)	Mgr.Centra-lity	Management Performance	-
Salk & Brannen, 2000	<u>Centrality relates to Individual Influence</u> - Central in task-advice network is found significantly related to individual influence (speed and efficiency of decision making, and consensus) in shaping team performance. Centrality has higher positive relationship with individual influence than Formal Position, Work Function and Nationality.	Associa-tion	Ind.Centra-lity, Formal Position, Work Function, Nationality (Japanese vs. German Managers), Orientation to Local Norms	Ind.Influence	Tenure

Author (s)	Findings	Effects/ Relation-ships	Indepen-dent Variables	Dependent Variables	Context Variables
	- In-degree and Betweenness Centrality are highly correlated.				
Mehra et al., 2001	<u>Centrality mediate the relationships between Self-Monitoring Behavior and Ind.Work Performance</u> - High self-monitors tends to occupy central betweenness position in friendship and workflow network and tends to have high performance.	Media-tion	Ind.Persona-lity (Self-Monitoring)	Ind.Perfor-mance	Rank, Tenure, Sex.
Sparrowe et al., 2001	<u>Centrality relates to Individual and Team Performance</u> - In-degree centrality in advice network positively related to ratings of individual performance. - At group level, centralization in hindrance network (difficult to work with others) did not negatively relate to team performance.	Associa-tion	Ind.Centra-lity, and Network Centraliza-tion	Ind.Perfor-mance and Team Performance	Organization Differences
Ahuja et al., 2003	<u>Centrality mediates the relationships between Ind.Work Role and Performance</u> - Degree centrality in communication network mediates the influence of functional role on individual performance in virtual team.	Media-tion	Ind.Work Role Characteri stics	Ind.Perform ance	-
Cross & Cummin gs, 2004	<u>Centrality relates to Individual Performance</u> - Centrality of boundary spanner in information and knowledge awareness network relates to performance in knowledge intensive work.	Associa-tion	Ind.Centra-lity	Ind.Perfor-mance	Tenure, Hierarchy, Gender, and Network Correlation

Author (s)	Findings	Effects/ Relatio n-ships	Indepen- dent Variables	Dependent Variables	Context Variables
Gibbons , 2004	<u>Centrality relates to Professional Value</u> - Central in task-advice and friendship networks played a significant role in shaping individuals' professional values. - Task advice network functions as a stabilizer of professional values and the friendship network functions as a catalyst for change. - Managerial implications - managers who want to build on existing beliefs may safely rely on existing advice relations, but managers who seek to champion cultural change themselves should first establish trusting, friendly relations with people in their organization.	Associa-tion	Ind.Centra-lity	Ind.Professio nal Value	Size, Network Density, Organization Gender Composition
Neubert & Taggar, 2004	<u>Centrality indicates Leader</u> - Centrality in task-advice and friendship networks refers to person who actively gives information to others on how to carry out the works and supportive on personal well-being. - Central actor (measured by degree centrality) in task-advice and friendship networks is seen as leader. - Men with high-level of network centrality was seen as leader than women.	Associa-tion	Ind.Centra-lity, Personality character-ristics	Perceived as a Leader	Task Interdepen-dence, Team Gender, Individual Differences (Age, Education Level, Tenure)
Bono & Anderso n, 2005	<u>Centrality relates to Transformational Leadership Behavior</u> - Managers who score higher on transformational leadership tend to hold more central positions in	Associa-tion	Mgr.Centra-lity	Leadership Behaviors	Tenure, Age, Gender and Hierarchical Level

Author (s)	Findings	Effects/ Relation-ships	Indepen-dent Variables	Dependent Variables	Context Variables
	organizational advice and influence networks.				
Moran, 2005	<u>Centrality relates to Trust which influence Performance</u> - Central project manager in task-advice, friendship and idea-generation network is trustful, and have Innovative Performance. - Manager central in closed network has higher Sales Performance.	Associa-tion	Mgr.Centra-lity	Managerial Performance	Demogra-phic: Age, Gender, Education Level, Tenure, # of Direct Formal Reports
Balkund i & Harrison , 2006	<u>Centrality relates to Team Performance</u> - Team's formal leader with in-degree centrality in team's task-advice and friendship networks is found having high team performance. - Team Density relates to team performance.	Modera-tion	Mgr.Centra-lity, and Team Structure	Team Performance	-
Hossain et al., 2006; Hossain & Wu, 2009; Hossain, 2009a, 2009b	<u>Centrality indicates coordinating behavior</u> - Centrality in e-Mail communication network relates to inter-project coordinator.	Associa-tion	Ind.Centra-lity	Coordina-ting Behavior	-
Mehra, Dixon, et al., 2006	<u>Centrality relates to Team Performance</u> - Team with formal leader central in leader's friendship network has high team performance and leader's reputation. - However, team with formal leader central in team's friendship network is only partially related to team performance.	Associa-tion	Mgr.Centra-lity	Team Performance and Leader Reputation	Sales Territory

Author (s)	Findings	Effects/ Relation-ships	Independent Variables	Dependent Variables	Context Variables
Pappas & Wooldridge, 2007	Centrality relates to development of New Ideas and Strategic Integration - Manager with degree centrality in communication network influence developing new ideas into strategic initiatives; Eigenvector has indirect influence on strategic reintegration.	Association	Mgr.Centra-lity	Divergent Strategic Influence	Tenure, Age, Hierarchical level
Kratzer et al., 2008; Kratzer et al., 2010	Centrality relates to Team Creativity - Team leader with very-high degree centrality in four networks (workflow, problem-solving, knowledge awareness, external communication) has found negatively relate to team creativity.	Association (Negative)	Mgr.Centra-lity	Team Creativity	Cross Nationality, Team Member's Boundary Spanning Capacity, Density, Team Tenure, Network Density
Balkundi et al., 2009	Centrality is mediated by Team Conflict in influencing Team Viability - In-degree centrality in task-advice network (ref as Leader Prestige) has positive effect on team viability. In contrast, betweenness centrality (ref as Leader Brokerage) has negative effect. Both centralities are mediated by Team Conflict. Note: This research used bootstrap method rather than Baron & Kenny (1986) approach and Sobel's test on testing mediation.	Media-tion	Mgr.Centra-lity	Team Conflict, Team Viability	Ethnic diversity, Leader's race

Author (s)	Findings	Effects/ Relation-ships	Independ-ent Variables	Dependent Variables	Context Variables
Smedlund & Choi, 2009	<u>Centrality interacts with Ind.Role to effect Performance</u> - Centrality predicts performance depending on the employee's role. Employees who are in a non-routine role benefit from centrality in task-advice network more than employees in a routine role.	Interac-tion	Ind.Centra-lity, Task Type	Ind.Perfor-mance	Tenure, Gender, Education level, Language skills and Formal role
Teigland & Wasko, 2009	<u>Centrality not relates to Individual Performance</u> - Degree centrality in task-advice network refer individual who tends to have highly access to useful knowledge. However, centrality is independent from intrinsic motivation. Individual who more intrinsic motivated is found having a higher performance, although they are not in central position in advice network.	Direct effect	Ind.Centra-lity, Intrinsic Motiva-tions	Ind.Perfor-mance	Organization position, tenure, professional experience
Xia, Yuan, & Gay, 2009	<u>Centrality highly relates to Performance than Personality</u> - Centrality actor in adversarial network (refer to individuals who highly disliked by others) has low performance rating, although they are conscientiousness, emotional stability, and openness to experiences.	Interac-tion	Ind.Centra-lity, Personality	Ind.Perfor-mance	Work experience and group size
Y. H. Lee, Yang, Wan, & Chan, 2010	<u>Centrality interacts with Personality to effect Performance</u> - In-degree centrality in friendship network has an interaction effect with conscientiousness personality in influencing	Interac-tion	Ind.Centra-lity, Personality	Ind.Perfor-mance	Age, Gender, Marriage, Education

Author (s)	Findings	Effects/ Relation-ships	Indepen-dent Variables	Dependent Variables	Context Variables
	performance. Highly careful persons who also well-connected with their friends tend to have higher performance.				
Moolenaar, Daly, & Sleegers, 2010	Centrality mediates the relationship between Transformational Leadership Behavior and Innovative Climate - Centrality in task-advice and friendship networks was found as a mediator on the relationship between transformational leadership and innovative climate.	Media-tion	Ind.Centra-lity, and Transfor-mational Leadership Behavior	Innovative Climate	Demo-graphic
Balkundi et al., 2011,	Centrality relates to Leader Charisma in effecting Team Performance - Leaders with degree centrality in task-advice network were seen as charismatic by their team, and this charisma was associated with high team performance	Media-tion	Mgr.Centra-lity, and Charismatic Leadership Behavior	Team Performance	Network Size, Leader Gender, Site, Leader Effective-ness
Rhee & Ji, 2011	Centrality has higher effect on Performance than Absorptive Capacity - Centrality (Degree, Betweenness and Closeness) in advice, influence and idea network has positive effects on managerial and innovative performance. Absorptive capacity had a positive effect on performance; however, less significant than centrality.	Direct effect	Ind.Centra-lity, Absorptive Capacity	Ind.Perfor-mance	Gender, Age, Rank and Firm size
Saonee, Manju, Suprateek, & Kirkeby, 2011	Centrality is mediated by Trust in influencing Individual Performance - Actor with high degree centrality in communication and	Media-tion	Ind.Centra-lity, Perceived Trust	Ind.Perfor-mance	Gender, Work Location, IS Ability, Team size

Author (s)	Findings	Effects/ Relation-ships	Indepen-dent Variables	Dependent Variables	Context Variables
	friendship network is being trust by others. Trusted actor has high performance.				
Sutanto et al., 2011	<u>Centrality indicates Leader</u> - Centrality in communication network is predictor of perceived as a leader in virtual team. Closeness centrality is found less significant than degree and betweenness.	Associa-tion	Ind.Centra-lity	Perceived as a Leader	Demograph ic, Type of Social Software Sys
Tashiro, Lau, Mori, Fujii, & Kajikaw a, 2011	<u>Centrality relates to Management Performance</u> - Manager with in-degree and betweenness centrality in e-Mail communication network is found positively relate to management performance.	Associa-tion	Mgr.Centra-lity	Management Performance	Age, Recruiting, Academic Status, Years of Service
Zhang & Peterson , 2011	<u>Centrality reflects Transformational Leadership in influencing Team Cohesion to effect Team Performance</u> - Leader with transformational leadership behavior influence team cohesion (measured as network cohesion) in effecting team performance. - Team with Dense Network (having well-connected among members or mean values of # relationships is high) has higher performance when Team Centralization (when network is concentrated around a small group of members or dispersion) is low.	Associa-tion	Mgr.Centra-lity, Network Cohesion	Team Performance	Team Size, Tenure, Prior Team Perfor-mance
Burton, Yu, Prybuto k, & Harden,	<u>Centrality not relate to Individual Performance</u> - Actor with high degree centrality in work support and hindrance network is	No Relation	Ind.Centra-lity	Ind.Perfor-mance	Age, Tenure, Job Grade

Author (s)	Findings	Effects/ Relation-ships	Indepen-dent Variables	Dependent Variables	Context Variables
2012	found not significantly relate to performance; but the network constraint (a measurement of tie diversity or structural hole) is more related to performance.				
Cadima, Ojeda, & Monguet, 2012	<u>Centrality relate to Individual Performance</u> - Centrality (degree, betweenness, closeness) in distributed learning communities is found significantly related to performance.	Associa-tion	Ind.Centra-lity	Ind.Perfor-mance	-
Chen & Li, 2012	<u>Centrality indicates Opinion Leader</u> - Centrality in four networks (job counseling, affective, intelligence and trust network) indicates leading users and opinion leaders.	Associa-tion	Ind.Centra lity	Perceived of Leading User and Opinion Leader	-
S. H. Lee, 2012	<u>Centrality and Information Seeking Behavior is mediated by Social and Personal Power</u> - Degree centrality in friendship network relates to individual extensive information seeking behavior. - Social and personal power mediates the relationship between centrality and information seeking behavior.	Associa-tion	Ind.Centra-lity, Social and Personal Power	Information seeking behavior	Gender, Age, Race, Materialism and Consumer needs
Wei-Li et al., 2012	<u>Centrality mediates Trust and Individual Performance</u> - In-degree centrality in knowledge sharing network mediates the relationship between Perceived Trust and Work Performance. Also, centrality (in-degree and closeness) has main effects	Media-tion	Ind.Centra-lity, Perceived Trust	Ind.Perfor-mance	Gender, Age, Education, Seniority

Author (s)	Findings	Effects/ Relation-ships	Independent Variables	Dependent Variables	Context Variables
	on performance.				
Carboni & Ehrlich, 2013	<u>Centrality interacts with Tenure to effect Performance</u> - Centrality (degree and betweenness) in communication network has no significant main effect on performance. However, it has an interaction effect with Tenure on Performance.	Interac-tion	Ind.Centra-lity, Tenure	Ind.Perfor-mance	Gender, Team Leader Position, Perceived Competence, Network Density, Team Size

A-2 – Team Cohesion and Team Performance

The literature summary is ordered by the publication year.

