Determinants of successful knowledge transfer: Unveiling social exchange theory insights on knowledge velocity and viscosity in enterprises

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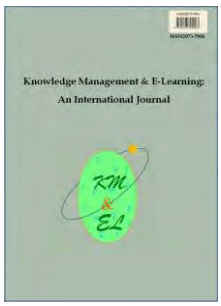

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Determinants of successful knowledge transfer: Unveiling social exchange theory insights on knowledge velocity and viscosity in enterprises

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Abstract: Corporate knowledge becomes enterprise strategic resources for sustaining corporate competitiveness by transferring irreplaceable diversified knowledge among employees. One key challenge for enterprises is to ensure that employees mutually and effectively share knowledge. This study integrates a social exchange perspective to understand key factors conducive to successful knowledge transfer in two dimensions: velocity and viscosity. Three key construct areas are examined for influence on the two dependent variables: micro levels (individual and group), macro level (organizational), and knowledge factors. 225 knowledge management system users in 15 companies were surveyed. A path analysis was used to validate 17 proposed hypotheses, with four major findings reported as results: 1) all eight predictive factors exhibited significant influence on both dependent variables; 2) measures of both dependent variables persistently increased with positive influence from common factors of

articulability, incentives and training; 3) the organization must consider differential effects of knowledge, individuality, and organization on the two dependent variables; and 4) some factors potentially negatively affect dependent variables. For example, excessive interaction may decrease velocity, while employees with high perceived self-efficacy may decrease velocity and viscosity.

Keywords: Knowledge transfer; Velocity; Viscosity; Social exchange theory

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1. Introduction

Increasing numbers of companies are using knowledge difficult to imitate as strategic resources for achieving sustainable advantages (Okere, 2017; Watson & Hewett, 2006). However, they are challenged by processing massive information, enabled by big data, Artificial Intelligence (AI), machine learning and Web 2.0 technologies (Ibekwe-SanJuan & Bowker, 2017; Perifanis & Kitsios, 2023; Sangpetch & Ueasangkomsate, 2023) transforming it into irreplaceable knowledge. Most important is sharing it with others in the context of data deluge and knowledge explosion. Sharing knowledge with others is time-consuming (Duan et al., 2010), as senders and recipients have different mental models and expectations influenced by different corporate cultures (Al-Kurdi et al., 2020). Effective knowledge transfer may help an organization improve performance and competitiveness. However, the success of knowledge transfer relies on key factors of knowledge supply (engagement culture, transfer channel effectiveness, budget allocation and leadership) and demand (absorptive capacity and knowledge infrastructure). These

include corporate culture, budget allocation, and leadership (Fongwa & Marais, 2016; Susanty et al., 2012).

Knowledge-sharing capacity is seen as a source of competitive advantage for many cross-industrial organizations (Filieri & Alguezaui, 2015; Kianto et al., 2019). It must be examined from the micro (individual and group) and macro (organizational) levels (Zahra et al., 2020). Attitude and leadership factors are relevant at individual and group levels, while knowledge bases, rules, and strategies may be decisive at organizational levels, insofar as they mutually interact and coevolve (Schmitt, 2016, 2019, 2020). Individuals are often unwilling to share knowledge with others, skeptical of receiving due credit. From the knowledge power perspective, a large knowledge gap between sender and recipient may aggravate distrust issues in knowledge sharing (Lu et al., 2018). In addition, hoarding knowledge gives a sensation of overpowering others, another reason for reluctance about knowledge sharing. On a group level, different mental models and thinking styles exist in teams assembled to perform knowledge-sharing activities. The difference in the shared mental model among team members can often cause disruption in the knowledge-sharing process, lowering team-based sharing capability (Xiang et al., 2013). At the organizational level, environmental diversity is problematic for knowledge sharing because of conflicting assumptions, climate, and social norms in different departments. Organizational routine and rigid organizational structure also discourage employees from sharing knowledge (Chen et al., 2014). Without top management support or proper incentives, employees will persist in choosing not to share knowledge with others.

Another critical level for examining knowledge transfer capacity is knowledge itself. Communication and information exchange may not necessarily be translated into effective knowledge transfer. Many inhibitors exist at the knowledge level, such as knowledge implicitness, content, location, cultural differences, articulability of senders, and differences in absorptive capability between knowledge provider and recipient.

To overcome knowledge transfer challenges at micro and macro levels, enterprises have installed Knowledge Management Systems (KMS). However, self-efficacy of system use creates further barriers to knowledge sharing. Companies are adopting KMS to facilitate the process of transferring explicit and implicit knowledge among employees. KMS has the potential to increase knowledge transfer velocity and viscosity as most knowledge can now be easily digitalized (Klein, & Todesco, 2021). Understanding key factors contributing to the increase of knowledge transfer velocity may elucidate how social community members mutually interact and identify bottlenecks impeding knowledge transfer (Zander & Kogut, 1995). Increasing velocity may help improve knowledge transfer efficiency. Knowledge transfer viscosity is about the usefulness of knowledge perceived by knowledge recipients. Therefore, improving viscosity directly enhances knowledge transfer effectiveness. Successful KMS must demonstrate an ability to increase knowledge transfer velocity and viscosity (Davenport & Prusak, 1998). A growing number of KMS are assimilated into social systems where social knowledge accumulated in online communities is as important as context knowledge (Mustapha, 2018). The proliferation of social learning environments mandates that knowledge transfer velocity and viscosity should be examined for relevance and applicability.

Knowledge transfer velocity and viscosity are key surrogates for measuring knowledge transfer success (Davenport & Prusak, 1998). To account for organizational complexity in knowledge exchange, this study used social exchange theory to consider contextual variables, including individual, knowledge, and organizational characteristics.

The current literature centers on implicit knowledge, knowledge complexity, knowledge satisfaction, knowledge transfer effectiveness, and attitude toward positive and negative knowledge transfer (Sarker, 2005). In addition to a paucity of studies about antecedents for knowledge transfer success (Davenport & Prusak, 1998; Pérez-Nordtvedt et al., 2008), the current literature has not closely examined key antecedents, particularly for knowledge transfer velocity and viscosity. Most importantly, few studies propose solutions to increase the two outcomes by improving antecedents. This paper tried to address the research gap by proposing an integrated research model based on personal, organizational, and knowledge factors.

