네트워크 중심성, 자율적 동기, 그리고 능력 간의 상호의존적 관계가 지식공유에 미치는 영향에 관한 연구

Analyzing the Interdependent Role of Network Centrality, Motivation and Ability in Knowledge Sharing

정상윤(Sangyoon Jung)*, 노상규(Sangkyu Rho)**

초 록

지식기반사회의 21세기에서 경쟁하는 기업들에게 조직구성원간의 지식공유는 기업의 핵심역량과 밀접한 연관을 갖는 핵심화두다. 특히 조직 내 네트워크의 위치 요인이 지식공유에 미치는 영향에 관해서는 학문적으로 논란이 계속되어 왔다. 이는 네트워크 중심성이 높을수록 정보에 대한 접근성이 높아지고 지식공유의 기회는 확대되는 반면에 약한 유대감으로 인해 실제 지식공유가 이루어지지 않는다는 논란이다. 본 연구에서는 지식 공유에 있어 세 가지 요소 – 네트워크 중심성, 자율적 동기, 그리고 지식공유능력 – 간의 상호작용이 지식공유에 미치는 영향을 보고자 한다. 그리고 더 나아가, 지식공유능력을 다양하고 깊이 있는 사전지식, SNS 활용능력, 그리고 자기효능감의 세 가지 측면으로 심도 있게 연구하였다. 그 결과, 부분적으로 네트워크 중심성과 자율적동기, 지식공유능력 간의 상호작용이 통계적으로 유의함을 밝혔다. 즉, 네트워크 중심성이 낮고, 높은 자율적동기, 그리고 사전지식이 많을 때 가장 높은 수준의 지식공유를 볼 수 있었다. 이를 통해, 동기와 능력이 강하면 네트워크의 주변적 위치라는 불리한 환경에서도 지식공유가 일어난다는 것을 알 수 있었다. 따라서 본 연구는 지식공유를 둘러싼 기존의 학문적 논쟁에 새로운 대안을 제시했다는 의의를 가진다.

ABSTRACT

In the context of knowledge sharing, network position has been a controversial subject. A central position in the network provides access to non-redundant knowledge, leading to more opportunities of knowledge sharing. On the other hand, as "bridging" relationships, its characteristics as a "weak tie" suggest innate lack of trust and reciprocity which is considered an impediment to share knowledge. This paper attempts to enlighten the underlying dynamic by examining the interaction between network centrality, motivation and ability in knowledge sharing. Furthermore, this paper examines the concept of knowledge sharing

ability in depth by operationalizing the construct into three aspects: extensive and diverse knowledge, social media utilization ability and self-efficacy. The results show a partially supported three-way interaction, where the highest level of knowledge provision is reported when the employee has low network centrality, high autonomous motivation and high knowledge sharing ability, i.e. extensive and diverse prior knowledge. Though all models indicate strong associations between network centrality and knowledge sharing, this suggests an even greater power of motivation and ability that gives the strength to overcome unfavorable environments of peripheral position. Therefore, this paper offers an alternative explanation to the existing debate whether network centrality positively or negatively influences knowledge sharing.

1. Introduction

Nowadays, knowledge has become the "primary driver of a firm's value [13]," as it is viewed as the foundation of firm's sustainable competitive advantage. From this standpoint, knowledge sharing has become more important as it is "the fundamental means through which employees can contribute to knowledge application, innovation and ultimately the competitive advantage of the organization [61]." Through mutual learning and cooperation, knowledge sharing benefits firms by reducing production costs, shortening project terms, and enhancing team performance. Therefore, researchers and managers both have aspired to understand the impetus of employees' knowledge sharing.

However, firms also face significant obstacles in internally sharing knowledge [34, 56, 58]. Numerous barriers to knowledge shar-

ing has been identified, including knowledge tacitness [60], limited absorptive capacity of knowledge acquirers [56], the tendency of people to hoard rather than share knowledge in order to exert power [27], and the absence of trust or reciprocal relations [43].

Recent studies focus on the element of social networks as a key predictor to overcome these difficulties in knowledge sharing. However conflicting views prevail as scholars pertain different aspects of social network to knowledge sharing [35, 45, 52]. An influential view highlights the central position of a large and open network, as it provides access to new and non-redundant knowledge [16, 22]. However, the brokerage function of the central position makes the relationships less likely to nurture trust or reciprocal relations. Without trust and reciprocity, these large networks may counterwork knowledge sharing from occurring [19, 31, 48].

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Building upon and expanding the study of Reinholt et al. [54], this paper proposes a theoretical framework in attempt to bridge this existing gap in the current literature. Grounded on the behavioral theory of motivation-opportunity-ability by Blumberg and Pringle [11], this paper demonstrates how the interaction between motivation and ability subverts the lack of trust and reciprocal norms in networks. In other words, though the employee's central network position might offer the perfect opportunity to engage in knowledge sharing, without any motivation and ability to fully explore the opportunity, knowledge sharing will not occur.
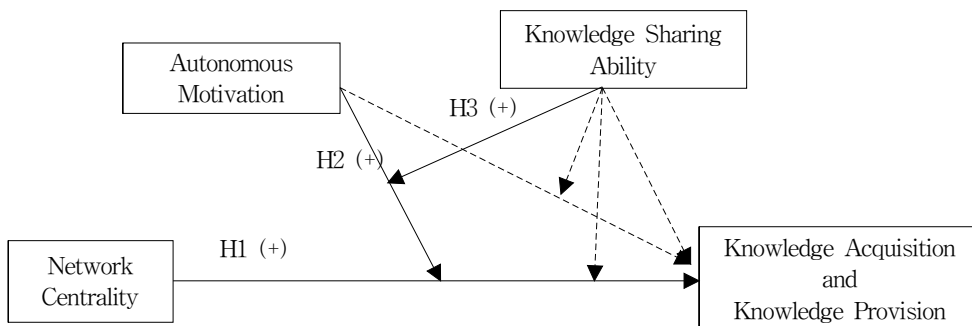
This paper contributes to extending our understanding on knowledge sharing in several ways. Firstly, this research provides an explanation for situations lacking knowledge sharing behaviors despite the opportunities [54]. In addition, by investigating the interactions among the three predictors – network centrality, autonomous motivation and sharing ability – this paper offers a relational explanation (of the three predictors) in knowledge

sharing. Thus giving insight into the underlying mechanism of employee knowledge sharing. Furthermore, the added layers of knowledge sharing ability and specifically highlighting the division between controlled and autonomous motivation brings depth and a multi-faceted understanding of the underlying mechanism of employee knowledge sharing. <Figure 1> represents the hypothesized relations and theoretical model.