Author (s)	Findings	Effects/ Relation-ships	Independent Variables	Dependent Variables	Context Variables
Mullen & Copper, 1994	<u>Team Cohesion (psychometric measure) positively relates to Team Performance</u> - Team cohesion positive relates to team performance. - Team cohesion is measured as three-facets: task commitment, interpersonal attraction and group pride. The cohesiveness-performance is due primarily to task commitment rather than interpersonal attraction and group pride. - The direct effect might also be from performance to cohesiveness rather than from cohesiveness to performance.	Associa-tion	Team Cohesion	Team Performance	Team Size, Degree of Interaction, Real/Exper iment Team

Author (s)	Findings	Effects/ Relation -ships	Indepen- dent Variables	Dependent Variables	Context Variables
Gully et al., 1995	<u>Team Cohesion (psychometric measure) has direct effect on Team Performance</u> - Team cohesion has positive direct effect on team performance. - The effect of team cohesion on team performance is stronger when team is working on task interdependence, i.e., team have to coordinate their knowledge, skills and efforts in complex and highly interdependent workflows. - The effect at team-level is stronger than individual-level, i.e., team cohesion is highly effect team performance than individual performance.	Direct effect	Team Cohesion	Team Performance	Team Size
Carless & De Paola, 2000	<u>Team Cohesion (psychometric measure) has direct effect on Team Performance</u> - Team cohesion positive relates to team performance. - Team cohesion is measured based on 18-items GEQ (Group Environment Questionnaire) and confirm to have three-facets: task cohesion, social cohesion and individual attraction to the group. The convergent and discriminant validity is tested with other team outcome variables, e.g., team effectiveness and job satisfaction. - The cohesiveness-performance is due primarily to task cohesion	Associa-tion	Team Cohesion	Team Performance	Work-Group Characteris -tics

Author (s)	Findings	Effects/ Relation -ships	Indepen- dent Variables	Dependent Variables	Context Variables
	rather than social cohesion and individual attraction to the group.				
Beal et al., 2003	Team Cohesion (psychometric measure) has direct effect on Team Performance - Team cohesion has positive direct effect on team performance. - Team performance is measured as two-facets: efficiency (performance behavior) and effectiveness (performance outcome). The cohesiveness-performance is mainly found in efficiency rather than effectiveness. - All three-facets of team cohesion are significant.	Direct effect	Team Cohesion	Team Performance	Team Size
Forreste r Jr & Tashchi an, 2006	Team Cohesion (psychometric measure) is significant predictor for Team Performance - Task cohesion positive relates to team performance (team effort, effectiveness and work satisfaction). Social cohesion positively relates to only work effectiveness.	Associa- tion	Team Cohesion (Social Cohesion & Task Cohesion)	Team Performance	Age, Attitudinal & Motivation al Styles, Team Size
Mach et al., 2010	Team Cohesion (psychometric measure) mediates Trust in effecting Team Performance - High trust in team leads to team cohesion, and high team cohesion leads to team performance. - Also, the paper found alternate model that the trustful leader develops cohesion in team which influences team members to trust each other, and these effects team	Media- tion	Team Cohesion, Trust	Team Performance	Demogra- phic, Past Perfor- mance

Author (s)	Findings	Effects/ Relation -ships	Indepen- dent Variables	Dependent Variables	Context Variables
	performance.				

A-3 – Antecedent to Individual Centrality and Interpersonal Relations in Team

The literature summary is ordered by the publication year.

Author (s)	Findings	Effects/ Relation -ships	Indepen- dent Variables	Dependent Variables	Context Variables
Klein et al., 2004	<u>Individuals' Personality influence their acquisition of central positions in their teams' social networks</u> - Individuals who were highly educated, low in neuroticism and activity preference became high in advice and friendship centrality. Also, team members' values similarity to their teammates also predicted advice and friendship centrality, i.e., homophily. - Individuals who were high agreeableness became high in friendship centrality. - The effects of demographic or surface similarity are inconsistent and may be overshadowed the effects of deep similarity in values and attitudes. Personality characteristics are significantly related to adversarial centrality.	Associa- tion	Persona- lity (IPIP), Values, Demo- graphic Charac- teristics	Ind.Central- ity	Team size
Casciaro & Lobo, 2008	<u>Interpersonal Affect interacts with Personal Competence to effect Task-Advice Relationships</u> - Personal Competence may be irrelevant when being dislike. Team members appear to seek out the task advice from	Interac- tion	Interper- sonal Affect, Personal Compe- tence	Presence of Task- Advice Relations	Homophi- lous Affiliations

Author (s)	Findings	Effects/ Relation -ships	Indepen- dent Variables	Dependent Variables	Context Variables
	work partner whom they like. - Affect strongly moderates competence whether the task interaction involves routine advice or creative problem solving. - Affect's moderation of competence was particularly striking when affect was measured as liking someone personally. Measuring interpersonal affect in terms of liking and disliking someone as a person may therefore be preferable, on both conceptual and methodological grounds. Note: Bayesian approach is used in this paper to account for structural confounds as they emerge in a purely data-driven approach.				
R. Y. J. Chua et al., 2008	Trust is significant predictor on presence of Task-Advice and Friendship Relationships - Affect-based trust is significantly higher in the presence of friendship relationships while cognition-based trust is positively associated with the presence of a task-advice relationships.	Associa- tion	Cognition- and Affect- based Trust	Presence of Task- Advice and Friendship Relations	Network size, relationship duration, frequency of interaction, industry and job function

Appendix B – Summary List of Variables, Questions and Scales

Variables	Data Types	Questions	Measure-ment Scales	Data Coding
Dependent variable				
1. Team Performance				
Work performance (rated by team)[1]	Ordinal	(1) the project was done in a cost-efficient way (2) the project was done in a time-efficient way (3) the project was within schedule (4) the project was within budget.	4 questions, 5-point scales	1-strongly disagree to 5-strongly agree
Work quality (rated by team)[1]	Ordinal	(1) the project result was of high quality, (2) the team was satisfied with the project result, (3) the product proved to be stable in operation (4) the product proved to be robust in operation.	4 questions, 5-point scales	1-strongly disagree to 5-strongly agree
Independent variables				
2. Project Manager Centrality				
Centrality in task-advice network	Interval	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?	1 question, normalized in-degree centrality	value as relationship strength, no symmetrize.
Centrality in friendship network	Interval	Who are very good friends of yours, people whom you see socially outside of work?	1 question, normalized in-degree centrality	value as relationship strength, no symmetrize.
Relationship strength	Ordinal	How close is the relationship with each contact?	1 question per nominated names, 5-point scales	1-not close to 5-very close
3. Team Cohesion				
Interpersonal attraction	Interval	(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.	4 questions, 5-point scales	1-strongly disagree to 5-strongly agree
Task commitment	Interval	(1) it is important to the members of our team to be part of this project, (2) the team did not see anything special in this project [reverse score], (3) the team members are strongly attached, (4) this project is important to our team.	4 questions, 5-point scales	1-strongly disagree to 5-strongly agree

Variables	Data Types	Questions	Measure-ment Scales	Data Coding
Group pride	Interval	(1) the members of our team felt proud to be part of the team, (2) every team members felt responsible for maintaining and protecting the team.	2 questions, 5-point scales	1-strongly disagree to 5-strongly agree
Context variables				
4. Individual Characteristics				
Gender	Nominal	Gender	1 question, 2 values as 0 and 1	0-female, 1-male
Ages	Ratio	Ages	1 question, input value	no coding, value as input
Education level	Ordinal	Highest Education Level	1 question, 4 values as 1 to 4	0- lower than Bachelor's degree, 1-Bachelor's degree, 2-Master's degree, 3-Doctoral degree
Work experience	Ratio	Work Experience in Software Development	1 question, input value	no coding, value as input
Software development role	Ordinal	What is your primary role in this project?	1 question, 6 values as 1 to 6	1-developer, 2-business analyst, 3-tester, 4-system analyst, 5-project manager, 0-other
Full-time/Part-time working	Nominal	How did you involve in this project?	1 question, 2 values as 1 and 2	0-part-time working, 1-full-time working
Frequency talk to project manager	Ordinal	In this project, how often did you talk to the project manager about work-related matters?	1 question, 4 values as 1 to 4	0-seldom or never, 1-once a month, 2-once a week, 3-daily
Experience with team	Interval	How long did you work in this project?	1 question, 5-point scales	1-less than 7 months, 2-7 to 12 months, 3-13 to 18 months,

Variables	Data Types	Questions	Measure-ment Scales	Data Coding
				4-19 to 24 months, and 5-more than 24 months
5. Work Characteristics				
Task interdependence	Ordinal	Tasks performed by team members are closely related to one another.	1 question, 5-point scales	1-strongly disagree to 5-strongly agree
6. Team Characteristics				
Team size	Interval	Number of team members.	-	no coding, value as input
Team tenure	Interval	Calculate from mean values of 'Experience with team'.	-	no coding, value from 3.5 to 33.5 months.
Network density	Interval	Calculate from the proportion of actual nominations among the total possible number of nominations.	-	no coding, value from 0 to 1
Network centralization	Interval	Calculate from the sum of differences between the largest individual centrality and the other actual score divided by the maximum possible sum of differences.	-	no coding, value from 0 to 1
7. Project Manager's Charisma				
Project Manager's charisma	Ordinal	(1) the project manager shows determination in accomplishing goals, (2) every team members have complete confidence in the project manager, (3) the project manager makes people feel good to be around him/her, (4) the project manager communicates high performance expectations, (5) the project manager generates respect, (6) the project manager conveys a sense of mission, (7) the project manager provides a vision of what lies ahead.	7 questions, 5-point scales	1-strongly disagree to 5-strongly agree

Note:
[1]Team's rating performance is used as the requested objective measures are unavailable and problematic in some projects.

