Knowledge sharing, intellectual capital and firm performance

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Abstract

Purpose – The aim of this paper is to investigate the impact of knowledge sharing (KS) on firm performance and the mediating role of intellectual capital (IC).

Design/methodology/approach – A research model was developed based on prior KS and IC studies. A survey was administered to a sample of high technology firms in China and 228 usable responses were collected. Structural equation modeling (SEM) was employed to test the research model.

Findings – Tacit KS significantly was found to contribute to all three components of IC, namely human, structural and relational capital, while explicit KS only has a significant influence on human and structural capital. Human, structural and relational capital, enhance both operational and financial performance of firms. The effect of KS on firm performance is mediated by IC. Explicit KS has a greater effect on financial performance than operational performance, whereas tacit KS has a greater impact on operational performance than financial performance.

Research limitations/implications – The sample of high technology firms in China might limit the generalization of the findings. Nonetheless, this study takes its lead from and extends prior research, thus providing a deepened understanding of the role of KS in organizational settings.

Practical implications – The paper suggests that managers can enhance firm performance by enhancing their KS and IC. Managers can develop corresponding strategies based on the findings to achieve their specific performance goals.

Originality/value – This is one of the first papers to examine how KS contributes to firm performance through the mediation of IC. It will add significant value for organizations trying to enhance their performance though KS practices.

Keywords Knowledge sharing, Intellectual capital, Firm performance

Paper type Research paper

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1. Introduction

In the era of knowledge-based economies, intangible resources and competencies are crucial for firms to survive in dynamic environments (Subramaniam and Youndt, 2005a, b; Teece et al., 1997). According to the knowledge-based view (KBV), knowledge-related resources are more likely to contribute to a firm's attaining and sustaining superior performance than tangible resources (Bogner and Bansal, 2007). Since knowledge is not evenly distributed within an organization, knowledge sharing (KS) among individuals, teams, and/or units is imperative for organizations to identify, capture, create, and accumulate their knowledge to facilitate both resource structuring and capacity building, which have been found to significantly increase firm performance (Wang et al., 2012). However, KS is a challenge facing organizations (O'Dell and Grayson, 1998) due to many barriers. Examples of these could be a firm's incentive systems being misaligned with the goal of implementing KS, or the failure of these incentive systems to reduce people's inherent hostility to KS (Husted and Michailova, 2002; Husted et al., 2012).

In general, KS can be regarded as the process of interaction, communication and coordination of knowledge or expertise (Haas and Hansen, 2007). It comprises a set of shared understandings related to providing employees with access to relevant information and using existing knowledge within organizations (Lin, 2007b). Knowledge-related competence and organizational performance can be enhanced by effective KS, because KS can make jobs easier and improve process efficiency by the exchange of relevant information, best practices, insights, experiences, preferences, lessons learned, as well as common and uncommon sense (Wang and Wang, 2012; Huang and Wu, 2010).

Much research has recognized the importance of KS, investigating how organizational, team, individual, or other factors such as culture/climate, management support, rewards/incentives, diversity, social networks, perceived benefits and costs, interpersonal trust and justice, beliefs of knowledge ownership, and so on influence KS (Down, 2001; Small, 2006; Wang and Noe, 2010; Xue et al., 2011). However, there is little empirical research in the extant literature concerning the specific effect of KS on firm performance. While some studies have pointed out that KS could result in reduced production costs, faster completion of new development projects, improved decision making and coordination, innovation capability, sales growth or revenue from new products and services (Huang et al., 2010; Mesmer-Magnus and DeChurch, 2009; Wang and Wang, 2012), the following questions remain unanswered: Does KS influence firm performance directly? Is the effect of KS on firm performance mediated by other variables? What is the mediation mechanism?

The KBV suggests that knowledge is the primary source of value, and a firm's value creation is primarily a function of its ability to accumulate and use knowledge (Hsu and Sabherwal, 2011; Zhou and Li, 2012). KS, the best way to effectively and efficiently create, sustain, and transfer knowledge, will be a source of knowledge-related competence, thus contributing to enhanced organizational performance and assets. Consistent with this view, Hsu (2008) verified that KS practices improve organizational performance through the development of human capital. Karagiannis et al. (2008) pointed out that sharing and transferring knowledge could be helpful for institutionalizing structural capital in a firm. According to Intellectual Capital (IC) theory, human capital,
structural capital and other knowledge assets are part of a firm’s IC, which can be defined as the sum of all knowledge used to form the process of conducting business to gain competitive advantages (Subramaniam and Youn, 2005a; Youn et al., 2004). Therefore, IC may be closely associated with or enhanced by KS, though little research has examined their relationship. Furthermore, beyond process-oriented tasks such as knowledge creation, sharing and utilization, IC deals with the valuation of knowledge in a corporation and aims to improve organizational competitiveness and performance. Thus, we specifically develop the argument that KS will influence firm performance both directly and indirectly by strengthening the firm’s IC.

We tested our hypothesis with a survey of high-technology firms in China. With independent intellectual property rights of a range of major products, high-technology firms play a key role in the ongoing economic development of China through knowledge-related production and innovation. As China has become more and more integrated into the global economy, competitive pressures on Chinese firms have intensified substantially, forcing high-technology firms to make full use of knowledge and develop IC to survive and succeed. The complex and dynamic nature of the transitional Chinese market makes it a rich field for exploring the relationships among KS, IC and firm performance.

This study makes three important contributions. First, by showing that IC can be an intermediate mechanism or conduit through which KS contributes to firm performance, we provide an enriched theoretical explanation on the role of KS in organizational settings. Second, by examining the influence of explicit and tacit KS on three components of IC, namely human capital, structural capital, and relational capital, which in turn lead to superior firm operational and financial performance, we offer a detailed account of the effects of KS and IC. Finally, we contribute to the KBV literature by empirically studying the relationships between KS, IC, and firm performance. Our findings aim to complement and extend previous research in this important area.