The remainder of the paper is organized as follows: Literature related to knowledge transfer and its antecedents will be examined. A theoretical model and hypotheses related to knowledge transfer velocity and viscosity will be proposed. Research methodology will then be discussed with respect to research design, data collection, and analysis method. Data analysis results will be reported. Theoretical and practical implications will be drawn from the findings. Research direction and limitations will be discussed to conclude the study.

2. Conceptual framework

When useful knowledge is effectively transferred among employees, a company can increase corporate value and performance (Gray, 2001). Knowledge may be classified as explicit and implicit and knowledge management consists of diverse activities, such as generation, storage, transfer, integration, and application (Alavi, 2001; Venkatraman, 2004). The success of knowledge transfer relies on knowledge application as well as transmission and absorption (Davenport & Prusak, 1998). Knowledge transfer is a dynamic process (Susanty et al., 2012), only useful when knowledge recipients recognize the value of transferred knowledge. Recipients might be individuals, groups, or organizations (Duan et al., 2010). The dynamic transferring process must be managed properly with appropriate tools and technologies (Ko, 2005; Wong, 2003). Facilitating knowledge transfer systematically can help knowledge recipients understand the knowledge transmitted (Li, 2014), make better use of it, and change their knowledge-sharing behavior (Ko, 2005).

One way to examine knowledge transfer dynamics is to engage employees in the spiral process of exchanging explicit and implicit knowledge involving socialization, externalization, combination, and internalization (Nonaka, 1995). The knowledge transfer process begins with sourcing knowledge from multiple sources (Jasimuddin, 2012). To effectively transfer knowledge, different methods should be implemented according to objectives (Pham, 2008). Five methods may be adopted to facilitate knowledge transfer: 1) serial; 2) near; 3) distant; 4) strategic; and 5) expert transfers (Dixon, 2000). A higher flow of knowledge may be exchanged when recipients have a higher absorptive capability and higher perceived value for transmitted knowledge (Gupta, 2000). An organization can further use technology such as KMS, provide training and incentives, and change organizational structure to increase the knowledge transfer success rate (Levin, 2004). These approaches may enhance idea creation, sharing, evaluation, dissemination, and adoption at organizational micro and macro levels.

Knowledge transfer consists of five general processes: 1) acquisition, 2) communication, 3) application, 4) acceptance and 5) assimilation (Gilbert, 1996). After transmitted knowledge is assimilated into core routines, an organization may leverage it to

attain sustainable competitiveness. Although research has underlined the importance of increasing knowledge transfer by these methods, the emphasis is often not on how to accelerate the transfer process and increase its scope. The main objective of this paper is to identify key factors that may increase knowledge transfer process velocity and viscosity. Davenport and Prusak's (1998) perspective that knowledge transfer success relies on knowledge absorption as well as transmission was primarily adopted. After knowledge is absorbed, recipients must be able to assimilate and apply it to improve job performance.

3. Knowledge transfer success

Knowledge transfer is successful when knowledge recipients effectively absorb, reclassify and apply transmitted knowledge to resolving situational issues (Battistella et al., 2016). However, the knowledge transfer process from sender to recipient may be influenced by many factors. The following discussion attempts to encapsulate relevant factors to create a holistic framework for understanding the causes of knowledge transfer success.

Among all predictors of knowledge transfer success, the importance of knowledge absorptive capacity is rapidly growing with the prevalence of big data and business analytics (Rodriguez & Da Cunha, 2018). These novelty technologies create opportunities for open innovation success, which may be enabled by organizational absorptive capacity (Kokshagina et al., 2017). Absorptive capacity includes the ability to acquire, absorb, transform, and use knowledge. Increasing any of these four abilities will positively impact knowledge transfer (Zahra & George, 2002). For example, an international firm adopted KMS to improve human resource management practices for headquarters and subsidiaries. After implementing KMS, the company found that improving absorptive ability increased employee job performance and incentives for sharing knowledge between headquarters and subsidiaries (Minbaeva, 2007).

Other factors, such as internal versus external knowledge characteristics, learning characteristics, employee characteristics, organizational structure, business process, and corporate policy, could influence absorptive capability (Lane, 2006). Absorptive capacity may exist at individual, group and organizational levels. It is important to know what roles antecedents at these levels should assume in the knowledge transfer process between senders and receivers at individual, group and organizational levels (Volberda, 2010).

Previous research used different approaches to measure knowledge transfer success (Davenport & Prusak, 1998). One was to assess how much-transmitted knowledge is assimilable in core routine tasks (Gilbert & Cordey-Hayes, 1996). Recipient satisfaction with transmitted knowledge is another way to measure knowledge transfer success (Szulanski et al., 2004). Useful knowledge transfer measures also comprise the sender's ability to describe and transform shared knowledge, as well as the recipient's capacity for applying the knowledge acquired (Cummings & Teng, 2003). How much transmitted knowledge is used by the recipient may be another sign of knowledge transfer success (Håkanson & Nobel, 2000). Zimmermann & Ravishankar (2014) suggest that in the networked society, social capital and expected results should be used to measure knowledge transfer success.

Knowledge may be transferred by different formats, such as text, graphics, or other multimedia (Davenport & Prusak, 1998). Although proper use of technology may increase knowledge transfer effectiveness (Alavi, 2001), failure to understand the importance and value of shared knowledge may lower incentives for recipients to absorb shared knowledge

(Ko, 2005). However, more motivated and skilled knowledge processors among recipients boost the likelihood of knowledge transfer success (Minbaeva, 2007).

Knowledge transfer may be examined at diverse levels, from individual, group (Williams, 2011), intraorganizational, interorganizational, transnational (Duan et al., 2010), and individual to collective level (Zhao & Anand, 2009). This study aims to understand key success factors for successful intraorganizational transfer of knowledge at the individual, group and organizational levels.