Appendix C – Questionnaire

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Social Network in Software Development Team

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งานวิจัยนี้เล็งเห็นถึงความสำคัญของโซเชียลเน็ตเวิร์กในทีมงานโครงการพัฒนาซอฟต์แวร์ของ
ท่าน โปรดให้ความอนุเคราะห์ในการตอบแบบสอบถาม โดยจะใช้เวลาประมาณ **15-20** นาที
โปรดตอบคำถามให้ครบทุกคำถามและส่งแบบสอบถามกลับภายใน   [วันที่]   คำตอบจาก
แบบสอบถามนี้ใช้เป็นข้อมูลเพื่อการวิจัยเท่านั้น กรุณาเข้าร่วมการตอบแบบสอบถามโดยเลือก
Begin the Questionnaire ด้านล่าง ผู้วิจัยหวังเป็นอย่างยิ่งว่าจะได้รับความอนุเคราะห์ข้อมูล
จากท่านด้วยดีและขอขอบคุณล่วงหน้ามา ณ โอกาสนี้

**This research addresses the importance of social networks in your software
development project team. Please participate in this research by completing the
online survey. It will take approximately 15-20 minutes to complete. Please
answer all the questions and return the survey by [Date]. All of your responses
will be used for academic research only. To participate, please click Begin the
Questionnaire below. The researcher hopes to receive your kind participation
and would like to thank you in advance for your time.**

ชื่อโครงการ *(Project Name)*	__< ชื่อโครงการตามที่ได้รับจากบริษัท >_____

Begin the Questionnaire

1) กรุณาเสนอชื่อสมาชิกในทีมของท่านที่ท่านพิจารณาว่ามีความสำคัญต่อการทำงานของท่านใน
โครงการนี้

(Please nominate your team's members who you considered important for your work in this project)

ใครคือแหล่งที่มาสำคัญของคำแนะนำอย่างมืออาชีพ ที่ท่านเข้าปรึกษาถ้าท่านมีปัญหาเกี่ยวกับการทำงาน หรือเมื่อท่านต้องการคำแนะนำเกี่ยวกับการตัดสินใจของท่าน *(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?)*					
รายชื่อ < รายชื่อสมาชิกในโครงการ >	*ระดับความสนิทสนม* *(how close is the relationship)*				
	ไม่สนิท (Not Close)			สนิทมาก (Very Close)	
☐ _<ชื่อ-นามสกุล >_____	1	2	3	4	5
☐ _<ชื่อ-นามสกุล >_____	1	2	3	4	5
☐ _<ชื่อ-นามสกุล >_____	1	2	3	4	5

ใครเป็นเพื่อนที่ดีมากของท่านที่ท่านสมาคมด้วยนอกเหนือจากเรื่องงาน *(Who are very good friends of yours, people whom you see socially outside of work?)*					
รายชื่อ < รายชื่อสมาชิกในโครงการ >	*ระดับความสนิทสนม* *(how close is the relationship)*				
	ไม่สนิท (Not Close)			สนิทมาก (Very Close)	
☐ _<ชื่อ-นามสกุล >_____	1	2	3	4	5
☐ _<ชื่อ-นามสกุล >_____	1	2	3	4	5
☐ _<ชื่อ-นามสกุล >_____	1	2	3	4	5

2) ท่านคิดเห็นอย่างไรเกี่ยวกับโครงการนี้
   What do you think about this project?

ความเห็นของท่านต่อโครงการ	ไม่เห็นด้วยอย่างยิ่ง (Strongly disagree)			เห็นด้วยอย่างยิ่ง (Strongly agree)	
กระบวนการทำงานภายในทีมมีความชัดเจนและตรงไปตรงมา *(Work flows among team members are clear and direct.)*	1	2	3	4	5
งานที่ทำในทีมมีความสัมพันธ์กันอย่างใกล้ชิด *(Tasks performed by team members are closely related to one another.)*	1	2	3	4	5
ทีมงานมีการประสานงานกันอย่างดี *(All members are fully incorporated in our team.)*	1	2	3	4	5
ผู้จัดการโครงการเข้าใจปัญหาและความต้องการของทีมเสมอ *(The project manager always understands the team's problems and needs.)*	1	2	3	4	5
ผู้จัดการโครงการช่วยแก้ปัญหาการทำงานของทีมเสมอ *(The project manager always helps the team solve problems in our work.)*	1	2	3	4	5
ทีมได้รับทรัพยากรที่เพียงพอและได้รับการสนับสนุนอย่างมีประสิทธิผลจากผู้จัดการเพื่อให้งานเสร็จ *(The team has sufficient resources and effective management supports to complete work.)*	1	2	3	4	5
ทีมได้รับการแจ้งให้ทราบถึงความคิดของโครงการ ความเชี่ยวชาญทางเทคนิค และการแก้ปัญหาจากผู้จัดการโครงการเสมอ *(The team always got informed of project ideas, technical expertise and solutions from the project manager)*	1	2	3	4	5
ผู้จัดการโครงการเป็นผู้นำที่มีประสิทธิภาพในการระบุปัญหา การแก้ไข และการดำเนินการตามแผนปฏิบัติการเสมอ *(The project manager effectively leads the team in identifying problems and solutions, and implementing action plans.)*	1	2	3	4	5

ความเห็นของท่านต่อโครงการ	ไม่เห็นด้วยอย่างยิ่ง (Strongly disagree)				เห็นด้วยอย่างยิ่ง (Strongly agree)
ทีมมีโอกาสที่จะโต้แย้งและปรับเปลี่ยนการแก้ปัญหา *(The team have chances to defend and justify solutions.)*	1	2	3	4	5
ความสัมพันธ์ในการทำงานกับผู้จัดการโครงการเป็นไปอย่างดีเยี่ยม *(Working relation with the project manager is extremely effective.)*	1	2	3	4	5
ผู้จัดการโครงการแสดงให้เห็นถึงความมุ่งมั่นเพื่อบรรลุเป้าหมาย *(The project manager shows determination in accomplishing goals)*	1	2	3	4	5
ทุกคนในทีมมีความมั่นใจในผู้จัดการโครงการ *(Every team members have complete confidence in the project manager)*	1	2	3	4	5
ผู้จัดการโครงการทำให้คนรู้สึกดีที่จะอยู่รอบเขา *(The project manager makes people feel good to be around him/her)*	1	2	3	4	5
การที่สมาชิกในทีมเป็นส่วนหนึ่งของโครงการนี้เป็นสิ่งที่สำคัญ *(It is important to the members of our team to be part of this project.)*	1	2	3	4	5
สมาชิกในทีมมีความเชื่อมโยงกันอย่างเหนียวแน่น *(The team members are strongly attached.)*	1	2	3	4	5
ทีมงานไม่เห็นอะไรพิเศษในโครงการนี้ *(The team did not see anything special in this project.)*	1	2	3	4	5
ผู้จัดการโครงการสื่อสารความคาดหวังให้การทำงานมีประสิทธิภาพสูง *(The project manager communicates high performance expectations)*	1	2	3	4	5
โครงการนี้มีความสำคัญต่อทีม *(This project is important to our team.)*	1	2	3	4	5
มีความขัดแย้งส่วนบุคคลมากมายภายในทีม *(There are many personal conflicts in our team.)*	1	2	3	4	5
มีความสนิทสนมระหว่างสมาชิกในทีม *(There is cohesion between the members of our team.)*	1	2	3	4	5

ความเห็นของท่านต่อโครงการ	ไม่เห็นด้วยอย่างยิ่ง (Strongly disagree)			เห็นด้วยอย่างยิ่ง (Strongly agree)	
ทีมงานรวมกันเป็นหนึ่ง *(Our team sticks together.)*	1	2	3	4	5
ผู้จัดการโครงการมีความน่าเคารพ *(The project manager generates respect)*	1	2	3	4	5
ผู้จัดการโครงการสื่อสารภารกิจ *(The project manager conveys a sense of mission)*	1	2	3	4	5
ผู้จัดการโครงการให้วิสัยทัศน์สำหรับอนาคต *(The project manager provides a vision of what lies ahead)*	1	2	3	4	5
สมาชิกในทีมรู้สึกภูมิใจที่ได้เป็นส่วนหนึ่งของทีม *(The members of our team felt proud to be part of the team.)*	1	2	3	4	5
ทุกคนในทีมรู้สึกรับผิดชอบในการรักษาและปกป้องทีม *(Every team member felt responsible for maintaining and protecting the team.)*	1	2	3	4	5
ผลงานของโครงการมีคุณภาพสูง *(The project result was of high quality.)*	1	2	3	4	5
ทีมพึงพอใจกับผลลัพธ์ของโครงการ *(The team was satisfied with the project result.)*	1	2	3	4	5
ผลิตภัณฑ์ (ซอฟต์แวร์) ได้รับการพิสูจน์ว่ามีเสถียรภาพในการดำเนินงาน *(The product proved to be stable in operation.)*	1	2	3	4	5
ผลิตภัณฑ์ (ซอฟต์แวร์) ได้รับการพิสูจน์ว่ามีความคงทนในการดำเนินงาน *(The product proved to be robust in operation.)*	1	2	3	4	5
โครงการได้ใช้งบประมาณอย่างมีประสิทธิภาพ *(The project was done in a cost-efficient way.)*	1	2	3	4	5
โครงการได้ใช้เวลาอย่างมีประสิทธิภาพ *(The project was done in a time-efficient way.)*	1	2	3	4	5
โครงการดำเนินงานได้ตามกำหนดเวลา *(The project was within schedule.)*	1	2	3	4	5
โครงการดำเนินงานได้ภายใต้งบประมาณที่ตั้งไว้ *(The project was within budget.)*	1	2	3	4	5

3) ข้อมูลทั่วไปของผู้ตอบแบบสอบถาม
(Demographic data)

เพศ (Gender)	___ ชาย (Male) ___ หญิง (Female)
อายุ (Age)	___ ปี (years)
ระดับการศึกษาสูงสุด *(Highest Education Level)*	___ ต่ำกว่าปริญญาตรี (Lower than Bachelor's degree) ___ ปริญญาตรี (Bachelor's degree) ___ ปริญญาโท (Master's degree) ___ ปริญญาเอก (Doctoral degree)
ประสบการณ์การทำงานด้านการพัฒนาซอฟต์แวร์ *(Work Experience in Software Development)*	___ ปี (years)
ระยะเวลาที่ท่านได้ทำงานในโครงการนี้ *(How long did you work in this project?)*	___ น้อยกว่า 7 เดือน (< 7 months) ___ 7 – 12 เดือน (7 – 12 months) ___ 13 – 18 เดือน (13 – 18 months) ___ 19 – 24 เดือน (19 – 24 months) ___ มากกว่า 24 เดือน (> 24 months)
ท่านได้มีส่วนร่วมในโครงการนี้อย่างไร *(How did you involve in this project?)*	___ ทำงานเต็มเวลา (full-time) ___ ทำงานไม่เต็มเวลา (part-time)
บทบาทหน้าที่หลักของท่านในโครงการนี้ *(What was your primary role in this project?)*	___ นักพัฒนาระบบ (Developer) ___ นักวิเคราะห์ธุรกิจ (Business Analyst) ___ นักทดสอบระบบ (Tester) ___ นักวิเคราะห์ระบบ (System Analyst) ___ ผู้จัดการโครงการ (Project Manager) ___ อื่นๆ โปรดระบุ (Other, please specify) _____
ในช่วงที่ท่านอยู่ในโครงการ บ่อยแค่ไหนที่ท่านได้พูดคุยกับผู้จัดการโครงการเกี่ยวกับเรื่องที่เกี่ยวข้องกับงาน *(In this project, how often did you talk to the project manager about work-related matters?)*	___ ทุกวัน (Daily) ___ อาทิตย์ละครั้ง (Once a week) ___ เดือนละครั้ง (Once a month) ___ น้อยมาก/ไม่เคย (Seldom or never)