The remainder of this paper is organized as follows. Section 2 puts forward the theoretical development and hypotheses. Section 3 describes research methodology. Data analysis and the findings are reported in section 4. Implications and limitations, future research directions, and concluding remarks are discussed in section 5.

2. Theoretical background and hypotheses
2.1 Knowledge sharing (KS)
KS refers to the activity through which knowledge in various forms is transferred or exchanged from one person, group or organization to another (McAdam et al., 2012). In comparison with influences and changes emphasized by knowledge transfer (Argote and Ingram, 2000), KS focuses more on the process of knowledge collection and diffusion, and contributes to knowledge exchange, application and creation, and ultimately, the knowledge-based capability within the organization (Wang and Wang, 2012). KS in an organization is very important for preserving its valuable heritage, learning new techniques, solving problems, creating core competencies, initiating new undertakings, and ultimately gaining competitive advantage (Hsu, 2008; Law and Ngai, 2008). For this reason, previous studies have attempted to understand KS practices from a variety of angles, such as tacit and explicit KS (Quigley et al., 2007; Reychav and Weisberg, 2010; Wang and Wang, 2012), management practices,
technology, and business models KS (McEvily et al., 2000), formalized and informal KS (Taminiau et al., 2009; Zahra et al., 2007), exploratory and exploitative KS (Im and Rai, 2008), solicited and voluntary KS (Teng and Song, 2011), and full and partial KS (Ford and Staples, 2010).

Based on Polanyi’s (1966) conceptualization of knowledge, the Socialization, Externalization, Combination, and Internalization (SECI) model explains the functions performed by tacit and explicit KS in the knowledge creation process (Nonaka, 1994). On the one hand, KS translates individual and group knowledge into organizational knowledge via the processes of externalization and combination. On the other, KS turns organizational knowledge into individual or group knowledge when internalization and socialization occur. It is worth mentioning that tacit KS is the foundation of socialization while explicit KS makes combination possible within the organization. As regards the process of externalization and internalization, both tacit and explicit KS play key roles in the transformation of the two types of knowledge.

As explicit knowledge is knowledge that can exist in symbolic or written form, explicit KS comprises almost all the forms of KS that are institutionalized within organizations. Practices of explicit KS are more common in the workplace because explicit knowledge can be easily captured, codified and transmitted. Management mechanisms, such as procedures, formal language, handbooks, and information systems, will promote employees’ willingness to share their explicit knowledge (Coakes, 2006). In contrast, as tacit knowledge cannot be expressed in verbal, symbolic and written form, face-to-face interaction is the primary means for tacit KS. Keys to tacit KS are the willingness and capacity of individuals to share what they know and to use what they learn (Holste and Fields, 2010). Human experience is the foundation of tacit KS because individuals cannot take advantage of new knowledge, unless they have earlier social software already in place (Nonaka and Takeuchi, 1995). Difficulties that may hinder tacit KS include coworkers’ unwillingness to share and/or use tacit knowledge, limited awareness of the tacit knowledge an individual possesses, difficulty in expressing tacit knowledge that is tied to mental and/or physical actions, and deficiency of applying context-specific tacit knowledge in other contexts (Holste and Fields, 2010).

2.2 Intellectual capital (IC)

IC is the sum of all knowledge and knowing capabilities that will be crucial for firms to gain a sustainable competitive advantage (Nahapiet and Ghoshal, 1998; Stewart and Ruckdeschel, 1998; Teece and Teece, 2000). Originally, the concept of IC was introduced to represent the difference between an organization’s book value and market value (Stewart, 1994). IC has been defined in many different ways, including: the knowledge assets that can be converted into value (Edvinsson and Malone, 1997); the sum of a company’s hidden assets not fully captured on the balance sheet; intellectual materials such as knowledge, information and experience that form the company’s competitive advantage (Stewart and Ruckdeschel, 1998); and the sum of all knowledge an organization can bring to bear on the process of conducting business to gain a competitive advantage (Youndt et al., 2004). While there are variations on these definitions, there is a great deal of convergence of opinion. Scholars generally agree that as a non-monetary, non-physical resource, IC contributes to an organization’s value creation and value extraction through the knowledge not only held by
individuals, but also stored within organizational databases, business processes, systems, and relationships (Serenko and Bontis, 2004; Sullivan, 1999; Thrylo and Kornukh, 2011; Youndt et al., 2004; Zharinova, 2011). Like other concepts in the knowledge-based literature, IC has suffered from the dilemma of being theoretically interesting, but extremely hard to identify.

Previous studies have proposed different frameworks that help us better conceptualize IC as well as making it easier to operationalize. Spender (1996), for example, combined two dimensions of explicit/tacit and individual/social knowledge to create a matrix of four different elements of an organization's IC. Edvinsson and Malone (1997) expounded their view of IC as being made up of two primary components: human capital and structural capital, which can be sub-divided into two categories: organizational capital and customer capital. Sveiby (1998) proposed a family tree to divide the IC into individual competence, internal structure, and external structure. Johannessen et al. (2005) categorized IC as human capital, structure capital, network capital and system capital. Drawing upon all of the existing discussions, we find that the most widely accepted framework of IC has three major components: human capital, structural capital, and relational capital (Chen, 2008; Chu et al., 2006; Herremans et al., 2011; Hsu and Fang, 2009; Namvar et al., 2010; Sharabati et al., 2010; Shih et al., 2010; Vergauwen et al., 2007).

