Mechanisms to motivate knowledge sharing: integrating the reward systems and social network perspectives

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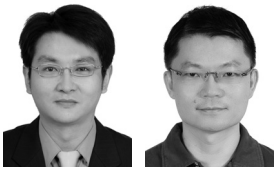

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Abstract

Purpose – *The purpose of this study is to develop a theoretical model that integrates two different mechanisms to explain knowledge sharing. First, adapted from traditional reward systems, the calculative-based mechanism (CBM) serves as the benchmark. Second, the relational-based mechanism (RBM) plays a complementary role. RBM is founded on social interaction and consists of two social network constructs: relational deposits (i.e. network and valued network centralities) and withdrawals (i.e. network and valued network densities).*

Design/methodology/approach – *This study collected survey data in collaboration with a health-care organization. The data collected from 180 respondents were tested against the research model using a partial least squares analysis.*

Findings – *This study found the CBM to be beneficial for knowledge sharing. The findings support the RBM prediction of a positive relationship between the deposit construct and knowledge sharing, but fail to support the RBM prediction on the withdrawal construct. The RBM explained about 15 per cent more of the variance than the CBM. In addition, the withdrawal construct of the RBM predicts respondents' beliefs in reciprocal obligation.*

Research limitations/implications – *RBM does not as strongly associate with economic benefits as the CBM, but it still plays a noteworthy role in increasing the possibility of an individual knowledge sharing.*

Originality/value – *The study is the first to propose the concepts of relational deposits and withdrawals. The authors use a roster-based sociometric approach to collect the social network data and to benchmark the effect of RBM with that of CBM on individual knowledge sharing and his/her beliefs in reciprocal obligation.*

Keywords *Knowledge sharing, Social networks, Belief of reciprocal obligation, Calculative-based mechanism, Relational-based mechanism*

Paper type *Research paper*

1. Introduction

Knowledge is an elite form of information that has been assimilated and reflected upon and that constitutes a critical personal asset that can contribute to sustainable organizational competitive advantage, sales growth and value creation (Conner and Prahalad, 1996). However, critical knowledge resides within employees and is not always readily available to those who need it. Accordingly, organizations need to seek effective mechanisms for encouraging their employees to engage in knowledge sharing, thereby increasing the organization's knowledge stock and gaining competitive advantage. Gibbert and Krause (2002) argued that a motivation mechanism that encourages and facilitates knowledge sharing is more effective than an enforcement mechanism. Thus, how to motivate employees to share knowledge is increasingly capturing the interest and attention of academics and practitioners.

According to the social exchange theory, individuals are willing to share their knowledge because such behavior brings desirable benefits. These benefits may take the form of a reward system or economic incentives provided by the organization, such as salary and

"As expected, the authors found the reward systems to be a significant facilitator of an individuals knowledge sharing."

bonus increases, promotion and job security (He and Wei, 2009). Individuals tend to share their knowledge only when the expected benefits outweigh the costs of sharing (Bock *et al.*, 2005). Benefits that fail to compensate for the costs of knowledge sharing are the biggest barriers (Huber, 2001). Liu *et al.* (2011) conducted a meta-analysis based on social exchange theory to investigate the influence of certain factors identified in past research on knowledge sharing and found that reward systems had the greatest effect on knowledge sharing. Thus, in this study, the authors use reward systems as one of independent variables. Here, this study terms a reward system a *calculative-based mechanism* (CBM) relating to an individual's assessment of the costs and benefits of knowledge sharing. Such an assessment is usually based on self-interest or personal gain, which is intuitively expected to be associated with economic benefit (Wasko and Faraj, 2000). This study posits that the CBM affects an individual's knowledge sharing.

However, because knowledge sharing is a social process, this study claims that knowledge sharing cannot be explained solely by economic incentives and that the social motivational factors emerging through interpersonal relationships must also be considered as key determinants of knowledge sharing (Hau *et al.*, 2013). Interpersonal interactions create social capital, which is made up of structural, relational and cognitive capital (Nahapiet and Ghoshal, 1998). An individual's social capital can influence the degree to which he or she can use mobilized resources, that is task-related assistance or information, embedded within the relationship networks. The inflow or outflow of mobilized resources, which correspond to relational withdrawals or relational deposits in interpersonal relationships, can strengthen the connection. Moreover, compared with those who receive mobilized resources from others, those who supply mobilized resources for others' use are believed to have a power advantage in their relationships with peers. Power advantage, in this study, refers to the ability of an individual to gain benefits in the form of superior access to information, influence and solidarity (Adler and Kwon, 2002). Individuals who gain such a power advantage through relational deposits tend to retain their dominant position by sustaining the provision of task-associated assistance and information to others and even by sharing crucial knowledge accumulated through the experience of dealing with tasks characterized by a high degree of uncertainty. Here, this study terms relational deposits and withdrawals together a relational-based mechanism (RBM).

The RBM and the CBM are notably different in that the former is not expected to be as strongly associated with economic benefits as the latter. Bourdieu (1986) argued that the benefits accrued from a social capital, such as access to information, influence over peers and the solidarity of membership, are only slowly realized, none of which are strongly associated with economic benefits. Bourdieu further indicated that social capital is sticky, less liquid and not readily converted to economic capital. Thus, the RBM is characterized by the slowness of the transition from the benefit of social capital to economic benefits. In other words, an individual cannot expect an immediate return in the form of rewards, but must simply rely on the goodwill of others to sustain future reciprocity (Blau, 1964). Thus, the extent to which a favor recipient intends to return something to the favor giver in exchange for his or her help, that is, holds a belief in reciprocal obligation, determines whether the favor giver can expect a future return.

The effects of extrinsic and intrinsic motivational factors on knowledge sharing have been widely investigated (Hung *et al.*, 2011) but gaps remain in the existing research on knowledge sharing. First, most previous research in this area presumes that the design of

extrinsic and intrinsic motivational factors is intended to encourage knowledge contributors to believe in a strong logical link between the two types of motivational factors and economic benefits, and thus to engage in knowledge sharing. However, extrinsic and intrinsic motivational factors differ in the strength of their logical link with economic benefits. Limited research attention has been paid to examining the effects of different types of motivational factors on an individual's knowledge sharing in terms of the strength of the logical link they perceive between those factors and economic benefits. To bridge this gap, this study introduces two motivational mechanisms, the CBM and RBM, which are characterized by a strong and weak logical association with economic benefits, and examine their effects on individual knowledge sharing (Lin *et al.*, 2012). Second, although past research has examined the effects of individual network centrality on knowledge sharing within an organization (Wasko and Faraj, 2005), the relationship between an individual's knowledge sharing and his or her position in the social network, weighted by the degree to which he or she controls information or resources influential in job-related tasks has yet to be investigated. In general, the likelihood that an individual engages in knowledge sharing is negatively associated with the degree to which he or she possesses valued information or resources. However, an individual who possesses such information and resources and is reluctant to share them may suffer negative evaluations from or even a boycott by other members of the organization. Thus, within an organization, the more valued the information or resources that an individual possesses, the likelier he or she is to share knowledge. Third, prior studies have presented a large body of findings on reciprocity's effects on knowledge sharing from the contributors' perspective (e.g. He and Wei, 2009, Kankanhalli *et al.*, 2005), but limited attention has been paid to the recipients' responses when they receive the knowledge contributions of others. Upon receipt of a favor from others, an individual is likely to feel a sense of indebtedness, and thus is likely to feel obligated to return the favor by engaging in reciprocal behavior. Thus, such a belief in reciprocal obligation is similar to the fear of "social sanctions" arising from the "free-rider" effect (i.e. receiving a favor from others without paying it back) (Wang and Noe, 2010). Fourth, Wang and Noe (2010) suggested that more empirical field studies on knowledge sharing are crucial to generalizing the findings of previous laboratory-based experimental studies using student samples. The predictions of motivational factors on an individual knowledge sharing in laboratory settings, drawing from prior studies, cast a doubt on its application in organizational context (Chowdhury, 2005). To bridge this gap, the authors conducted the study in an organization of health-care industry, notable for providing knowledge-intensive professional services.