Submit the Survey

Thank You for Your Participation

Appendix D – Team Demographic Data – Detail by Team

Team	Team Size	#Resp	Gender F	Gender M	Avg. Ages (Years)	Education-level M	Education-level B	Education-level L	Avg. Work Exp (Years)	Avg.Exp With Team (Years)	#Full-time Members	PM	Dev	BA	T	SA	Oth	Avg. Task Ind.
R01	19	19	5	14	32	11	8		9	0.7	17	1	10	1	6		1	3.6
R03	14	13	4	9	30	5	7	1	8	1.9	12	1	8		2		2	4.2
R04	18	16	6	10	31	9	7		7	1.9	16	1	8	2	4		1	4.1
R05	20	19	8	11	30	9	10		8	2.2	19	1	10	1	4		3	4.3
R06	14	11	3	8	29	3	8		6	1.2	11	1	9		1			3.9
R07	14	14	4	10	30	6	8		7	1.6	12	1	9		2		2	4.0
R08	24	22	4	18	29	12	10		6	1.5	22	1	18	2	1			3.8
R09	27	22	11	11	39	12	10		9	1.7	12	1	10		1	1	9	4.2

Note:
Gender: F-Female, M-Male
Education-level: M-Master's degree, B-Bachelor's degree, L-Lower than Bachelor's degree
Software Development Role: PM-Project Manager, Dev-Developer, BA-Business Analyst, T-Tester, SA-System Analyst, Oth-Other.
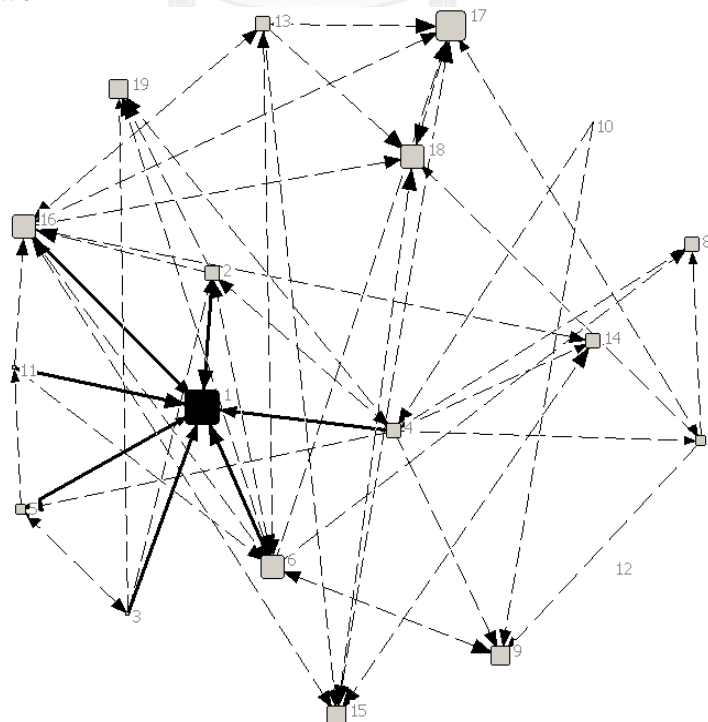Task Ind. stands for Task Interdependence

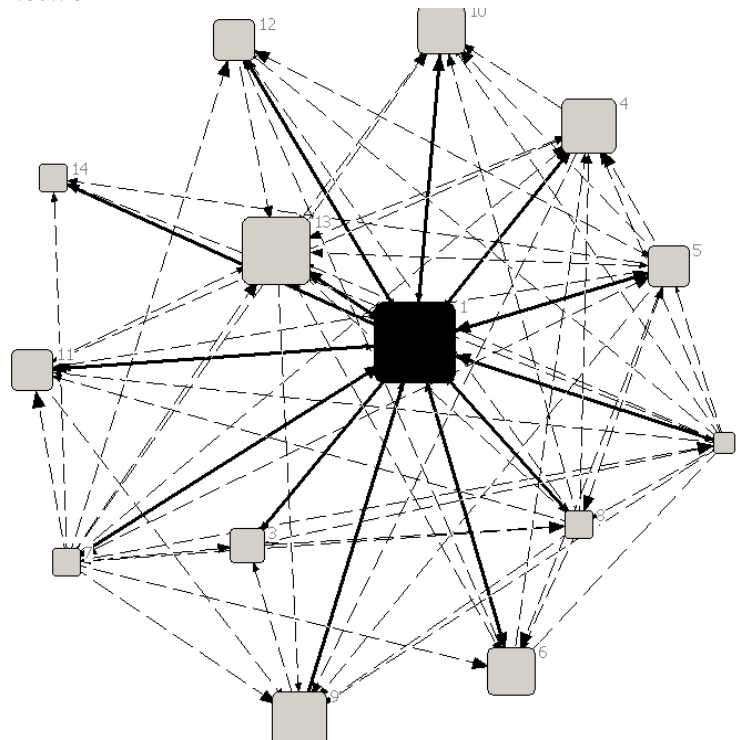# Appendix E – Team's Social Network Graph

Team: R01

Task-Advice Network

Friendship Network

151
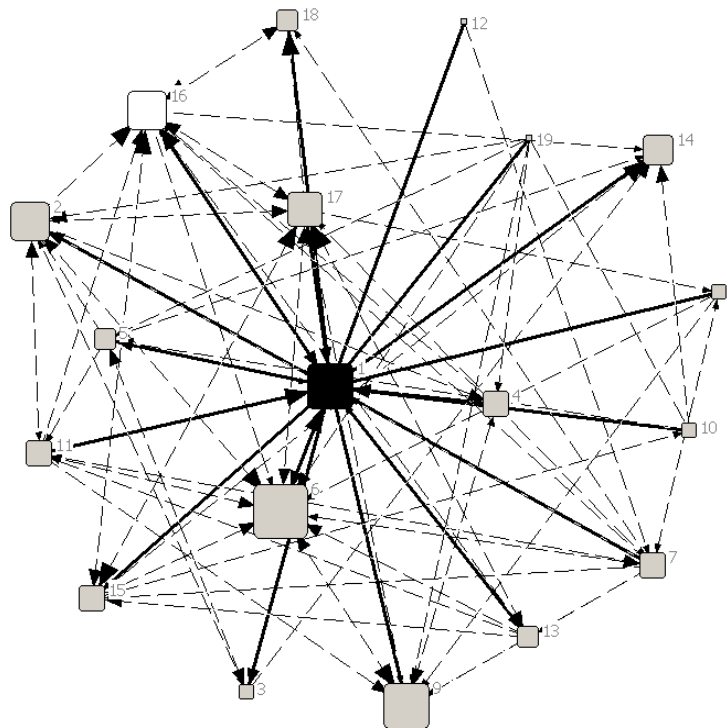
Team: R03

Task-Advice Network

Friendship Network

Team: R04

Task-Advice Network

Friendship Network

Team: R05

Task-Advice Network

Friendship Network

Team: R06

Task-Advice Network

Friendship Network
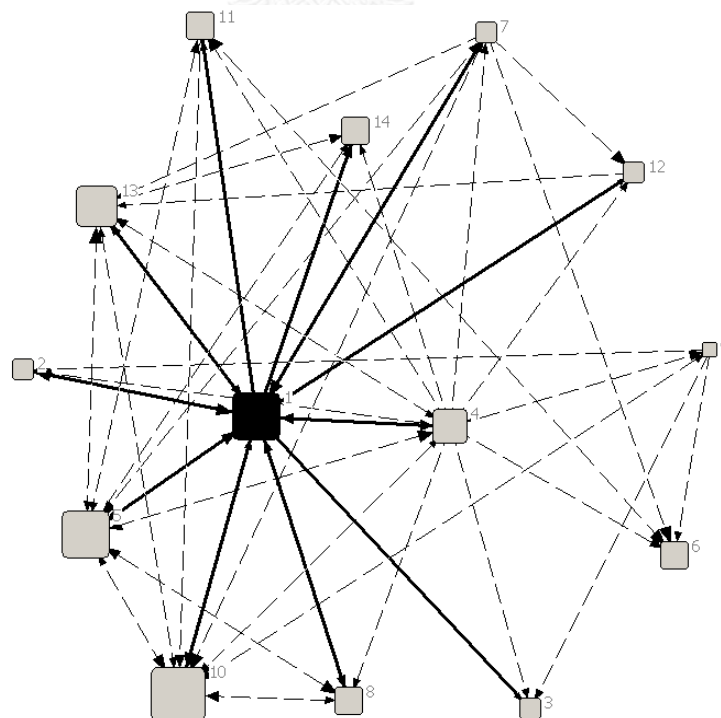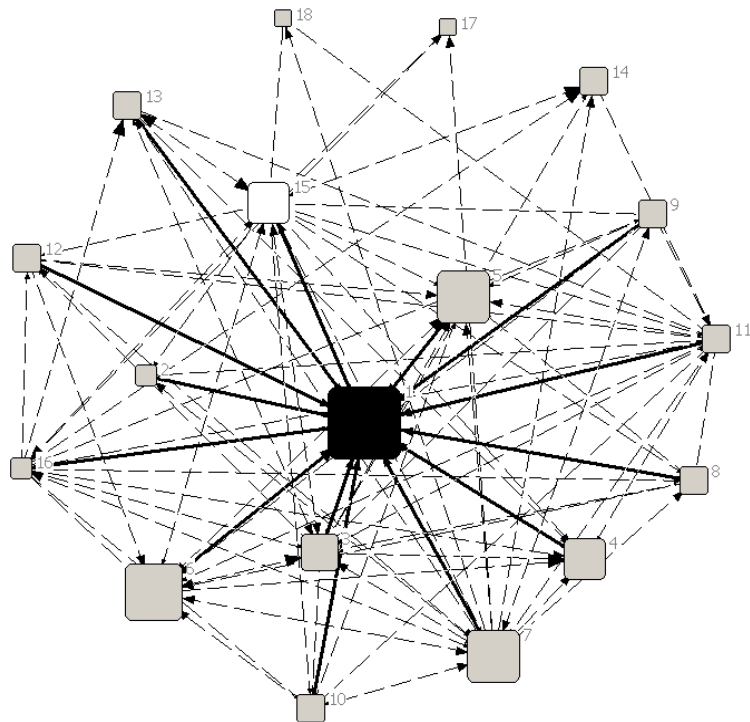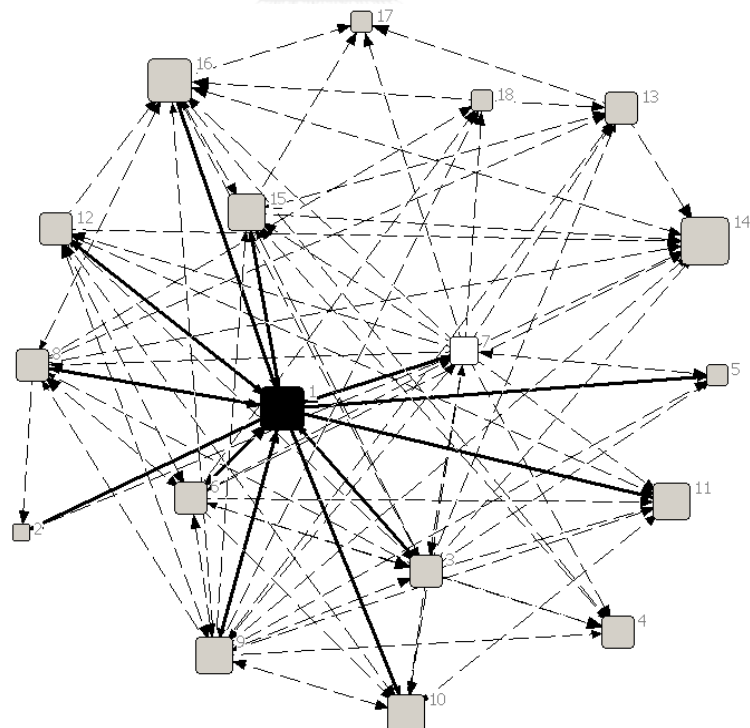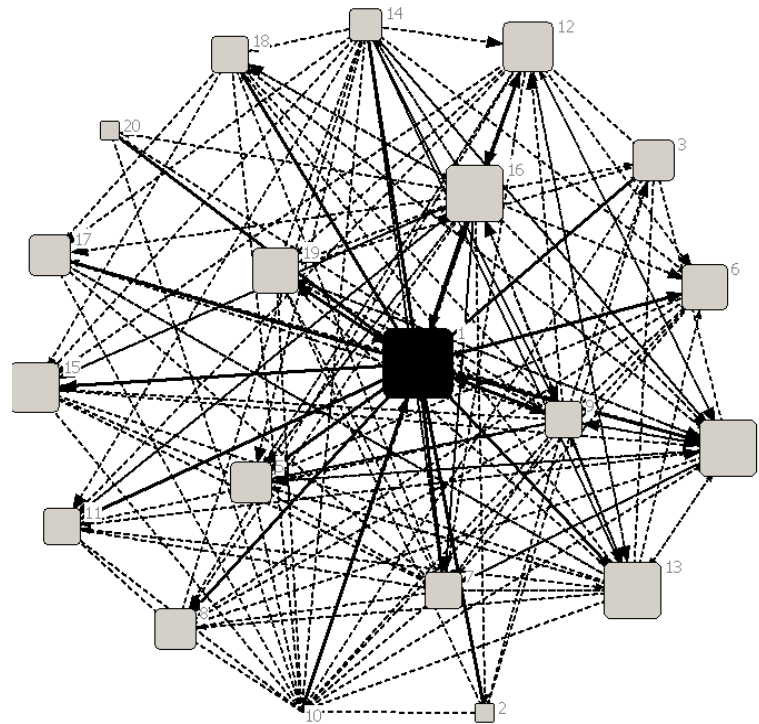
Team: R07