Human capital, which is embedded in employees, is the sum of employees' competence, knowledge, skills, innovativeness, attitude, commitment, wisdom, and experience. It represent the individual knowledge stock of an organization to reach certain targets (Bontis et al., 2007; Cabello-Medina et al., 2011; Campbell et al., 2012; Nick and Alexander, 2007; Ruzzier et al., 2007). Structural capital refers to the valuable intangible assets that employees cannot take away when getting off work or leaving the organization (Edvinsson and Malone, 1997). Structural capital is embedded in organizations and is best described as the valuable strategic assets of organizational capabilities, organizational culture, routines, procedures, information systems, hardware, software, databases, company images, patents, copyrights, trademarks, and so on (Aramburu and Saenz, 2011; Karagiannis et al., 2008; Zangoueinezhad and Moshabaki, 2009). Relational capital refers to the knowledge and learning capabilities that exist in relationships between an organization and its external stakeholders (Bontis, 1998; Cegarra-Navarro and Sanchez-Polo, 2008a, 2008b; Dewhurst and Navarro, 2004; Kale et al., 2000). It is critical to organizations because it helps to create organizational value by connecting internal intellectual resources with external stakeholders (Carmeli and Azeroual, 2009; Collins and Hitt, 2006; De Clercq and Sapienza, 2006; Kong and Farrell, 2010).

2.3 Research hypotheses

This paper aims to investigate how KS contributes to firm performance through the mediating effect of IC. We develop a research model that shows the relationships among the constructs to be studied (see Figure 1).

2.3.1 KS and IC. According to the KBV, knowledge is the key resource that constitutes organizational capability or knowledge-based capital. However, if knowledge stays isolated within certain individuals or units, it is difficult for a firm to make full use of existing knowledge and accumulate or develop its IC. Therefore, knowledge sharing is important in utilizing knowledge to develop IC (Hsu and
Sabherwal, 2012). As KS involves the transfer or dissemination of knowledge from one person or group to another (Hsu, 2008; Karagiannis et al., 2008), it is a critical aspect of the leveraging, transmission and creation of knowledge, and a fundamental process for enterprise knowledge management (Small, 2006). KS is likely to increases the scope of the knowledge being integrated by different kinds of specialized knowledge, and facilitates a knowledge-based capability that is inimitable for competitors (Grant, 1996).

Explicit KS can directly increase codified knowledge and skills of the receiver and the knowledge provider can also deepen the understanding of their own knowledge through feedback and discussion (Ipe, 2003). Interaction and personal contact involved in explicit KS may well promote the effectiveness of learning, change staff’s knowledge structure, and lead to improved individual performance (Chao et al., 2011; Huysman and de Wit, 2004). Thus, arrangements that support knowledge sharing among employees will help to develop organizational human capital (Hsu, 2008; Spender and Marr, 2006):

H1a. Explicit KS is positively associated with human capital.

In the course of explicit KS, job-related knowledge, both technical and non-technical, will be deposited in the organization as a result of information exchange, discussion and engineering development for the sake of problem solving (Karagiannis et al., 2008). In collaborative decision-making environments, better design and utilization of management structures can be achieved by a certain degree of information and knowledge sharing (Yoon et al., 2011). Structural capital represents the institutionalized knowledge about the form of organizational processes, structures, technologies, policies and culture. It will be enhanced through the institutionalization
of both the individual and group knowledge that is present in the firm during the learning process, which is always accompanied by explicit KS (de Pablos, 2004):

\[ H1b. \] Explicit KS is positively associated with structural capital.

When people work together for a common goal in groups and organizations, explicit KS practices will help them establish either structural ties characterized by closeness and frequent interactions or relational ties that exhibit relational aspects such as trust and trustworthiness (Carmeli and Azeroual, 2009). As individuals in the same organization usually have complementary specialties and task assignments, the sharing of information and resources and collaboration will improve their job performance and personal relationships (Hu, 2009). Through the flow of useful information, high-quality relational capital is likely to result from the exchange of knowledge and learning from one party to the other:

\[ H1c. \] Explicit KS is positively associated with relational capital.

As tacit knowledge is embedded in action, contextualized in practice and subjected to actors’ interpretations, it can hardly be codified, identified, retrieved and shared with others (Peet, 2012). In the ‘place of knowledge making’, tacit KS takes place through the connections of individuals, groups, and units, amplifies the knowledge of ‘knowing more than we can tell’ possessed by the employees, and leads to organizational knowledge creation (Nonaka and Takeuchi, 1995; Nonaka and von Krogh, 2009). Through the exchange of tacit knowledge, team members could gain and use hands-on skills, idiosyncratic experiences and special methods to perform better with a cognitive innovation style (Bloodgood and Chilton, 2012). Therefore, tacit KS could actually improve common sense, tactile experiences, social skills, intuition, emotions, and unarticulated mental models of the involved stakeholders, which all add to the pool of a firm’s human capital:

\[ H2a. \] Tacit KS is positively associated with human capital.

In the day-to-day activities within organizations, signs of tacit knowledge such as intuition, feelings, insights and personal abilities can be detected (Joia and Lemos, 2010). When people work toward the same goal, performance improvement can be achieved through the sharing of individual experience, reflection, and talent (Bueno et al., 2010). Some tacit KS is formal, resulting from training events, or conferences, while others are more informal, resulting from interdepartmental task forces, informal social networks and employee interactions (Holste and Fields, 2010). The result of tacit KS not only changes the way individuals think and behave, but also adds new content to existing routines, procedures, cultures, and learning systems, or even rebuilds the infrastructure of an existing establishment:

\[ H2b. \] Tacit KS is positively associated with structural capital.

