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Multi-level knowledge sharing: the role of perceived benefits in different visibility levels of knowledge exchange

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Abstract

Purpose – This paper aims to explore the relationships between participants' perceived benefits of sharing knowledge privately, within a group or with the general public within an organisational knowledge network. The quality and quantity of knowledge shared are explored in relation to the level of knowledge sharing visibility (both content and participants' profiles).

Design/methodology/approach – A research framework of perceived benefits of knowledge sharing is designed; survey and content analysis are used to explore influences of perceived benefits on the quantity and quality of knowledge shared by participants for each level of knowledge sharing within an organisation. The research model is empirically tested using a questionnaire survey with 205 participants and content analysis of their contributions in a high-tech corporate group. This study uses the partial least squares path-modelling method to explore relationships between constructs of the research model.

Findings – The current research results show that intrinsic benefits are more influential than extrinsic benefits for private knowledge sharing, while extrinsic rewards play an important role at the public knowledge sharing within organisations. In addition, results indicate that both the quality and quantity of knowledge sharing at the group-level knowledge sharing are significantly higher than at the private and the public levels.

Practical implications – Contemporary knowledge management systems are developed by integrating communication channels in different visibility levels of knowledge exchange. Managers of knowledge management systems are advised to use the research outcome for developing incentive strategies in different levels.

Originality/value – In contrast to previous studies that focus on only one level of knowledge sharing, this paper explores relationships between perceived benefits of knowledge sharing with the quantity and quality of shared knowledge for three distinct levels of knowledge sharing.

Keywords Visibility, Knowledge sharing, Perceived benefit, Knowledge network, Social determination theory

Paper type Research paper

1. Introduction

Knowledge sharing aids organisations in building competitive advantage by enabling them to react quickly to problems, shorten product development duration and support organisational innovation (Wang and Noe, 2010). However, facilitating participation in knowledge sharing still remains a major challenge for researchers and practitioners (Martinez, 2015). Contemporary knowledge management (KM) systems have been designed to support the emergent social nature of knowledge sharing as a socially embedded activity. Electronic knowledge networks (EKN) support such social dynamics in

self-organised and open activity systems (Faraj *et al.*, 2008). These networks are supported by different knowledge sharing channels, ranging from private to public communication between participants (Wasko and Faraj, 2005; Kankanhalli *et al.*, 2005b).

Establishing communication channels between participants does not assure that knowledge sharing will actually take place within and between organisations. Knowledge sharing performance depends on how participants use the technologies provided (Hwang *et al.*, 2015; Sedighi *et al.*, 2015). Obviously, one of the critical challenges in fostering knowledge contribution is individual participation, which is explicitly related to the participants' propensity to share knowledge with others (Chiu *et al.*, 2006; Chang and Chuang, 2011). Previous studies show the importance of influential factors such as motivation and perceived benefits to clarify why individuals participate in knowledge sharing (Sedighi *et al.*, 2015; Stenius *et al.*, 2016; Law *et al.*, 2017). These factors significantly influence individual knowledge sharing in terms of quantity and quality (Lou *et al.*, 2013).

Contemporary KM technologies such as Enterprise Social Media (ESM) have been developed to increase unstructured knowledge sharing within organisations (Leonardi, 2014; Grant, 2016). These systems use visible communicative technologies within organisations to transform invisible communications to visible knowledge exchanges (Leonardi *et al.*, 2013). These technologies improve third parties' metaknowledge about shared knowledge as well as participants' profiles (Leonardi, 2014). Knowledge sharing channels are structured by private, group and public knowledge exchange among participants (Sedighi *et al.*, 2016). Knowledge sharing channels enable participants to select knowledge recipients with whom they wish to communicate, and selecting the level of knowledge contribution visibility in the network (Sedighi *et al.*, 2017). The level of knowledge sharing visibility as a predictor of knowledge sharing behaviours (Zhang *et al.*, 2013) may influence participants' contributions. Previous research has focused on a single level knowledge sharing, for which there are two main explanations: firstly, it is difficult to collect multi-levelled data; secondly, it is not often possible to measure the visibility level of interactions, i.e. the level of knowledge sharing, deployed. This paper explores the effects of perceived benefits at different levels of the knowledge sharing:

RQ1. How can individual perceived benefits influence the quality and quantity of knowledge sharing within a knowledge network at the different levels of the knowledge sharing?

The paper uses self-determination theory (SDT; Deci and Ryan, 1985) to explore knowledge sharing behaviour in knowledge networks. SDT clarifies how participants voluntarily participate in knowledge exchange by postulating three types of perceived benefits: intrinsic benefits, internalised extrinsic benefits and external regulation (Deci and Ryan, 2002). Although several studies have deployed the SDT for one visibility level, this paper extends existing studies by using the SDT to analyse different levels of knowledge sharing.

The rest of this work is organised as follows. Section 2 reviews relevant work on knowledge sharing, knowledge networks and visibility levels, after which the relationship between communication and the individual perceived benefits are explained. Section 3 identifies our research hypotheses and research framework. Section 4 scopes out the research design and data analysis, and results are then presented using statistical models in Section 5. Section 6 lays out the discussion, interpreting the meaning of the model results. Then, Section 7 of the paper concludes, while listing out the limitations and future research.

2. Background

2.1 Knowledge sharing

Knowledge sharing is a significant process of organisational innovation and leveraging knowledge asset (Boer *et al.*, 2011; Massa and Testa, 2009). Companies claim that the

knowledge sharing process provides a base for their competitive advantages (Ipe, 2003). Knowledge sharing is defined as a sustained process of exchanging knowledge through knowledge exchange channels between individuals, groups and organisations (Oyemomi *et al.*, 2016). Knowledge shared can be categorised as either explicit or tacit. As tacit knowledge is embedded in employees' mind or experience and it is not easy to codify, but explicit knowledge can be expressed in explicit forms, such as documents, reports or instructions (Hau *et al.*, 2013). This study focuses on sharing personal codified experiences within organisations through enterprise social networks. As knowledge sharing starts from the individuals who generate knowledge, investigations on knowledge sharing from the individual perspective exposes the complex nature of the human decision-making. Individual knowledge sharing between employees occurs via written documents, observations and face-to-face communications in synchronous or asynchronous systems. The important role of individual knowledge sharing to maintain organisational competitive advantages has been extensively highlighted in many studies (Wang and Noe, 2010; Liu and Liu, 2011).

This paper considers network members as sources of knowledge for whom participation in knowledge sharing can be measured through knowledge contribution. A few KM studies examine the quality aspect of knowledge sharing (Lou *et al.*, 2013; Chang and Chuang, 2011), but measuring knowledge sharing behaviour within organisations need to focus on both quality and quantity aspects of knowledge sharing (Chiu *et al.*, 2006). Quantity of knowledge sharing is measured by the volume of shared knowledge, while quality of knowledge is measured with evaluating the helpfulness of shared knowledge (Wasko and Faraj, 2005). Furthermore, Kyoon Yoo (2014) introduces three aspects of perceived knowledge quality: perceived intrinsic knowledge quality, perceived contextual knowledge quality and perceived actionable knowledge quality. These three aspects are all of importance for the evaluation of perceived quality of shared knowledge.

2.2 Knowledge networks

Knowledge sharing between experts in high-tech companies is not the same as between other employees in the same companies. A large portion of knowledge shared by experts in networks relates to their experiences (Panahi *et al.*, 2013). Communication is the main mechanism of sharing lessons-learned and tacit knowledge among such participants (Liu and Liu, 2008). Several KM technologies have been developed to promote communication between employees. Knowledge network is a type of social networks in which relations represent shared knowledge among participants (Al-Hashem and Shaqrah, 2012). Knowledge networks are enabled by computer-mediate technology, so-called EKN.