2. Theoretical Background and Hypothesis Development

2.1 Network Position

Based on social network theory, extant literature asserts that the centrality of network position influences knowledge sharing in a positive way [2, 4, 16, 58]. As individuals are embedded within social structures, they are "enmeshed in webs of relationships [66]."

〈Figure 1〉 Theoretical Model

Within these webs of relationships, one's social context functions both as a channel and as a reservoir at the same time. As Anderson [2] and Reinholt et al. [54] stated, "each tie in an employee's network represents a channel through which knowledge can flow to and from the employee."

Utilizing these dual function of a network as a channel and a reservoir is determined by one's position within the network. Network centrality, "the connectedness to others within an organization [44]" by definition, conceptualizes the social position and context in terms of the number of ties. That is, different network positions offer different opportunities in knowledge sharing [58]. Therefore the degree of one's network centrality functions both as opportunity and constraint to receive information, access and control resources, and seek for advice and/or social support [14, 15]. Employees at the more central position will possess numerous ties, implying more access and control [4, 38]. Therefore, employees will not only have ample chance to transfer but also to accumulate useful and critical knowledge. On the contrary, peripheral network positions offer little opportunity to transfer or assimilate knowledge. That is, employees who lack ties can be seen as an outsider of the social scene and communication with less chance to share and accrue knowledge [63]. This is turn, leads to less engagement in knowledge sharing. In short, employees in the center of network are more likely to receive work-wise influential knowledge and also be at the position to engage in knowledge sharing than others.

Hypothesis 1a: The centrality of an employee's network position is positively associated with the employee's knowledge acquisition.

Hypothesis 1b: The centrality of an employee's network position is positively associated with the employee's knowledge provision.

2.2 Autonomous Motivation in the context of Network Position

Blumberg and Pringle [11] posits the motivation-opportunity-ability (MOA) framework where the individual level of performance is determined by opportunity, willingness, and capacity. Building upon the MOA framework, this paper contends that the performance of knowledge sharing will be determined by the presence and interaction among those three factors. The unique aspect of the MOA framework is how each factors are considered as partial determinants to each other; therefore the focus is on the interaction among those three factors rather than its individual influence on knowledge sharing behavior. Therefore, autonomous motivation is viewed within the context of network centrality rather than as an independent factor [54].

Though central network positions may render favorable conditions to share knowledge, the lack of trust or the burden of psychological and social cost may hinder knowledge sharing [17, 48]. As Granovetter [33] illustrated high network centrality is associated with large networks and their numerous but "weak" ties. Therefore little trust or reciprocal norms exist. In this environment, to ask for knowledge may be perceived as a sign of weakness or incompetence among colleagues or to oneself. This causes a threat to one's desired positive self-image or sense of self-worthiness [6]. In addition, knowledge can also be perceived as power where sharing knowledge may be viewed as a dismantling threat rather than opportunity. The above offers explanation for the differing levels of engagement in knowledge sharing despite possessing the equal degree of centrality within ones' networks.

In this context, rather than just encouraging or mandating knowledge sharing, fostering the motivation to share knowledge must precede [12]. Based on self-determination theory where different kinds of motivation promotes different kinds of behavior as well [25], autonomous motivation becomes important in particular compared to controlled motivation. Autonomous motivation occurs when an individual engages in a certain behavior on one's own accord and is comfortable to because the behavior is congruent with the individual's own interests and values [64]. Controlled motivation on the contrast, is derived when there is pressure either externally or self-imposed. External sources refer to rewards or avoiding punishments whereas self-imposed pressure is culminated through poor integration of external demands. For example, an individual engaging in a particular behavior because the person would feel approved or accepted for doing it, or guilty or unworthy for not [24]. Therefore, autonomous motivation will lead to putting in more efforts for longer hours, show more endurance in the face of difficulty, and feel less insecure compared to controlled motivation. As a result, autonomous motivation will exhibit more positive behavioral outcome than controlled motivation.

Autonomous motivation further implies proactive engagement in utilizing their networks to improve their own knowledge or to help others [25, 64]. Therefore employees, who are autonomously motivated to share knowledge, will more likely optimize their central position and in turn will strengthen the positive relations between network centrality and knowledge sharing.

Hypothesis 2a: The positive association between the centrality of an employee's network position and knowledge acquisition is strengthened when the employee is autonomously motivated toward knowledge sharing.

Hypothesis 2b: The positive association between the centrality of an employee's network position and knowledge provision is strengthened when the employee is autonomously motivated toward knowledge sharing.

2.3 Interaction between Network Position, Autonomous Motivation and Ability

Lastly, in accordance with the classic motivation-opportunity-ability theories, this study focuses on the individuals' knowledge sharing ability in conjunction with their motivation to share knowledge and opportunities offered by their network position. As Blumberg and Pringle [11] addressed, no single aspect can single handedly educe high level of knowledge sharing. Lower values of any one of the dimension will result in decreased level of knowledge sharing. However, high network centrality must precede knowledge sharing ability and autonomous motivation for high levels of knowledge sharing to occur. That is, scarce knowledge sharing opportunities will cause low level of knowledge sharing regardless of the high level of ability and motivation.

In addition to the theoretical model of Reinholt et al. [54], this study expanded the concept of "knowledge sharing ability" by re-flecting the current change in organizations and incorporating constructs that has been receiving increasing academic attention. Accordingly, knowledge sharing is operationalized into three distinct constructs: possession of extensive and diverse knowledge [54], SNS utilization, and knowledge sharing self-efficacy.

2.3.1 Extensive and Diverse Knowledge

Originally Reinholt et al. [54] conceptualized knowledge sharing ability as the possession of extensive and diverse knowledge. For knowledge sharing to occur, not only is a central position in the network and appropriate motivation necessary but also it is essential to have the ability to be able to understand all the knowledge acquired and be able to communicate effectively. This is especially the case of employees with high network centrality, because their network ties tend to bring diverse individuals with disparate knowledge into contact [16]. The extensiveness and diversity of knowledge an individual previously possessed improves one's ability to share knowledge as it functions as a broader and deeper foundation to absorb new knowledge [18]. Furthermore, it will also function as an instrument to re-interpret or reconstruct the context in order to convey the knowledge in different circumstances [52]. Therefore, along with the fulfillment of both opportunity and motivation, competent ability to act upon opportunity is essential in reaching high levels of knowledge sharing.

2.3.2 SNS Utilization Ability

Upon the arrival of Web 2.0, cumulative changes have been made in the way we perceive and/or approach the World Wide Web and our role in it. Business paradigms have shifted and business environments have been altered [10, 50]. Contrasting to earlier times when people were limited to passive viewing of contents, new platform has emerged enabling user interaction and collaboration via mobile internet, cloud computing and social media and so on. Considering these influences on knowledge sharing, this study attempts to explore a facet of knowledge sharing ability as SNS utilization ability.