When tacit knowledge, which is the main source of core competitive advantage, is shared for special reasons, the receiver will greatly appreciate the valuable subjective, context-specific insights, intuitions, or hunches transferred from the providers. With the development and implementation of collaborative programs, the interactional dynamics involved in tacit KS helps to enhance mutual understanding, trust and cohesion (Yang and Lai, 2012). Previous research has found that once tacit KS occurs,
both parties involved would not only avoid making demands that can seriously
damage common interests, but also promote their relationships through activities such
as pursuing the same preference, sharing private experience, and expressing goodwill
and showing concerns (Hsu and Wang, 2012; Kong and Farrell, 2010; Wu et al., 2008):

$H2c$. Tacit KS is positively associated with relational capital.

2.3.2 IC and firm performance. IC, the sum of knowledge-related resources, represents
the wealth of ideas, abilities, infrastructures and relations that determine the
competitiveness of an organization (Sharabati et al., 2010). Human, structural and
relational capital, conceptualized as three components of IC, offer a powerful approach
to differentiating organizational financial and non-financial performance (Hsu and
Sabherwal, 2011; Hsu and Fang, 2009; Phusavat et al., 2011; Shih et al., 2007, 2010;
Youndt et al., 2004). Therefore, an increasing number of companies in America and
Europe publicize their IC reports to stakeholders for the benefits of confirming their
position as leaders in their fields.

As organizations need individuals who are knowledgeable, with excellent
problem-solving skills and the ability to make effective decisions, human capital is
considered to be the underlying strategic resource for sustainable competitive
advantage in today’s fast-paced, rapidly changing environment (Bontis et al., 2007;
Campbell et al., 2012; Mengistae, 2006). Given that a firm’s products and services are
always provided by its personnel, it is clear that a firm’s ability to produce new
products, improve operational and managerial efficiency, or heighten the level of
productivity and quality is closely linked to its human capital (Cabello-Medina et al.,
2011). Human capital is the most important aspect of IC, and firms that have realized
its importance and invested in their employees tend to enjoy better operational
performance (Seleim et al., 2007; Wang et al., 2011):

$H3a$. Human capital is positively associated with firm operational performance.

Human capital might also lead to improved financial outcomes of the business (Ling
and Jaw, 2006). Companies could maximize their ROI with high-yield investments in
human capital (Le Blanc et al., 1998). CEOs with international assignment experience, a
special type of human capital, are found to be able to create value for their firms and
themselves, especially when such human capital is bundled together with other
organizational resources and capabilities (Carpenter et al., 2001). In an investigation of
the relationship between being a ‘great place to work’ and firm performance, (Fulmer
et al., 2006) found that companies in the 100 Best Companies to Work for in America
list tended to enjoy not only positive workforce attitudes, but also better financial
performance than companies in the broader market, and in some cases, over the
comparison group made up of their peers:

$H3b$. Human capital is positively associated with firm financial performance.

Structural capital, sometimes used interchangeably with organizational capital,
includes all non-human reserves of knowledge in a firm employed to achieve better
performance (Bontis, 1998; Martinez-Torres, 2006; Youndt et al., 2004). With the
accumulation of structural capital, firms strengthen work procedures/processes to
improve production and service efficiency, facilitate communication and technical
exchange, and optimize problem solving to lower costs and improve quality (de Pablos,
Consequently, firms incorporating structural capital in their overall business strategies will not only creatively improve the way they gather, produce and transmit knowledge, but also gain a better position to generate higher quality, lower costs, and deeper insight leading to improved operational performance (Aramburu and Saenz, 2011; Zangoueinezhad and Moshabaki, 2009):

**H4a.** Structural capital is positively associated with firm operational performance.

If an organization has poor procedures and systems to deploy necessary resources and track its actions, the organization will find it difficult to achieve its performance goals. Conversely, an organization that provides strong structural support to its core business by nurturing an innovation culture, developing organizational commitment of sufficient resources, and engaging top-level management will excel in financial performance (De Brentani and Kleinschmidt, 2004). Moreover, structural capital propels organizations' value creation activities, which have a positive effect on their performance. Phusavat et al. (2011), for example, found that structural capital positively and significantly affects a manufacturing firm's financial performance, (i.e. return on equity, return on assets, revenue growth and employee productivity):

**H4b.** Structural capital is positively associated with firm financial performance.

Organizations emphasizing strategic relationships almost inevitably focus on the relationship with their stakeholders (Hsu and Wang, 2012). With the support of relational capital, staff can be enabled to pinpoint new issues for further attention, exploit the cognitive arsenal within the network, and define better ways for the uptake and implementation of tasks. By building relational capital with customers or partners, firms may find new and improved ways to do business by learning from others' advanced experiences and becoming more innovative (Cousins et al., 2006; Dewhurst and Navarro, 2004). Therefore, a firm could increase the level of quality improvement, cost reduction, responsiveness, productivity and asset management through the new insights derived from its strong relational capital:

**H5a.** Relational capital is positively associated with firm operational performance.

Recent research has suggested that relational capital may reduce transaction costs, enhance cooperation, enable entrepreneurship and the creation of start-up companies, and strengthen supplier relations, regional production networks and inter-firm learning (Moran, 2005; Thuy and Quang, 2005; Zhang and Fung, 2006). De Clercq and Sapienza (2006), for example, found venture capitalists' perception of portfolio performance would be amplified by the positive effect generated from relational capital. Germain et al. (2011) confirmed that, in hospitals, engaging in relational exchanges with suppliers was associated with better financial performance when responsiveness was high. Zhang and Fung (2006) showed that the flow of social capital is a significant determinant of an enterprise’s financial performance:

**H5b.** Relational capital is positively associated with firm financial performance.

### 2.3.3 KS and firm performance

According to KBV, knowledge, both explicit and tacit, constitutes the primary resource for firms to gain and sustain a competitive advantage (Felin and Hesterly, 2007; Reus et al., 2009). While most explicit knowledge and certain
tacit knowledge can be retained by an organization for value creation and value extraction, it is knowledge sharing or integration that combines scattered knowledge to enhance innovation, creativity, and ultimately achieve performance gains (Gao et al., 2009). Many current knowledge sharing practices, such as training and development programs, IT systems, reports and official documents, and cross-function teams, are good examples of knowledge integration in that they combine knowledge across a broad spectrum to enhance the quality of products and services, increase responsiveness to customer needs, strengthen innovation capability, and improve firm performance (Wang and Wang, 2012).