Several definitions have been developed to clarify functionality of EKNs in specific settings. This study defines EKNs as a contemporary technical features to use dynamic, emergent and continuous communication between participants rather than static documentation (Faraj *et al.*, 2008). These networks provide a collaborative and open environment for self-organised participation (Faraj *et al.*, 2008). They use different asynchronous and synchronous electronic communication technologies between employees by focusing on knowledge exchange and social network structure (Štorga *et al.*, 2013; Faraj *et al.*, 2008). EKNs are sustained through individual communications and self-identification of expertise, which can overcome the limitations of conventional KM systems such as knowledge repositories (Štorga *et al.*, 2013). These networks include a variety of communication technologies for instance private online communication, discussion forums (Montero *et al.*, 2007) and wikis (Kane, 2011).

2.3 Levels of knowledge sharing

Knowledge networks enable participants to share knowledge with different levels of knowledge sharing. Visibility of individuals' participation for knowledge contribution

constructs different levels of knowledge sharing in knowledge networks. Visibility of knowledge exchange is the level of participants' awareness of "who knows what and who knows whom" by observing shared knowledge and knowledge relations (Leonardi, 2014). Similarly, Zhang *et al.* (2013) identify knowledge exchange visibility as employees' opportunities to observe knowledge sharing behaviours within organisations. Contemporary KM systems (e.g. ESM) have adopted visible knowledge exchange systems to improve level of knowledge sharing. Indeed, increasing transparency of exchanging messages and profiles of participants (Leonardi, 2014) improves the KM performance at the highest level of knowledge sharing. These systems have transformed private communication technologies (e.g. telephone or face-to-face meeting) to visible communication technologies (e.g. enterprise knowledge media).

EKNs promote individual knowledge sharing by developing private, semi-transparent and transparent environments for participation (Sedighi *et al.*, 2016). A knowledge network is inherently multi-levelled from the viewpoint of knowledge sharing, but most studies consider only one level (Phelps *et al.*, 2012). Three levels of knowledge sharing have been recognised in EKNs. *Private* knowledge sharing channels are designed in knowledge networks to exchange knowledge between two participants: a knowledge sender and a knowledge recipient (Hsiao *et al.*, 2017). This kind of knowledge exchange can be defined as one-to-one communication between two participants. *Group* knowledge sharing channels are developed for few-to-few communication between a group of participants (Brandzaeg and Heim, 2009). The visibility of communication is developed within closed groups. *Public* knowledge sharing technologies support knowledge sharing with all networks members within organisations. These platforms support many-to-many communications (Raman *et al.*, 2005).

2.4 Perceived benefits of participation

Previous studies focus on perceived benefits of knowledge sharing to explain participants' propensity to share their knowledge (Chang and Chuang, 2011; Jeon *et al.*, 2011). Knowledge sharing in EKNs as a volunteer activity within organisations needs to be encouraged through perceived benefits and individual outcome expectations (Paroutis and Al Saleh, 2009). Participation in a social phenomenon is strongly dependent on participants' expectations about perceived benefits such as respect, recognition, moral obligation and enjoyment (Blau, 1964; Wasko and Faraj, 2000). Furthermore, participants' motivation for knowledge sharing is continuously influenced by values, such as personal and social values (Oliveira *et al.*, 2016). Knowledge exchange within an organisational context is a form of social exchange that is moderated by these values. Knowledge exchange is also a process of exchanging valuable resources that are expected to deliver benefits to the participants. The participants' propensity to share knowledge is strongly related to their perception of these benefits (Cyr and Wei Choo, 2010).

Self-determination theory (SDT) is used to develop the research framework of this study. This theory classifies different motivational factors as well as personal perceived benefits regarding the level of individual self-determination (the level to which a drive incarnate intrinsically or is promoted externally; Ryan and Deci, 2000). The SDT defines the motivational factors as reasons for behaving in a particular way, referring to participants' perceptions of positive consequences that are caused by knowledge sharing (Al-Busaidi *et al.*, 2017). These personal perceived benefits are the main motivational factors for participants to share knowledge. This theory distinguishes two different individual perceived benefits: extrinsic benefits and intrinsic benefits (Rode, 2016). SDT is used to explore individual's knowledge sharing in different studies of the KM field (Wu and Zhu, 2012; Wang and Hou, 2015).

Extrinsic benefits are defined by distinction between two types of benefits: external regulations and internalised extrinsic benefits (Ryan and Deci, 2000). External regulations refer to tangible or intangible benefits, which can regulate participants'

behaviours to perform a specific task. Deci and Ryan (1985) propose that external regulations control individual behaviours based on participants' core-self needs. This type of extrinsic benefit includes a spectrum of participants' benefits from monetary to non-monetary categories such as bonus, performance appraisals systems and status within an organisation (Wang and Hou, 2015). Internalised extrinsic benefits represent a part of incentives that originate externally and are enhanced inherently by participants. Reciprocity is a main example of internalised extrinsic benefits in the KM domain that facilitates knowledge sharing attitude and intention (de Almeida *et al.*, 2016). Furthermore, intrinsic benefits can refer to the inherent happiness in performing tasks. Altruism and knowledge self-efficacy have been found to be two main intrinsic benefits (Hsu and Lin, 2008; Chang and Chuang, 2011; Al-Qadhi *et al.*, 2015). Razmerita *et al.* (2016) mention altruism as the main perceived benefit of individual knowledge sharing in enterprise social networks. In the review of existing studies in Appendix 1, key research concerning the participants' perceived benefits are summarised examining the level of knowledge sharing. Participants are shown to contribute to knowledge networks to exchange knowledge if the individual perceived benefits outweigh the perceived costs of participation.

3. Hypothesis and research framework

Using the SDT as theoretical foundation, this section describes the research framework for the present study. The research framework explores how perceived benefits influence quantity versus quality aspects of knowledge shared by participants on different levels of knowledge sharing in EKNs. It considers influential factors in private, group and public levels of knowledge sharing that influence both the quantity and quality of shared knowledge. The research framework (see Figure 1) is structured by extrinsic and intrinsic benefits. The framework is designed with selected perceived benefits. Consequently, the literature review is used to examine main perceived benefits in different knowledge exchange platforms. Table I summarises the main perceived benefits, found in a review of the literature. The results propose two types of external regulations (reputation and material rewards): one internalised extrinsic benefit (reciprocity) and two intrinsic benefits (altruism and knowledge self-efficacy) as the five most influential perceived benefits of knowledge sharing within organisations. While most KM studies investigate impacts of perceived benefits on the quantity of knowledge sharing (Bock *et al.*, 2005; Zhang *et al.*, 2010), this study develops the framework to explore relationships between perceived benefits with both the quantity and the quality aspects of shared knowledge on different levels of knowledge sharing.