Task-Advice Network

Friendship Network
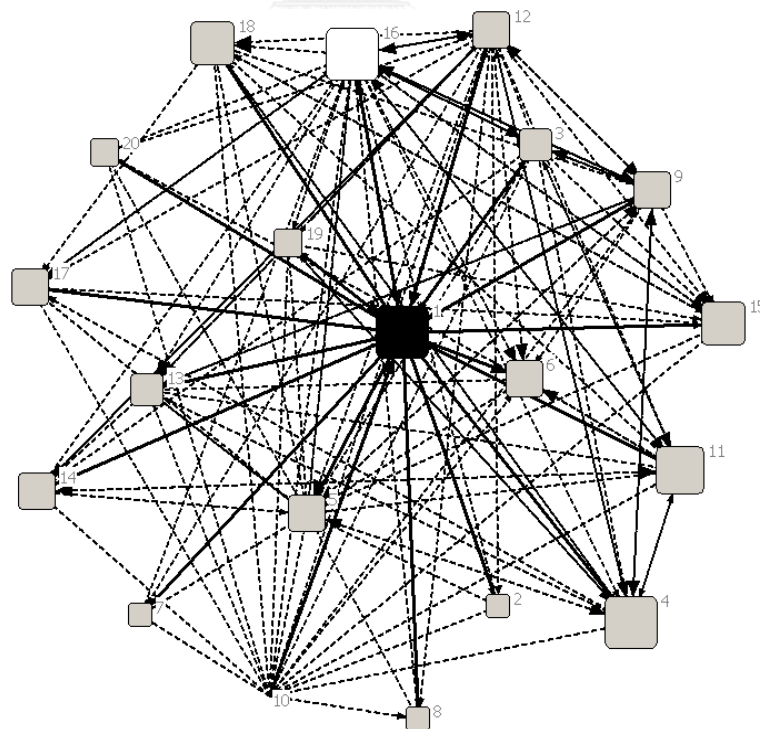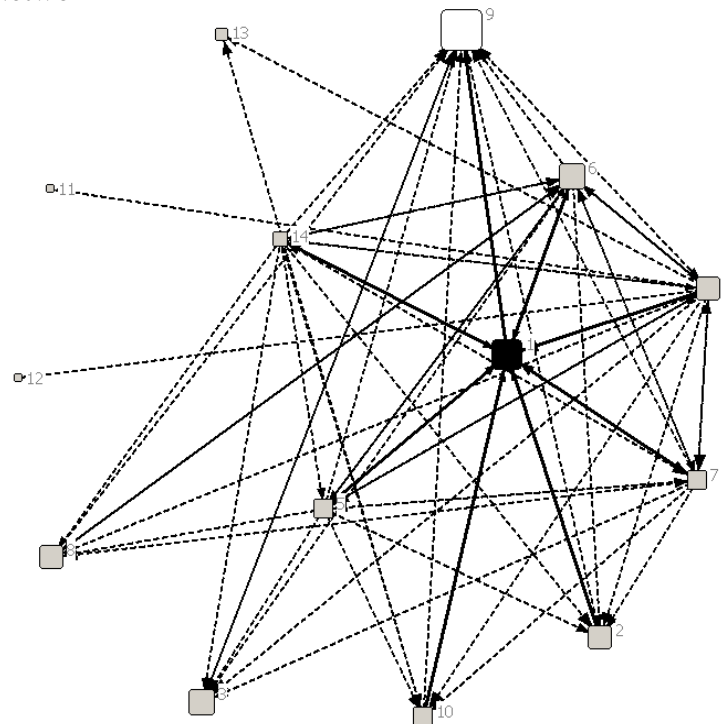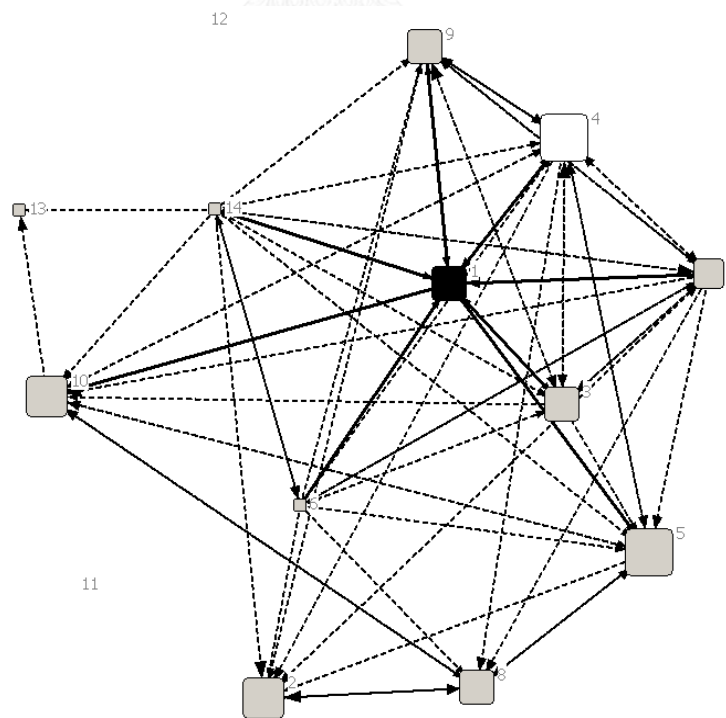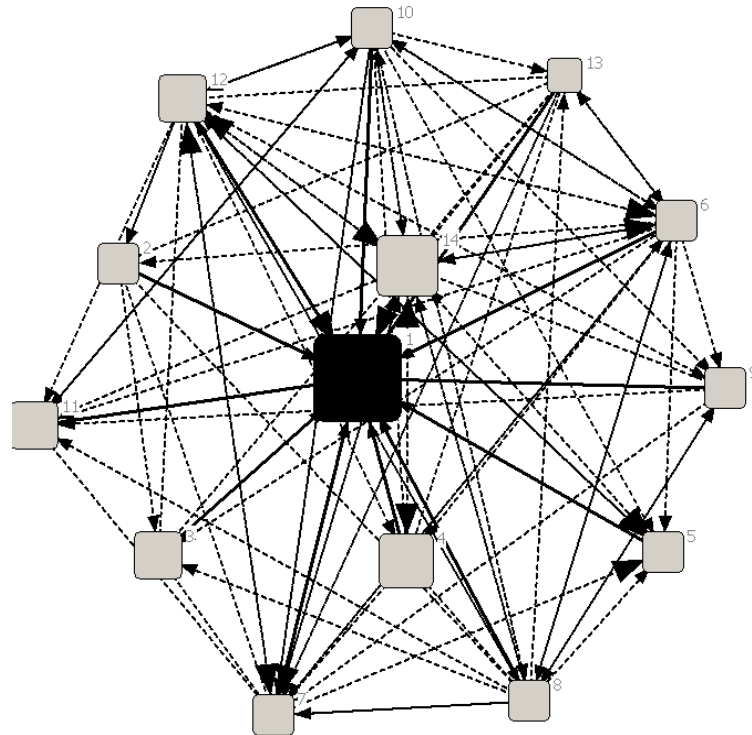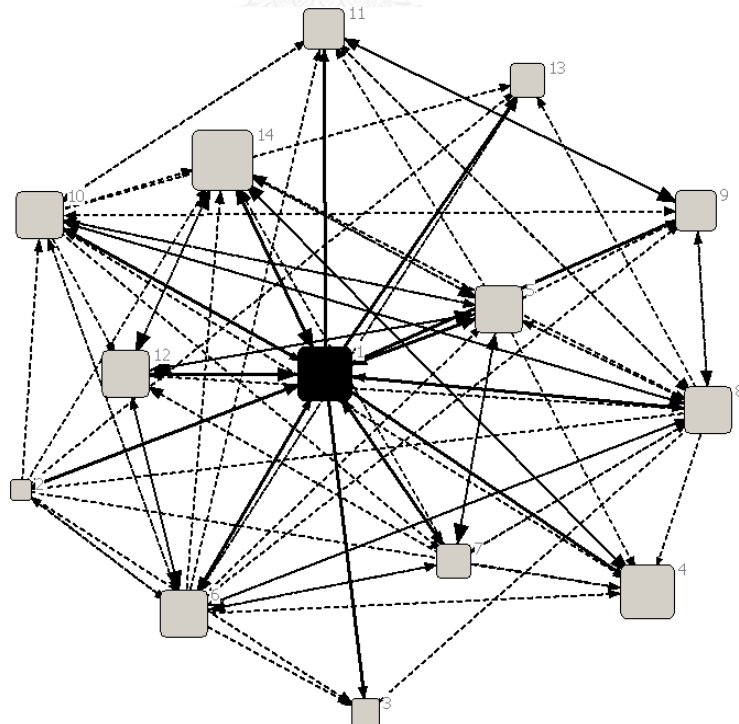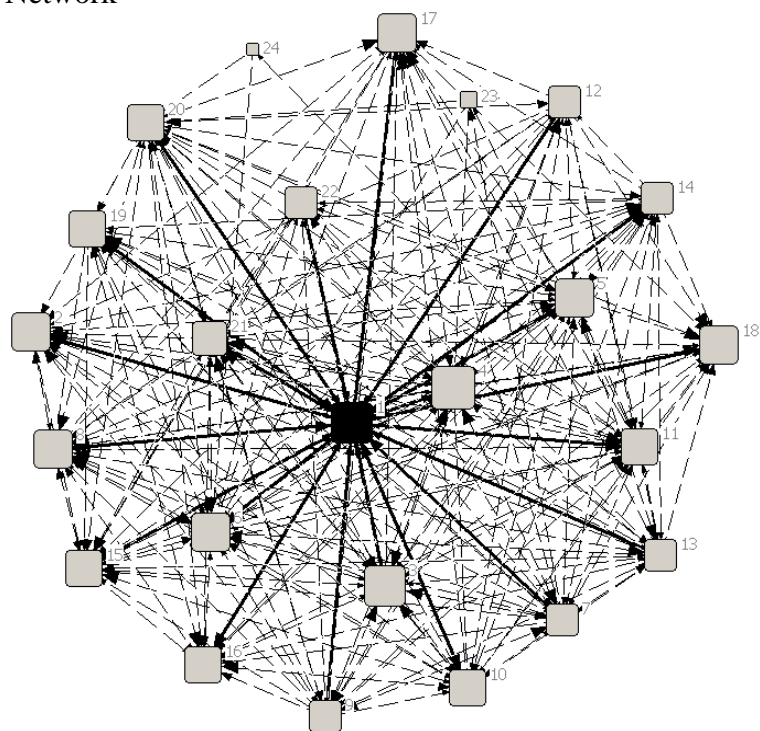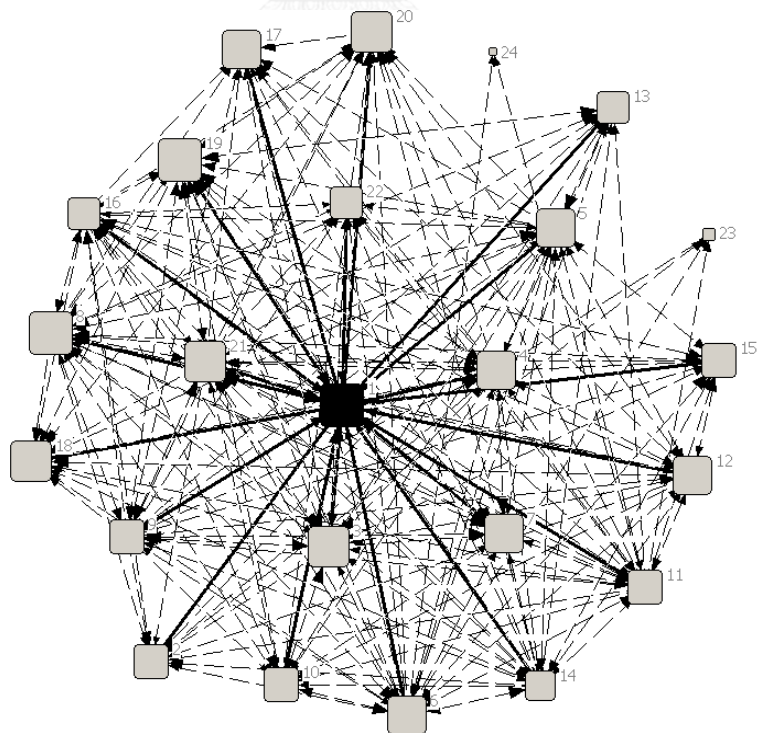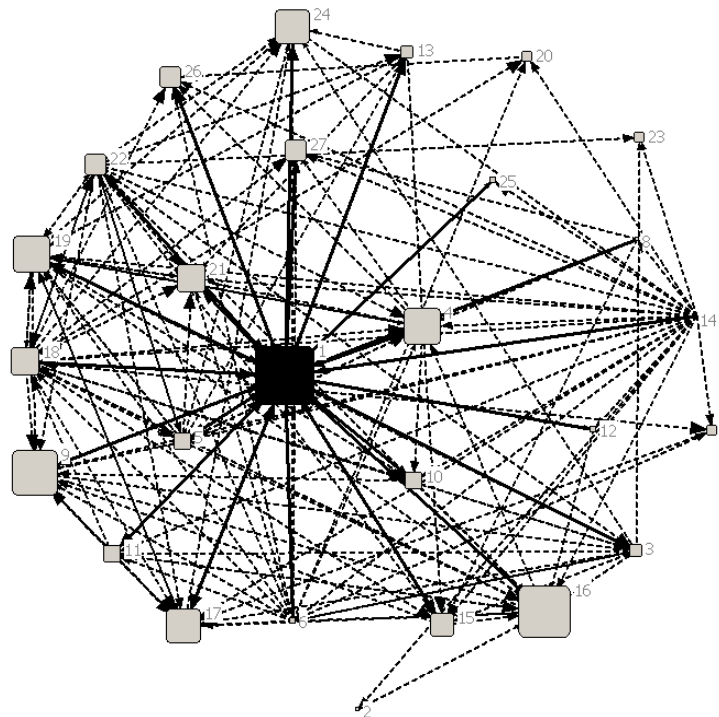
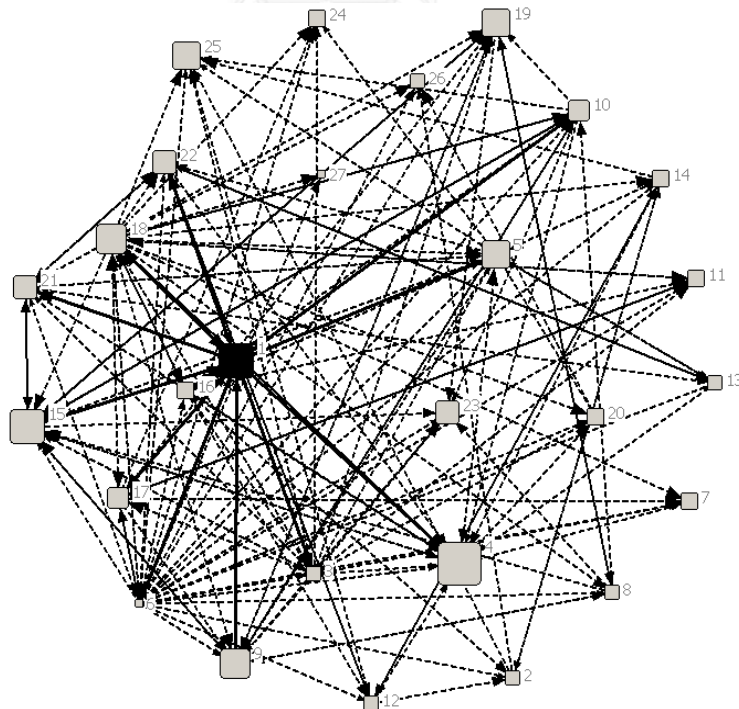**Team: R08**