Organizational learning occurs when firms expand or renew their knowledge stocks over time by investing in explicit KS, such as training, acquiring external technologies, and hiring external experts. Explicit KS stimulates flows of new knowledge and guides future actions. This increases the distribution of knowledge across organizational members, facilitates the emergence of common meanings, and enables existing capabilities to be synthesized and reconfigured. Therefore, explicit KS has significant influences on employees' values, organizational engagement and management norms, which are central to enabling superior operational performance. As suggested by van den Hooff and De Ridder (2004), explicit KS processes, with the flow of new information and codified knowledge, would contribute to organizational efficiency and effectiveness:

\[ H6a. \] Explicit KS is positively associated with firm operational performance.

Exchange of explicit knowledge within a firm can bring disparate knowledge sources together and turn this into a driving force for financial performance. An increased level of explicit KS helps to take advantage of the existing formal knowledge and expertise in integrated problem solving, which can result in improved products and processes (Lawson et al., 2009). Lee (2001), for example, found that once successful explicit KS takes place directly in outsourcing projects, firms' financial outcomes would be enhanced. Carr and Kaynak (2007) suggested that information sharing within a firm and between firms was necessary for helping organization members identify critical issues, and eventually led to product quality improvement and financial performance. Wang and Wang (2012), confirmed that explicit KS practices facilitated innovation and financial performance:

\[ H6b. \] Explicit KS is positively associated with firm financial performance.

As tacit knowledge is an essential part of experiential knowledge acquired by individuals during the course of (holistic) working, tacit KS contains person-, situation- or context-oriented interactions. This practice stimulates organization members, groups and units to exchange their own experience or knowledge and think together, to a certain extent. Therefore, tacit KS can be the backbone of organizational learning and bring enormous benefits to an organization (Akbar, 2003; Down, 2001; Matthew and Sternberg, 2009; van Woerkom and Sanders, 2010). These benefits include lower costs, improved delivery, fewer quality problems, early insights into new technologies, and on-time product launches (Hsu, 2008; Sher and Lee, 2004). Law (2008), for example, found that tacit KS led to the improvement of business processes, product and service offerings of a firm, and better operational performance:

\[ H7a. \] Tacit KS is positively associated with firm operational performance.
The value-creating capability that resides in the sharing of know-how or tacit knowledge of the engineers, managers and marketing staff creates a sustainable competitive advantage (Harold, 2008). Du et al. (2007) explored the relationship between knowledge sharing and firm performance based on a survey and found that different dimensions of knowledge sharing play a host of roles in affecting performance. A firm’s financial performance tends to increase when the firm improves its tacit KS, especially when it is related to outsourcing, sales, cost reduction, quality assurance, R&D, and customer management:

\[ H7b: \text{Tacit KS is positively associated with firm financial performance.} \]

### 3. Research methodology

#### 3.1 Data collection

We adopted a survey method to test the hypotheses. Although the survey approach has some disadvantages, such as providing only a snapshot of the situation at a certain point in time, it has advantages relative to case studies and other qualitative methods. Specifically, surveys allow for precise measurement of theoretical constructs, quick data collection, rigorous data analysis using advanced, statistical techniques, and quantitative identification of complex relationships (Gable, 1994). Case studies are more appropriate when the boundaries of the focal phenomena are not well defined, and the relationships between constructs cannot be quantitatively evaluated. Since in this study, the boundaries of the KS phenomenon are relatively well defined and the relationships between constructs are statistically testable, a survey method is fully justified.

A random sample was drawn from high-technology firms in the Jiangsu province (one of the most developed provinces in China). Our sampling choice was based on three considerations. First, KS in high-technology firms plays a crucial role in facilitating IC development because knowledge resources and assets are fundamental in this highly competitive business sector. Second, it is important to develop knowledge-related production and innovation to stay competitive in the transitional economy in China. This forces high-technology firms to pay more attention to KS and IC so as to attain competitive advantages. Third, these selected firms seriously encourage KS and believe that it could improve operational or financial performance, thus offering an appropriate setting for examining the relationship between KS and performance.

Following the key informant approach, which suggests that top managers represent the best source for firm-level information, we directed our questionnaires (each company received one questionnaire) to the CEO/general manager or senior manager. A total of 691 firms were approached via mail or email. Some firms did not respond, and some firms’ data were discarded because of incomplete questionnaires. Finally, 263 completed surveys were collected. After removing the obviously invalid responses (e.g. selecting the same answer for all questions), 228 were retained for analysis, showing an effective response rate of 32.9 percent.