In addition, EKNs have been developed by multi-levels knowledge sharing. The research framework is tested in three distinct levels of knowledge sharing: private, group and public levels. In private knowledge sharing, a knowledge sender and a knowledge recipient talk in a confidential communication environment. Furthermore, visibility of communications is

Figure 1 Research framework

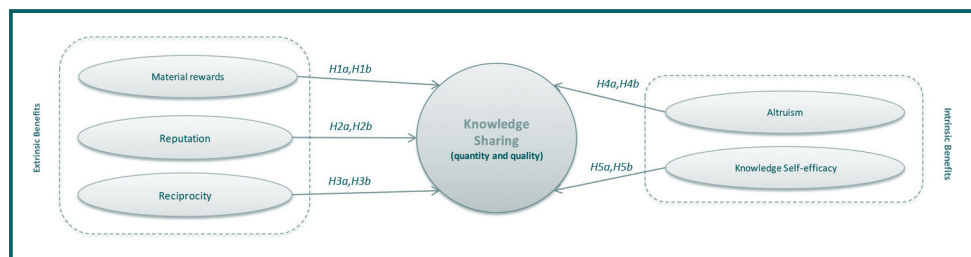


Table I Perceived benefits of knowledge sharing

<i>Perceived benefits</i>			
<i>Categories</i>	<i>Items</i>	<i>Definitions</i>	<i>Source</i>
External regulation	Material rewards	Participants' perception of the value of material rewards (non-monetary) through participation	Bock <i>et al.</i> (2005), Lin (2007), Lin and Lo (2015), Sedighi <i>et al.</i> (2016)
	Reputation	Participants' perception of the value of enhancing respect or earning prestige through participation	Wasko and Faraj (2005), Wu and Zhu (2012), Zhang <i>et al.</i> (2014), Yan <i>et al.</i> (2016), Sedighi <i>et al.</i> (2016)
Internalised extrinsic benefit	Reciprocity	Participants' perception of the value of receiving knowledge in return	Wasko and Faraj (2005), Lin (2007), He and Wei (2009), Hau <i>et al.</i> (2013), Sedighi <i>et al.</i> (2016)
Intrinsic benefits	Altruism	Participants' perception of the value of gratification in helping other participants by sharing knowledge	Hsu and Lin (2008), Chang and Chuang (2011), Adali <i>et al.</i> (2014), Sedighi <i>et al.</i> (2016)
	Knowledge self-efficacy	Participants' judgement of the value of his/her competency to provide/share knowledge to others users	Kankanhalli <i>et al.</i> (2005a), Hsu <i>et al.</i> (2007), Chen <i>et al.</i> (2012), Lou <i>et al.</i> (2013), Sedighi <i>et al.</i> (2016)

limited to a group, when participants share knowledge in the group-level. Participants are also given the opportunity to share their knowledge with all participants within the organisation in the public-level. Constructs of the research model and hypotheses are discussed below.

From the external regulations perspective, knowledge sharing in different levels is affected by material rewards. Material rewards consist of a range of monetary and non-monetary incentives. A major segment of KM studies criticise financial rewards (monetary incentives) because of temporary influences of such rewards on knowledge sharing behaviour (Lin, 2007; Bartol and Srivastava, 2002). Our research considers the non-monetary side of material benefits such as job promotion, job security, flexible work hours and sabbaticals. Non-monetary material rewards have been shown to improve knowledge sharing performance (Kankanhalli *et al.*, 2005a). This study explores two hypotheses that relate to this effect of material benefits on the both sides of knowledge sharing behaviour:

H1a. Material rewards (non-monetary) have a positive influence on the quantity of knowledge shared by participants in EKNs.

H1b. Material rewards (non-monetary) have a positive influence on the quality of knowledge shared by participants in EKNs.

Professional recognition is an extrinsic benefit that influences participants' knowledge sharing. Reputation is the level to which members suppose that their contributions will enhance recognition and position in organisations (Hsu and Lin, 2008), influencing knowledge sharing (Chang and Chuang, 2011). The reputation system as a main external benefit has been examined in the domain of virtual community to leverage knowledge sharing in organisations (Lou *et al.*, 2013). Therefore, creating self-images and enhancing positions in organisations is a crucial perceived benefit influencing participants to share valuable knowledge through knowledge networks. Thus, two hypotheses are proposed to explain reputation's effects on knowledge sharing behaviour:

H2a. Reputation from participation has a positive influence on the quantity of knowledge shared by participants in EKNs.

H2b. Reputation from participation has a positive influence on the quality of knowledge shared by participants in EKNs.

Reciprocity is a perceived benefit, which promotes participants' engagements in knowledge exchange because of the expectation that participants will receive knowledge in return, in the future (Davenport and Prusak, 1998; Gouldner, 1960). Two kinds of reciprocal exchange behaviours have been outlined in the network studies: direct reciprocity and indirect (generalised) reciprocity (Faraj and Johnson, 2011). Direct reciprocity refers to knowledge sharing between two participants as a recipient and a provider, while generalised reciprocity explains shared knowledge as reciprocated by someone else, not the exact knowledge recipient (Ekeh, 1974). Private knowledge exchange is promoted only by direct reciprocity because the visibility of the knowledge exchange is restricted to a knowledge sender and a knowledge recipient, while knowledge exchange through the group and the public levels are supported by direct and generalised reciprocity. Therefore, the hypotheses are as follows:

H3a. Reciprocity from network participants has a positive influence on the quantity of knowledge shared by participants in EKNs.

H3b. Reciprocity from network participants has a positive influence on the quality of knowledge shared by participants in EKNs.

Altruistic behaviour as enjoyment in helping others in knowledge networks has been defined as a main reason of knowledge sharing behaviour in KM systems (Chang and Chuang, 2011). The SDT theory examines how altruism influences participants to perform high-quality activities. Thus, participants with the altruistic intention of enjoyment in helping others create more valuable, useful and helpful knowledge (Wasko and Faraj, 2005). Therefore, the following hypotheses are proposed:

H4a. Altruism has a positive influence on the quantity of knowledge shared by participants in EKNs.

H4b. Altruism has a positive influence on the quality of knowledge shared by participants in EKNs.

As mentioned before, knowledge self-efficacy as a kind of intrinsic benefits influences knowledge sharing performance (Lin, 2007). Indeed, participants with a high level of knowledge self-efficacy have valuable outcomes, while they can be satisfied inherently to show their competences. Therefore, participants tend to contribute in the knowledge sharing process regarding the quantity and quality aspects because participants expect that their capabilities to share valuable knowledge help others (Kankanhalli *et al.*, 2005a).

H5a. Knowledge self-efficacy has a positive influence on the quantity of knowledge shared by participants in EKNs.

H5b. Knowledge self-efficacy has a positive influence on the quality of knowledge shared by participants in EKNs.

4. Research design

The research framework categorises perceived benefits for different levels of the knowledge sharing, affecting knowledge sharing in knowledge networks. The framework is evaluated using two types of data. Independent variables' data are collected using a survey questionnaire for the three levels of knowledge sharing. Data based on content analysis (dependent variables) measure participants' knowledge sharing behaviour within the EKN.

4.1 Organisational context

The data are collected from a group of companies (25 companies) that operate in the energy industry, in the area of development of thermal power plants and independent

power plants (IPP) under the engineering, procurement, and construction. The subjects in the study are electrical engineers, manufacturing engineers, production controllers, power plant staff and first line managers. All participants have access to the knowledge network and can voluntarily participate in knowledge sharing. The network provides three integrated levels of knowledge sharing, which is supported with a Web-based platform. Knowledge contents can be transferred privately among participants by private posting. Participants have an opportunity to develop knowledge communities regarding the interested topics. Contents of a knowledge community are visible for the community members. Furthermore, the knowledge network has a public environment (message board) in which all posts are visible for all participants within the organisation.

4.2 Procedures

4.2.1 Survey questionnaire. All independent variables' statistics are collected with a questionnaire. The questionnaire was distributed in August 2014, for a period of three weeks. The first part of the questionnaire clarifies the research goal, confidentiality conditions and knowledge exchange visibilities with a few examples. The second part of the questionnaire measures perceived benefits of knowledge contribution for the three levels of the knowledge sharing with the five-point Likert-type scale (*Never, Rarely, Sometimes, Often and Always*). The questions are designed based on the literature. The measuring scales of material rewards and reciprocity are adapted from [Lin's \(2007\)](#) study. Reputation is based on [Kankanhalli et al. \(2005a\)](#) and [Wasko and Faraj \(2005\)](#). Altruism is adopted from [Chang and Chuang \(2011\)](#). Self-efficacy is based on [Kankanhalli et al. \(2005a\)](#) and [Lin \(2007\)](#). [Appendix 2](#) depicts all items in the second part of the questionnaire. An initial evaluation of the questionnaire performed by five KM experts in the energy industry sector led to minor revisions in the questionnaire to ensure content validity, readability and understandability.