Task-Advice Network

Friendship Network

Team: R09

Task-Advice Network

Friendship Network

Appendix F – Project Manager's Interview Paragraphs

F-1 – Task-oriented Leader Characteristics

The project manager's interview paragraphs are ordered by the leader behavioral characteristics, i.e., clarifying, planning, monitoring operations, and problem solving, project managers, and minutes of interview that the managers answered to each interview question.

Project Manager	Minutes of Interview	Interview Paragraph	Leader Behavioral Characteristic
R03	[16:45-18:30]	I will always emphasize to the team that to complete the work is not simply just to finish your own job but to finish the team's work.	Clarifying
R03	[16:45-18:30]	If we finish our work, we should not just sit, playing and waiting for the next task. We should consider contributing to the team.	Clarifying
R03	[33:00-34:00]	We focused on our work and did it to our best. Not to pay attention to others especially the bad example. We will do our jobs and do it well.	Clarifying
R03	[40:00-42:00]	I have worked with them before I stepped up to be team leader. I think they are dedicating to works than before. Partly may be because I put my attitudes to them. I share my perspectives that **if we put all our efforts to the work we will achieve the result. Not to worry about others.**	Clarifying
R03	[40:00-42:00]	Some junior may ask and compare their workloads. I will not have this attitude. My attitude is **who put the efforts to the work will achieve the result and success. When I talked one-on-one with junior, I always tell them this.**	Clarifying
R03	[47:00-49:00]	There ever been a very serious issue. Our developer remove a code in a share java class and this impact many webpages that call the function. Upon we resolved the issue, **I setup and print-out the guideline to let the team concern and aware on work quality. I even emphasized if this happen again they may got -1 point mark in their individual performance.** However, in fact, I will not punish them like this. I just want to ensure we are follows and pay attention to not let it happen again. I have to emphasize the serious issues we	Clarifying

Project Manager	Minutes of Interview	Interview Paragraph	Leader Behavioral Characteristic
		faced and this is work.	
R04	[26:00-27:50]	I have meeting with some members who have repeated work issues. It is an open-discussion session. I asked if they aware on the issues, how to solve and prevent it from happening again.	Clarifying
R04	[38:20-40:00]	In managing people, I set their expectations since the beginning that they may not always have the works they liked. We may need to swop the works which may be bored for them; but **delivering the work is whole team's responsibility. So we need someone to do and work together to complete.** I tell them since beginning to manage their expectations.	Clarifying
R05	[11:40-12:30]	They may compete but not too much. One thing that I tried to convince them is that competing with others will not make you promoted to be a senior developer; rather it is your work contributions to the team and always improving yourself. **Technical skills would less benefit if you are unable to work collaborate with others. I tried not to have them competing with each other**.	Clarifying
R05	[23:35-24:40]	There ever a case that he feel it is not his issue, i.e., the bug is causing because the program in other part not supporting his design. This I suggested him that as we are interfacing function with users so **we should take care or at least to talk with that developers to ensure our works are in quality**.	Clarifying
R05	[24:40-27:32]	I may not the person who formally talked with members in guiding where they should correct and develop. I personally not like that kind of talks. However, they know that when I said something, I really meant it. I am an easy-going person but when it is a serious incident, **I talked with them directly and with a clear position, I may respectful in their views.**	Clarifying
R05	[27:32-29:55]	Some persons not aware that I already push the works with my simple message. I talked with them frankly and if they are finished it is all done. Some persons **I have to explain them the reasons why I have to push the work to let them understand the situations and work together**.	Clarifying
R05	[37:50-40:33]	Before this I encouraged them to talk and exchange their ideas which will speed up the works, rather than working alone.	Clarifying

Project Manager	Minutes of Interview	Interview Paragraph	Leader Behavioral Characteristic
R06	[01:09:20-01:10:40]	Here we not strict on working in the office hours. However, **I am not quite happy if they came to work late on the morning that we have conference call meeting with onsite team. I had one-on-one with them and ask them to come in office and join the meeting on time.**	Clarifying
R07	[05:20-07:00]	**I set their work environment as knowledge sharing and work collaboration**, i.e., helping each other. I tried to make it tangible rather than abstract by doing things like giving rewards to the person who helped out others, volunteering and sharing knowledge. **I keep providing feedback to ensure they are doing as I expect, i.e., to have a shared environment.**	Clarifying
R07	[19:35-20:30]	Some junior members may too confident and complaint when team not go with their opinion. It is general. I simply explained them that even my opinions may be rejected. Working as a team, we should listen to each other and go as a team, as a same direction. I think they are quite ok.	Clarifying
R07	[20:30-22:18]	So when I moved in as their leader, I tried to make them trust on my skills, i.e., I helped them setup work process, and as it works well so they trusted me.	Clarifying
R07	[22:18-25:03]	As a leader, I believe in being reasonable and always provide reasons to the team would make the team listen, respect and follow my direction.	Clarifying
R07	[36:15-37:45]	They are competing sometimes; however, **I built the work collaboration cultures and reviewed their work performance based on their results and delivery**.	Clarifying
R07	[36:15-37:45]	I have given feedback on their work performance every three months. **The key point is they are clear on their responsibilities and the target so they will be able to focus and perform in the right direction. I always make this clear.**	Clarifying
R07	[42:43-46:49]	To manage impacts from redundancy, I have arranged an open discussion in team to let them know the reason and minimize gossip. I encourage them to the see the good side – the person who got redundancy has got a bonus package. For me, I manage work transition periods. **I think it is important to have clear communication to let them understand and encourage them to move on**. If we have skills,	Clarifying