4. Factors influencing knowledge transfer success

The current literature examines factors influencing knowledge transfer success at the individual-, internal organization-, external organization-, and international organization-levels. Knowledge transfer success requires considering both velocity and viscosity (Davenport & Prusak, 1998). Knowledge transfer velocity is the speed at which knowledge moves between employees in an organization. Knowledge transfer viscosity is the richness of knowledge transferred from sender to recipient. Increasing knowledge velocity is often at the expense of knowledge viscosity, because only essential information and knowledge (emails, memos, and white papers) may be readily transmitted. To boost viscosity, knowledge senders and recipients must engage in time-consuming knowledge exchange (mentoring, discussion, and on-the-job training). Usually, a company must decide on intended knowledge transfer purposes and emphasize either transfer velocity or viscosity (Pérez-Nordtvedt et al., 2008). This study tries to identify and examine the influence of key factors at the micro (individual and group), macro (organization), and knowledge-levels on these two knowledge transfer constructs.

A study of 15 industries shows that knowledge source distance, embeddedness, and reliability significantly influence knowledge transfer success. For companies using enterprise resource planning (ERP) systems for knowledge transfer, a study shows that top management support, incentives, industry experience, and project management skills positively impact knowledge transfer. In addition, the stickiness of relationships and shared mental mode may also enhance knowledge transfer efficiency (Hung et al., 2012). Duan et al. (2010) cited ten factors potentially increasing knowledge transfer in non-profit organizations: cultural awareness, motive, trust, languages, and transfer channels significantly influence knowledge transfer effectiveness. Joshi et al. (2007) primarily studied the influence of the credibility of knowledge sources on employee satisfaction with knowledge transfer decisions. Previous studies also show that other factors, including knowledge sender and recipient incentives (Ko, 2005), distance (Dahlan, 2005; Kusuma, 2023), and knowledge embeddedness (Cummings & Teng, 2003), could affect knowledge transfer in different contexts. Table 1 summarizes major factors positively affecting knowledge transfer success in domestic, international, and non-profit organizations.

5. Social exchange theory

Social Exchange Theory (SET) posits that social behaviors are outcomes of a negotiated exchange process between parties based on a subjective cost-benefit analysis and comparing alternatives (Homans, 1961). Generally, behaviors are repeated if rewards exceed any cost of action. The underlying principle stresses the importance of two central properties of social exchange: self-interest and interdependence (Roloff, 1981). Social

exchange behavior may only be sustained when the self-interests of exchanged parties are fulfilled. Self-interest can be economic or psychological (Blau, 1964; Emerson, 1976) rewards, measured tangibly or intangibly. As such, social exchange behaviors may be examined from economic (tangible reward/cost) or utilitarian (psychological gains/loss) perspectives.

Table 1
Critical success factors for knowledge transfer success

Authors	Research context	Influencing factors	Dependent variables
Hung et al. (2012) Hung (2012)	Investigate factors affecting the knowledge transfer environment of companies adopting ERP	Top management support, interdepartmental coordination, internal incentive mechanism, industry experience, and project management skill	Knowledge transfer success
Duan et al. (2010)	Factors affecting knowledge transfer by nonprofit international organizations	Cultural awareness, motives, knowledge distance, trust, transparency, relationship, partnerships, objectives, language, and transfer channels	Knowledge transfer success of international organizations
Joshi et al. (2007)	Factors influencing knowledge transfer between organizational system developers	Technical capability, information systems project management skills, culture, trust, and communication	Satisfaction with knowledge transfer
Ko et al. (2005)	Contextual factors of knowledge transfer for companies implementing ERP	Codification capability, decodification capability, credibility of knowledge sources, internal and external incentives of knowledge recipients and contributors	Knowledge transfer success
Dahlan et al. (2005)	Key success factors for promoting internal knowledge transfer	Knowledge distance, geographical distance, project size, learning culture, knowledge embeddedness, and articulability	Knowledge transfer success
Cummings & Teng (2003)	Key success factors of team-based knowledge transfer	Knowledge Embeddedness, articulability, organizational distance, geographical distance, knowledge distance, social norm distance, learning culture, and transformation mechanisms	Knowledge transfer success

Information system (IS) studies (Kankanhalli et al., 2005; Liang, 2008) have applied SET in analyzing social behaviors of users mutually sharing knowledge by Electronic Knowledge Repository systems (EKR). These studies examined the effect of economic (cost-benefit analysis; financial incentives) and social (trust, mutual benefits, improved computer self-efficacy) factors on knowledge exchange behaviors. For instance, Pee's (2012) study shows that intrinsic incentives are more influential than extrinsic ones in encouraging employees to mutually share knowledge by EKR. Pee also found that many approaches may be used to enhance the effect of extrinsic knowledge-sharing motivations. Those approaches include the design of job autonomy, skill diversity, and empowerment.

Knowledge sharing is critical for boosting organizational competitiveness (Yusof et al., 2012). The quality of shared knowledge may be much improved by increasing trust among employees. Knowledge sharing is also critical for online social community success. Online community members are satisfied by exchanging useful information and knowledge. Knowledge self-efficacy may be improved by the exchange of useful information (Cheung, 2013). SET has been widely adopted to examine user behavior in mutually exchanging information in corporate and online communities. This study tries to expand the current literature by considering knowledge transfer velocity and viscosity as intangible benefits of knowledge transfer success (Davenport & Prusak, 1998). Knowledge transfer velocity refers to the quantity of knowledge that may be exchanged. Knowledge transfer viscosity refers to the quality of knowledge perceived by knowledge recipients. The ideal knowledge

transfer process is to increase both velocity and viscosity as joint fulfillment of exchange party self-interest, sustaining the social exchange process. Based on Liang et al.'s (2008) study on the use of SET to examine knowledge transfer, this study includes personal, organizational, and environmental factors as independent variables. In addition, knowledge (Cummings & Teng, 2003) and environmental (Hung et al., 2012) factors are considered in our proposed framework.

6. Knowledge factors affecting knowledge transfer processes

6.1. The effect of knowledge articularity on knowledge transfer velocity and viscosity

A major challenge for international acquisitions is the successful transfer of business or technological know-how from the acquirer to the acquired, due to its implicit nature (Bresman, 1999; Reus et al., 2016). To confront this challenge, companies adopt different methods, including personal visits, online and offline meetings, and demonstrations to increase knowledge articulability so that sticky or implicit knowledge may be made more explicit or communicative to acquiring knowledge recipients (Jarrahi et al., 2021). Articulability is a dominant factor of knowledge velocity to help increase knowledge dissemination from the knowledge push perspective (Prinsloo et al., 2017). The intervention of creative articulability methods (body language, story-telling, and painting) may increase the probability of knowledge transfer success, improving knowledge vicosity through experience exchange fulfillment between senders and receivers (Polanyi, 1966). However, a lack of articulability (cultural differences) in knowledge transfer may result in knowledge acquisition and absorption issues (Ahammad et al., 2016; Håkanson & Nobel, 2000). Therefore, enhancing articularity may potentially increase knowledge transfer velocity and viscosity:

H1a: Knowledge articulability has a positive effect on knowledge transfer velocity.