4.2.2 Content analysis. Content analysis is adopted in this research to clarify individual knowledge sharing (dependent variables) in the knowledge network. All posts are collected from the data set during the six months (from 1 March 2014 through 31 August 2014). Authors use the latent content analysis on all posts to clarify the meaning of the contents. This method is a qualitative and systematic technique to clarify meaning of the manifest contents ([Babbie, 2016](#)). The outcome of the latent content analysis classifies knowledge contributions as knowledge articles, knowledge requests, answers to questions or other types of contents. Only knowledge articles and response to questions are selected as knowledge objects for quantifying the dependent variables. Thus, questions and other types of message (i.e. "this is useful" or "thanks") are excluded from the data set. The quantity aspect of the knowledge sharing is measured by the number of shared knowledge. The knowledge network enables authors to use participants' user names to retrieve knowledge contributions to measure the volume of shared knowledge. The quantity of shared knowledge is normalised ([Chiu et al., 2006](#)) by transferring the number of shared knowledge to a five-point scale (see [Table II](#)).

The quality aspect of knowledge object is evaluated by adopting items from [Kulkarni et al. \(2006\)](#) and [Kyoon Yoo \(2014\)](#)'s models. These models examine "accuracy", "timeliness", "reliability", "relevancy" and "applicability" as five attributes of the knowledge quality.

Table II Normalising collected data (quantity of shared knowledge)

<i>Quantity of shared knowledge</i>	<i>Five-point scale</i>
Less than two instances of shared knowledge	1
Two to three instances of shared knowledge	2
Four to five instances of shared knowledge	3
Six to seven instances of shared knowledge	4
More than seven instances of shared knowledge	5

Accuracy, timeliness and reliability aspects refer to perceived intrinsic knowledge quality, while relevancy signifies perceived contextual knowledge quality and applicability refers to perceived actionable knowledge quality. On request, the company provided two independent domain experts for different knowledge categories. These experts assessed the initial four attributes, while the average score of users is used to evaluate the applicability of knowledge. These five items, which are used in research concentrating on assessing contents in enabled IT platforms (Chiu *et al.*, 2006), are used to measure the quality of shared knowledge. All attributes are calculated with the average of a five-point Likert scale (De Winter and Dodou, 2010), ranging across very low, low, moderate, high and very high. Participants' scores are measured by assigning the mean of knowledge scores in each level of knowledge sharing.

As knowledge contribution in the network is not anonymous, the outcome of the completed questionnaires is matched to participants' knowledge contributions. Furthermore, demographic data are provided by the human resource department of the company.

4.3 Data analysis

Partial least squares structural equation modelling (PLS-SEM) technique is used to analyse the results. This method is used when data sets have a non-normal distribution or small size observations (Hair *et al.*, 2014). PLS-SEM is used to analyse results as it is a type of SEM approach, which supports formative constructs (Hair *et al.*, 2014). R-code "plsrm" package (version 0.4.2; Sanchez *et al.*, 2015) is used to analyse the data. All results are analysed in three independent PLS-SEM models for three different levels of knowledge sharing. Using PLS-SEM the relationships between different items of the SDT and knowledge sharing on three levels is tested. As data are measured from two different sources, links between independent and dependent variables are created for each respondent. Consequently, the relationships on each level of knowledge sharing are examined.

PLS-SEM method includes the two-step analysis method to analyse the research model. The first phase of the PLS-SEM method consists of the evaluation of the measurement model (outer model), whereas the second phase includes assessment of the structural relationships of model constructs (inner model) (Hair *et al.*, 2011).

4.4 Respondents

During the study, 723 participants used the knowledge network at least for one of the three levels of knowledge sharing. The questionnaire was distributed to all active participants in the knowledge network. With a response rate of 29.5 per cent, 213 questionnaires were collected. Two hundred and five complete questionnaires were analysed (eight incomplete questionnaires were excluded). The number of completed questionnaires is noted to be above the minimum sample-size threshold [defined as five to ten times the largest number of structural relations to latent variables (Chin, 1998)]. Regarding the completed questionnaires, the content analysis is used for respondents' contribution to measure the quality and quantity aspects of shared knowledge. The data set shows that 2,154 notes were transferred by respondents on all three levels of knowledge sharing. The outcome of the analysis categorises 1,881 knowledge articles and responses to questions. These knowledge objects are evaluated to measure knowledge contribution quality and quantity of respondents. Content analysis reveals that 93 per cent of shared knowledge is created regarding knowledge requests (answering to questions) for the private-level, while 66 per cent of knowledge at the group-level and only 24 per cent of knowledge at the public-level are being shared to answer questions.

Table III represents the demographics of the respondents. As depicted, 31.2 per cent of participants have less than 10 years' experience, whereas 68.8 per cent have been in the company more than 11 years. Approximately 50 per cent of participants hold an MSc degree.

Table III Demographics of respondents (N = 205)

Characteristics	Values	Frequency	(%)
Gender	Male	171	83.4
	Female	34	16.6
Age	18-28	6	2.9
	29-35	96	46.8
	36-42	85	41.5
	>42	18	8.8
Education	Bachelor	104	50.7
	Master	101	49.3
Position level	Managers	34	16.6
	Supervisors	24	11.7
	Experts	131	63.9
	Technicians	16	7.8
Work experience	1-10	64	31.2
	11-15	73	35.6
	16-20	33	16.1
	>20	35	17.1

The χ^2 test is used on collected data to check non-respondents bias. The results show no significant differences between demographic data of non-response and response participants. The data are also tested for the late and early response bias. Multivariate analysis of variance (MANOVA) is performed to compare demographic data of initial 31 (15 per cent) respondents with the last 31 (15 per cent) respondents. The differences of demographics data between the two groups are not significant ($p < 0.05$).

5. Results

The results of this study are explained below. Firstly, results of the measurement model characteristic are elaborated. The second section represents structural model results.

5.1 Measurement model

The composite reliability is used to evaluate the internal consistency of constructs in the outer model. As shown in Table IV, the composite reliabilities surpass 0.7 [the acceptable threshold following (Chin, 1998)]. Outer loadings and average variance extracted (AVE) values are measured to test the convergent validity of the outer model. As depicted in Table III, all loading factors exceed 0.7 and all AVEs surpass 0.5 as thresholds for accepting the convergent validity of models (Hair *et al.*, 2014). Furthermore, all assessed loading factors are significant. Discriminant validities of the proposed model are analysed by comparing the square roots of AVEs and constructs' correlations. Table V indicates that model discriminant validity holds as correlations of constructs with other latent variables are less than the AVE's square root.

A paired T-test is used to calculate differences between the quality and the quantity of shared knowledge across three levels of knowledge sharing. As shown in Table V, the quantity and the quality of shared knowledge at the group-level are higher than that at the private-level. There is a significant difference in the mean of the knowledge quantity for the group-level ($M = 3.414$, $SD = 1.179$) and the quantity of shared knowledge in the private-level ($M = 3.009$, $SD = 1.252$) conditions: $t(204) = 5.222$, $p < 0.01$ as well as the quality of shared knowledge [$t(204)=2.302$, $p < 0.05$]. Likewise, the mean of the shared knowledge volume for the group-level is significantly higher than the mean of the shared knowledge volume ($M = 2.658$, $SD = 0.96$) for the public-level [$t(204)=12.468$, $p < 0.01$], as well as the quality of shared knowledge [$t(204)=6.777$, $p < 0.01$]. Hence, participants make significant knowledge contributions at the group-level of knowledge exchanges.