The objectives of this study were to:

- develop an RBM conducive to knowledge sharing and to enhancement the belief in reciprocal obligation; and
- empirically validate the proposed model through a field study and benchmark it against the CBM of individual-level knowledge sharing.

These objectives were proposed to help answer the following research questions:

RQ1. Does the CBM, which incorporates the construct of organizational reward systems, facilitate knowledge sharing?

"Organizational tenure captures a nurses familiarity with health-care expertise, implying that senior nursing staffs are more inclined to contribute knowledge to peers rather than acquire it from them."

> "The findings imply that intensive social interaction can foster individual goodwill in the knowledge sharing arena."

RQ2. Does the RBM, which incorporates the relational deposit and withdrawal constructs, facilitate knowledge sharing?

RQ3. Does the relational withdrawal of the RBM facilitate an individual's belief in reciprocal obligation?

RQ4. Against the benchmark of the CBM, does the addition of the RBM better explain individual knowledge sharing?

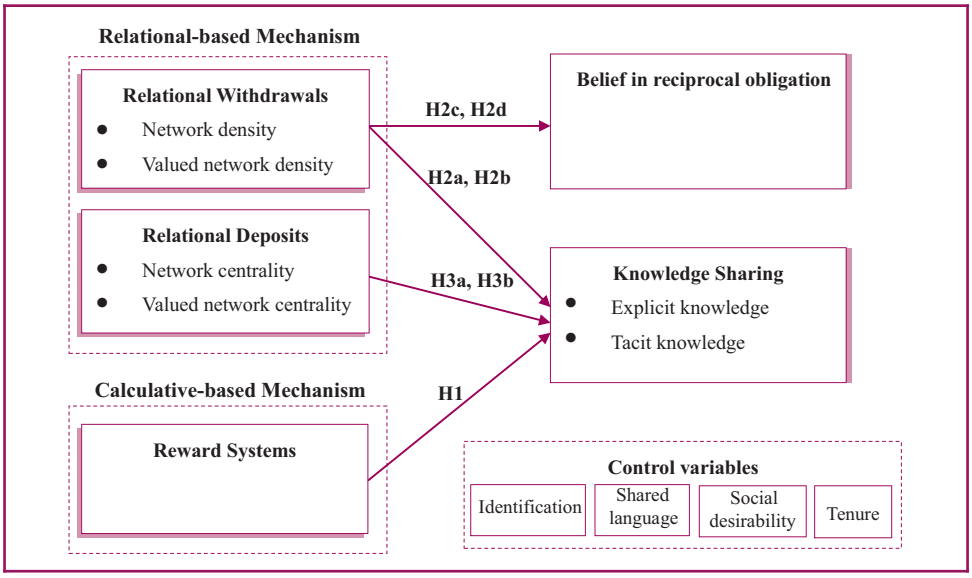
This study fills four gaps in the existing knowledge sharing research and makes three main contributions to the literature. First, prior studies have focused predominately on reward systems as preliminary incentives to elicit individual knowledge sharing, whereas, to the best of the authors' knowledge, this is the first study to examine the integrated influence of reward systems (CBM) and the RBM on knowledge sharing in terms of the strength of the association with economic benefits. The results showed that the motivation effect on knowledge sharing is stronger when a reward system is accompanied by the RBM. Second, relational deposits can influence individual knowledge sharing because they constitute the power advantage that an individual gains from mobilizing the resources embedded in his or her social relationships within the organization. Such power advantages allow individuals to get things done and achieve their goals. Relational deposits are one manifestation of these advantages. To retain their power advantages (i.e. relational deposits), those who possess proprietary resources and information are more likely to share their knowledge. Third, receiving a favor from another organizational member induces a feeling of indebtedness, which constitutes a reciprocal obligation toward the favor giver. Although the favor recipient may be unable to contribute knowledge in return immediately, the feeling of indebtedness strengthens an individual's belief that he or she has a reciprocal obligation to do so in future.

The remainder of this paper is organized as follows. In the next section, this study proposes the research model and hypotheses and then applies social exchange theory and social capital theory to develop a model of how the CBM and RBM foster knowledge sharing. The model is then validated empirically through a field study at a health-care organization that focuses on knowledge sharing among nurses. Finally, the results of the study and implications are discussed.

2. Research model and hypotheses

The research model explains knowledge sharing by incorporating constructs from social exchange theory and social capital theory (Figure 1). Knowledge sharing is the dependent variable, and includes both explicit and tacit knowledge sharing. From a social exchange theory perspective, the reward systems in the CBM serve as benchmark antecedents that are assumed to have a positive effect on an individual's knowledge sharing. The two constructs in the RBM (i.e. relational deposits and withdrawals) are derived from social capital theory and are also expected to have a positive effect on the knowledge sharing. In addition, this study also examines the effect of relational withdrawals of the RBM on individual's belief in reciprocal obligation. The following sections introduce the two mechanisms and four control variables (i.e. identification, shared language, social desirability and tenure) and investigate their effects on dependent variables.

Figure 1 Research model



2.1 Social exchange theory and the CBM

Social exchange theory outlines the rules that manage resource exchanges among people. The resources may be either tangible products or intangibles such as valuable information (Miller and Kenny, 1986). Homans (1974) posited that exchange norms are propelled by whether the exchange value meets an individual's self-interest. Sahlins (1972) developed the concept of balanced exchange, which emphasizes that the resources exchanged are economic or symbolic equivalents and that a short time lag occurs between when a resource is given and when goods are received in return.

In social exchanges, when an individual helps others, he or she has a general expectation of future returns, such as obtaining desired resources. Knowledge can be viewed as an intangible resource that is shared through social exchange (Barachini, 2009). In the knowledge sharing context, whereas the knowledge taken away through social exchange is viewed as a cost due to the resultant resource loss, the knowledge received through social exchange is viewed as a benefit (Kankanhalli *et al.*, 2005). If the benefits obtained outweigh the costs, then individuals are willing to contribute their knowledge. Past studies suggest that maximizing the benefits and minimizing the costs can motivate individuals to share their knowledge through knowledge management (KM) systems (Wasko and Faraj, 2000).

The CBM in this study was derived from the social exchange theory. According to this mechanism, knowledge sharing is molded by a rational assessment of the costs and benefits of engaging in knowledge sharing. Based on this assumption, if the sharing costs outweigh an individual's self-interest, he or she may not intend to contribute knowledge. In other words, knowledge sharing should have a yield equivalent to the return with little delay. Thus, the CBM emphasizes the intuitive and strong association between knowledge sharing and short-term economics benefits.

2.1.1 Reward systems and knowledge sharing. As employees have limited time and energy, they tend to evaluate whether their efforts to share knowledge are valued or rewarded by their organization (Davenport and Prusak, 1998). The share of resources that an individual acquires also depends on the motivation of his or her contacts, often in the form of organizational rewards (Adler and Kwon, 2002). Reward systems comprise the economic incentives provided to employees to mold their behavior or improve their performance (Cabrera and Bonache, 1999). Therefore, an organization's reward systems act as an

important motivator of employee knowledge sharing. In this study, reward systems include economic rewards that range from monetary (e.g. salary and bonus increases) to non-monetary incentives (e.g. promotion).

Previous empirical studies have shown that the effects of reward systems on individual knowledge sharing have been mixed. For example, Bock *et al.* (2005) found that extrinsic rewards had a negative effect on attitudes toward knowledge sharing. He and Wei (2009) found no relationship between extrinsic motivation and knowledge sharing. Contrary to the negative or neutral effects of rewards, Kankanhalli *et al.* (2005) found that organizational rewards positively influenced employees' knowledge contribution in terms of their use of electronic knowledge repositories. Kim and Lee (2006) also found that pay system based on performance evaluation positively increased employee's motivation to contribute knowledge. Liu *et al.* (2011) further indicated that reward systems are the most widely used and most influential factors in knowledge sharing. This study anticipates that reward systems positively influence individual knowledge sharing and propose the following hypothesis:

H1. Reward systems are positively related to individual knowledge sharing.