H1b: Knowledge articulability has a positive effect on knowledge transfer viscosity.

6.2. The effect of knowledge source credibility on knowledge transfer velocity and viscosity

Knowledge source credibility is pivotal in online social community knowledge exchange because of information overload and limited user information processing capability according to the elaboration likelihood model (ELM) (Zha et al., 2018). In addition, the lack of face-to-face (F2F) interaction between knowledge sender and recipient, as well as ease of information manipulation have accentuated the importance of content contributor reputation. The reputations of content creators and disseminators have become an important surrogate used by online community members to assess knowledge credibility. Reputable experts are often recognized as possessing credible knowledge (Davenport & Prusak, 1998). Low knowledge source credibility (misconceptions, misinformation, inaccurate beliefs, and myths) may impede individual ability to acquire new knowledge (Van Boekel et al., 2017). As such, source credibility becomes an important vehicle for accelerating knowledge exchange (Mizerski et al., 1979). But unreliable knowledge sources may inhibit transmission and absorption as untrustworthy for knowledge recipients (Szulanski et al., 2004). Knowledge source credibility is a key precondition for efficient

knowledge transmission and absorption (Joshi, 2007). It is imperative to increase knowledge source credibility with the goal of increasing knowledge transfer velocity and viscosity to facilitate efficient knowledge exchange among community or organizational members (Ko, 2005; Milagres & Burcharth, 2019). Therefore, we propose:

H2a: Knowledge source credibility has a positive effect on knowledge transfer velocity.

H2b: Knowledge source credibility has a positive effect on knowledge transfer viscosity.

6.3. The effect of knowledge distance on knowledge transfer velocity and viscosity

Individuals possess different domain knowledge and cultures. Knowledge distance between sender and recipient converges when domains of knowledge mutually resemble or overlap (Cummings & Teng, 2003). Cultural differences may also create organizational diversity, including different knowledge, insights, and alternative views (Hajro et al., 2017). A multicultural team often faces more knowledge exchange challenges than a homogeneous cultural team, as knowledge distance converges. Knowledge transfer is often more effective with closer, rather than farther, knowledge distance (Dahlan, 2005). For instance, knowledge-sharing performance is stronger within, rather than between, firms (Zimmermann et al., 2018). A study investigating knowledge transfer performance among cluster enterprises discovered that the closer relationship, organizational and knowledge distance improved knowledge transfer performance (Han, 2013; Nguyen et al., 2019). Therefore, people with similar domain knowledge are likelier to engage in a focused search and demonstrate creativity in the knowledge exchange process (Acar & Van den Ende, 2016). However, the learning flow could halt when people with extended knowledge distance try to mutually exchange knowledge (Hamel, 1991). Thus, knowledge distance is critical to increasing knowledge transfer velocity and viscosity. A company must form an effective knowledge team based on the knowledge distance of team members:

H3a: Short knowledge distance has a positive effect on knowledge transfer velocity.

H3b: Short knowledge distance has a positive effect on knowledge transfer viscosity.

6.4. Personal factors affecting knowledge transfer processes: The impact of self-efficacy on knowledge transfer velocity and viscosity

Self-efficacy is personal confidence in possessing the ability to achieve intended results. KMS self-efficacy refers to a knowledge owner's ability to use KMS to accomplish planned outcomes (Compeau, 1995; Hasan, 2006). KMS self-efficacy ranges from the ability to use KMS to generate, store, and share knowledge with others, to utilizing stored knowledge (Chen et al., 2012). KMS self-efficacy is a strong predictor for different sharing behaviors and intentions to share knowledge with others (Van Acker et al., 2014). KMS self-efficacy is an important personal trait, critical for the success of KMS implementation (Marakas, 1998). When employees have high KMS self-efficacy, they are likelier to be able to leverage KMS to increase knowledge transfer velocity and viscosity:

H4a: KMS self-efficacy has a positive effect on knowledge transfer velocity.

H4b: KMS self-efficacy has a positive effect on knowledge transfer viscosity.

6.5. The effect of interaction on knowledge transfer velocity and viscosity

Interaction is about communication duration and frequency (Liang, 2008). Knowledge as a social capital can help a firm create value in the form of innovation (Shujahat et al., 2018; Shujahat et al., 2019). The value creation process arises from combining and exchanging knowledge as resources (Moran, 1999) valuable to the sender and recipient. This interaction is an essential process to help improve the knowledge exchange process (Cummings & Teng, 2003). Companies should encourage employees to mutually interact through knowledge transfer mechanisms such as water cooler exchanges, talk rooms, knowledge fairs, and open forums. The availability of these effective mechanisms potentially motivates knowledge owners to communicate and interact in depth and oftener with others (Rajaeian et al., 2018). By increasing the degree of employee interactions, companies improve knowledge transfer performance (Nahapiet, 1998; Milagres & Burcharth, 2019) velocity and viscosity:

H5a: Interaction has a positive effect on knowledge transfer velocity.

H5b: Interaction has a positive effect on knowledge transfer viscosity.

6.6. Organizational factors affecting knowledge transfer processes: The effect of top management support on knowledge transfer velocity and viscosity

Acquiring external knowledge and integrating it with internal knowledge may promote innovation, helping to realize economic gains (Trantopoulos, 2017). However, top management support is needed to access and integrate knowledge from diverse sources (Swanson et al., 2020) such as customers, competitors, academia, and consultants as the innovation process consumes time, money and other resources. With a strong commitment from top management, knowledge workers may increase the velocity and viscosity of mutually exchanging knowledge:

H6a: Top management support has a positive effect on knowledge transfer velocity.

H6b: Top management support has a positive effect on knowledge transfer visocisty.