Table IV Latent and manifest statistics

Private-level Latent construct	Items	Private-level				Group-level				Public-level			
		Factor Loading	CR	AVE		Items	Factor Loading	CR	AVE	Items	Factor Loading	CR	AVE
Material rewards	IMR01	0.828**	0.867	0.710	GMR01	0.850**	0.888	0.810	OMR01	0.776**	0.766	0.583	
	IMR02	0.916**			GMR02	0.870**			OMR02	0.792**			
	IMR03	0.819**			GMR03	0.920**			OMR03	0.700**			
	IMR04	0.804**			GMR04	0.954**			OMR04	0.784**			
Reputation	IRP01	0.808**	0.844	0.744	GRP01	0.859**	0.835	0.751	ORP01	0.907**	0.858	0.778	
	IRP02	0.918**			GRP02	0.899**			ORP02	0.886**			
	IRP03	0.741**			GRP03	0.838**			ORP03	0.852**			
Reciprocity	IRC01	0.907**	0.887	0.812	GRC01	0.879**	0.866	0.789	ORC01	0.880**	0.843	0.761	
	IRC02	0.901**			GRC02	0.919**			ORC02	0.856**			
	IRC03	0.840**			GRC03	0.864**			ORC03	0.881**			
Altruism	IAL01	0.886**	0.859	0.780	GAL01	0.887**	0.872	0.797	OAL01	0.842**	0.842	0.759	
	IAL02	0.889**			GAL02	0.927**			OAL02	0.914**			
	IAL03	0.855**			GAL03	0.863**			OAL03	0.855**			
Knowledge self-efficacy	ISE01	0.891**	0.883	0.741	GSE01	0.802**	0.875	0.727	OSE01	0.841**	0.923	0.813	
	ISE02	0.886**			GSE02	0.882**			OSE02	0.936**			
	ISE03	0.850**			GSE03	0.885**			OSE03	0.894**			
	ISE04	0.814**			GSE04	0.837**			OSE04	0.932**			
Quantity of shared knowledge	IQN01	1.000**	1,000	1,000	GQN01	1.000**	1,000	1,000	OQN01	1.000**	1,000	1,000	
Quality of shared knowledge	IQL01	0.838**	0.838	0.669	GQL01	0.790**	0.824	0.665	OQL01	0.818**	0.931	0.783	
	IQL02	0.772**			GQL02	0.810**			OQL02	0.932**			
	IQL03	0.759**			GQL03	0.833**			OQL03	0.950**			
	IQL04	0.805**			GQL04	0.844**			OQL04	0.926**			
	IQL05	0.766**			GQL05	0.801**			OQL05	0.786**			

Notes: CR: Composite reliability; AVE: Average variance extracted; ** $p < 0.01$

Table V Correlations and variances extracted of latent variables

Construct	Mean	S.D	1	2	3	4	5	6	7
<i>Private-level</i>									
Material rewards (1)	2,121	0.933	<i>0.842</i>						
Reputation (2)	3,318	0.941	0.018	<i>0.862</i>					
Reciprocity (3)	3,502	1,036	-0.089	0.037	<i>0.901</i>				
Altruism (4)	3,791	0.890	-0.396	0.289	0.205	<i>0.883</i>			
Knowledge self-efficacy (5)	3,887	0.897	-0.409	0.311	0.245	0.696	<i>0.860</i>		
Quantity of shared knowledge (6)	3,009	1,252	-0.217	0.129	0.231	0.555	0.464	<i>1,000</i>	
Quality of shared knowledge (7)	3,168	0.913	-0.312	0.191	0.166	0.597	0.498	0.530	<i>0.817</i>
<i>Group-level</i>									
Material rewards (1)	2,374	1,149	<i>0.900</i>						
Reputation (2)	3,185	1,116	-0.185	<i>0.866</i>					
Reciprocity (3)	3,710	0.978	-0.139	0.408	<i>0.888</i>				
Altruism (4)	3,713	1,042	-0.224	0.402	0.346	<i>0.892</i>			
Knowledge self-efficacy (5)	3,634	1,034	-0.110	0.352	0.550	0.533	<i>0.852</i>		
Quantity of shared knowledge (6)	3,414	1,179	-0.115	0.507	0.636	0.581	0.642	<i>1,000</i>	
Quality of shared knowledge (7)	3,328	0.969	-0.122	0.316	0.461	0.523	0.553	0.564	<i>0.815</i>
<i>Public-level</i>									
Material rewards (1)	2,107	0.992	<i>0.763</i>						
Reputation (2)	2,951	1,080	-0.146	<i>0.882</i>					
Reciprocity (3)	3,320	1,073	-0.169	0.380	<i>0.872</i>				
Altruism (4)	3,588	1,085	-0.086	0.311	0.355	<i>0.871</i>			
Knowledge self-efficacy (5)	3,334	1,079	-0.284	0.355	0.397	0.349	<i>0.901</i>		
Quantity of shared knowledge (6)	2,659	0.955	-0.225	0.533	0.545	0.395	0.499	<i>1,000</i>	
Quality of shared knowledge (7)	2,905	0.999	-0.119	0.360	0.387	0.261	0.534	0.643	<i>0.884</i>

Note: The italic diagonal elements are the square root of the AVE values

Furthermore, the Wilcoxon rank-sum test as a non-parametric test is used to examine the existence of gender differences in propensity to acquire benefits. The results show no gender difference in participants' propensity for material rewards, reciprocity, altruism and knowledge self-efficacy. Nevertheless, the test shows a significant difference between females and males with respect to professional reputation in the EKN. Females have fewer tendencies to strive for professional reputation in the knowledge network (Figures 2 and 3).

5.2 Structural model

The research outcome of the inner models is presented in Figure 3. The inner models are assessed with the ability of exogenous latent variables to interpret the endogenous constructs. Two main methods have been used to assess inner models in PLS-SEM technique: coefficient of determination (R^2) and cross-validated redundancy (Q^2 ; Hair et al., 2014). R^2 clarifies the volume of variances that are explained with latent constructs. This assessment technique represents the PLS-SEM models' predictive accuracy. As can be seen in Figure 2, the hypothesised significant relations account for 33 per cent of variance for the volume of shared knowledge and 37 per cent of variance in the quality of shared knowledge for private-level knowledge sharing. Moreover, the hypothesised paths of the group-level knowledge sharing accounts for 62 per cent of the variance in the quantity of shared knowledge and 41 per cent of the variance in the quality of shared knowledge. Finally, perceived benefits for public-level knowledge sharing account for 48 per cent of the variance in the quantity of shared knowledge and 34 per cent of variance in the quality of shared knowledge. These results indicate that the model explains variances for the three levels. Thus, the model proves a fairly good fit with the collected data. Furthermore, the blindfolding procedure (Q^2) is used to evaluate the model's predictive relevancies of latent constructs. Non-zero Q^2 values specify that the model's predictive accuracy is acceptable (Sarstedt et al., 2014). The blindfolding technique shows both endogenous constructs in three models are well above zero, which represent the model's predictive relevance.