2.2 Social capital theory and the RBM

This study draws on social capital theory (abbreviated as SCT hereafter) to explain individual knowledge sharing. SCT posits that social capital, which comprises the sum of the resources embedded in an individual's interpersonal relationships, significantly affects the degree to which the individual creates and shares knowledge (Nahapiet and Ghoshal, 1998). The basic tenet of SCT is that interpersonal relationships can provide rich resources (Coleman, 1990) and social capital can be classified into three dimensions, namely, structural, relational and cognitive capital (Nahapiet and Ghoshal, 1998). The structural dimension concerns the overall pattern of interpersonal connections or social interaction ties among the people within an organization or social unit. The relational dimension concerns the nature of personal relationships based on the history of prior interactions. Trust, identification and norms are the main facets of the relational dimension. The cognitive dimension concerns the resources that contribute to shared understanding and meaning, such as shared language and vision. This study argues that individuals with high social capital are able to acquire help[1] from others and thereby solve the problem at hand or create a new idea, both of which are conducive to personal performance. Furthermore, the acceptance of help obliges the receiving individual to provide help in return to sustain the social capital embedded in his or her social relationships, which is close to "obligations and expectations" embedded in the social capital (Coleman, 1990).

The RBM is an extension of the structural dimension of social capital theory, which focuses on the degree to which actors interact with alters within an organization[2], and thus focuses on social interaction (Tsai and Ghoshal, 1998). Social interaction involves giving and taking, which changes the relationship dynamics, and those who benefit from the change in dynamics repeat such interactions to sustain their advantage. The RBM explains the tendency to help (to make deposits) rather than be helped (to make withdrawals) in terms of a power advantage in that this mechanism provides an effective means for dominant individuals to retain their dominant relational position.

The primary salient feature of the RBM is that, unlike the CBM, it presupposes an indirect association between knowledge sharing and economic benefits. Adler and Kwon (2002) indicated that the power advantages of interpersonal relationships cannot be readily converted to economic or other advantages, as cashing in on an investment in an interpersonal relationship takes time. Prior studies that draw on the SCT conception of structural capital have paid less attention to whether motivational mechanisms that are not readily associated with economic benefits affect individual knowledge sharing. In consequence, this study compares the structural capital dimension of SCT with the social exchange theory to address the research question. The relational and cognitive dimensions

of the social capital theory, although not the focus of this study, are included for control variables *identification* and *shared language*, respectively.

2.2.1 Relational-based mechanism. Whether an individual can succeed depends on who rather than what he or she knows. Maxwell (2003) proposed that 12.5 per cent of the money an individual makes comes from knowledge, and 87.5 per cent can be traced to his or her interpersonal relationships. In other words, interpersonal relationships are the keys to wealth and success. An interpersonal relationship involves bi-directional behavior, whereby one actor acts outwardly toward another and the other acts inwardly in return (Hanneman and Riddle, 2005). Increased or decreased social interaction can determine an individual's role within an organization. When social interaction is inflowing, the individual is the recipient; when it is outflowing, he or she is the donor. While the donor can have the power advantage in an interpersonal relationship, the recipient gives others the opportunity to ask favors in return.

The metaphor of a relationship account is central to the concept of the RBM. Relationship accounts require long term, periodical transactions or else they become inactive (Adler and Kwon, 2002). Activating an inactive interpersonal relationship account requires large investments in time and effort in terms of interaction. Relational deposits involve offering favors to others, whereas withdrawals entail asking others for favors. An increase in relational deposits corresponds to an increase in the individual's interpersonal power advantage that can be converted into better resource access, influence and solidarity (Adler and Kwon, 2002). Knowledge is a valuable resource in organizations. Individuals who give more favors are more likely to have better access to knowledge through the resulting interpersonal relationship power advantage. Knowledge is an elite form of information that has been assimilated and reflected on and which provides a critical personal asset that can affect an organization's assessment of an individual's value and promotion. Therefore, sharing knowledge suggested that the knowledge giver is of less personal importance to the organization. However, some individuals choose not to free-ride but energetically engage in knowledge sharing, which is contrary to the basic survival instincts. The theory of collective action offers a reasonable explanation of this contradictory scenario in proposing that the more individuals engage in regular contact with one another, the more likely they are to develop a "habit of cooperation" and act collectively (e.g. share knowledge) (Marwell *et al.*, 1988). Collectives characterized by high levels of structural capital (i.e. dense social connections and central connections within the collective) are more likely to sustain collective action (Casimir *et al.*, 2012). Consequently, this study argues that individuals who are highly connected with others (i.e. frequently give help to or get help from others) have a strong propensity to share their knowledge. In this study, the interpersonal network configurations of nurses in a health-care organization, such as their location and interaction patterns, are described as a social network. This social network is supported by the formal organizational structure of the health-care organization and informal interpersonal relationships, and in this sense, it is a typical network that combines formal and informal networks.

2.2.2 Withdrawals from and deposits into the relationship account. Social ties indicate the extent to which actors are connected with alters within their social unit (Sykes *et al.*, 2009). Studies in this field have typically investigated the exchange of help (i.e. *advice* in other studies) (Krackhardt and Hanson, 1993). Help tie, which functions as a primary communication channel to spread information and knowledge, acquire resources for routine tasks (Krackhardt and Hanson, 1993), and provide resources to both actors and alters in their daily contacts (Granovetter, 1973).

Social ties are directional, running both inward and outward. Whereas an *inward tie* refers to an actor accepting help from an alter within the organization, an *outward tie* indicates that an actor provides help to an alter within the organization. Following the coping and influencing mechanisms by Sykes *et al.* (2009), in this study, the authors describe inward ties as situations in which nurses seek help with patient-care tasks from coworkers at a

nurse station. Outward ties describe situations in which nurses are contacted by coworkers to help with patient-care tasks at a nurse station.

Network density and *network centrality* are important structural characteristics that delineate the interaction patterns in an organizational unit. An individual's position in a social network can provide social support and social influence to other people. Thus, the authors use network density and network centrality to model *withdrawals from* (i.e. obtaining help from others) and *deposits into* (i.e. giving help to others) the relationship account, respectively.

2.2.3 Network and valued network densities. Network density of inward ties is a good predictor of the level of assistance received from others. The more inward ties that individuals accumulate, the greater their chances of receiving assistance from others (Lee *et al.*, 2010). In this study, the authors use egocentric network density to represent that a nurse obtains help from coworkers at a nurse station. That is, each nurse is given a score that reflects *how often* he or she obtains help from coworkers. In this study, as the nurses obtain help in regard to the use of specific instruments and tasks (e.g. catheterization, chest tapping and advanced cardiac life support), the helps they acquire can improve their job performance. A relational withdrawal from the relationship account in exchange for job performance, which is converted to a payoff, indicates that an individual is somehow obliged to return help to sustain collective action.

The egocentric network density indicates how often a nurse withdraws from his or her relationship account. However, the egocentric network density focuses simply on the structural characteristics of the social network and ignores the effect of the alter's characteristics on the social ties. To address this problem, Sykes *et al.* (2009) introduced the concept of valued network density, which describes whether an individual can obtain help that is perceived to be important within a social unit to boost his or her propensity to act collectively. Valued network density refers to the ties connecting the focal actor and alters, and is weighted by the perceived strength of the ties and of others' control of the information and resources that are needed for health care. Help from a value-weighted connection indicates *how much* an actor withdraws from his or her relationship account.