Social Network Services (SNS) have infiltrated people's daily life with astounding velocity to become an important social platform for interaction and communication [5, 21]. By the definition of SNS of Bennett et al. [10], SNS focuses on "building online communities of people who share interests and/or activities, or who are interested in exploring the interests and activities of others." The phenomenal success of SNS such as Facebook, twitter [41, 51] and so on has proved its succession as the alternative mechanism to the traditional media use [3] in connecting, communicating and interacting with each other [21]. That is, through SNS, the physical limitation of space and time has collapsed, expanding the knowledge sharing space.

The unique social nature and exponential growth of SNS has academics and firms consider profitable ways to embrace social networking as an effective business tool. According to Williamson [65], social networking tools can help revitalize organizations through harnessing collective intelligence and increasing productivity. Nardi et al. [46] underlined that many recognize SNS as efficient means to easily maintain and/or further explore professional or work-related networks.

In the context of network position, the potential of SNS can be explored through the "strength of weak ties" [32]. According to Granovetter [32], when a link, or "tie" is weak between individuals there is a much better chance of individuals' social circles not overlapping. Subsequently there is more opportunity to access new resources, non-redundant information and to connect with new individuals. This is especially the case when an individual possesses a central network position, since the network consists of numerous weak ties. High SNS utilization skills will enable this individual to optimize the central network, manifesting the strength of weak ties. Therefore, individuals holding central network positions with appropriate motivation and SNS utilization ability will exhibit more knowledge sharing behavior.

2.3.3 Knowledge Sharing Self-Efficacy

As Bandura [7, 9] has defined, self-efficacy is people's beliefs in their own ability to influence their lives through completing tasks and reaching goals. In turn, self-efficacy plays a

major role in individuals' motivation and be-havior regarding tasks, goals and challenges [8, 39]. Generally, people with a strong sense of self-efficacy tend to choose more challenging tasks, make more efforts and endure the hard-ships longer to complete a task compared to those with low self-efficacy [8]. Therefore, self-efficacy has been a credible indicator to exhibit related behaviors.

Several researchers have employed the con-cept of self-efficacy in the context of knowledge sharing. There have been studies that prove the positive relation between knowledge shar-ing self-efficacy (KSSE) and knowledge shar-ing intentions [12, 37, 42]. Previous studies have focused on the direct relation or the path KSSE would influence knowledge sharing. However, this study examines self-efficacy in an interac-tional context, where network centrality and autonomous motivation plays a considerable role in knowledge sharing.

> Hypothesis 3a: There is a three-way inter-action between the centrality of an employee's network position, autonomous moti-vation for knowledge shar-ing, and knowledge-sharing ability: the level of knowl-edge acquisition is highest when all three dimensions are high.
>
> Hypothesis 3b: There is a three-way inter-action between the centrality

of an employee's network position, autonomous moti-vation for knowledge shar-ing, and knowledge-sharing ability: the level of knowl-edge provision is highest when all three dimensions are high.

3. Methods

3.1 Data Collection and Research Instrument

To extend the grounds of generalization from previous studies, the data analyzed in this study was collected from various firms across diverse fields. Reinholt et al. [54] and previous re-searches regarding network centrality had conducted their survey in one or few companies in order to capture vigorous knowledge sharing activities and gain control for external factors. However this study was designed to collect data from various companies to see if the inter-actional role of network position, motivation and ability still prevailed. In exception with the scope of companies, the aim was still to involve as many individual employees poten-tially involved in knowledge sharing as possible.

The survey was distributed three times for the duration of a month, starting from October 19th till November 23rd, 2013. In total, 400 ques-tionnaires were handed out and a total of 317

〈Table 1〉 Correlations and Descriptive Statistics[a]

Variables	Mean	sd.	Min.	Max.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Knowledge acquisition	5.23	1.08	1	7														
2. Knowledge provision	5.1	1.18	1	7														
3. Network centrality	10.57	7.69	0	26	.34	.37												
4. Autonomous motivation	4.71	1.10	3	7	.39	.40	.12											
5. Knowledge sharing ability	4.16	1.19	1	7	.35	.28	.20	.28										
6. Friendship	5.34	1.43	1	7	.29	.39	.22	.24	.15									
7. Independence	5.01	1.42	1	7	-.13	-.14	-.19	.06	-.08	-.07								
8. Informal contacts	5.59	1.24	1	7	.36	.35	.28	.27	.30	.30	-.04							
9. Trust	3.26	1.32	1	7	-.16	-.10	-.20	-.03	-.04	-.02	.09	-.17						
10. Time availability	4.03	1.49	1	7	.00	.10	.16	-.07	-.04	.14	-.16	.16	-.38					
11. Availability of IT systems	4.72	1.48	1	7	.33	.26	.17	.13	.30	.10	-.19	.19	-.15	.01				
12. Tenure	9.61	7.36	1	34	.21	.29	.31	.03	.24	.16	-.28	.17	-.07	.18	.27			
13. Education	2.26	0.56	1	4	-.05	-.05	.00	.00	.03	-.02	-.05	-.04	.03	.03	.01	.15		
14. Controlled motivation	3.79	1.27	1	7	.16	.12	-.10	.40	.22	.10	.12	.04	.22	-.14	.11	-.06	.07	
15. Social Expectations	5.18	1.15	1	7	.25	.23	.16	.19	.30	.15	-.06	.21	.02	.03	.19	.15	.07	.23

[a] All coefficients above .07 are significant at 5% level; n=241.

were recovered resulting in almost 80% of response rate. However, due to systematic and/or user missing data, the number of eligible responses free of common method bias was reduced to 241. In the case of the construct for SNS utilization ability, the sample size was further reduced to 204 because the responses of people who did not use any SNS except mobile instant messaging services such as Kakaotalk or Naver Line were excluded. To make sure the survey did not favor a certain company in particular, we received no more than maximum of 30 surveys per one company.

The questionnaire was developed by combining questionnaire items from established literature review. To test and compare the same model of Reinholt et al. [54] it was crucial to have the exact same survey items measuring the same construct. Thankfully, we were able to obtain the survey via email from the authors and the questionnaire items were translated. The key items of the questionnaire are presented in the appendix. To ensure the clarity and integrity of each item and the comprehensiveness of the overall format, management scholars were asked for trackback translation, following the usual recommended procedure. SNS utilization ability was operationalized by adapting items from Rha [55]'s study. Items measuring KSSE were based on studies of Hsu et al. [37] which was built on the premise of Compeau and Higgins [20] and Nonaka et al. [47]. <Table 1> shows the mean values, standard deviations, and correlations for all the

measured variables. To examine the consistency of the results, measurement invariance was tested. All variables concerned in this study were measured self-reportedly on a seven point Likert scale with the exception of Network centrality which was measured as a single item. Factor analysis was conducted to test each construct's validity and Cronbach's alpha to examine the reliability.