Project Manager	Minutes of Interview	Interview Paragraph	Leader Behavioral Characteristic
		they will not take the works from us.	
R07	[51:24-53:22]	**I always emphasize that everyone wants to achieve and complete the work and go home to rest. So we should help each other out as well as share the issues so others can help. We work together.**	Clarifying
R01	[10:00-11:38]	This project is initially very critical. The initial estimation is un-realistic. Although we did many re-estimate, it remains delay in months. **I break down work details, impacts and dependency and re-plan.** It is quite better now; however, it may due to the work experience of the developers in knowing how to do and plan.	Planning
R01	[23:30-24:22]	What we do is we are trying to explain and convince them to understand that if they are the owner of the company, they will also make the same decision. **We should focus on delivering the software first and later to release service pack.**	Planning
R03	[18:30-20:50]	I feel upset sometimes, as the work is unable to deliver according to plan.	Planning
R04	[15:00-16:00]	What I am doing now is to setup a pair of senior and junior developers and make them participating on the works such as doing code reviews or backup each other's works. **I also relocate each pair of them, i.e., this pair will not always work with each other; I will relocate them every two weeks.** They may have to do two works and pairing with different persons.	Planning
R04	[16:00-18:00]	Here we have some challenges in team development to build the members to participate with each other, with senior members (which have so less), and to deliver the works. So I want to see more interactions and participations, so **I tried to assign the works to them with some cross functions**. Another point is for work results, if they are working alone, they may encounter some work issues which might impact work quality, so there should have someone to reviews so **I assigned cross-working to have senior to help junior in reviewing the works**.	Planning
R04	[33:45-34:30]	My role is to plan and assign works to the team. I guided the team in high-level development, i.e., technical design and tools. I will let my team working in detail.	Planning

Project Manager	Minutes of Interview	Interview Paragraph	Leader Behavioral Characteristic
R04	[34:30-35:50]	I think my approach in rotating the works in team would influence team performance. I planned this for ensuring we can assign any works to any members seamlessly and streamline. However, building work rotations may impact short-term work results. This is due to switching cost and learning time. Now we can assign the works specifically for individual to purposively build skills and develop ownership. We will fix works on individual and less rotations.	Planning
R04	[43:00-45:30]	Our team are collaborate and have senior developers guide juniors on technical-related. Juniors are not worked under senior and have to work on their own. Seniors are ok and **I allocated some works out from seniors to let them have some rooms for guiding the juniors. I assigned seniors for specific areas and let juniors be able to approach the seniors.** Fortunately the team has seniors that are open to talk.	Planning
R04	[#2: 01:25-02:18]	However, since the team is quite new and with half of team is junior, our team approach would be started with centralized and depended on me. Lucky that we are about to ready so in mid-year I will decentralize to let them work by themselves.	Planning
R05	[5:35-8:50]	I have to see and match members with similar working styles in assigning them to a project.	Planning
R06	[30:09-31:59]	Actually I participated with the team when there is issue. It is quite a day-to-day issue that **I will make decision on the requirement option.** Some cases such as they are unable to deliver the work by plan, **I will coordinate with other parties to manage and reprioritize the plan.**	Planning
R06	[01:02:40-01:05:17]	Sometimes it would spend only 10 minutes to finalize solution, which I make decision for them. I am good in making decision on scope and prioritize requirements and solutions for them.	Planning
R07	[07:00-09:53]	**I also set up a pair-programming for them to talk and set goals together.** Those who are not so strong could share and set goals with the stronger person. **The goal would be 'to deliver this component by this timeframe' so the person who lacks skills would speed up while the stronger person would provide some help.** If they are not helping each other and	Planning

Project Manager	Minutes of Interview	Interview Paragraph	Leader Behavioral Characteristic
		doing alone, it will not finish. Also when they work together, they would develop relationships. I see they are working better.	
R07	[07:00-09:53]	**Another thing I tried to relocate, as in agile, is a pair programming so I set owner and backup.** The owner is main developer while backup is person who helped on reviewing and doing unit-test. I switched their positions to have them talk, help and have close relationships with each other.	Planning
R07	[09:53-10:17]	I tried to relocate their work to let them work with each other and align their goals.	Planning
R07	[25:03-25:55]	I setup the team to have backup persons in each work component, so I always fine to let them take vacation leaves to get a full charge and relax. So they would be happy in working with us. They are my good team and I believe they stay good like this.	Planning
R07	[54:00-01:01:05]	I also encourage them to work together such as **I swop and assign the work for them to get to know and work on the same objective and direction.** So they will learn from each other and fortunately they have lunch together.	Planning
R01	[11:48-12:25]	As PM, I have milestone and I have weekly catch up to report work progress every 2 weeks. This is to monitor and resolve the issue, i.e., relocate resource to recover the delay.	Monitoring operations
R01	[28:05-29:12]	**The cases that I involve are mainly the issues that already took long times and yet to finish as it may need some levels of power and authority to finalize the decision**. I will then involve and decide that we will go with this solution and direction.	Monitoring operations
R05	[12:30-15:10]	For this kind of cases, I have to aware, **although I have assigned the work, I will monitor if they are ok**.	Monitoring operations
R05	[19:30-23:35]	N#11 is a very talent junior and high confident; however, many members not want to work with him. He always comments others on their quality of work (i.e. coding) and rewrites the whole codes although he is assigned to touch only a part. This took him to spend times longer than others. Some seniors and persons who worked with him are not like him. **I have kept monitoring his works and found quality issues, i.e., bugs in production due to his rewriting the whole codes and missing logics**.	Monitoring operations
R06	[32:51-	We less likely have low morale and stresses due	Monitoring

Project Manager	Minutes of Interview	Interview Paragraph	Leader Behavioral Characteristic
	36:12]	to **I keep monitor and leverage their work loads**. When they unable to deliver works on time or if they encounter complex issues, they will report me.	operations
R06	[01:02:40-01:05:17]	My main responsibility is to plan and monitor work as well as helping them on testing. **I focused on making sure we can deliver in every two weeks according to plan, and helped on coordinating with other parties as well as seeking helps for the team**.	Monitoring operations
R07	[32:48-35:22]	Some members may response email in acknowledging issues so fast and carelessness, i.e., put can instead of cannot. So I have the team to always report and cc me on the issues.	Monitoring operations
R07	[51:24-53:22]	My role is to drive team performance. **I track issues, help them on finding solutions, and act as a connector, i.e., to find and allocate team members to help others.** I played the role as advisor, i.e., I connected persons who have capability and ideas to help others who may be stuck on some tasks. As leader, I see and know their experience and skills so I can connect each of them to deliver the best work.	Monitoring operations
R03	[20:40-22:00]	I think my personality may influence them. Also, **I think it is my experience in making decisions on solving technical issues. It is quite fast and we are able to deliver the software product as the product manager would like to have**. I think my team may learn from this. For example, some technical issues such as this page is slow, **I would be the one who thinks about new workflow and solutions.** I will just share them the idea and let them work out the detail.	Problem Solving
R03	[42:30-46:00]	I think they saw me from how I worked and solved the issue. Generally the team may feel guilty when they have bugs. They may feel stress like N#11, actually he is quite careless. I not blame him but I tell him that having bugs is nature of development works. The point is how to do to improve the works. **The team capability is not defined by how many issues; rather, it is defined by how well we can handle the issues and move forward. We may have handled three issues but we can solve it in three hours which is better than in three days.** So they will be more careful.	Problem Solving

Project Manager	Minutes of Interview	Interview Paragraph	Leader Behavioral Characteristic
R03	[42:30-46:00]	Also, if it is corner case and need to find workaround, our team stayed focus on how to solve it. Even recently on N#9's issue, she always said she did the test. I suggested her to **let's focus on finding the root causes and let's resolve it. Then, we may find way to prevent this to happen; rather than spending time to discuss who have to get blame**.	Problem Solving
R03	[01:03:00-01:04:30]	May be my technical background as 10 years experiences and my working styles. I always guide the team with providing reason so they will respect and follow on my suggestions.	Problem Solving
R04	[53:30-54:04]	At that time, I move the focus in finding who is right or wrong to solve the issue first. I tell them to focus in solving the issue first and not to worry about other things.	Problem Solving
R07	[20:30-22:18]	I provided comments and ideas on solution in building trust as their leader.	Problem Solving
R07	[25:55-30:19]	Team ever stressful, i.e., when we are working with the new BA. There were 3-4 BA who provided the software requirement to us but later they resign. Their replacement is quite new so it is blank to us to move on our development. As we are delivering financial-related software while our developers are so technical, we would highly depend on BA in providing software specification to us. At that time, the only one and last BA also resign while there are lots of incoming works and the company has no direction to increase the headcount. So we discussed and find solution.	Problem Solving
R07	[32:48-35:22]	There were cases that team may think it is not their issues due to they are not aware, not know and careless. We talked openly and let them know it is their issues. We not blame as everyone can make mistake. **What to do is to solve issues and find preventions**. Generally they accepted and focused in resolving it.	Problem Solving
R07	[35:22-36:15]	We may have stubborn and point-fingers sometimes; **in general I not focus to find the wrong person but to find the root causes and resolves**. I focus on works as it is overall team responsibilities. The issue might be due to the person was too overloaded or no one helped him to review the codes. **I rather see it is as a team to work together to resolve it fast**.	Problem Solving

Project Manager	Minutes of Interview	Interview Paragraph	Leader Behavioral Characteristic
R07	[37:45-39:02]	There was a case that a senior was not deliver according to target – he always say it is unable to do so I assigned another junior and the junior can complete the work. I have to evaluate the senior as less performance than average to let him aware and improve.	Problem Solving
R07	[40:43-42:43]	Besides reasonable, open-mind, role-model and knowledge sharing, I am also working hard, especially in the past. I was technical specialist so I work quite hard and very focus on delivering the work and solution. I quite compromise and rarely have issues with others. I focused on work and not like competition – **when they have arguments, I focus on what is practical for work solutions rather than who will win. I focus on work and I am fully dedicated.**	Problem Solving

F-2 – Relationship-oriented Leader Characteristics

The project manager's interview paragraphs are ordered by the leader behavioral characteristics, i.e., supporting, developing, recognizing, and empowering, project managers, and minutes of interview that the managers answered to each interview question.