6.7. The effect of training on knowledge transfer velocity and viscosity

Training is an important organizational factor to help predict knowledge transfer success (Ekore, 2014). An effective group training program may help expatriates acquire interpersonal and cross-functional coordination abilities, enhancing their understanding of cultural differences in destination countries (Shah & Barker, 2017). Together with group training, individual training can further increase knowledge transfer effectiveness and help advance employee knowledge (Zhao & Anand, 2009). Training can also be used as a catalyst to successfully promote the sharing of team-based knowledge (Guchait et al., 2016). Effective training programs may lead to successful knowledge transfer and lower absorption efforts in many knowledge areas, such as cultural knowledge (Kayes, 2005; Swanson et al., 2020), technical knowledge (Van der Heiden et al., 2015), and other areas. As a result, knowledge workers may increase the velocity and viscosity of the mutual exchange of knowledge:

H7a: Training has a positive effect on knowledge transfer velocity.

H7b: Training has a positive effect on knowledge transfer viscosity.

6.8. The effect of incentives on knowledge transfer velocity and viscosity

Incentive systems have been considered as popular creativity-enhancing catalysts for knowledge transfer in the context of knowledge-intensive enterprises (Castellano, 2017). Incentives have a differential effect on influencing knowledge transfer between group members with equal or different statuses asked to solve interdependent tasks (Haesebrouck et al., 2018). It is important to make good use of incentives to create a knowledge-sharing climate (Nguyen et al., 2019), potentially increasing knowledge transfer velocity and viscosity:

H8a: Incentives for knowledge exchange have a positive effect on knowledge transfer velocity.

H8b: Incentives for knowledge exchange have a positive effect on knowledge transfer visocisty.

6.9. The effect of knowledge transfer velocity on knowledge transfer viscosity

Effective knowledge transmission may increase knowledge absorption success (Hung et al., 2015) Therefore, knowledge exchange is a bilateral process benefiting the knowledge sender and recipient. Knowledge recipients mostly benefit by receiving useful knowledge efficiently. However, when tacit or thick knowledge is involved, increasing knowledge transfer velocity cannot always ensure knowledge transfer viscosity success, as the latter requires a longer knowledge process such as apprenticeship or mentoring (Davenport & Prusak, 1998). Advanced technology (data visualization, virtual reality and online simulation, collaborative software, and business intelligence software) potentially resolves the dilemma of velocity versus viscosity. Some technologies capture the wealth (or thickness) of knowledge and transfer it to recipients more receptively. Therefore, increasing knowledge transfer velocity may potentially increase knowledge transfer viscosity:

H9: Knowledge transfer velocity has a positive effect on knowledge transfer viscosity.

This discussion leads to the development of a research model (see Fig. 1):

7. Research method

7.1. Sample and data collection

This study aims to understand factors helping to increase knowledge transfer velocity and viscosity. Subjects invited to participate were corporate employees experienced with using KMS in the knowledge transfer process. A draft questionnaire was initially developed and modified from questions in previously published papers. Three knowledge management experts and two doctoral students were invited to evaluate the draft questionnaire content validity. Their suggestions were included in the revised draft questionnaire used to conduct a pilot test with 25 Executive Master of Business Administration (EMBA) students in the field of information management. Their feedback was solicited after the pilot test to further improve survey questionnaire validity and reliability. Feedback included how to restructure questions to be clearer and more comprehensible.

The study adopted existing items to measure major constructs, as illustrated in Table 2. Construct questions were placed on a 5-point Likert scale, ranging from 1, strongly disagree, to 5, strongly agree. Table 2 presents constructs and their sources.

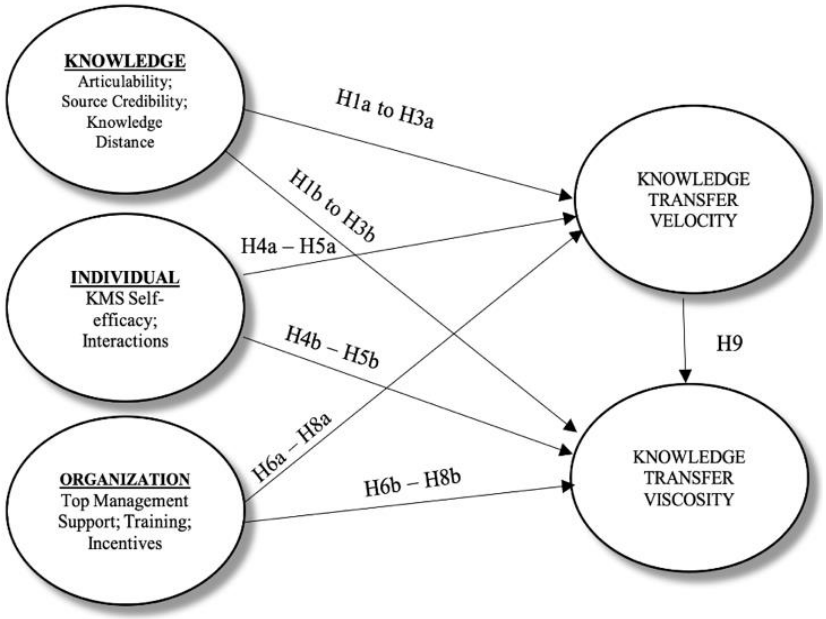

Fig. 1. Research model (controllable variables: PEU and PU of KMS)

Table 2
Theoretical construct items

Variable	Question items	Source
Articulability	• Through the knowledge management system, I can easily receive knowledge. • Those who use knowledge management systems to perform tasks need experienced employees to help less experienced employees. • Corporate Education and Training I use a knowledge management system to make knowledge transfer quick and easy.	Prinsloo et al. (2017); Ahammad et al. (2016); Håkanson and Nobel (2000)
Knowledge sources creditability	• I think the knowledge source of the knowledge management system is trustworthy. • I think the knowledge source of the knowledge management system is professional. • I think the knowledge source of the knowledge management system is well-trained.	Van Boekel et al. (2017); Mizerski et al. (1979); Szulanski et al. (2004); Joshi (2007); Ko (2005)
Knowledge distance	• The more similar knowledge I and other employees have to each other, the easier it is to transfer knowledge using a knowledge management system. • If I have a knowledge base, I can easily understand and use the knowledge of the knowledge management system. • The knowledge provider has a knowledge base and can easily understand the knowledge I want to acquire • I think that the different levels of knowledge among employees will make knowledge transfer difficult in the knowledge management system	Hamel (1991); Zimmermann et al. (2018)