The help that individuals receive through their social networks is likely to be greater if the network members occupy social positions that give them control over a range of resources (Wellman and Wortley, 1990). Valued network density thus also refers to the strength of an individual's inward ties, as weighted by the control that others exert over the resources that support the patient-care task. These resources include task advice, instrument instruction and the way in which the resources are controlled by other units (e.g. respiratory therapy, nutrition consultation and chemotherapy). To obtain help from the individuals who have control over resources is more valuable to the recipients, as obtaining such help involves a relatively costly withdrawal from the relationship account and highly benefits job performance. Consequently, a nurse is more obligated to promote and conduct collective action (e.g. share knowledge), as long as collective action benefits the organizational survival and competitiveness, and which is premise to keep his or her personal interest intact. Therefore, the authors posit the *H2a* and *H2b*:

H2a. Individuals with higher levels of network density will demonstrate more positive knowledge sharing.

H2b. Individuals with higher levels of valued network density will demonstrate more positive knowledge sharing.

According to the norm of reciprocity, when an individual receives favors from others, he or she should return favors beyond what he or she has received (Gouldner, 1960). The type of interpersonal relationship determines the degree to which the favor recipient expresses gratitude to the favor giver (Blau, 1964). If an individual receives help from acquaintances or strangers, he or she will feel more gratitude than if he or she had received help from family members because helping one's family is regarded as a necessity, whereas helping

acquaintances or strangers goes beyond the accepted norms of interaction (Bar-Tal *et al.*, 1977). A favor exchange between acquaintances can be characterized as a long-term reciprocal exchange. Until the favor is returned, the recipient will feel a sense of debt and obligation, which is close to the concept of "obligations and expectations" embedded in social capital that Coleman (1990) proposed. The essence of favor exchange is that the favor recipient will return the favor at any cost (Hwang, 1987). Once received, the favor will be recorded in the favor recipients' favor account (Hwang, 1987), a metaphor similar to the concept of relational withdrawals in this study. Favor recipients are advised to restore their favor accounts to a state in which help is afforded others more often than it is received. Otherwise, they are likely to feel a subjective burden (SB), a psychological state characterized by distress, anxiety and even depression (del-Pino-Casado *et al.*, 2011). In other words, if favor recipients return the favor in question as soon as possible, they will reduce their SB. Before returning a favor, however, an individual must have a strong belief in reciprocal obligation; that is, he or she must feel obligated to return the favor to the favor giver in the future (Bock *et al.*, 2006).

Wasko and Faraj's (2000) research echoed the above argument. Their findings indicate that when an individual receives a favor, he or she experiences an obligation cost. To release him or herself from the obligation, he or she needs to return to the contributor the benefit arising from the previous favor. Hence, based on the norm of reciprocity, the authors propose that favor recipients not only express gratitude toward those who provide them with favors but will also return the favor to the favor giver in the form of information, resources or knowledge in the future. The amount of help that individuals receive through their social networks is likely to be greater if the members of those networks occupy social positions that give them control over a range of resources. The authors further hypothesize that favor recipients who receive valued information or resources express much more gratitude than do those who receive more ordinary information and resources, and thus that their belief in reciprocal obligation is stronger than that of others. The foregoing analysis leads us to *H2c* and *H2d*:

H2c. Individuals with higher levels of network density will demonstrate more positive beliefs in reciprocal obligation.

H2d. Individuals with higher levels of valued network density will demonstrate more positive beliefs in reciprocal obligation.

2.2.4 Network and valued network centralities. Network centrality refers to the relative numbers of direct and indirect links an individual has with others in his or her social network (Mossholder *et al.*, 2005). Individuals with high levels of network centrality give more help to their coworkers (Lee *et al.*, 2010). The authors further argue that individuals with high levels of network centrality give help more than they receive, and thus have a power advantage in their interpersonal relationships. This power advantage is converted into influence over the decisions made by others (Kleinnijenhuis *et al.*, 2011; Sykes *et al.*, 2009) and corresponds with an increase in the balance of the individual's relationship account. To sustain influence and importance in their organizations, employees replicate behaviors that serve to increase their interpersonal power advantage. Providing help enables employees to convey their utilitarian values to others in the organization, and is one of the roots of social influence (Kleinnijenhuis *et al.*, 2011). The more help an employee gives to others, the more cognitively central the employee is to the organization (Kameda *et al.*, 1997). Thus, an individual with a high level of network centrality is more likely to have a strong sense of belonging to the organization and sustain a habit of cooperation in line with the organization's norms and expectations (Rogers and Kincaid, 1981). Therefore, he or she will be more likely to share knowledge with other members of the organization.

Egocentric network centrality indicates how often an individual makes a deposit into his or her relationship account. However, egocentric network centrality ignores the effect of the alter's characteristics on the actor's position in the social network. Therefore, the authors adopt valued network centrality to address this problem. Valued network centrality refers to

the extent to which the individual's peers perceive that he or she controls the resources to conduct effective health-care-related tasks.

To give help in a value-weighted connection indicates how much an actor deposits in his or her relationship account. Help given by individuals through their social networks is likely regarded greater if he or she occupy social positions that give control over many resources (Kim and Lee, 2006). Valued network centrality thus also refers to the strength of an individual's social ties, weighted by others' perception of his or her control over resources that support the patient-care task. To provide help that is perceived to be critical and valuable corresponds to a relatively large relationship account deposit. A nurse who has control over valued resources is more likely to be sought out by others and become a catalyst for knowledge sharing. Thus, the nurse will be more likely to act in line with the expectations and norms of the organization to sustain his or her control over the resources and to retain his or her perceived importance in the organization. Therefore, the authors posit the *H3a* and *H3b*:

H3a. Individuals with higher levels of network centrality will demonstrate a more positive knowledge sharing.

H3b. Individuals with higher levels of valued network centrality will demonstrate a more positive knowledge sharing.

3. Research method

This study adopted the field survey methodology in collecting the data used to test its hypotheses to improve the generalizability of the results.

3.1 Organizational context

Previous studies have emphasized technological issues pertaining to knowledge sharing across or within units and organizations; for example, most studies were conducted on KM systems (e.g. the reviews of Alavi and Leidner, 2001). However, KM systems are merely one way of analyzing knowledge sharing, and face-to-face interactions are a required mechanism for sharing rather sticky knowledge (Szulanski, 2000). In addition, knowledge sharing that occurs between employees is the key to determining team and organizational knowledge (Cabrera and Cabrera, 2005). In this study, the authors focused on a health-care organization, as it represents a knowledge-intensive workplace where up-to-date studies of medical KM are limited (Lin *et al*., 2008; Kim *et al*., 2012). In addition, this study adopted nurses as the target sample because they must interact frequently with their colleagues to exchange their professional health-care knowledge. The lack of a motivational knowledge sharing mechanism to access vital knowledge from colleagues who have important and scarce resources in health-care organizations may result in more serious consequences for patients. For example, in 2011, the National Taiwan University Hospital, which had excellent organ transplant records in health-care treatments, almost damaged its reputation in a knowledge and information sharing accident. The hospital suffered an HIV organ transplant scandal, in which an HIV-infected donor's organs were unknowingly transplanted into five patients. This event resulted from an error by a coordinator who misunderstood a phone conversation and was unable to obtain help from colleagues. Such reckless accidents rarely occur, especially in Taiwan, which is famous for its health-care insurance design and mechanisms. The motivational mechanism of knowledge and information sharing is clearly strongly related to the lives of hospital patients. An investigation into knowledge and information sharing in health-care organizations is thus an important means of improving the quality of health care for patients.

Nurses are supposed to be caring, which is the primary and fundamental requirement to workers on health-care industry. Health-care industry is distinguished for low tolerance of delay for patient care information and high accuracy for treatment instructions. An unintentional mistake in a medical process is likely to damage human lives in short term and to bring about lawsuits of medical malpractice. Hence, a nurse's propensity to care patient

is partly molded by the requirement of jobs and likely to carry over to actions conducive to seamless delivery of caring process, such as knowledge sharing. Some high-technology industries, similar to health care, usually have low tolerance of information delay and stress seamless delivery service, and the impact of lack of knowledge sharing on organization is able to track, so their employees' propensities to share knowledge are akin to nurses'.