3.2 Measures

3.2.1 Knowledge Sharing

In the line of Davenport and Prusak [28] and Reinholt et al. [54], knowledge sharing is measured by both aspects of provision and acquisition. Both dependent variables are determined via self-report. Originally Reinholt et al. [54] had measured the respondent's acquisition and provision of knowledge from both colleagues in his or her current project team and colleagues working on other projects. However, since South Korean companies generally work in departments rather than projects, the item was partially altered. Hence, regarding knowledge acquisition, the respondents were asked to indicate the extent to which they had received/used knowledge from colleagues in other departments (two items) and from within the firm (two items). Knowledge provision items asked the extent of provision within the same criteria. The total of eight items is measured by a seven-point Likert scale anchoring

from 1, "no or very little extent," to 7, "very large extent." The construct of both Knowledge acquisition and provision was created by averaging the observation of four items. The construct of knowledge acquisition obtained .94 for Cronbach's alpha, composite reliability of .83, and .55 for average variance extracted (AVE). Knowledge provision construct obtained .96 for Cronbach's alpha, composite reliability of .91, and .71 for average variance extracted (AVE). All these measures indicate a strong and congruent construct.

3.2.2 Network Centrality

Network centrality was operationalized through degree centrality, which refers to the number of direct contacts an employee has [30]. Degree centrality is considered to be the most appropriate indicator visibly [30, 63]. The variable is a single-item measure (the number of contacts in the knowledge network) which is the norm for self-reported facts such as age, education and, as in this case, the number of contacts in a network [62].

3.2.3 Autonomous Motivation

In order to differentiate the types of motivation that lead to specific behaviors, the widely accepted Self-Regulation Questionnaire (SRQ) [53] was adapted into the context of knowledge sharing. As Reinholt et al. [54] clarified, this research focuses on the leading aspect of motivation to a "specific behavior (such as knowledge sharing) over time" rather than a "general and stable personality trait." Respondents were asked what the underlying reason was for taking part in knowledge sharing. As have previous researchers, the SRQ measure of intrinsic and identified motivation is used to estimate autonomous motivation. Items considered to construct the autonomous motivation were such as, "...because I enjoy it" (intrinsic), "...because I like it" (intrinsic), "...because I find it personally satisfying" (identified), and "...because I think it is an important part of my job" (identified). Respondents answered in a seven-point Likert scale anchoring from 1, "strongly disagree," to 7, "strongly agree." The construct of autonomous motivation was calculated by averaging the four items observed values. The construct obtained .78 for Cronbach's alpha, composite reliability of .65, and .38 for average variance extracted (AVE).

3.3.4 Knowledge-Sharing Ability

a. Extensive and diverse knowledge. Previous researches such as Cohen and Levinthal [18] and Reinholt et al. [54] have conceptualized knowledge-sharing ability in terms of prior knowledge extensiveness and diversity. They argue that abundant preexisting knowledge in an individual level functions as a fertile foundation to learn from others and/or in explaining what one knows to others. Therefore survey items asked the re-

spondents the extent of involvement in (general and specialized) training, job rotation, and career development. These activities were thought to have given access to company-specific knowledge and help widen the knowledge base. Respondents answered in a seven-point Likert scale anchoring from 1, "no or very little extent," to 7, "very large extent". The construct of knowledge sharing ability as extensive and diverse knowledge was calculated by averaging the four items' observed values. The construct obtained .82 for Cronbach's alpha, composite reliability of .67, and .35 for average variance extracted (AVE).

b. SNS utilization ability. This construct was calculated by averaging the observed value of four items adapted from Rha [55]'s study: whether an individual comments or write/upload contents on the internet, and whether the purpose of SNS is to share or transfer contents across the internet or to share one's own contents on the internet. This construct is a more behavioral indicator compared to the general quantitative measure which was usually operationalized by calculating frequency or time spent on SNS [21]. The respondents answered in a seven-point Likert scale anchoring from 1, "no or very little extent," to 7, "very large extent". The construct of knowledge sharing ability as SNS utilization ability was calculated by averaging the four items' ob-

served values. The construct obtained .81 for Cronbach's alpha, composite reliability of .55, and .24 for average variance extracted (AVE).

c. Knowledge sharing self-efficacy. This construct was calculated by averaging the observed value of four items that were adapted from the study of Hsu et al. [37], which had strong grounds in measuring KSSE [20, 47]. The four items asked to the respondents were regarding confidence of sharing knowledge and the ways to provide it within the company. The respondents answered in a seven-point Likert scale anchoring from 1, "no or very little extent," to 7, "very large extent". The construct of knowledge sharing ability as KSSE obtained .93 for Cronbach's alpha, composite reliability of .89, and .67 for average variance extracted (AVE).

3.3 Control Variables

A number of control variables were added to control for knowledge-sharing opportunities innate in employees' jobs: friendship, trust (reverse-coded), informal contacts, independence, time availability (reverse-coded), availability of IT systems, tenure, education and controlled motivation. All questions were measured on a seven-point Likert scale.

It was necessary to control for trust as it was emphasized as the critical variable in which

affected the vitality of knowledge sharing [43]. The question asked if "there was a trusting climate among employees." Social expectations were also controlled in order to exclude the possible influence of social desires on knowledge sharing. On a seven-point scale, respondents were asked to assess the extent to which one agrees with the statement "I share knowledge in accordance with the company's expectations." In the same context, some aspects of ability, e.g. tenure and education, needed to be differentiated from the knowledge sharing ability construct. Moreover, to specifically see autonomous motivation at work, any potential influences of controlled motivation had to be suppressed as well. As with the autonomous motivation variable, respondents were asked to assess their underlying reasons for engaging in knowledge sharing. The construct consists of five items adapted from the SRQ questionnaire that measured external and introjected motivations. The Cronbach's Alpha coefficient is .91, composite reliability of .81, and .52 for average variance extracted (AVE). The construct was calculated as the average of the five items.

4. Results

Following the procedure performed by Reinholt et al. [54], this study conducted hierarchical moderated regression models to examine the proposed hypotheses. The concept of knowledge sharing was investigated in two dimensions: knowledge provision and acquisition. These two dependent variables were self-reported on a seven point Likert scale. The independent variables were employees' network centrality, autonomous motivation and all three knowledge sharing abilities, namely the extensiveness and diversity of knowledge, SNS utilization ability and knowledge sharing self-efficacy (KSSE). All of the independent variables were also self-reported on a seven point Likert scale except for network centrality. Though self-reported, network centrality was a single item measure. To consider this difference in scale, all concerning variables in relation with interaction terms were standardized before being converted to interaction terms. The variance inflation factor (VIF) was calculated to see if there was a problem of multicollinearity, but as presented in <Tables 2> to <Tables 7> together with the regression results, all VIF values were smaller than 10 indicating multicollinearity had not occurred.