KMS self-efficacy	• Even if I have not used a knowledge management system before, I am willing to choose to use a knowledge management system to get my job done. • Even if I only have a reference manual for a KMS, I will use a KMS to get the job done. • If I have seen others use a knowledge management system before I use it, I will choose this system to get my job done. • If I have experience using a knowledge management system to get my job done, I will continue to use it to get my job done.	Van Acker et al. (2014); Marakas (1998)
Interaction	• In the process of knowledge transfer, I maintain close cooperation with many knowledge providers. • During the process of knowledge transfer, I spend a lot of time interacting with knowledge providers. • In the process of knowledge transfer, I personally know some knowledge providers. • In the process of knowledge transfer, I often communicate and coordinate with some knowledge providers.	Rajaeian et al. (2018); Nahapiet (1998)
Top management support	• Business executives believe that knowledge transfer between employees is an important factor for the future success of the company. • The employees of the enterprise are very aware that the executives want knowledge transfer between employees. • Business executives strongly support the implementation and operation of knowledge transfer.	Trantopoulos (2017)
Training	• The enterprise arranges knowledge management experts to instruct employees on the professional capabilities required in the knowledge management system. • The enterprise has relevant support for providing employees with personalized knowledge management system technology. • The company has provided enough knowledge management system-related training to teach me how to use the knowledge management system. • I have acquired knowledge management system-related training, which enables me to use the system efficiently.	Guchait et al. (2016); Kayes, (2005); Van der Heiden et al. (2015)
Incentives	• The company provides better job assignments to help me acquire knowledge from the knowledge management system. • The company provides job promotions to help me acquire knowledge from the knowledge management system. • The company provides opportunities to increase my salary to help me acquire knowledge from the knowledge management system. • The company provides a high bonus to help me acquire knowledge from the knowledge management system.	Castellano (2017); Haesebrouck et al. (2018)
Knowledge transfer velocity	• I think the knowledge transfer speed of the knowledge management system is very fast. • I can acquire knowledge from the knowledge management system in a timely manner. • I think that using the knowledge management system allows me to acquire and apply the knowledge of the knowledge management system in a very short period of time. • I think the knowledge transfer speed of the knowledge management system is very fast.	Hung et al. (2015); Davenport and Prusak (1998)
Knowledge transfer viscosity	• I can completely acquire new knowledge from the knowledge management system and be proficient in knowledge. • I am able to acquire new knowledge from the knowledge management system and fully understand the knowledge. • I think the new knowledge in the knowledge management system is easy to understand • I can completely acquire new knowledge from the knowledge management system and be proficient in knowledge.	Hung et al. (2015); Davenport and Prusak (1998)

After the survey questionnaire was finalized for the full-scale study, 15 companies currently adopting KMS were identified among the top 500 manufacturing and service companies in Taiwan, as listed by Commonwealth Magazine in 2017. To collect at least 200 responses, 10 to 20 questionnaires were mailed to each company, requesting that they be forwarded to staff with experience of using workplace KMS. To ensure that data was

provided by a single employee per questionnaire, one Internet protocol (IP) address was acceptable for each. The company contact person received a gift card if over 10 responses were sent.

225 valid responses (87.8% valid response rate) were received after removing 31 invalid ones. All respondents had experience with using KMS. About 74% were technicians (engineers or researchers), and the remaining 26 % were managerial staff (department head, director, or senior director). Of participants, 31.6% worked in banking and finance, followed by insurance (19.6%), education (18.7%), utilities (10.7), telecommunication (8%), semiconductors (7.1%), and petroleum (4.4%). When asked about KMS types and related experience, 48.9% adopted in-house KMS and 51.1% used different KMS. Most participants used KMS for at least three years (41.8%), followed by two years (8%), and one year (50.2%).

In addition to demographical analysis, sample representativeness was assessed by conducting an independent *t*-test with two survey groups, one collected online (137 responses) and another paper-based (88 responses). The *t*-test was conducted against the difference in two dependent variables (knowledge transfer velocity and viscosity). Test results indicated that neither of the two variables significantly differed between paper-based and online survey groups (see Table 3). Therefore, all responses were aggregated and entered for statistical analysis.

Table 3
Result of the independent *t*-tests between groups using paper-based and online surveys

Measurement items of knowledge transfer success	*t*-test value	*p* value
Knowledge transfer velocity	0.602	0.439
Knowledge transfer viscosity	1.066	0.303

A reliability test was conducted to assess consistency and stability of questions used to measure each construct (see Table 4). Cronbach's α values showed that all questions other than one question used to measure the knowledge transfer viscosity variable exceeded 0.7 (Hair et al., 2014). The question was therefore removed from the validity test.

Table 4
Reliability and validity test results

Variables	# of modified items used to measure each variable	Reliability index (Cronbach's α value)
Articulability	3	0.778
Knowledge source credibility	3	0.897
Knowledge distance	4	0.828
Kms self-efficacy	4	0.827
Interaction	4	0.873
Top management support	3	0.869
Training	4	0.874
Incentives	4	0.920
Knowledge transfer velocity	3	0.839
Knowledge transfer viscosity	2	0.753

The Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity were conducted to assess content and criterion validity. Both results exceeded threshold values (KMO = 0.907 > 0.5; Bartlett = 0.000 < 0.05), indicating that underlying factors did not contribute to the variance proportion among variables, and factor analysis of all variables could be useful (Hair et al. 2010). Data was then analyzed by principal component analysis (Kaiser, 1958). The factor loading value had to be at least 0.4 according to the sample size (325 responses) (Hair et al., 2010).

To run factor analysis by Structural Equation Modeling (SEM), it was necessary to assess normality, multicollinearity, quality of variances for each variable, and independence of error terms. Probability plots or quantile-quantile (QQ) plots for all variables showed that all data points fell on the 45-degree reference line, indicating that all data were normally distributed. Pearson correlation coefficients (PCC) used to measure linear correlation between variables was under 0.8, indicating that multicollinearity was absent. The resulting *p*-value from Levene's test exceeded the significance level (0.05), indicating the presence of homoscedasticity in population variances (Hair et al., 2010). Durbin-Watson values ranged from 1.687 to 2.068. Because all values approximated the threshold value of 2.0, the assumption of meeting independence of error terms was also met. With all four basic assumptions met, all data were entered into the full-scale SEM test. SmartPLS 3.2 software was adopted to run the SEM test with the specified 1000 bootstrapping samples. Table 5 summarizes the hypothesis test results.