We compared the responding firms with the non-responding firms in terms of industry type. The Chi-squared test was insignificant. We also checked the possibility of non-response bias by comparing the characteristics of the earliest 57 respondents (25 percent) and the last 57 respondents of the final sample. The t-test for company size and the chi-squared test for the industry type of the company are all statistically insignificant, suggesting that there are no significant differences between the two groups. Hence, non-response bias is not a serious concern (Armstrong and Overton, 1977).
3.2 Measurement
All measurement items were reused or adapted from existing scales in the literature to ensure reliability and content validity of latent variables. The explicit KS measurement was adapted from Liebowitz and Chen (2001), and Wang and Wang (2012). The tacit KS measurement was adapted from Holste and Fields (2010), Lin (2007a), and Wang and Wang (2012). The human capital measurement was adapted from Bontis (1998), Chen et al. (2009), Hsu and Fang (2009), and Youndt et al. (2004). The structural capital measurement was based on Bontis (1998), Hsu and Fang (2009), and Wu et al. (2008). The relational capital measurement was derived from Bontis (1998), Hsu and Fang (2009), and Longo and Mura (2011). The operational performance measurement was adapted from Bowersox et al. (2000). The financial performance measurement was based on Bowersox et al. (2000), Inman et al. (2011), and Vaccaro et al. (2010). The detailed measurement items are shown in the Appendix.

Because the questionnaire was initially written in English, we performed a translation of the original instrument into Chinese. Some modifications were made to align the scales with the Chinese context. An expert panel of two professors, six CEOs, and senior business managers examined the face validity of the measurement items. After a pilot and several revisions, the final questionnaire was developed for data collection. A seven-point Likert scale ranging from 1 (totally disagree) to 7 (totally agree) was used throughout the questionnaire.

3.3 Control variable
To account for differences among firms, firm size was included in our research model as a control variable. We selected this variable because of its potential impact on firm performance, as suggested by Ravichandran and Lertwongsatien (2005). Firm size implies greater pricing and bargaining power, and the prevalence of operation and management routines, all of which can influence firm performance. In this study, firm size was measured by the natural log of the number of employees.

3.4 Common method bias test
To test the common method bias, we use Harman’s one-factor test (Podsakoff et al., 2003) and a fully saturated causal model (Williams et al., 2003). A principal factor analysis of the measurement items yielded seven factors with eigenvalues greater than 1, accounting for 75.4 percent of the total variance, with the first factor accounting for 33.7 percent of the variance. Since a single factor did not emerge, and one general factor did not account for most of the variance, common method bias was considered unlikely to be a serious problem. A fully saturated model also showed that common method bias was not present because item loadings were generally found to be statistically insignificant with unrelated constructs.

4. Results
4.1 Measurement model
We first performed confirmatory factor analysis (CFA) by employing structural equation modeling (SEM) to evaluate the overall measurement model. Convergent validity and discriminant validity were assessed. Convergent validity is the degree to which items that are supposed to measure a single construct agree with each other. We tested convergent validity by assessing factor loadings, which should be significant
and exceed 0.6, composite reliabilities, which should exceed 0.8, and the average variance extracted (AVE), which should be more than 0.5 for all constructs (Fornell and Larcker, 1981). In our model, all of the factor loadings are greater than 0.6 and significant at the 0.01 level. Factor loadings range from 0.69 to 0.91. Composite reliabilities (CR) range from 0.89 to 0.94. AVE ranges from 0.62 to 0.73. The results show that our model meets the convergent validity criteria. We evaluated the internal reliability of scales by using Cronbach’s alpha (C-α). This statistic ranges from 0.89 to 0.95, which are all higher than 0.7. Table I shows the means, SD, factor loading, AVE, CR and C-α of every construct.

Discriminant validity is the degree to which items that are supposed to measure a specific construct do not predict conceptually unrelated constructs (Kline, 2010). We used Fornell and Larcker’s approach (Fornell and Larcker, 1981) to assess discriminant validity. In this approach, the AVE for each construct should be higher than the squared correlation between the same construct and any other construct. Table II indicates that the measurement model has satisfactory discriminant validity.

In Table II, the diagonal elements in italics denote the AVE and the off-diagonal elements are the squared correlations between constructs. It is obvious that each diagonal element is higher than its respective off-diagonal elements. Therefore, all constructs in the measurement model were judged as having adequate discriminant validity.

We assessed the measurement model fit by evaluating:

- absolute fit measures, including observed normed $\chi^2$ ($\chi^2$/df), goodness-of-fit index (GFI) and root mean square error of approximation (RMSEA);
- incremental fit measures, including normed fit index (NFI), adjusted goodness-of-fit (AGFI) and comparative fit index (CFI); and
- parsimonious fit measures, including parsimony goodness-of-fit index (PGFI) and parsimony normed fit index (PNFI).

As shown in Table III, all fit indices met satisfactory levels. Therefore, we conclude that the model fits the data well and is thus suitable for testing the research hypotheses.

### 4.2 Structural model

Table IV and Figure 2 show the results of hypothesis testing of the structural relationship among the latent variables. The first three hypotheses concern the relationships between explicit KS and three components of intellectual capital. The effects of explicit KS on human and structural capital are 0.257 and 0.266 ($p < 0.05$), supporting $H1a$ and $H1b$. However, the effect of explicit KS on relational capital is not significant ($b = 0.093, p > 0.10$). Thus, $H1c$ is not supported. The effects of tacit KS on human, structural and relational capital are 0.228, 0.321 and 0.319, which are statistically significant ($p < 0.05$). Thus, $H2a$, $H2b$ and $H2c$ are supported.

According to Table IV and Figure 2, the effects of human capital on operational and financial performance are 0.200 and 0.203 which are statistically significant ($p < 0.05$). Thus, $H3a$ and $H3b$ are supported. Structural capital had significant effects on both operational and financial performance ($b = 0.292, p < 0.05$; $b = 0.144, p < 0.05$). Therefore, $H4a$ and $H4b$ are supported. Relational capital has significant effects on
both operational performance ($b = 0.114$, $p < 0.10$) and financial performance ($b = 0.199$, $p < 0.05$), providing support for $H5a$ and $H5b$.