The focal health-care organization in this study is a regional teaching hospital, and its nurses are the focal subjects. This hospital was selected because it is one of the best medical centers in Taiwan and expressed a great interest in this study. Headed by a superintendent and two vice superintendents (i.e. medical affairs and administration), it comprises 18 medical treatment units, six medical service units and seven administrative/ medical research units. The hospital has 350 beds and 500 employees in total.

Although the influence on inter-nurse knowledge sharing of differences in the way that different hospital units are organized was not considered in this study, the authors can reasonably infer that such between-unit differences are unlikely to have had a significant influence on the findings because the nurses under study were motivated to share knowledge in structured occurrences by both the hospital reward system and their relationship with other nurses. The reward system, which is regulated by the hospital administrators, is an organizational measure applicable to every unit in the hospital. Hence, the moderating effect of between-unit organizational differences on the relationship between the reward system and inter-nurse knowledge sharing is negligible at best.

The organizational characteristic most likely to differ between hospital units is the workload volume. A nurse with a heavier workload is likely to have greater interaction with others. However, most hospital units in Taiwan are understaffed. Hospital administrators and the accreditation authority are taking serious measures (e.g. criterion of evaluation) to balance workload volumes across hospital units, thus reducing the likelihood of between-unit workload differences. In sum, the authors can reasonably infer that workload differences between hospital units do not significantly moderate the relationship between the inter-nurse relationship and knowledge sharing.

3.2 Subjects and data collection procedure

The unit of analysis is the individual and the sampling frame is composed of nurses in a regional teaching hospital. Nurses are knowledge workers, whose duties are associated with patient care, including catheterization, chest tapping and advanced cardiac life support. To develop a habit of cooperation in a health-care unit is valuable to ensure patient safety. Such collective action justifies the use of this sampling frame.

There may be some concern over the use of nurse-only interpersonal networks rather than the hospital-wide network. It seems intuitive that the relationship between nurses and other hospital staff could influence the knowledge sharing between nurses or that between nurses and other hospital staff. However, the authors consider nurse-to-nurse knowledge sharing to be of relatively greater importance because nurses represent the largest body of employees in any hospital. The current nursing shortage may also render the influence of inter-nurse relationships on inter-nurse knowledge sharing even more important. Most hospital units are understaffed, and nurses are thus strongly dependent on the cross-cover of others in completing their beds duties each day. The relationship between the nurses in a particular unit is likely to be stronger than their relationship with other hospital staff, and thus the authors can reasonably infer that the relationship between the nurses in a given unit is a more powerful predictor of knowledge sharing between nurses than are other relationships. In addition, the logical link between inter-nurse relationships and knowledge sharing is easier to observe in structured occurrences. The primary occurrences of nursing staff knowledge sharing are during shift changes and quality control circles. At the change-of-shift meeting, a change-of-shift report containing information pertaining to patients is given by charge nurses to their successors on duty. Charge nurses are not legally permitted to leave the hospital until they have provided these reports. A quality

control circle is a forum for discussing patient care problems and future plans, and it also serves to improve interpersonal and intradepartmental communication and as a knowledge-sharing opportunity. Although doctors have similar expertise to nurses, the patient-related information they give to nurses takes the form of medical orders; that is, instructions for patient treatment rather than nursing knowledge or information on new procedures. Thus, the authors can reasonably infer that knowledge sharing between nurses is more strongly linked with inter-nurse relationships than is the doctor–nurse relationship. Finally, administrative staffs are responsible for providing essential support to health-care professionals and are unlikely to have intensive patient contact. Their knowledge is less relevant to nursing care, and thus their influence on knowledge sharing between nurses is necessarily weaker than that exerted by inter-nurse and nurse–doctor relationships. Accordingly, we believe it was appropriate in this study to use nurse-only networks rather than hospital-wide networks in investigating the effects of inter-nurse relationships on inter-nurse knowledge sharing.

In terms of data collection, as this study collected whole-network data, thus the authors needed to work in collaboration with the human resources department of the focal hospital to obtain the roster of nurses. A total of 189 nurses in 12 nurse divisions worked in the hospital. The whole-network questionnaires were distributed to all the nurses in each division. The respondents were required to fill out the questionnaire in relation to the roster in their division. This study analyzed the data separately by division. If more than 80 per cent of the respondents filled out the questionnaires in each division, the questionnaires were regarded as valid data that could be used for further analysis. Each nurse received USD10 for his or her participation. The researchers interacted extensively with a nursing director and a supervisor; this study thus excluded them from the analyses to avoid introducing bias. The survey was also pretested with a small group of respondents before administration to ensure the reliability and validity of the measurement scale.

The main survey yielded 187 responses, and after data screening, 180 valid responses (valid response rate of 96 per cent) were approved for the analysis. Furthermore, no division had less than an 80 per cent response rate, an important threshold for whole-network analysis (Sparrowe *et al.*, 2001). Based on *t*-tests with a *p*-value > 0.01, no significant differences were found between the responding and non-responding returns pertaining to gender, education level and seniority, indicating no non-response bias. Among the 180 valid respondents, 99 per cent were female, and most of the respondents were aged under 30 years (75 per cent). The seniority of most of the respondents was under 15 years (85 per cent), and most held a bachelor's degree (98 per cent).

3.3 Measurement of the constructs

Based on the foregoing literature review, the proposed research model contained seven constructs. Data were collected to measure these seven constructs and test the model fitness. This section describes the measurement of each construct and presents some example items. Formal definitions of the constructs and items are summarized in Table I, adapted from prior studies to enhance validity. All of the scales used were measured on a five-point Likert scale (ranging from 1 = completely disagree to 5 = completely agree), except for the scales used for the social network constructs, which were measured on a six-point Likert scale. To ensure the content validity of measurement, all of the measurements were translated into Chinese by the authors and then reviewed by two bilingual experts who majored in health care to assess the appropriateness and adequacy of the translations. Back translation was also used to assure consistency between the Chinese and original English versions of the questionnaire instrument.

3.3.1 Independent variable.

3.3.1.1 Calculative-based mechanism. Reward systems: Hospitals in Taiwan have implemented a reward system to encourage their doctors and nursing staff, the groups of employees most closely related to the hospitals' incomes. The reward system for nurses

Table I Construct definitions

Construct	*Definition*	*Reference*
Independent variables		
Relational-based mechanism		
Withdrawals: ND	Assessment of the frequency with which contacts are made to get help from others	Sykes *et al.* (2009)
Withdrawals: VND	Assessment of peers who have resources the nurse perceives to be important and influential to the task relevant to his or her job	Sykes *et al.* (2009)
Deposits: NC	A nurse's network centrality is a function of how many connections he or she has and how many connections his or her peers have. A nurse is more central when there are more connections within his or her local network. Fewer connections within his or her local network means he or she is more powerful. Power comes from being connected to those that are powerless	Sykes *et al.* (2009)
Deposits: VNC	A function of a nurse's peer assessment of his or her control of information and other resources relevant to health care	Sykes *et al.* (2009)
Calculative-based mechanism		
Reward systems	The extent to which an individual believes he or she will receive economic rewards for knowledge sharing	Bock *et al.* (2005) Kankanhalli *et al.* (2005)
Dependent variables		
Knowledge sharing		
Explicit knowledge sharing	The extent to which an individual believes he or she engages in explicit knowledge sharing	Bock *et al.* (2005)
Tacit knowledge sharing	The extent to which an individual believes he or she engages in tacit knowledge sharing	Bock *et al.* (2005)
Belief of reciprocal obligation	The belief of feeling obligated to return information, resources or even knowledge to the favor contributor in the future	Bock *et al.* (2006)

Notes: ND: network density; NC: network centrality; VND: valued network density; VNC: valued network centrality

includes promotions and pay raise. A pay raise is usually the byproduct of a promotion. The possibility of a promotion encourages nurses to pursue advancement by writing up and disseminating case studies that have been accepted by the Taiwan Nurses Association. A patient case study is an evidence-based research report that details the symptoms of illness from its beginning to final stages in addition to any health-care procedures or nursing practices found to be effective or even innovative at each stage. The more of these patient case studies that nurses disseminate, the greater their likelihood of being promoted. The participating hospital in this study has implemented this reward system for nurses in all units.