All models included an identical set of control variables as addressed by Reinholt et al. [54]: friendship, independence, informal contacts, trust, time availability, and availability of IT systems. These factors were controlled on account of potential influence on opportunities to share knowledge. Furthermore, additional factors were controlled such as tenure, education, controlled motivation, and social expectations as well to estimate the sole influence of the independent variables. Hierarchical mod-

〈Table 2〉 Results of Hierarchical Regression Analysis on Knowledge Acquisition[a]

Variables	Knowledge Acquisition			
	Model 1	Model 2	Model 3	Model 4
Intercept	1.52	2.74***	2.69***	2.70***
Network centrality		0.26**	0.27***	0.29***
		1.27	*1.28*	*1.34*
Autonomous motivation		0.14	0.16	0.18*
		1.28	*1.34*	*1.54*
Knowledge-sharing ability		0.17*	0.18*	0.17*
		1.36	*1.41*	*1.41*
Autonomous motivation×network centrality			−0.23**	−0.22**
			1.30	*1.30*
Autonomous motivation×Knowledge-sharing ability			0.07	0.08
			1.32	*1.33*
Network centrality×Knowledge-sharing ability			−0.15*	−0.15*
			1.17	*1.18*
Autonomous motivation×Network centrality× Knowledge-sharing ability				*−0.05*
				1.28
Friendship	0.19**	0.14*	0.13*	0.13*
	1.14	*1.19*	*1.19*	*1.19*
Independence	−0.10	−0.08	−0.08	−0.08
	1.14	*1.15*	*1.17*	*1.17*
Informal contacts	0.16**	0.10	0.10	0.10
	1.21	*1.30*	*1.31*	*1.31*
Trust	0.07	0.03	0.03	0.03
	1.28	*1.31*	*1.33*	*1.34*
Time availability	−0.04	−0.01	−0.01	0.00
	1.25	*1.29*	*1.29*	*1.29*
Availability of IT systems	0.18**	0.14*	0.14**	0.14**
	1.19	*1.23*	*1.23*	*1.23*
Tenure	0.11	0.01	0.01	0.01
	1.23	*1.32*	*1.33*	*1.33*
Education	−0.05	−0.11	−0.07	−0.06
	1.04	*1.04*	*1.05*	*1.05*
Controlled motivation	0.17**	0.14*	0.11	0.11
	1.15	*1.35*	*1.38*	*1.38*
Social expectations	0.07	0.03	0.04	0.03
	1.15	*1.21*	*1.25*	*1.27*
F	8.18***	8.17***	8.22***	7.76***
R^2	0.26	0.32	0.37	0.37
Adjusted R^2	0.23	0.28	0.32	0.32
F change		6.29***	6.08**	0.61

a. All independent variables are standardized. Values in italic are VIFs.
*p < .05, **p < .01, ***p < .001

〈Table 3〉 Results of Hierarchical Regression Analysis on Knowledge Provision[a]

Variables	Knowledge Provision			
	Model 1	Model 2	Model 3	Model 4
Intercept	1.56	2.76**	2.71**	2.75**
Network centrality		0.26**	0.27**	0.31***
		1.27	*1.28*	*1.34*
Autonomous motivation		0.20*	0.22*	0.29**
		1.28	*1.34*	*1.54*
Knowledge-sharing ability		0.11	0.12	0.11
		1.36	*1.41*	*1.41*
Autonomous motivation×network centrality			-0.20*	-0.19*
			1.30	*1.30*
Autonomous motivation×Knowledge-sharing ability			0.08	0.10
			1.32	*1.33*
Network centrality×Knowledge-sharing ability			-0.14	-0.16*
			1.17	*1.18*
Autonomous motivation×Network centrality ×Knowledge-sharing ability				-0.14*
				1.28
Friendship	0.22***	0.17**	0.17**	0.16**
	1.14	*1.19*	*1.19*	*1.19*
Independence	-0.08	-0.07	-0.07	-0.07
	1.14	*1.15*	*1.17*	*1.17*
Informal contacts	0.15*	0.09	0.10	0.09
	1.21	*1.30*	*1.31*	*1.31*
Trust	-0.01	-0.05	-0.05	-0.04
	1.28	*1.31*	*1.33*	*1.34*
Time availability	0.03	0.06	0.07	0.07
	1.25	*1.29*	*1.29*	*1.29*
Availability of IT systems	0.14*	0.11	0.12*	0.12*
	1.19	*1.23*	*1.23*	*1.23*
Tenure	0.20**	0.03*	0.03*	0.03*
	1.23	*1.32*	*1.33*	*1.33*
Education	-0.04	-0.08	-0.04	-0.01
	1.04	*1.04*	*1.05*	*1.05*
Controlled motivation	0.13*	0.09	0.07	0.08
	1.15	*1.35*	*1.38*	*1.38*
Social expectations	0.01	-0.02	-0.02	-0.04
	1.15	*1.21*	*1.25*	*1.27*
F	7.77***	7.61***	7.23***	7.19***
R^2	0.25	0.30	0.34	0.35
Adjusted R^2	0.22	0.26	0.29	0.30
F change		5.56**	4.20**	4.65*

[a] All independent variables are standardized. Values in italic are VIFs.
*p < .05, **p < .01, ***p < .001.

⟨Table 4⟩ Results of Hierarchical Regression Analysis on Knowledge Acquisition[a]