The overall results are analysed by testing the hypothesised relationships between the latent variables. Figure 2 indicates significant and non-significant relations between perceived benefits and individuals' knowledge sharing at three levels. A p-value of 0.05 is used as the cut-off to signify meaningful (significant) relations between variables. The outcome of the private-level model shows that material rewards have no direct influence on the quantity of shared knowledge ($\beta = 0.036, p > 0.1$) and the quality of shared knowledge

Figure 2 Quantity and quality of shared knowledge

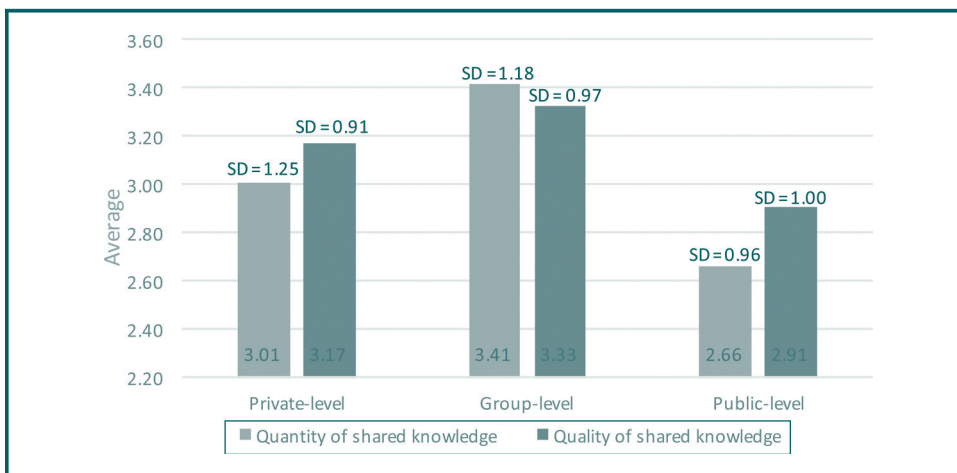
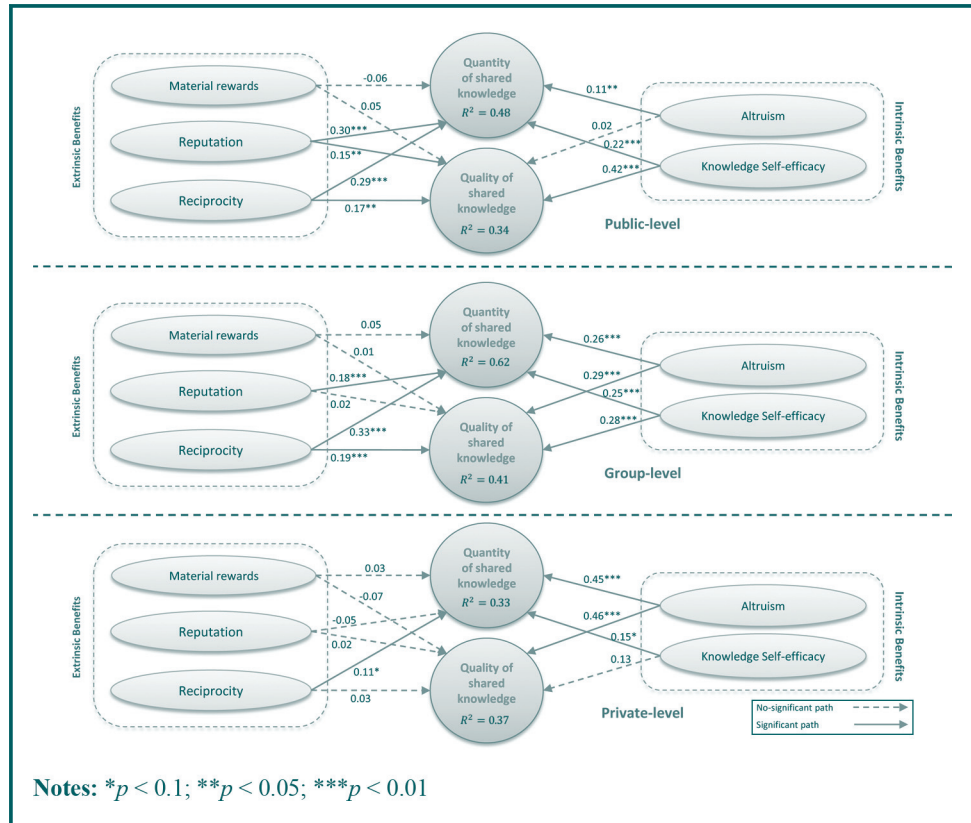


Figure 3 Structural model results



($\beta = -0.071, p > 0.1$); therefore, both $H1a_{private}$ and $H1b_{private}$ are not supported. Reputation has no significant influences on the both quantity and quality of shared knowledge ($\beta = -0.055, p > 0.1, \beta = -0.016, p > 0.1$), so both $H2a_{private}$ and $H2b_{private}$ are not supported in the private-level. Although direct reciprocity has a significant impact on the quantity ($H3a_{private}$) ($\beta = 0.106, p < 0.1$), there is insufficient data to prove a relation between direct reciprocity and the quality of shared knowledge ($H3b_{private}$) ($\beta = 0.031, p > 0.1$) in the private-level. Altruism has significant relationships with the quantity and the quality of shared knowledge ($\beta = 0.459, p < 0.01; \beta = 0.462, p < 0.01$); hence, $H4a_{private}$ and $H4b_{private}$ are supported in the private-level knowledge sharing. Furthermore, knowledge self-efficacy has a significant impact on the volume of shared knowledge ($\beta = 0.150, p < 0.1$) and supports $H5a_{private}$, while it has no significant relation with the quality of shared knowledge ($\beta = 0.134, p > 0.1$), and so, $H5b_{private}$ is not supported.

In the group-level knowledge sharing, material rewards have no direct effects on the both quantity and quality of shared knowledge ($\beta = 0.054, p > 0.1; \beta = 0.01, p > 0.1$); thus, there is not enough data to support both $H1a_{group}$ and $H1b_{group}$ in the group level knowledge sharing. Reputation has a significant effect on the quantity of shared knowledge ($\beta = 0.183, p < 0.01$), and it supports $H2a_{group}$; however, this item has no relation with the quality of shared knowledge ($\beta = 0.018, p > 0.1$). Thus, $H2b_{group}$ is not supported. Reciprocity has significant impacts on both the quantity and quality of shared knowledge ($\beta = 0.335, p < 0.01; \beta = 0.197, p < 0.01$); therefore, both $H3a_{group}$ and $H3b_{group}$ are supported. Both intrinsic incentives, altruism ($\beta = 0.266, p < 0.01; \beta = 0.299, p < 0.01$) and knowledge self-efficacy ($\beta = 0.258, p < 0.01; \beta = 0.280, p < 0.01$) have significant impacts on the both sides of knowledge sharing in the group-level knowledge sharing; thus, $H4a_{group}, H4b_{group}, H5a_{group}$ and $H5b_{group}$ are supported.

Results of knowledge sharing in the public-level signifying material rewards have no significant effects on both the quantity and the quality aspects of shared knowledge in the public-level ($\beta = -0.059, p > 0.1$; $\beta = 0.053, p > 0.1$); therefore, $H1a_{public}$ and $H1b_{public}$ are not supported. Reputation has positive effects on the quantity and the quality of shared knowledge in the public-level ($\beta = 0.299, p < 0.01$; $\beta = 0.151, p < 0.05$); hence, $H2a_{public}$ and $H2b_{public}$ are supported. Likewise, reciprocity has significant influences on both aspects of shared knowledge ($\beta = 0.293, p < 0.01$; $\beta = 0.166, p < 0.05$) that support both $H3a_{public}$ and $H3b_{public}$. Altruism has a positive effect on the quantity of shared knowledge ($\beta = 0.116, p < 0.05$) but has no significant impact on the quality aspect of shared knowledge in the public-level ($\beta = 0.011, p > 0.05$); therefore, $H4a_{public}$ is supported but $H4b_{public}$ is not supported. Moreover, knowledge self-efficacy has significant relations with the quantity and the quality aspects of knowledge sharing ($\beta = 0.219, p < 0.01$; $\beta = 0.426, p < 0.01$); thus, $H5a_{public}$ and $H5b_{public}$ are supported.

6. Discussion

The analysed data signify different interesting relations for the three levels of knowledge sharing. Knowledge sharing quantity and quality for group-level knowledge exchange are significantly higher than quantity and quality aspects of shared knowledge for the private and the public levels. In addition, intrinsic incentives play an important role in private and group levels of knowledge sharing, while extrinsic rewards (except material rewards) have significant influences on the quality and quantity of shared knowledge in the public-level knowledge sharing.