Table 5
Hypothesis test results

Hypotheses	Path coefficients	*t* values
H1a: AC → KTS	0.393	12.151***
H1b: AC → KTD	0.149	10.422***
H2a: SC → KTS	0.038	4.917***
H2b: SC → KTD	0.000	4.722***
H3a: KD → KTS	0.282	9.633***
H3b: KD → KTD	0.045	7.650***
H4a: SE → KTS	−0.014	6.244***
H4b: SE → KTD	0.000	5.753***
H5a: IN → KTS	−0.022	5.268***
H5b: IN → KTD	0.186	8.139***
H6a: SS → KTS	0.020	6.354***
H6b: SS → KTD	−0.046	6.429***
H7a: T → KTS	0.115	8.243***
H7b: T → KTD	0.106	9.488***
H8a: RE → KTS	0.148	7.140***
H8b: RE → KTD	0.128	8.786***
H9: KTS → KTD	0.423	14.578***

Note. *** $p < .001$. ** $p < .01$. * $p < .05$. AC = Articulability; SC = Source credibility; KD = Knowledge distance; SE = Self-efficacy; IN = Interactions; SS = Top management support; T = Training; RE = Incentives; KTS = Knowledge transfer velocity; KTD = Knowledge transfer viscosity.

SmartPLS was used to assess independent variable predictability for two dependent variables in the research model: 1) knowledge transfer velocity (R^2 = 0.543), and 2)

knowledge transfer viscosity ($R^2 = 0.599$). Independent variables in the research model had moderate ($R^2 \geq 0.50$) predictive accuracy for the two dependent variables (Henseler, 2009).

Eight independent variables together accounted for 54.3% of the variance in knowledge transfer velocity. Six independent variables significantly positively affected knowledge transfer velocity: knowledge articulability ($\mu = 0.393$); knowledge distance ($\mu = 0.282$); incentive ($\mu = .148$); training ($\mu = 0.115$); source credibility ($\mu = 0.038$); and top management support ($\mu = 0.02$), in decreasing order of significance. By contrast, two independent variables significantly negatively affected knowledge transfer velocity: KMS self-efficacy ($\mu = -0.014$), and interaction ($\mu = -0.022$).

Eight independent variables together comparatively accounted for 59.9% of the variance in knowledge transfer viscosity. Six independent variables significantly positively affected knowledge transfer velocity: knowledge transfer velocity ($\mu = 0.423$); interactions ($\mu = 0.186$); articulability ($\mu = 0.149$); incentives ($\mu = 0.128$); training ($\mu = 0.106$); and knowledge distance ($\mu = 0.045$). By contrast, two independent variables, including source credibility ($\mu = 0.00$) and self-efficacy ($\mu = 0.00$), had no effect on knowledge transfer viscosity. In addition, top management support ($\mu = -0.046$) negatively affected knowledge transfer viscosity.

8. Discussion

This study focused on enterprise staff using knowledge management systems to explore factors influencing successful knowledge transfer, measured by knowledge transfer velocity and depth. Rooted in social exchange theory, the framework enhanced knowledge and technological characteristics, examining factors motivating successful knowledge transfer through these systems.

First, in terms of knowledge characteristics, articulability significantly and positively impacted knowledge transfer (Cummings & Teng, 2003). Clear, comprehensible knowledge accelerated delivery and assimilation. However, source credibility did not notably influence knowledge absorption, as employee motivation stemmed from necessity rather than source credibility (Davenport & Prusak, 1998). Knowledge administrators should be appointed to ensure accuracy. Secondly, individual characteristics play a pivotal role. KMS self-efficacy significantly and positively influenced knowledge transfer and knowledge absorption (Chen et al., 2012). This empowerment enabled personal experience integration and new knowledge construction, irrespective of prior use or experience. Interaction was also significant, fostering knowledge absorption (Cummings & Teng, 2003). Employee interaction in knowledge management system forums enhanced communication and reliance.

Thirdly, moving to organizational factors, top management support did not notably impact knowledge absorption (Davenport & Prusak, 1998), suggesting that employee motivation arose from job requirements. In addition, training did not notably influence knowledge absorption (Zhao & Anand, 2009) due to system design inefficiency. Finally, knowledge transfer success characteristics offered insight. Knowledge transfer significantly and positively impacted knowledge absorption (Davenport & Prusak, 1998). This emphasized the role of clear knowledge characteristics. Knowledge absorption significantly and positively influenced knowledge transfer success (Minbaeva et al., 2003), impacted by knowledge levels, interactions, top support, and rewards. These key findings

elucidated results in relation to the research gap and prior studies as a basis for theoretical and practical implications as well as future research directions.

9. Academic and research implications

The study aims to elucidate factors and their influence on knowledge transfer success to maximize benefits and minimize costs for knowledge senders and recipients. Two variables were used to measure knowledge transfer success: knowledge transfer velocity and knowledge transfer viscosity.

Research model factors differentially impacted knowledge transfer velocity and viscosity based on path coefficients as indicators for causal relationships (Wright, 1921). To increase knowledge transfer velocity, organizations should emphasize improving knowledge articulability and shortening knowledge distance, followed by providing incentives and effective training programs. By contrast, to increase knowledge transfer viscosity, organizations should focus on increasing knowledge transfer velocity, encouraging interactions between senders and recipients, followed by improving knowledge articulability by providing incentives and offering training programs. Three factors persistently positively affect knowledge transfer velocity and viscosity: knowledge articulability, incentives, and training. Organizations must strive to improve these three knowledge transfer areas.

In addition to the major findings, other factors investigated also positively or negatively influenced knowledge transfer velocity and viscosity. Although the presence of source credibility and top management support may marginally increase knowledge transfer velocity, excessive interactions and high perceived KMS self-efficacy of knowledge owners may decrease knowledge velocity. Although shortening knowledge distance may marginally increase knowledge transfer viscosity, source credibility, self-efficacy, and top management support have minimal or negative influence.