The effect of explicit KS on operational performance is non-significant ($b = 0.058$, $p > 0.10$), failing to support $H6a$. The effect of explicit KS on financial performance has a value of 0.214 and is statistically significant ($p < 0.10$), providing support for

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</table>

Table I. Results of CFA and internal reliability testing
H6b. Contrary to H7a, tacit KS has no direct effect on operational performance because the path coefficient is only 0.014 and not significant ($p > 0.10$). Finally, H7b is supported because the path coefficient between KS and financial performance is statistically significant ($b = 9.189$, $p < 0.05$).

### 4.3 Additional analysis

To reveal the mediating role of IC components, indirect effects and total effects were calculated (Table V). As Table V shows, the three components of IC do indeed mediate the effects of KS on operational performance and financial performance. Our results suggest that the effect of explicit KS on operational performance is fully mediated by the IC components, whereas its effect on financial performance is partially mediated. In contrast, the effect of tacit KS on operational performance is partially mediated, whereas its effect on financial performance is fully mediated. In addition, explicit KS seems to have a weaker total effect on operational performance than financial performance ($b = 0.194$ vs $b = 0.308$), and tacit KS seems to have a stronger effect on operational performance than financial performance ($b = 0.385$ vs $b = 0.241$).

### 5. Discussion

This study has three key findings. First, tacit KS will significantly contribute to all three components of IC, namely human, structural and relational capital, while explicit KS only has a significant influence on human and structural capital. Second, human,
<table>
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<th>Hypothesis</th>
<th>Estimate</th>
<th>$p$</th>
<th>Remarks</th>
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<td>H1a EKS → HC</td>
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</tr>
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<td>H1b EKS → SC</td>
<td>0.266 **</td>
<td>&lt; 0.001</td>
<td>Supported</td>
</tr>
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<td>H1c EKS → RC</td>
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<td>H2a TKS → HC</td>
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<tr>
<td>H3a HC → FP</td>
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<td>H3b HC → OP</td>
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<td>&lt; 0.001</td>
<td>Supported</td>
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<tr>
<td>Firm scale → FP</td>
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<td>0.836</td>
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</tr>
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</table>

**Note:** *Significant at the 0.10 level (two-tailed), ** significant at the 0.05 level (two-tailed)*

Table IV. Standardized path coefficients

**Figure 2.** Research model and results of hypothesis test
structural and relational capital will play key roles in enhancing both operational and financial performance of firms. Finally, the effect of explicit KS on operational performance is completely mediated by human and structural capital whereas the link between explicit KS and financial performance is partially mediated. The effect of tacit KS on financial performance is completely mediated by IC while the link between tacit KS and operational performance is partially mediated.

5.1 Theoretical contributions

The main finding from our study is uncovering how KS contributes to firm performance through the mediation of IC. To date, few studies have examined the mechanism that underlies the relationship between KS and firm performance. To fill this gap, we put forward a theoretical model and confirmed that KS not only has a direct relationship with performance, but also indirectly influences firm performance by strengthening IC. The results of our study provide some novel insights into the KBV processes by demonstrating the business value of two kinds of KS and three components of IC.

The positive relationship between KS and IC is a new finding in the field of knowledge management and IC research. Our study suggests that both explicit and tacit KS bring about benefits to organizations by creating opportunities to enhance components of IC. Explicit KS will enhance human and structural capital through the exchange of official documents and reports, training and development programs, IT systems, and other such actions. These findings are partly consistent with previous research (Hsu, 2008; Karagiannis et al., 2008). However, explicit KS does not significantly improve relational capital, implying that it takes more than sharing of codified knowledge and formal documents for a firm to establish and maintain good relationships with internal and external stakeholders.

Although the empirical relationships between IC and firm performance have been examined, very little research considers the specific effects that human, structural and relational capital have on different types of firm performance in one integrated model. Consistent with previous studies (Bontis et al., 2007; Ling and Jaw, 2006; Skaggs and Youndt, 2004), our findings regarding the effect of human capital suggest that work experience, professional skills, creative ideas and knowledge possessed by a firm’s staff will enhance both operational and financial performance of the firm. In regard to
structural capital, we found that a company’s infrastructure, such as operations procedures, response speed, information systems, culture and atmosphere bring both operational and financial benefits. This result is somewhat consistent with the findings of Zangoueinezhad and Moshabaki (2009). We also observed that relational capital contributes to both kinds of performance, confirming that it is critical for organizations to develop good relationships with employees and partners.

Previous research on the KS-performance relationship has been focused on the individual level and team (group) level. Recently, attention has been drawn to the implication of KS on performance at the organization level (Law and Ngai, 2008; Wang and Wang, 2012). An important contribution of our study is that it explains how the two kinds of KS influence firm performance differently. Our results show that explicit KS in the work environment will increase the return on investment, assets, sales, profitability, and growth of a company with respect to its key competitors, validating the findings of previous research (Wang and Wang, 2012). Tacit KS is found to have a direct effect on a firm’s operational performance, such as customer satisfaction, quality development, cost management, speed of response, and productivity. These results indicate that explicit KS is more important or relevant to value creation activities such as outsourcing and sales, while tacit KS has a greater effect on issues related to quality of products and services or management procedures, which are often represented by a firm’s non-financial or operational performance.

5.2 Practical implications
For management practitioners who are concerned with the value of KS, our study presents several intriguing insights. First, the mediating role of IC suggests that firms should do more than merely structure appropriate KS activities. They have to clearly understand the effects of KS and IC on firm performance. As different components of IC have a variety of effects on firm performance, managers should work together to build mechanisms to ensure that IC are channeled properly so as to attain desired performance levels. Specifically, more attention should be paid to knowledge embedded in organizational systems, such as routines, procedures, and other structural capital, in conditions where the level of operational results needs to be raised. When the priority is on improving financial performance, managers should make more effort to increase the knowledge and experience of their staff for developing human capital.