The authors used three items adapted from Bock *et al.*'s (2005) and Kankanhalli *et al.*'s (2005) studies to measure this construct. The respondents were asked to describe the organization's reward systems according to the following:

- "It is attractive for me to receive monetary rewards in return for sharing professional knowledge (e.g. quality control circle participation, case study report)".
- "It is attractive for me to receive a higher salary in return for my knowledge sharing".
- "It is attractive for me to get promoted for my knowledge sharing."

3.3.1.2 Relational-based mechanism. The authors collected the social network data using a roster-based sociometric approach. The social network data included the interaction frequency and actors' assessments of alters' control of information and other resources. The authors used the data to compute the four independent variables discussed earlier, i.e.:

1. network density;
2. valued network density;

3. network centrality; and
4. valued network centrality.

A social network is an interaction network that describes the degree to which individuals communicate or exchange help with others in an organization, and consists of the individuals and the ties that connect them. Ties represent the communications made to seek help from or help peers. This study created a help network matrix based on the individuals' assessments of the frequency with which they seek or give help to their peers in an organization (values ranging from 0 to 5, with 0 indicating no connection and 1-5 indicating the degree of help obtained or given). In addition, individuals were asked to evaluate their peers' control of information, and other resources relevant to health care (values ranging from 0 to 5, with 0 indicating no control and 1-5 indicating the degree of control). This study collected four metrics for a respondent *i* with respect to a nurse *j* (Sykes *et al.*, 2009).

1. *Get-help*$_{ij}$: Assessment of the frequency with which contacts are made to get help from nurse *j*.
2. *Give-help*$_{ij}$: Assessment of the frequency with which contacts are made by nurse *j* to seek help.
3. *Information-control*$_{ij}$: Evaluation of nurse *j*'s control of information relevant to health care.
4. *Resource-control*$_{ij}$: Evaluation of nurse *j*'s control of resources relevant to health care.

For example, get-help$_{ij}$ was elicited from the following statement: "For the following people, indicate the extent to which you contact with them to get help relevant to health care". Give-help$_{ij}$, information-control$_{ij}$ and resource-control$_{ij}$ were elicited in a similar fashion.

Following a study by Sykes *et al.* (2009), this study used the get-help and give-help networks to build the network density and centrality measures, respectively. The former reflects the extent to which a nurse seeks help from peers in the organization, and the latter reflects the extent to which a nurse provides help to the peers with whom he or she interacts:

- *Network density*: The network density was computed for each ego (nurse) to account for the peers from whom he or she frequently seeks help, and is expressed as the number of dichotomized ties divided by the number of possible pairs (Sykes *et al.*, 2009).
- *Valued network density*: The valued network density was computed for each nurse to account for the peers who have resources he or she perceives to be important and influential to the task relevant to his or her job, and is expressed as the sum of the weighted tie strength from the average assessment of resources controlled by peers divided by the sum of the possible pairs.
- *Network centrality*: This study used Bonacich's approach, which is widely accepted as being superior to the original network centrality calculation (Hanneman and Riddle, 2005), to compute the network centrality. A nurse's network centrality is a function of how many connections he or she has and how many connections his or her peers have. Nurse *i*'s network centrality can be expressed as $C_i = \Sigma A_{ij}(a + bC_j)$, where A_{ij} is nurse *i*'s adjacent matrix constructed from the give-help matrix and a and b are a normalization parameter and attenuation factor, respectively (Sykes *et al.*, 2009).
- Valued network centrality: The valued network centrality for nurse *i* is a function of a peer assessment of his or her control of information, and other resources relevant to health care. Valued network centrality can be expressed as $VNC_i = 1/(n - 1)(\Sigma\ Information_{ij} + Resourses_{ij})$, where n is the number of nurses in the organization (Sykes *et al.*, 2009).

3.3.2 Dependent variable.

3.3.2.1 Knowledge sharing. The knowledge sharing construct in this study includes measures of both explicit and tacit knowledge. The authors used two items adapted from Bock *et al.* (2005) to measure an individual's explicit knowledge sharing. Sample items include "I frequently share my nursing care reports with colleagues of my organization" and "I always share patient care report or case analysis with colleagues of my organization". The authors used three items adapted from the study by Bock *et al.* (2005) to measure an individual's tacit knowledge sharing. Sample items include:

- "I frequently share my nursing experiences or knowhow with colleagues in the organization".
- "I always provide my know-where or know-whom at the request of other organizational members".
- "I often share my professional knowledge from the in-service program with colleagues".

3.3.2.2 Belief in reciprocal obligation. This study used three items adapted from the study by Bock *et al.* (2006) to measure belief in reciprocal obligation. Sample items include "If my colleagues share their information or resources with me, I believe that I will then share my information, resources, or knowledge with them in the future", "If my colleagues share information or resources with me, I feel that I am obligated to do the same for them in the future" and "If my colleagues share information or resources with me, I believe that I should render assistance equivalent to or beyond their contributions in the future".

3.3.2.3 Control variables. This study includes four control variables to avoid any confounding bias in the estimates of the relationship between the independent variables and knowledge sharing. First, the RBM is an extension of the structural dimension of social capital theory. The relational and cognitive dimensions of social capital theory, although not the focus of this study, are included in the control variables *identification* and *shared language*, respectively, because each of these variables is a representative facet of the corresponding dimension. Chiu *et al.* (2006), for example, showed that identification and shared language positively influence individual knowledge sharing. This study used three items adapted from the study by Chiu *et al.* (2006) to measure identification and shared language, respectively. Second, in the health-care environment, an employee's tenure is an important variable that may affect information searching or providing (Lee *et al.*, 2011; Singh *et al.*, 2010). Thus, the authors reasonably infer that tenure is also applicable to an employee's knowledge sharing. Finally, to detect social desirability bias, i.e. the tendency of some respondents to answer questions in a way that makes them look good, this study used a short version of the Marlowe-Crowne Social Desirability Scale to provide a partial check of respondents' self-report validity (Strahan and Gerbasi, 1972). In sum, in this study, the authors included *identification*, *shared language*, *tenure* and *social desirability* as the control variables.

3.4 Data analysis

UCINET version 6.403 was used to analyze the sociometric data. To test the hypotheses, the authors performed partial least squares (PLS) analysis using the SmartPLS 2.0 (M3) software package because it is suitable for early-stage research model construction (Fornell and Bookstein, 1982) and the small sample condition (Chin *et al.*, 2003). Following the suggestions by Anderson and Gerbing (1988), the authors adopted a two-step approach to validate the research model. The purposes of the two steps were to test and confirm the measurement and structural models. This study tested the measurement model using a confirmatory factor analysis to evaluate the discriminant and convergent validity of all of the constructs, and used the structural model to evaluate the significance of the path coefficients and test the research hypotheses.

4. Results

4.1 Analysis of the measurement model

The measurement model was used to assess the reliability and validity of the reward systems, knowledge sharing, belief in reciprocal obligation and four control variables (i.e. social desirability, identification, shared language and tenure). The model includes multiple items but excludes four social network constructs (i.e. network density, network centrality, valued network density and valued network centrality) that used single indicators per construct per individual.

This study evaluated the construct reliability of the measures using Cronbach's alpha and the composite reliability (CR). The Cronbach's alphas of each construct measure were as follows:

- reward systems = 0.87;
- knowledge sharing = 0.87;
- belief in reciprocal obligation = 0.94;
- identification = 0.84;
- shared language = 0.82; and
- social desirability = 0.81.