Knowledge sharing performance for the three different levels indicates that group-level knowledge sharing is most effective. This finding is consistent with theoretical studies (Wasko and Faraj, 2000; Sie *et al.*, 2014) that indicate successful performance of collaboration technologies for group-level knowledge sharing technologies such as communities of practice (CoP). In addition, the quality of shared knowledge for private-level is higher than that for public-level knowledge sharing. This outcome highlights the role of customisation in knowledge sharing systems. Most of the knowledge in the private-level exchange is created by knowledge requests. To this end, knowledge providers create customised experiences for the knowledge requests. Customising knowledge significantly improves the quality of shared knowledge, which represents a type of the virtual experiential knowledge (Matsuo and Easterby-Smith, 2008). Additionally, knowledge in the public-level knowledge sharing needs to be shared in general structures in understandable formats for large audiences. This structure reduces the quality of shared knowledge by removing valuable details of practical and complex experiences.

The quantity of shared knowledge in the private-level is significantly higher than the volume of knowledge at the public-level. This finding shows a significant barrier to share knowledge in visible knowledge exchange areas, for which users are not sure whether their contributions are reliable for others. This kind of barrier is identified as the risk of losing face in the KM studies (Vuori and Okkonen, 2012). Apart from these findings, comparing participants' contributions between the three levels of knowledge exchange signifies a new direction for KM studies. These results are contrary to the outcomes of existing studies, which show that individuals' knowledge sharing is increased only by transforming private communication to the public knowledge exchange (Leonardi, 2014). A significant part of participants' knowledge contributions is emerging in controlled visibility level of knowledge exchange such as group-level knowledge sharing. Furthermore, the results show KM designers cannot ignore the private-level (invisible) knowledge sharing. The results show all knowledge exchange channels are essential to support knowledge sharing.

The results show material rewards have no significant influence on knowledge sharing either in the quality or quantity aspect. This finding is inconsistent with a minor part of previous studies, which specifies organisational rewards support the knowledge sharing performance (Lin and

Lo, 2015; Razmerita *et al.*, 2016). On the other hand, these results are consistent with a major part of the KM studies, which highlight the insignificant or neutral effects of organisational rewards on knowledge sharing (Masterson *et al.*, 2000; Lin, 2007; Lam and Lambermont-Ford, 2010). Besides, Hau *et al.* (2013) found negative effects between organisational rewards and participants' intentions to tacit knowledge sharing. As the data are collected from a high-tech company, respondents may not be encouraged by the material rewards. Indeed, they are compensated by other perceived benefits, such as enhancing status and reputation in professional communities. In the following sections, the outcome of the research framework's analysis is examined for the three levels of knowledge sharing.

6.1 Private-level knowledge sharing

The significant influences of intrinsic rewards (altruism and self-efficacy) on the quantity aspect and the quality aspect of shared knowledge demonstrate the important role of intrinsic incentives in private (invisible) knowledge exchange environments. This finding has not been empirically verified in KM studies, but there is literature that highlights the role of altruism and knowledge self-efficacy on knowledge sharing behaviour regardless of the visibility aspect (Wasko and Faraj, 2005; Kankanhalli *et al.*, 2005a; Lou *et al.*, 2013).

Among the extrinsic benefits perspective, only reciprocity has a small impact on the volume of shared knowledge. This kind of reciprocal behaviour as direct reciprocities between knowledge providers and knowledge seekers is highlighted in the social exchange theory (Blau, 1964). As knowledge sharing is promoted by reciprocity in the private-level knowledge exchange, it can only influence the volume of knowledge shared by participants without affecting the quality aspect. In general, results show intrinsic benefits have more effects on shared knowledge rather than extrinsic benefits in the private-level knowledge sharing.

6.2 Group-level knowledge sharing

Intrinsic benefits significantly improve both the quantity and the quality of shared knowledge in the group-level knowledge sharing. This finding underlines the position of altruism and self-efficacy in the context of knowledge communities. These results are consistent with several studies (Wasko and Faraj, 2005; Chen and Hung, 2010; Lou *et al.*, 2013), which emphasised the role of intrinsic benefits as important incentives for knowledge sharing.

Reciprocity strongly influences the quantity and the quality of shared knowledge. This finding indicates the importance of the generalised reciprocity within the group-level knowledge exchange. The generalised reciprocity in the KM domain represents an expectation of participants to receive knowledge from a group of participants and not exactly from an individual (Wasko and Faraj, 2005). This finding is consistent with several studies (Bock *et al.*, 2005; Lin, 2007) that argued employees' participation have strong dependencies with reciprocity.

The results indicate that reputation influences the volume of shared knowledge, while it has no significant relation with the quality aspect. Network users rate the applicability of knowledge. This rating mechanism supports participants to enhance reputations and statuses within knowledge communities. Moreover, the system creates a list of highly rated knowledge in different periods (daily, weekly and monthly) that can boost participants' recognition in a community. This results consistent with Chiu *et al.* (2006), in which they signify that individual identification have a significant positive relationship with the quantity of shared knowledge in virtual communities. Furthermore, reputation has been identified to clarify the controlling nature of external regulations in the knowledge exchange domain (Ryan and Deci, 2000; Lou *et al.*, 2013).

6.3 Public-level knowledge sharing

The analysed data in the public-level knowledge sharing show a significant impact of extrinsic benefits (except material rewards) on both aspects of knowledge sharing.

Undeniably, relationships between extrinsic benefits and individuals' knowledge sharing performance are significantly higher than relations between intrinsic benefits and shared knowledge in the public-level knowledge sharing. A feasible explanation captures the trade-off between intrinsic and extrinsic benefits. Relations between intrinsic and extrinsic benefits has been examined in "crowding theory" (Osterloh and Frey, 2000). According to this theory, when participants are stimulated simultaneously by both intrinsic and extrinsic benefits, then individuals are more open to external controls. Hence, extrinsic benefits "crowd-out" intrinsic benefits. In general, existing extrinsic perceived benefits indicate the reason of crowding-out intrinsic benefits in public knowledge sharing.

Reciprocity, as an internalised extrinsic motivation, significantly influences both the quantity and quality of shared knowledge. These findings are consistent with Wasko and Faraj (2000), who indicate knowledge sharing of online communities' users are motivated by reciprocity. Furthermore, Oh (2012) examines reciprocity as a perceived benefit of participants to engage in knowledge exchanges.

Public-level knowledge exchange is an opportunity for participants to enhance status. Additionally, top-ranked knowledge providers within the network are acknowledged every month. This recognition mechanism promotes organisational participants' reputations. This extrinsic benefit significantly promotes both sides of knowledge sharing. This outcome is consistent with Witherspoon *et al.* (2013), who signify a significant relation between individuals' reputation and individual knowledge sharing.

From the intrinsic benefits perspective, knowledge self-efficacy has positive effects on the quantity and the quality of shared knowledge, while altruism has a significant impact on only the quantity of knowledge sharing. This finding is consistent with Kankanhalli *et al.* (2005a), in which they found both enjoyments in helping others and knowledge self-efficacy have significant impacts on knowledge sharing behaviour in knowledge repositories. This finding is consistent with Lou *et al.* (2013), who indicate enjoyments in helping others has a significant effect on the quantity as compared with the quality of knowledge contribution in Q&A environments.

7. Conclusion

Recent contemporary KM systems provide different knowledge sharing levels with different visibility levels. This study explores the influences of participants' perceived benefits of knowledge sharing for different levels of knowledge sharing. The results elucidate upon how extrinsic and intrinsic perceived benefits influences may differ in terms of the knowledge sharing visibility. Intrinsic benefits (knowledge self-efficacy and altruism) are more influential than extrinsic benefits (reputation and reciprocity) in determining knowledge sharing behaviour in the private-level, while extrinsic rewards play an import role in the public-level. The results signify that both the quality and quantity of shared knowledge for the group-level knowledge sharing are significantly higher than the quality and the quantity of shared knowledge in private and public levels.