Second, firms should be cautious with KS. With the development of information technology (IT), sharing knowledge will speed up the process of IC development and accumulation, which in turn increases firm performance. However, IT is a double-edged sword and could become a threat to firms if it is misused to leak personal information, business secrets, or intellectual property data (Liang and Xue, 2009). Thus, managers should take measures to regulate KS at different levels of their organization, especially in the digital world. In order to avoid privacy and security concerns, firms must realize that the benefits of KS come with a lot of risks that need to be carefully managed to avoid unnecessary losses. It is advisable for firms to establish KS policies to categorize knowledge and clearly define the scope and boundaries of knowledge sharing activities.

Third, if confidential knowledge is not involved, stimulating both explicit and tacit KS is beneficial. To facilitate explicit KS, managers should establish the necessary organizational structures and processes that encourage the exchange of job-related and codified knowledge. Since tacit KS is more difficult to monitor, managers can rely on
team climate and social influences to help knowledge workers internalize the value of KS and subsequently adopt new behaviors (Liang et al., 2010). To foster tacit KS, managers may consider designing work based on teams, rewarding individuals based on collective performance, and arranging informal activities, such as dining together and traveling together as a department, to increase the willingness and enthusiasm of individuals to collaborate with each other and to use what they have learned.

Finally, because high-technology firms in China have realized the importance of knowledge-related resources and competence for survival and development in the highly competitive, complex and dynamic environment, the lack of measurement tools for KS and IC could hinder their KS and IC development initiatives. The KS and IC scales developed in this paper are theory-driven and adapted for the situation of Chinese high-tech enterprises. Chinese high-tech firms could employ these scales to evaluate their current KS practices and identify inadequacies.

5.3 Limitations and future research opportunities
This study has several limitations that call for further research in the matter. First, this study employed a cross-sectional research design. Although our results are consistent with theoretical reasoning, the cross-sectional design prevented us from inferring causality from the hypothesized relationships. Future research might address this issue by using longitudinal designs or experimental methods to draw causal inferences.

Second, this study is based on self-reported assessments, which may be vulnerable to common method bias (CMB). While the Harman one-factor test and fully saturated causal model do not indicate that CMB is a significant problem, this concern may not be completely ruled out. Future research may benefit from using objective measures for firm performance, which can be independently verified.

Third, this study selected high-technology firms in China as the sample. These firms are characterized by knowledge-intensive tasks and intellectual property-based competition. Therefore, the relationships among KS, IC, and firm performance might be stronger in these firms than firms in general. Future research can investigate firms in different industries and contexts to confirm or extend our findings.

Finally, this study makes a unique contribution to the current body of knowledge by examining the relationships among KS, IC and firm performance. However, it does not consider the roles played by context factors, such as organizational cultures, routines, knowledge creation, accumulation and other knowledge management processes or strategies, and environmental uncertainty. Future studies might gain insights by exploring the effects of these contextual factors.

References


Appendix. Measurement items

**Explicit KS**

1. Employees in my organization frequently share existing reports and official documents with members of my organization.
2. Employees in my organization frequently share reports and official documents that they prepare by themselves with members of my organization.
3. Employees in my organization frequently collect reports and official documents from others in their work.
4. Employees in my organization are frequently encouraged by knowledge sharing mechanisms.
5. Employees in my organization are frequently offered a variety of training and development programs.
6. Employees in my organization are facilitated by IT systems invested for knowledge sharing.

**Tacit KS**

1. Employees in my organization frequently share knowledge based on their experience.
2. Employees in my organization frequently collect knowledge from others based on their experience.
3. Employees in my organization frequently share knowledge of know-where or know-whom with others.
4. Employees in my organization frequently collect knowledge of know-where or know-whom with others.
5. Employees in my organization frequently share knowledge based on their expertise.
6. Employees in my organization frequently collect knowledge from others based on their expertise.
7. Employees in my organization will share lessons from past failures when they feel that it is necessary.
**Human capital**

1. Employees hold suitable work experience for accomplishing their job successfully in our company.
2. Employees of our company have excellent professional skills in their particular jobs and functions.
3. The company provides well-designed training programs.
4. The employees of our company often develop new ideas and knowledge.
5. Employees are creative in our company.

**Structural capital**

1. The overall operations procedure of our company is very efficient.
2. Our company responds to changes very quickly.
3. Our company has an easily accessible information system.
4. Systems and procedures of our company support innovation.
5. Our company’s culture and atmosphere are flexible and comfortable.
6. Our company emphasizes new market development investment.
7. There is supportive among different departments in our company.

**Relational capital**

1. Our company discovers and solves problems through intimate communication and effective collaboration.
2. Our company maintains appropriate interactions with its stakeholders.
3. Our company maintains long-term relationships with customers.
4. Our company has many excellent suppliers.
5. Our company has stable and good relationships with the strategic partners.

**Operational performance**

1. Customer satisfaction of our company is better than that of key competitors.
2. Quality development of our company is better than that of key competitors.
3. Cost management of our company is better than that of key competitors.
4. Responsiveness of our company is better than that of key competitors.
5. Productivity of our company is better than that of key competitors.

**Financial performance**

1. Return on investment of our company is better than that of key competitors.
2. Return on assets of our company is better than that of key competitors.
3. Return on sales of our company is better than that of key competitors.
4. Average profitability of our company is better than that of key competitors.
5. Profit growth of our company is better than that of key competitors.
6. Sales growth of our company is better than that of key competitors.
About the authors
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