Variables	Knowledge Acquisition			
	Model 1	Model 2	Model 3	Model 4
Intercept	1.67[*]	2.67[**]	2.68[**]	2.45[**]
Network centrality		0.27[**]	0.28[**]	0.33[***]
		1.29	*1.29*	*1.44*
Autonomous motivation		0.22[*]	0.25[**]	0.26[**]
		1.36	*1.49*	*1.50*
SNS Utilization ability		0.05	0.05	0.07
		1.17	*1.17*	*1.20*
Autonomous motivation×network centrality			−0.19[*]	−0.22[**]
			1.26	*1.34*
Autonomous motivation×SNS Utilization ability			0.07	0.06
			1.28	*1.29*
Network centrality×SNS Utilization ability			−0.01	−0.01
			1.29	*1.29*
Autonomous motivation×Network centrality ×SNS Utilization ability				−0.13
				1.40
Friendship	0.16[*]	0.11	0.10	0.10
	1.16	*1.21*	*1.23*	*1.23*
Independence	−0.12	−0.10	−0.10	−0.09
	1.13	*1.14*	*1.15*	*1.15*
Informal contacts	0.17[*]	0.11	0.11	0.12
	1.22	*1.29*	*1.30*	*1.30*
Trust	0.10	0.06	0.04	0.04
	1.28	*1.30*	*1.32*	*1.32*
Time availability	−0.07	−0.04	−0.03	−0.03
	1.26	*1.29*	*1.30*	*1.30*
Availability of IT systems	0.15[*]	0.12[*]	0.12[*]	0.12[*]
	1.21	*1.21*	*1.22*	*1.22*
Tenure	0.15[*]	0.02	0.02	0.02
	1.24	*1.37*	*1.40*	*1.40*
Education	−0.06	−0.14	−0.09	−0.04
	1.05	*1.07*	*1.09*	*1.12*
Controlled motivation	0.16[*]	0.13	0.14	0.13
	1.18	*1.34*	*1.37*	*1.37*
Social expectations	0.09	0.08	0.07	0.09
	1.14	*1.16*	*1.18*	*1.20*
F	7.31[***]	7.41[***]	6.66[***]	6.53[***]
R^2	0.27	0.34	0.36	0.37
Adjusted R^2	0.24	0.29	0.31	0.32
F change		5.91[**]	2.58	3.21

[a] All independent variables are standardized. Values in italic are VIFs.
[*]p < .05, [**]p < .01, [***]p < .001.

〈Table 5〉 Results of Hierarchical Regression Analysis on Knowledge Provision[a]

Variables	Knowledge Provision			
	Model 1	Model 2	Model 3	Model 4
Intercept	1.73	2.84**	2.84**	2.63**
Network centrality		0.28**	0.29**	0.34***
		1.29	1.29	1.44
Autonomous motivation		0.26**	0.27**	0.28**
		1.36	1.49	1.50
SNS Utilization ability		0.05	0.05	0.07
		1.17	1.17	1.20
Autonomous motivation×network centrality			−0.16	−0.19*
			1.26	1.34
Autonomous motivation×SNS Utilization ability			0.05	0.04
			1.28	1.29
Network centrality×SNS Utilization ability			0.01	0.01
			1.29	1.29
Autonomous motivation×Network centrality ×SNS Utilization ability				−0.12
				1.40
Friendship	0.19**	0.14*	0.13*	0.13*
	1.16	1.21	1.23	1.23
Independence	−0.10	−0.08	−0.08	−0.08
	1.13	1.14	1.15	1.15
Informal contacts	0.15*	0.09	0.10	0.10
	1.22	1.29	1.30	1.30
Trust	0.01	−0.04	−0.05	−0.05
	1.28	1.30	1.32	1.32
Time availability	0.01	0.03	0.04	0.04
	1.26	1.29	1.30	1.30
Availability of IT systems	0.10	0.08	0.08	0.08
	1.21	1.21	1.22	1.22
Tenure	0.24***	0.04**	0.04**	0.04**
	1.24	1.37	1.40	1.40
Education	−0.03	−0.07	−0.03	0.02
	1.05	1.07	1.09	1.12
Controlled motivation	0.12	0.09	0.09	0.09
	1.18	1.34	1.37	1.37
Social expectations	0.04	0.02	0.01	0.03
	1.14	1.16	1.18	1.20
F	6.87***	7.13***	6.10***	5.93***
R^2	0.26	0.33	0.34	0.35
Adjusted R^2	0.22	0.28	0.29	0.29
F change		6.16**	1.43	2.44

[a] All independent variables are standardized. Values in italic are VIFs.
*$p < .05$, **$p < .01$, ***$p < .001$.

〈Table 6〉 Results of Hierarchical Regression Analysis on Knowledge Acquisition[a]

Variables	Knowledge Acquisition			
	Model 1	Model 2	Model 3	Model 4
Intercept	1.52	2.50**	2.57**	2.62**
Network centrality		0.27**	0.23**	0.26**
		1.27	1.38	1.48
Autonomous motivation		0.13	0.16	0.19*
		1.39	1.41	1.53
Knowledge sharing self-efficacy		0.06	0.06	0.07
		1.49	1.67	1.68
Autonomous motivation×network centrality			-0.27***	-0.24**
			1.19	1.37
Autonomous motivation×Knowledge sharing self-efficacy			0.04	0.03
			1.31	1.35
Network centrality×Knowledge sharing self-efficacy			0.15	0.14
			1.28	1.33
Autonomous motivation×Network centrality ×Knowledge sharing self-efficacy				-0.08
				1.45
Friendship	0.19**	0.13*	0.13*	0.13*
	1.14	1.22	1.23	1.24
Independence	-0.10	-0.09	-0.09	-0.09
	1.14	1.16	1.17	1.17
Informal contacts	0.16**	0.12	0.11	0.10
	1.21	1.29	1.31	1.34
Trust	0.07	0.03	-0.01	0.00
	1.28	1.31	1.37	1.37
Time availability	-0.04	-0.03	-0.02	-0.02
	1.25	1.27	1.30	1.30
Availability of IT systems	0.18**	0.15**	0.15**	0.15**
	1.19	1.20	1.21	1.21
Tenure	0.11	0.01	0.01	0.01
	1.23	1.38	1.38	1.38
Education	-0.05	-0.14	-0.13	-0.13
	1.04	1.06	1.07	1.07
Controlled motivation	0.17**	0.16*	0.16*	0.16*
	1.15	1.33	1.35	1.36
Social expectations	0.07	0.06	0.06	0.06
	1.15	1.16	1.17	1.17
F	8.18***	7.78***	7.71***	7.35***
R^2	0.26	0.31	0.35	0.36
Adjusted R^2	0.23	0.27	0.31	0.31
F change		5.04**	5.42**	1.38

[a] All independent variables are standardized. Values in italic are VIFs.
*$p < .05$, **$p < .01$, ***$p < .001$.