7.1 Implications for practitioners

The outcome of this study not only enriches the theoretical foundation of knowledge sharing by exploring the visibility level of exchanging knowledge but also provides important implications for KM system developers. This study has important implications for practitioners who attempt to design an incentive strategy for knowledge sharing. Firstly, with respect to the research context, the results highlight how extrinsic and intrinsic incentives promote knowledge sharing behaviour for private, group and public levels. These findings guide designers to develop a comprehensive, integrated, all-inclusive and combined incentive plan for all visibility levels of knowledge exchange. Certainly, the incentive plan needs to be designed by a set of mechanisms to promote intrinsic benefits for knowledge

sharing in invisible knowledge exchange environments. These mechanisms include multi-pronged and cultural strategies within organisation to stimulate individuals' intrinsic motivations such as altruism. Furthermore, KM designers need to spend more effort in developing incentive mechanisms align with the extrinsic benefits in visible knowledge exchange channels.

The second implication concerns the use of different knowledge exchange channels within organisations. Although all knowledge exchange levels are necessary for knowledge exchange, a big volume of high-quality knowledge is generated in the group-level communications. Therefore, the main concern of KM developers in high-tech companies should be to design efficient group-level knowledge exchange platforms (such as network of practices) to improve knowledge sharing level. Moreover, when organisations need high quality knowledge for strategic goals, motivating participants to share knowledge on the group-level may enhance a good solution.

Thirdly, the research framework assists KM practitioners to design an integrated communication structure. Demonstrating three visibility levels of knowledge exchanges in the research framework postulates a general guideline for structuring private, group and public communication levels among participants. Additionally, three levels of knowledge exchange provide a strategic knowledge map for organisations to develop knowledge sharing mechanisms.

7.2 Limitations and future research

The results are promising, and they invite future research. This study focuses on a group of companies in the energy industry. This can limit the generalisability of the results. Whether similar results are to be found in other business contexts and domains is an open question. Furthermore, the generalisability of the results may be limited as the sample is skewed towards males. This also holds for the comparison of perceived benefits across the three levels of knowledge exchange. Our focus on perceived benefits invites new research focus on perceived costs of knowledge sharing in relation to knowledge contribution. Furthermore, the individuals' participation is measured using active participants' data; the outcome can be generalised by measuring data from both active and non-active participants. Moreover, future research is required to demonstrate the improvement results of suggested practical recommendations. This paper provides insights upon which this future research can be based.

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Further reading

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Appendix 1

Table A1 Summary of key research in perceived benefits and organisational knowledge sharing

<i>Theoretical foundation</i>	<i>Technology</i>	<i>Level of knowledge sharing</i>	<i>Perceived benefits (selected)</i>	<i>Dependent variables</i>	<i>Data collection/ Research scope</i>	<i>Source</i>
Social exchange	Online health community	Public	Sense of self-worth Face concern Reputation Social support Cognitive costs Executorial costs	General knowledge sharing behaviour Specific knowledge sharing behaviour	Survey/ Two major firms online health communities in China	Yan <i>et al.</i> (2016)
Social exchange	–	Public	Material rewards	Explicit knowledge sharing Implicit knowledge sharing	Survey/ a Chinese hospital	Lin and Lo (2015)
Social exchange	–	Group	Reputation Reciprocity Economic rewards Self-efficacy Enjoyment of helping	Explicit knowledge sharing Implicit knowledge sharing	Mixed method: interview and survey/an organisation work of computer-based education systems	Zhang <i>et al.</i> (2013)
Social capital	–	–	Organisational rewards Reciprocity	Tacit knowledge sharing intention Explicit knowledge sharing intention	Survey/seven firms in Korea	Hau <i>et al.</i> (2013)
Rational action	–	–	Enjoyment Organisational Incentives	Knowledge sharing intention	Survey/ 10 companies in China	Wu and Zhu (2012)
Theory of planned behaviour Economic exchange Social exchange Self-determination	Knowledge management system	–	Reciprocal Benefits Reputation Enhancement Enjoyment in Helping Others	Knowledge sharing behaviour	–	–
-	Community of practice	Group	Perceived benefits Perceived barriers	–	Case study/ qualitative data, form two sets of communities	Wolf <i>et al.</i> (2011)
Expectation-confirmation Theory of reasoned action	Knowledge repository	Public	Image Reciprocity	Contribution on KM Seeking knowledge	Survey/an international IT company	He and Wei (2009)
Theory of reasoned action	–	Public	Organisational rewards Enjoyment in helping Material rewards	Knowledge sharing intention	Survey/50 organisations in Taiwan	Lin (2007)

(continued)

Table A1

<i>Theoretical foundation</i>	<i>Technology</i>	<i>Level of knowledge sharing</i>	<i>Perceived benefits (selected)</i>	<i>Dependent variables</i>	<i>Data collection/ Research scope</i>	<i>Source</i>
Self-determination			Reciprocity			
Social exchange Social capital	Knowledge repository	Public	Knowledge self-efficacy Enjoyment in helping others	Knowledge repository usage	Survey/10 public sector organisations in Singapore	Kankanhalli et al. (2005a)
Theory of reasoned action	–	Public	Reciprocity Extrinsic rewards Image	Intention to share knowledge Attitude towards knowledge sharing	Survey/13 organisations in seven industries in Korea	Bock et al. (2005)
Collective action Individual motivation Social capital Social exchange	Electronic networks of practice	Public	Reputation Enjoy helping Self-rated expertise Reciprocity	Helpfulness of contribution Volume of contribution	Survey/a national legal professional association in the USA	Wasko and Faraj (2005)

Appendix 2

Table All Questionnaire items		
Construct	Item wording and code	Source
Material rewards	MR01: I share my knowledge in the knowledge network to gain career promotions opportunities	Developed by authors Lin (2007)
	MR02: I share my knowledge in the knowledge network to improve my job security	
	MR03: I share my knowledge in the knowledge network to get flexible work hours	
	MR04: I share my knowledge in the knowledge network to get sabbaticals	
Reputation	RP01: I share my knowledge through the knowledge network to increase my position in organisation	Kankanhalli <i>et al.</i> (2005a) Wasko and Faraj (2005)
	RP02: I share my knowledge through the knowledge network to improve my reputation in the organisational professional field	
	RP03: I share my knowledge in the knowledge network to earn respect from employees	
Reciprocity	RC01: I share my knowledge in the knowledge network to receive knowledge in return in the future	Lin (2007)
	RC02: I share my knowledge in the knowledge network because I believe my question will be answered in the future	
	RC03: I share my knowledge in the knowledge network to receive helpful knowledge from the knowledge recipient	
Altruism	AL01: I share my knowledge in the knowledge network because I like to assist participants	Kankanhalli <i>et al.</i> (2005a) Yu and Chu (2007)
	AL02: I share my knowledge in the knowledge network because I feel happy to assist participants in solving their problems	
	AL03: I share my knowledge in the knowledge network because I enjoy helping other participants by sharing knowledge	
Self-efficacy	SE01: I share my knowledge in the knowledge network because I am confident in my capability to create knowledge that participants consider helpful	Kankanhalli <i>et al.</i> (2005a) Lin (2007)
	SE02: I share my knowledge in the knowledge network because I have the expertise necessitated to create valuable knowledge for participants	
	SE03: It does not really make any difference whether I share my knowledge with others in the knowledge network (Reverse coded)	
	SE04: Most other participants can create valuable knowledge than I can in the knowledge network (Reverse coded)	

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