Project Manager	Minutes of Interview	Interview Paragraph	Leader Behavioral Characteristic
R01	[13:45-15:22]	**I would arrange one-on-one with the member who I known that he/she may unable to carry/take the workload anymore. I explained to them that this situation will not so long.** It would be temporary and draw their focus on the impacts if we unable to deliver. What will be the result to the team and also him/her.	Supporting
R03	[18:30-20:50]	I have one-on-one sessions with individual team members, approximately half an hour or more per month. **I ask about their lives if it remains joyful or if there are any issues or problems.**	Supporting

Project Manager	Minutes of Interview	Interview Paragraph	Leader Behavioral Characteristic
R04	[48:00-49:50]	In handling issues, **I stepped in to help managing the outside parties to let them worked out the issues**. If the issue is critical and complex, I will assign seniors to guide juniors on resolutions as appropriate. I want the juniors to learn and take ownership by themselves.	Supporting
R04	[49:50-51:30]	We have no issues in pointing fingers among members in team. There were situations that a junior developed the program codes that causing issues to other part of the programs and he got blames from outside parties. Luckily that he got mails and came to update me the issues. So **I stepped in to manage that parties and let the junior solved the bugs**.	Supporting
R04	[51:30-53:30]	Why they consulted me rather than seniors although I assigned them to work with the senior? I am not so sure. I think it may be because my level and seniors are not so different. They may feel that it is safe to talk to me. If they talked to QA and BA, they might get blame for quality issues. We are so concerns about issues in production. Actually I am quite stress; but **I always tell them that it is just the fault, the issues that we need to solve. Not to worry and just move on to solve them. They may feel safe to talk to me.**	Supporting
R04	[54:04-56:00]	Whether other members aware on the issues? This I have some concerns. I would not point out who made the issues; however, some might feel that I not update and share information to the team. So, I raised and updated in retrospective meeting which arranged in monthly after the issue resolved rather than pointed out in daily meeting. This will be a summary of issues, root causes, resolutions and preventions. **I tried not to point out issues upfront, i.e., when it happened, to let them focus rather than feeling guilty which may impact the work**.	Supporting
R05	[8:50-11:40]	My team members have different personalities. Seniors compromise quite a bit. They have their own opinion but they will not take sides in suggesting solutions. Juniors are good in technical skills however they have high confidence. They are biased and so intense in discussions. So **I have to step in to slow the arguments down.**	Supporting

Project Manager	Minutes of Interview	Interview Paragraph	Leader Behavioral Characteristic
R05	[30:50-32:28]	I personally think that supervisor skills would not benefit if he/she could not lead the members to do the works for him. I also assigned a lot of works to my team so I have to share different perspectives and positions that as a leader I have to take and drive the works while **as their older sister I understand that we already have a load of works**. **This may be my personal feelings that as a team I have to share their concerns and conflicts.** If it remains happened, there will be a tough situation in team which I have to take care.	Supporting
R05	[44:39-47:35]	I believe in balancing the joyful and work-focused modes; so I will select the way in approaching and following up their work. I am a bit stressed and want to get work done, **but the way I go about it is not to drive and push them but to see and help them out… I believe that pushing them would make them stressed and would serve no benefit.**	Supporting
R05	[44:39-47:35]	Generally I am not serious with them even the works. **Although the topic is serious, I will not approach them with serious mode. It would be let's work together, what to do to help you out, what is blocker to release. I believe that pushing them would make them stressful and no benefits.**	Supporting
R05	[52:15-01:01:50]	**In my view, team members' attitudes are the most important.** For example, there were cases that we are working so late on many issues in production. We have to work until midnight for three big issues consecutively. They would feel a high stress and too much for them. **I have to encourage them and let them know the reasons, i.e., this issue is much impact in production and it is raised by senior management so we need to stay focus to deliver in fast.**	Supporting
R05	[01:06:10-01:13:00]	I selected team with variety to allow different perspectives besides technical skills, i.e., N#11, he has different opinions that other may not think about. New joiners always have high confident while for me I want different opinions. I belief this will benefit the discussions. **I always tell them we should discuss and have alternative ideas but we should have a best conclusion without fighting with each other.**	Supporting

Project Manager	Minutes of Interview	Interview Paragraph	Leader Behavioral Characteristic
R07	[13:08-15:02]	**We ever have a situation where the team morale dropped**, i.e., redundancy. I talked with them openly and have a clear communication on the reasons and the impacts on our works, i.e., they have redundancy due to work relocation and our works in this part may got impact to resolve. I don't want them to gossip. **I encourage them to see the reason, i.e., we have got less works may partly due to our work capabilities are limited, so we should improve our skills to survive**.	Supporting
R07	[22:18-25:03]	**I think being empathetic and kind are also important as a leader. Although the work is urgent, I think we can always manage. I trust them.** I would find if they have issues so I can help. I also think they trusted me because I trusted them. So to me, leader should reasonable and kind. I also participated in their personal events, i.e., housewarming, weddings, to let them know that **I also care about them as a person.** I would find if they have issues so I can help.	Supporting
R03	[14:00-14:40]	**I have encouraged N#10 to speak out his opinions** since I started leading this team. He talked to me and told me that sometimes he does not agree with the senior members; however, it is ok to just simply follow. I have suggested that he not do this, even to me…**If you are unable to think and work by yourself, you are still a follower.** Actually I encourage everyone.	Developing
R03	[18:30-20:50]	He has issues in his thinking process. So **I guided him with some examples on how to prioritize the works**. Showing the sample which was happening also helped him understand.	Developing
R03	[23:40-25:10]	**As a leader, I try to let my team think and work by themselves to let them learn. My responsibility is to support them to grow.** In some meeting session, **I have the solution but I will encourage them to thought.** Not like Thai culture. Thai people like someone to tell them what to do. When we allow them to think and do by themselves, they would be happy, enjoy and feel challenging to do. Most development works are quite challenging to think to brainstorm and to find the solution that is very interesting to them to adopt. This will	Developing

Project Manager	Minutes of Interview	Interview Paragraph	Leader Behavioral Characteristic
		bring their motivation to do and they will do it well.	
R03	[34:00-35:15]	I talk to them in our one-on-one meetings and guide them to seeing and following the good example.	Developing
R03	[37:00-40:00]	So from then, **I have coached the team to take ownership individually on their responsible work items including request to close switch, do their own work plan, but will randomly select a person to take lead on integrating the work plan**. For grooming, I will sit in and let N#6 to lead as he is BA. He has overall picture of the product.	Developing
R03	[01:03:00-01:04:30]	However, recently, when the team approaching me for the suggestions, I will not answer them directly but will ask them back and let them think by themselves. I want to build them up to have more skills and capabilities.	Developing
R04	[27:50-29:20]	I think some of them are respecting me. May be because I step in to prevent them from getting blame. Another part would be **I tried to find rooms for their personal development rather than just simply delivering the works**. I always tell them that the reason I rotated the works is for them to have a broaden knowledge and skill, although it may spend times to learn. This would benefit that they will not bored with the work. Actually if we fit them to a single work, we will deliver the work faster and I will not headache like this. However, I think it is good for them. I think they are ok with this.	Developing
R04	[42:00-43:00]	I let them evaluate themselves. Actually I think they are aware on what to improve. So when I let them review themselves first, it will align with what I would suggest them to build. **I want them to learn and do their self-improvement.** I am not like to 'point-out' or 'blame' that this is their issues and needs to improve. **I generally asked them to think and see. If they see it by themselves, it will be easily for them to adapt and improve.** So I add some small points to build them.	Developing
R05	[44:39-47:35]	Sometimes, they may simply just step out, see, plan and reprioritize their works to get done; and these things I need to coach them.	Developing

Project Manager	Minutes of Interview	Interview Paragraph	Leader Behavioral Characteristic
R05	[47:35-49:00]	I believe that some personalities came from their outside works and environments in their lives. Once they grow up, they will aware and be able to select and control such personalities. I always aware and let them see if they are showing aggressive behavior as their natures. **In depth, I looked at them not only for how they acted to me but also how they treated others, and plan carefully who they should work with and learn from, as this is important for their career development.**	Developing
R06	[43:12-50:31]	Junior members are quiet, so I will ask them on their interests and challenges in works. **I will assign the works for them to build their skills and have seniors to guide them.** Some juniors are initiating their ideas but most are following what other suggested.	Developing
R07	[07:00-09:53]	Members who have strong technical skills may feel that others are not capable. I have to talk with them to refine their attitudes and feedback some persons to improve their skills.	Developing
R07	[30:19-31:47]	It is quite easy to get buy-in from our developers since it is benefit to them to also take BA role. **I provided full support to them, i.e., train their English communication skills. Although they are junior members, they can run demonstrations with foreign product managers via teleconference and be proud.** They will follow although they need to adjust and speed up their skills, even though it is quite challenging for them. It would be fun and challenging works rather than boring with a fixed formula.	Developing
R03	[22:00-23:20]	May be, I am a type of person who giving credit to the team. So they would not feel that they did the work but not take credit. **I let them get involved in the work to learn and I recognize them. I acknowledge their work to relevant parties such as product managers, as well as if there is a chance I point out to our boss that he/she is delivering this good work.** I personally think this would influence the team and effect team performance. They would feel and take ownership of the works together.	Recognizing
R07	[05:20-07:00]	**I will provide them the rewards as a part of individual performance in delivering values.** They would see that the things they did will provide benefits back to them so they will	Recognizing

Project Manager	Minutes of Interview	Interview Paragraph	Leader Behavioral Characteristic
		participate in contributing more.	
R01	[28:05-29:12]	Situation that I can let them working on their own would be 'technical decision'. For example, I am aware that the team is currently encounter and working on the issues but **I will not involve and direct on what would be the solution. I will let the team works on the issues and invites related parties.** They drive their own works. They discussed internally in the team to come up with solution and present to the business users. I will not involve.	Empowering
R04	[21:40-24:00]	For people-related challenges, it is not quite an issue. It is simply about I am not clear about their nature so assigning and managing works that suitable for this team is quite a challenge. So **I tried to adapt the team by having an open discussion with them that if we feel the work is not in the right track, we will adjust and change until it is appropriate.** Instead of putting the team to try something that we feel it is not works, we adjusted and changed. This may be seen as trial and error.	Empowering
R05	[19:30-23:35]	I always suggested him that everyone can make mistake. Other's mistake is not a big deal to blame, however, we are working on a big and complex task which having others to help would provide benefits of team works. **Teamwork is about belief in your team on their skills and opinions**.	Empowering
R06	[01:32:30-01:33:20]	**I open for new ideas and like to have the team to contribute their ideas. If their ideas are work and can improve the work delivery, we will go with it.** So I let the team to work directly with the product manager sometimes.	Empowering
R07	[11:00-11:58]	I like to have different ideas and opinions so I want everyone to share and discuss their ideas. **I always encourage them to let share idea first.** Whether it will be accepted or not would depend on the situation and others, but if everyone contributes idea would bring different perspectives and a good solution. Although it is not the best, it is always good to move on.	Empowering
R07	[17:30-19:00]	Sometimes we have different opinions and conflicts between members, such as in meeting discussion. So we tried to reconcile and be reasonable, i.e., **let everyone provide their reasons**. If their inputs are good and unable to settle, we may use votes. I like to setup	Empowering

Project Manager	Minutes of Interview	Interview Paragraph	Leader Behavioral Characteristic
		brainstorm meeting and use retrospective to list out pros and cons and make decision together. **Although we not always have consensus decision, the persons who we didn't go with their idea should accept the decision as a team**.	
R07	[54:00-01:01:05]	Also, in meeting, **I let them contribute their ideas and ask the quiet person to also share his ideas. This will let them participates the discussion openly.** In agile, we have story points that everyone will talk and rate points via line program together. So everyone will speak, share and discuss ideas as the application will ask everyone to participate.	Empowering

VITA

Raschada Nootjarat was born on March 29th, 1976 in Bangkok, Thailand. She received a B.Eng. in Computer Engineering with 2nd class honours from Chulalongkorn University in 1998, and M.Eng. in Computer Engineering in 1999 from the same university. She had extensively experienced and goal-oriented business and systems integration with 14 years record of career achievement at Accenture, a world leading global management consulting, technology services and outsourcing company. She completed her Ph.D. in IT in Business Program from Chulalongkorn University in 2014, under the scholarship of Chulalongkorn Business School. Her Ph.D. dissertation focused on how the project manager's social network position in team affects team process and performance. Her primary research interest is in the area of social network analysis in teams and workgroups in organizations.