〈Table 7〉 Results of Hierarchical Regression Analysis on Knowledge Provision[a]

Variables	Knowledge Provision			
	Model 1	Model 2	Model 3	Model 4
Intercept	1.56	3.52***	3.50***	3.52***
Network centrality		0.24**	0.23*	0.24*
		1.27	1.38	1.48
Autonomous motivation		0.11	0.13	0.14
		1.39	1.41	1.53
Knowledge sharing self-efficacy		0.35***	0.32**	0.32**
		1.49	1.67	1.68
Autonomous motivation×network centrality			−0.17*	−0.15
			1.19	1.37
Autonomous motivation×Knowledge sharing self-efficacy			−0.01	−0.02
			1.31	1.35
Network centrality×Knowledge sharing self-efficacy			0.04	0.03
			1.28	1.33
Autonomous motivation×Network centrality× Knowledge sharing self-efficacy				−0.04
				1.45
Friendship	0.22***	0.14*	0.14*	0.14*
	1.14	1.22	1.23	1.24
Independence	−0.08	−0.09	−0.09	−0.09
	1.14	1.16	1.17	1.17
Informal contacts	0.15*	0.07	0.08	0.07
	1.21	1.29	1.31	1.34
Trust	−0.01	−0.07	−0.08	−0.08
	1.28	1.31	1.37	1.37
Time availability	0.03	0.04	0.05	0.05
	1.25	1.27	1.30	1.30
Availability of IT systems	0.14*	0.11	0.11	0.11
	1.19	1.20	1.21	1.21
Tenure	0.20**	0.02	0.02	0.02
	1.23	1.38	1.38	1.38
Education	−0.04	−0.17	−0.16	−0.16
	1.04	1.06	1.07	1.07
Controlled motivation	0.13*	0.12	0.12	0.12
	1.15	1.33	1.35	1.36
Social expectations	0.01	−0.03	−0.02	−0.02
	1.15	1.16	1.17	1.17
F	7.77***	8.98***	7.74***	7.28***
R²	0.25	0.34	0.36	0.36
Adjusted R²	0.22	0.30	0.31	0.31
F change		10.00***	1.91	0.28

[a] All independent variables are standardized. Values in italic are VIFs.
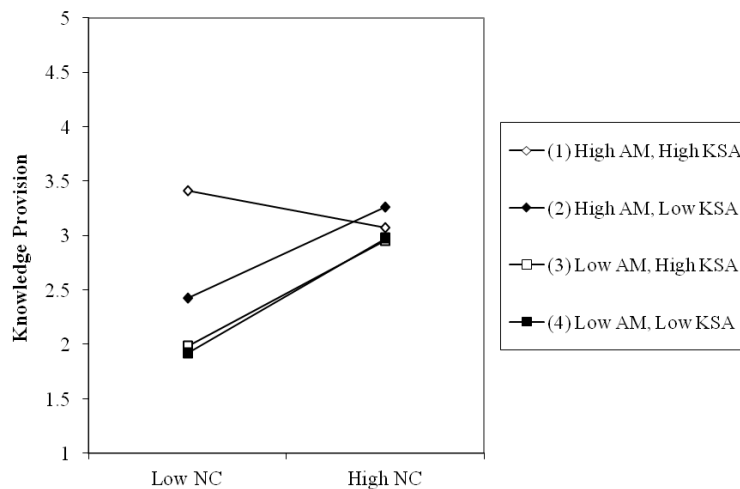*p < .05, **p < .01, *** p < .001.

erated regression was performed step by step. Model 1 only included the controlled variable. In model 2, all first-order associations between knowledge sharing and network centrality, autonomous motivation and knowledge sharing abilities were added to the process. Model 3 incorporated the two way interactions and model 4 proceeded to include the hypothesized three-way interaction among independent variables.

<Table 2> and <Table 3> demonstrates the relations between knowledge sharing (acquisition and provision) and central network position and autonomous motivation, and knowledge sharing ability as extensive and diverse prior knowledge. <Table 4> and <Table 5> also depicts the same relation with the exception of knowledge sharing ability being operationalized as SNS utilization ability. Lastly, <Table 6> and <Table 7> presents the same associa-

tion but knowledge sharing ability indicates knowledge sharing self-efficacy.

Among the hypothesized three-way interactions, the only statistically significant result is the three-way interaction among network centrality and autonomous motivation, and knowledge sharing ability as extensive and diverse knowledge in relation to the behavior of providing knowledge. As <Table 3> presents, this model also exhibited a statistically significant increase in variance explained by .01 (F = 4.65, p < .05). The R^2 increased from .50 in model 1 to .60 in model 4, a 10 percent increase. This level of increase of individual knowledge provision will have an important impact on the overall performance of the organization.

To understand the results in depth, we followed the procedures formalized by Aiken and West [1], plotting the three-way interaction

〈Figure 2〉 Three-way Interaction with Knowledge Provision as Dependent Variable

according to the high and low levels of each variable. The pattern of <Figure 2> describes the interactional results in regard to hypothesis 3b. As expected, high network centrality generally displays an increase in knowledge provision compared to low network centrality. High level of autonomous motivation compared to low level, started at a higher point of knowledge provision. Interestingly, the highest level of self-reported knowledge provision is when the employee possessed low network centrality, high autonomous motivation and high knowledge sharing ability, i.e. extensive and diverse prior knowledge as well. On the contrary, employees in the central of network showed, despite the high autonomous motivation and extensive and diverse prior knowledge, decreased level of knowledge sharing. Therefore, hypothesis 3b was not supported.
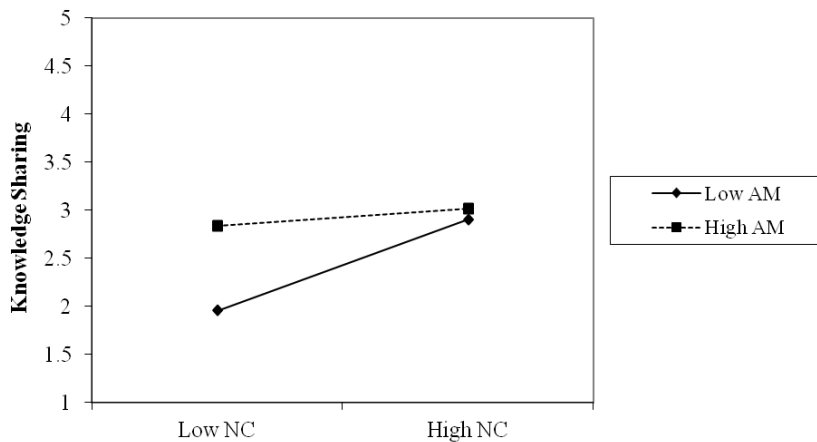
To report for completeness, the significant relation between network centrality and the self-reported knowledge provision (beta = .262, p< .01; model 2, <Table 3>), and between knowledge acquisition (beta = .263, p<.01; model 2, <Table 2>) was statistically significant. The two-way interaction between network centrality and autonomous motivation also tested statistically significant (beta = - .200, p < .05; model 3, <Table 3>, beta = - .227, p < .01; model 3, <Table 2>).

Since all the other models did not yield statistically significant results regarding the hypothesized three-way interactions, simple re-lations and two-way interaction interpretations is in line. In the cases association between network centrality and self-reported knowledge acquisition, both knowledge sharing ability as SNS utilization ability and KSSE resulted in significant statistics (beta = .270, p < .01; model 2, <Table 4>; beta = .269, p< .01; model 2, <Table 6>). The moderated relations between network centrality and autonomous motivation in knowledge acquisition also showed similar results (beta = - .191, p< .05; model 3, <Table 4>; beta = - .272, p< .001; model 3, <Table 6>).