All values were above 0.7 and exceed the threshold values.

To validate the measurement model, this study assessed the content, convergent and discriminant validities. Content validity was ensured by asking health-care experts and practitioners to review the instruments and pilot tests. The authors assessed convergent validity by testing the CR and average variance extracted (AVE) of the measurement scales. The CR statistics in Table II show that all of the constructs exceeded the acceptable value of 0.7 (Bagozzi and Yi, 1988). The authors examined the AVE values to determine whether they were greater than the recommended value of 0.5 (Fornell and Larcker, 1981). As shown in Table II, the AVE values of all of the constructs ranged from 0.60 to 0.89. Thus, the statistics demonstrated good convergent validity.

This study determined discriminant validity by assessing whether the square root of the AVE for each construct was greater than the correlation levels involving the construct. Table III presents the means, standard deviations and correlations of the study constructs. All of the correlations were satisfactory, with the diagonal in Table III showing that the square roots of the AVEs for each construct were higher than the inter-construct correlations, demonstrating good discriminant validity (Chin, 1998). These results indicate that all of the constructs used in this study are acceptable and reliable.

4.2 Analysis of the structural model

This study performed a PLS analysis using the SmartPLS 2.0 software to validate the structural model. The authors adopted the bootstrap resampling method (200 resamples) to verify the significance of the model's path coefficients. The results are summarized in Table IV. This study validated three models that included four control variables (i.e. social

Table II Results of confirmatory factor analysis

Measures	*Items*	*Composite reliability*	*Average variance extracted*
Reward systems (RS)	3	0.92	0.79
Knowledge sharing (KS)	5	0.89	0.62
Belief of reciprocal obligation (BRO)	3	0.96	0.89
Identification (ID)	4	0.89	0.68
Social desirability (SD)	10	0.82	0.60
Shared language (SL)	3	0.83	0.61

Table III Means, standard deviations, and correlations between constructs

Construct	*Mean*	*Sd.*	*SD*	*ID*	*SL*	*TE*	*RS*	*ND*	*NC*	*VND*	*VNC*	*BRO*	*KS*
SD	3.68	0.82	**0.77**										
ID	3.12	0.85	0.13	**0.82**									
SL	3.73	0.75	0.23	0.48	**0.78**								
TE	8.36	2.06	0.01	0.08	−0.01	NA							
RS	3.47	1.01	0.25	0.31	0.39	−0.21	**0.88**						
ND	0.49	0.28	0.09	−0.11	0.04	−0.13	0.08	NA					
NC	0.82	0.57	0.07	−0.06	−0.08	0.10	0.01	0.27	NA				
VND	5.85	3.95	0.15	−0.03	0.07	−0.26	0.06	0.28	0.25	NA			
VNC	10.24	2.48	0.05	0.02	0.08	0.40	−0.06	0.02	0.21	0.10	NA		
BRO	3.93	0.86	0.23	0.12	0.11	−0.22	0.27	0.12	0.06	0.18	0.05	**0.94**	
KS	3.67	0.81	0.16	0.35	0.26	0.25	0.28	0.05	0.13	0.04	0.38	0.18	**0.78**

Notes: SD: social desirability; ID: identification; SL: shared language; TE: tenure; RS: reward systems; ND: network density; NC: network centrality; VND: valued network density; VNC: valued network centrality; BRO: belief of reciprocal obligation; KS: knowledge sharing; the bold values in the diagonal are the square roots of the average variances extracted (AVEs); the off-diagonal elements are the correlations among the constructs

Table IV Structural model results

Dependent variables		*KS*	*BRO*
Predictor	*Model 1*	*Model 2*	*Model 3*
Control variables			
SD	0.27***	0.28***	0.25***
ID	0.19**	0.20**	0.09*
SL	0.05	0.07	0.09*
TE	0.10*	0.11*	−0.21*
Independent variables			
RS	0.18**	0.24**	
ND		0.01	0.14**
VND		0.04	0.19**
NC		0.15**	
VNC		0.32***	
R^2	0.26	0.41	0.22

Notes: SD: social desirability; ID: identification; SL: shared language; TE: tenure; RS: reward systems; ND: network density; NC: network centrality; VND: valued network density; VNC: valued network centrality; BRO: belief of reciprocal obligation; KS: knowledge sharing;; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

desirability, identification, shared language and tenure), a reward system and four social network constructs. The first model served as a benchmark; it included only four control variables and a reward system, which prior studies have found to be the most influential predictors of knowledge sharing. The three control variables were significantly related to the dependent variable (social desirability: $\beta = 0.27$, $p < 0.001$; identification: $\beta = 0.19$, $p < 0.01$; tenure: $\beta = 0.10$, $p < 0.05$) except shared language ($\beta = 0.05$, $p > 0.1$). The reward system had a positive and direct effect on individual knowledge sharing ($\beta = 0.18$, $p < 0.01$), which echoes the findings by Kankanhalli *et al.* (2005) and Kim and Lee (2006), who reported beta coefficients between a reward system and knowledge sharing are around 0.20. Thus, the coefficient of reward system presented in Table IV is close to the average reported in previous research. This model explained 26 per cent of the variance. These results demonstrate that users are more likely to share knowledge when their organizations provide related rewards such as promotions, bonuses, and higher salaries, thus supporting *H1*.

Aside from the aforementioned five constructs, the second model included four predictors pertaining to social network constructs. Contrary to the expectation, network density did not have a significant relationship with an individual's knowledge sharing ($\beta = 0.01$, $p > 0.1$); thus, *H2a* was not supported. Similarly, valued network density did not have a significant

relationship with an individual's knowledge sharing ($\beta = 0.04$, $p > 0.1$); thus, *H2b* was not supported. Consistent with prior studies (Wasko and Faraj, 2005), network centrality had a positive influence on individual knowledge sharing ($\beta = 0.15$, $p < 0.01$), thus supporting *H3a*. Valued network centrality also had a positive such influence ($\beta = 0.32$, $p < 0.001$), thus supporting *H3b*. Model 2 explained 41 per cent of the variance in knowledge sharing, a 15 per cent increase over Model 1. The beta between network centrality and knowledge sharing was 0.15, which is relatively small compared to that in Wasko and Faraj's (2005) research ($\beta = 0.46$). However, they do not distinguish between network centrality and valued network centrality, and thus their beta is a result of the combination of these two variables. This study not only differentiates between these two variables but it also distinguishes their effects on knowledge sharing. The betas for network centrality and valued network centrality were 0.15 and 0.32, respectively, for a summation of 0.47, which is close to the beta in Wasko and Faraj (2005).

Finally, with regard to the dependent variable *belief in reciprocal obligation*, the third model included two predictors pertaining to the social network constructs. The four control variables were significantly related to the dependent variable (social desirability: $\beta = 0.25$, $p < 0.001$; identification: $\beta = 0.09$, $p < 0.05$; shared language: $\beta = 0.09$, $p < 0.05$; tenure: $\beta = -0.21$, $p < 0.05$). Identification and shared language are control variables corresponding to the relational and cognitive dimensions, respectively, and their beta coefficients in Model 3 are smaller than those of network density and valued network density. This finding indicates that the contributions to reciprocal obligation made by the relational and cognitive dimensions of social capital theory are weaker than those made by the structural dimension. In addition, tenure in the study hospital was a control variable assessing an individual degree of experience in his or her current job. It was positively linked to knowledge sharing ($\beta = 0.11$) and negatively linked to an individual's belief in reciprocal obligation ($\beta = -0.21$). Although the influence of tenure on both dependent variables was quite moderate, its presence does not rule out the predictive power of the independent variables for knowledge sharing and belief in reciprocal obligation.