Results also show that knowledge transfer velocity is a prerequisite for knowledge transfer viscosity success, as the former most strongly impacts the latter. Therefore, in addition to improving the three common areas, organizations should focus on two key areas critical to knowledge transfer velocity success: knowledge distance and interactions. After the viscous cycle is constructed, organizations may achieve knowledge transfer success by high transfer velocity and viscosity.

Organizations are knowledge markets in which employees may share knowledge to improve job performance (Davenport & Prusak, 1998). Knowledge transfer is a fluid process, with knowledge potentially exchanged between teams, organizations, and business partners (Duan et al., 2010). Sharing organizational knowledge is multiform and multi-location, at conferences, water coolers, online forums, and discussion rooms. To ensure effective knowledge transfer, an organization must remove personal, team, knowledge, organizational and external barriers to the transferring process (Olaniran, 2017). These include lack of trust, cultural homogeneity, time, or meeting places, as well as recipient incentive and absorptive capacity (Davenport & Prusak, 1998).

These findings extend previous research investigating general knowledge transfer approaches into two more specific knowledge transfer success areas: velocity and viscosity. In addition, three common factors are identified with a lasting impact on knowledge transfer velocity and viscosity: knowledge articulability, incentives, and training. Key

factors differentially affect knowledge transfer velocity and viscosity. Depending on the purpose of knowledge transfer, organizations must emphasize the cultivation of these specific factors. To increase knowledge transfer velocity, organizations should center on knowledge articularity and distance. By contrast, interaction and knowledge transfer velocity are more critical to increasing knowledge transfer viscosity. Fig. 2 shows relationships between common and specific factors pertinent to the success of knowledge transfer velocity and viscosity.

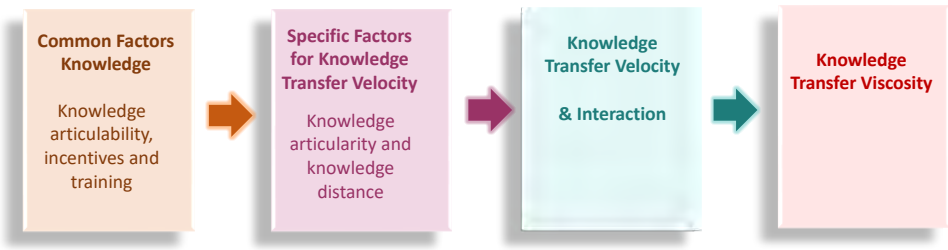

Fig. 2. Common and specific factors of knowledge transfer velocity and viscosity

The goal of achieving both knowledge transfer velocity and viscosity is difficult to obtain simultaneously because they are differently driven by knowledge, individual and organizational factors. This validates the social exchange theory assumption that knowledge exchange processes as human relationships are formed by the use of subjective cost-benefit analysis (Yan et al., 2016) and comparing two alternatives: increasing knowledge transfer velocity or viscosity. The rational choice of alternatives depends on the presence of diverse factors.

10. Practical implications

Knowledge transfer success between domestic and international research and development (R&D) partners relies on the extent of interactions between knowledge source and recipient, shared common knowledge (shorter knowledge distance), and knowledge articulation (Cummings & Teng, 2003). This stresses the importance of knowledge distance, interactions, and knowledge articulation. More to the point, an organization should employ knowledge, and individual and organizational factors to increase knowledge velocity and viscosity. Knowledge factors, such as improved knowledge articulabilty and shortened knowledge distance, are most effective for increasing knowledge transfer velocity within and between organizations. Individual (increased employee interactions), and knowledge factors (shortened knowledge distance) should be employed jointly for the most effectiveness in increasing knowledge transfer viscosity.

In addition to understanding the differential effect, an organization must ensure the presence of three essential elements in an organization: high knowledge articulablity, motivating incentives, and effective training programs. These three factors are indispensable for knowledge transfer velocity and viscosity success.

12. Limitations and future research

These findings would benefit from a closer examination of different approaches used to improve each factor investigated. For instance, although the presence of proper incentives

effectively promotes knowledge sharing, the amount of knowledge shared differed for equal-status groups depending on the use of individual or group incentives (Haesebrouck et al., 2018). A previous study showed that transactional (contract) and relational (trust) mechanisms may differently affect the amount and credibility of knowledge transferred among virtual industry partners (Liu et al., 2017). Future research might examine how either mechanism affects knowledge transfer velocity and viscosity.

Knowledge transfer consists of four general processes: knowledge generation, sharing, evaluation, transfer and adoption. To boost knowledge transfer success, the current literature has identified factors, including training, incentives, organizational structure (Gonzalez & Martins, 2014), technology, knowledge characteristics, knowledge absorption, and environment (Dahlan, 2005). However, the knowledge transfer process is more complex in practice because these factors could affect each other over time, thereby influencing knowledge transfer velocity and viscosity. Therefore, it is important to manage antecedents for key factors affecting knowledge transfer velocity and viscosity as well as the factors themselves (Susanty et al., 2012).

The study delves into strategies to enhance knowledge transfer velocity and viscosity. While acknowledging the potential mediating effect of knowledge transfer velocity between the nine preceding factors and knowledge transfer viscosity, it is noteworthy that further examination would necessitate the formulation of at least nine additional hypotheses. Investigating the mediating effect holds significant potential as an intriguing, expansive area for future research.

13. Conclusion

This study integrates a social exchange perspective to understand key factors conducive to the increase of knowledge transfer velocity and viscosity. These two measures of knowledge transfer success provide intangible benefits for employees engaging in the knowledge exchange process. As more useful knowledge is acquired, employees are likelier to apply this knowledge to solving problems at hand. This study examines three antecedent areas for knowledge transfer success: knowledge, individual and organizational factors. Eight factors were investigated for relative influence on knowledge transfer velocity and viscosity. A survey of 225 users of 15 different KMS indicated that most of these eight factors positively influenced either dependent measure. However, a few factors had marginal or negative influence. Suggestions were made to researchers and practitioners about employing these factors as expenditure for achieving the benefit of increasing knowledge transfer velocity and viscosity.

Author Statement

The authors declare that there is no conflict of interest.

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