Knowledge provision and central network position also posited a positive relation in both SNS utilization ability and KSSE (beta = .280, p < .01; model 2, <Table 5>; beta = .243, p < .01; model 2, <Table 7>) The interaction coefficient between network centrality and autonomous motivation also revealed to be statistically significant in KSSE ((beta= −.169, p< .05; model 3, <Table 7>); However in the notion of SNS utilization ability, the interactional relation did not prove to be statistically important.

Therefore, hypothesis 1a and 1b, positing a positive relation between network centrality and self-reported knowledge sharing were all supported across all regression models. Hypothesis 2a and 2b, predicting a positive moderating effect of autonomous motivation on the relation of network centrality and knowledge sharing, also displayed a statistically significant result. With the exception of SNS utilization of ability as knowledge sharing ability,

〈Figure 3〉 Two-way Interaction with Knowledge Sharing as Dependent Variable

where Hypothesis 2b did not yield a statistically significant result. To further understand the nature of the moderating effect, we plotted the two-way interaction as Dawson and Richter [23] specified. As <Figure 3> shows, autonomous motivation has a negative moderating effect on the relation between network centrality and knowledge sharing, as in both knowledge provision and acquisition.

5. Discussion and Conclusion: Contributions and Limitations

In the context of knowledge sharing, the inherent characteristic of network position has been controversial: though a central position in the intra-organizational network provides opened access to non-redundant knowledge, its innate attribute as "weak ties" that lack mutual trust has been considered as an impediment to knowledge sharing. Grounded on the behavioral theories of motivation-opportunity-ability [11], Reinholt et al. [54] demonstrates how the large open network can be fully explored in the premise of autonomous motivation and knowledge sharing ability. That is, knowledge sharing is highest when all three elements of network centrality, motivation and ability are high. Network centrality not only presents numerous opportunities to transfer and accumulate knowledge but also open doors to new and non-repetitive information. However, this opportunity is seized only by whom who is motivated on one's own volition and possesses knowledge sharing ability; therefore countervailing the shortcomings of central position of networks.

In attempt to extend the findings of Reinholt et al. [54], while maintaining the gist of it, this study examines the generalizability of the re-

search model by expanding the sample to multiple companies across diverse fields. In addition, the concept of knowledge sharing ability is studied in more depth: reflecting the rise of a new communication platform, SNS utilization ability is measured as well as knowledge sharing self-efficacy, a psychological dimension functioning in close with motivation. The combination of academically emerging constructs and established constructs will contribute to deeper understanding of knowledge sharing and have managerial implications.

The results showed that the highest level of self-reported knowledge provision is when the employee possessed low network centrality, high autonomous motivation and high knowledge sharing ability, i.e. extensive and diverse prior knowledge. Though all models did prove strong associations between network centrality and knowledge sharing, this suggests an even greater power of motivation and ability that gives the strength to overcome unfavorable environments.

The theoretical contribution of this paper is that it uncovers a more complicated dynamic between network centrality, motivation and ability in knowledge sharing. In other words, this paper offers an alternative explanation to the existing debate whether network centrality positively or negatively influences knowledge sharing. Though the findings does strongly support the view where the central position of an employee opens to more chances and degree of knowledge sharing [4, 38, 58, 63],

yet the results indicate that the centrality of the network characteristics which hinder knowledge sharing may be stronger than perceived. That is, being at a central position hinders knowledge sharing because of its characteristics as a "weak tie," where trust and reciprocal norms are insufficient and knowledge sharing can be seen as a weakness or losing power [16, 27, 48]. On the other hand, the results also can be interpreted as individuals' motivation and ability combined together having more power to overcome the shortcomings of the peripheral position.

Another finding included the negative moderating effect of autonomous motivation. Previous literature regarding autonomous motivation heavily concentrates on positive influences. Negative influences are academically rarely reported. The reason why the positive association between the centrality of an employee's network position and knowledge sharing is weakened when the employee is autonomously motivated toward knowledge sharing could be an interesting topic for future studies.

Results of this study could only be properly interpreted in the light of its limitations: the focus on quantitative traits opposed to qualitative traits may have prevented an integrative understanding from all viewpoints. The study was designed to focus on the occurrence of the knowledge sharing itself, rather than the quality of knowledge shared. By indirectly asking to what extent one used the knowledge

obtained however does imply the usefulness of the knowledge. Network centrality was measured by a proxy of degree centrality which its simplicity helped to see relations clearly. However, the quality or pathway of network was not considered despite the potential influence on knowledge sharing. For future research, a more sophisticated measure can be incorporated to reflect a more dimensional understanding of the network and its dynamic in the knowledge sharing literature.

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〈Appendix〉

	Items Adapted from Questionnaire of Reinholt et al. [54]
	Knowledge Acquisition
1	To what extent have you received knowledge from colleagues in other departments?
2	To what extent have you used knowledge from colleagues in other departments?
3	To what extent have you received knowledge from colleagues within the firm?
4	To what extent have you used knowledge from colleagues within the firm?
	Knowledge Provision
1	To what extent have colleagues in other departments received knowledge from you?
2	To what extent have colleagues in other departments used knowledge from you?
3	To what extent have colleagues within the firm received knowledge from you?
4	To what extent have colleagues within the firm used knowledge from you?
	Autnomous Motivation (: Self-Regulation Questionnaire [52])
	Why do you share knowledge with others?
1	...because I enjoy it (intrinsic)
2	...because I like it (intrinsic)
3	...because I find it personally satisfying (identified)
4	...because I think it is an important part of my job (identified)
	Knowledge-sharing ability. **a. Extensive and diverse prior knowledge**
	To what extent are you included in the following?
1	General management training
2	Specialised professional training
3	Organised job rotation
4	Career development
	Items Adapted from Questionnaire of Rha [55]
	Knowledge-sharing ability. **b. SNS utilization ability**
1	I comment on interesting information I come across on SNS
2	I create contents and share/upload them on the internet
3	The reason why I use SNS is to share or transfer contents across the internet
4	The reason why I use SNS is to share one's own contents on the internet
	Items Adapted from Questionnaire of Hsu et al. [37]
	Knowledge-sharing ability. **c. Knowledge sharing self-efficacy**
	To share your knowledge, how confident are you ....
1	⋯ in providing your experiences, insights or expertise as an example?
2	⋯ in providing your experiences, insights or expertise by engaging in dialogue with others?
3	⋯ in providing your ideas and perspectives to others through participating in discussions?
4	⋯ in articulating yourself in written, verbal or symbolic forms?

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