The authors found network density to have a significant relationship with an individual's belief in reciprocal obligation ($\beta = 0.14$, $p < 0.01$), thus supporting *H2c*. Valued network density was also found to have a significant relationship with this belief ($\beta = 0.19$, $p < 0.01$), and thus *H2d*, too, is supported. This model explained 22 per cent of the variance. The betas for these two variables are intuitively small. However, this study not only differentiates between them but also distinguishes their effects on an individual's belief in reciprocal obligation. The betas for network density and valued network density were 0.14 and 0.19, respectively, for a summation of 0.33. The authors summarize the results of the hypotheses tests in Table V.

5. Discussion

This study explored two different mechanisms to account for an individual's knowledge sharing: a *CBM* that consists of reward systems, and a *RBM* that comprises relational deposits and withdrawals. As expected, the authors found the reward systems to be a significant facilitator of an individual's knowledge sharing. This echoes the findings by Kim

Table V Hypotheses test results

Hypothesis	*Hypothesized relationship*			*Conclusion*
H1	RS	→	KS	Supported
H2a	ND	→	KS	Not supported
H2b	VND	→	KS	Not supported
H2c	ND	→	BRO	Supported
H2d	VND	→	BRO	Supported
H3a	NC	→	KS	Supported
H3b	VNC	→	KS	Supported

and Lee (2006) and Witherspoon *et al.* (2013), who found that organizational rewards were positively related to the frequency of knowledge sharing.

This study lends support to the RBM, with social network constructs explaining about 15 per cent of the additional variance beyond the traditional predictor (specifically reward systems), thereby giving us a better understanding of the knowledge sharing. The results showed that network centrality and valued network centrality were both significantly related to an individual's knowledge sharing, which suggests that the motivation for individual knowledge sharing depends not only on the frequency of dyadic interactions but also on the accumulation of social interactions. In addition, the association between knowledge sharing and valued network centrality was found to be stronger than that between knowledge sharing and network centrality, which suggests that the knowledge sharing is stronger when the contributors possess more organizational resources.

Contrary to the authors' expectation, the findings further showed that network and value network densities were not significantly related to knowledge sharing. The authors speculate that the junior nurses usually serve as the knowledge recipients since mentorship prevails among nurses in health-care organizations, and the seniors may often serve as health-care knowledge contributors (Andrews and Wallis, 1999). In other words, organizational tenure captures a nurse's familiarity with health-care expertise, implying that senior nursing staffs are more inclined to contribute knowledge to peers rather than acquire it from them. In conclusion, knowledge sharing in health-care organization being initiated by senior nurses, who have more valuable knowledge than juniors, implies that the seniors' help to juniors for patient care routine in health-care organization is conducive to share knowledge, which in turn leads to the forward circulation of knowledge sharing.

However, the findings do show both network and valued network densities to be significantly related to an individual's belief in reciprocal obligation, which suggests that an individual who receives more favors will have a stronger such belief, which may alleviate any free-rider concerns with regard to knowledge sharing. An individual who receives favors from others in the form of knowledge may be unable to return that knowledge immediately, but his or her belief in reciprocal obligation will drive him or her to do so in the future. In conclusion, the findings imply that intensive social interaction can foster individual goodwill in the knowledge sharing arena.

6. Conclusions

This study validates the relationship between the CBM, the RBM and an individual's knowledge sharing. The power of the RBM's network centrality to explain an individual's knowledge sharing is compatible with that of the CBM (i.e. reward systems). Considering its tie strength and control of health-care-related resources, the RBM's valued network centrality has a stronger explanatory power for knowledge sharing than network centrality, which takes only social network characteristics into account. Therefore, the RBM provides a valuable perspective for understanding an individual's knowledge sharing.

This study has a few notable limitations. First, the authors used a self-report questionnaire survey with data collected from a single source, giving rise to a potential common method bias that could threaten the causality explanations. However, such a bias is of less concern in this study, as the authors adopted the psychological separation method suggested by Podsakoff *et al.* (2003) when designing the questionnaire. This study excluded variable introductions to prevent respondents from connecting with the variable measurement criterion. In addition, the authors measured the social network constructs through peer reviews rather than through the self-report questionnaire to reduce the threat of a single source concern. Therefore, the possibility of common method bias was reduced. Second, the collected cross-sectional data indicate that the posited causal relationships can only be inferred, and not proven. Third, as this study examined individual knowledge sharing in a sample collected from a health-care organization in Taiwan, the generalizability of its

findings to other settings and regions requires further confirmation. In addition, the health-care organization network the authors examined is a closed network, wherein the failure to reciprocate in the long term can and likely does result in future sanctions against the non-reciprocating actor by fellow network members. Accordingly, the findings may not applicable to an open network environment without further confirmation. A fruitful direction for future research would be to fit the model with data collected in other cultural and regional contexts.

This study contributes to the KM research by deepening the understanding of employees' knowledge sharing. The RBM social network constructs help to explain knowledge sharing, and look beyond traditional CBM reward systems as its key predictors. The study posits that social network constructs effectively seize informal interactions that the reward systems construct may not account for and provide insights that can guide managerial direction. Thus, the RBM social network constructs create future research opportunities that could clarify earlier findings and improve the knowledge.

When the accumulated influence of knowledge sharing is inflowing, the individual is a knowledge sharing recipient; when it is outflowing, he or she is a knowledge sharing donor. As they make a more significant contribution, donors take a more central role in social networks, while recipients take a more peripheral role. An individual's knowledge sharing influence is embedded in the progressive social contexture instead of the short-term exchange. In other words, the relationship account in this study has significant implications for future organizational knowledge sharing research.

In this study, the authors sought to answer questions pertaining to motivating knowledge sharing from an economic benefit association perspective. For practitioners, an understanding of two knowledge sharing mechanisms is critical to motivating employees to share within organizations. The findings offer insights that may assist organizations in enhancing their employees' knowledge sharing. First, they suggest that reward systems may positively influence an individual's knowledge sharing. A lack of reward or incentive systems is an important inhibitor of knowledge sharing, especially in health-care organizations (Lin *et al.*, 2008). Thus, the findings suggest that organizations should ensure they provide sufficient extrinsic rewards (such as promotions, bonuses or increased salaries) that induce their employees to share knowledge (Kankanhalli *et al.*, 2005; Nan, 2008).

Second, the findings suggest that network and valued network centralities may be positively related to an individual's knowledge sharing. An individual with a high network centrality is designated an "opinion leader". Opinion leaders are often the centers of formal (i.e. power) or informal (i.e. expertise) networks, implying that they have more influence than those on the periphery. Thus, management should attempt to align their opinion leaders' knowledge sharing standpoints with the organization, as it may influence other employees' knowledge sharing intentions in both formal and informal networks. In addition, knowledge sharing reward systems should be differentiated according to the employees' placement in the related social networks.

Third, the results suggest that while the RBM does not directly associate with economic benefits as the CBM; it plays an additional important role in increasing the possibility of an employee's knowledge sharing relative to the CBM. Although the conversion of the RBM to economic benefits is slower than that of CBM, creating atmosphere in an organization that facilitates knowledge sharing between employees should involve a motivation mechanism that incorporates both short- and long-term effects.

Fourth, the findings suggest that when an individual receives favors from others, even if he or she does not have the ability to share that knowledge immediately, he or she will feel obligated to do so in future. Thus, creating an atmosphere within the organization that encourages favor recipients to return favors as soon as possible is likely to encourage knowledge sharing among organizational members.

Future research could establish a nomological network for an individual's knowledge sharing by examining additional antecedents, and further explore the moderating roles of culture differences to advance the knowledge of the knowledge sharing model's boundary conditions.

Notes

1. While the term *advice networks* is more widely used and its essence is consistent with what the study used, the word *help* rather than *advice* in this study is more appropriate to communicate with subjects. To be consistent with this, the authors use the term *help networks* rather than the term *advice networks*.

2. In social network, the focal individuals and the other members within a social unit are termed actors and alters, respectively.

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