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Knowledge transfer and boundary conditions

A study of SMEs in business incubation centers in China

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Abstract

Purpose – The purpose of this paper is to examine innovative practices and emphasize the mechanism of knowledge transfer across knowledge boundaries. By comparing and discussing the emerging boundary issues in knowledge transfer among small- and medium-sized enterprises (SMEs) registered in the incubation centers in China, this paper identified the main knowledge transfer approach and several contextual and organizational factors impacting knowledge transfer.

Design/methodology/approach – The authors conduct 39 semi-structured in-depth interviews with employees working within business incubation centers in China. The study uses thematic analysis for data analysis.

Findings – Our results contribute to the literature of knowledge transfer and in particular to our understanding of boundary conditions and knowledge transfer approaches in emerging economies. The results also highlight several contextual and organizational factors which impact knowledge transformation across the pragmatic boundary in the context of China.

Practical implications – First, organizations need to establish an effective process with tools to accommodate novelty; second, organizations should be aware of the impact of entrepreneurial orientation on innovative performance; and third, it will help organizations if they adopt and integrate information-rich media in managing innovative practices.

Originality/value – This research highlights the impact of contextual and organizational factors of SMEs on knowledge transfer in emerging markets and chooses incubation centers as study subjects, which is an organizational context that has not been thoroughly studied due to its unique nature and emerging complexity.

Keywords Knowledge transfer, SMEs, China, Entrepreneurial orientation, Rich media, Pragmatic boundary

Paper type Research paper

Introduction

The issue of boundaries has been regarded as a vital factor in examining knowledge transfer in organizational studies (Hansen, 1999; Lank *et al.*, 2008). The burgeoning literature has addressed the importance of managing knowledge across boundaries in driving innovation and organizational success (Nonaka, 1994; Leonard-Barton, 1995; Davenport and Prusak, 1998). Much of the existing literature focuses on categorizing and gauging the complexity of a boundary and describing the properties of boundaries to



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resolve the incompatibilities among the different approaches to obtain knowledge and to cross boundaries in organizations (Dick *et al.*, 2017; Carlile, 2002; Argote, 1999; Dougherty, 1992). The literature highlights that the knowledge transfer approach has to match the boundary condition in order to create new knowledge efficiently (Huber, 1991; Hargadon and Sutton, 1997; Carlile, 2002, 2004). This issue becomes more challenging in emerging economies where there is a high degree of uncertainty and risk taking in a volatile business environment. However, little is known about the particular types of boundary conditions and knowledge transfer approaches relevant in emerging economies, as most studies have examined knowledge practices in developed economies (Guennif and Ramani, 2012; Grimpe and Sofka, 2016; Lee *et al.*, 2010; Jiang and Li, 2009; Milagres and Burcharth, 2019). Research calls for in-depth understanding of complex boundary conditions and knowledge transfer approach in emerging economies, and in particular the impacting factors on knowledge transfer across boundaries.

This study aims to understand the boundary conditions that foster knowledge transfer within business incubation centers in China. It examines innovative practices and emphasizes the mechanism of knowledge transfer across boundary conditions. By comparing and discussing the emerging boundary issues in knowledge transfer among small- and medium-sized enterprises (SMEs) registered in the incubation centers in China, this study identified several contextual factors that impact boundary conditions with a focus on shared value and interests, and trust. This study also examined two important organizational factors, SMEs' entrepreneurial orientation and the use of information-rich media, to investigate how they impact knowledge transfer across boundaries.

For the following reasons, this research is set in China, a unique context of emerging economy. First, most studies on knowledge transfer across boundaries have focused on developed economies, and only limited research has been conducted to understand the patterns in emerging economies such as China (Guan *et al.*, 2009; Lin, 2018). Second, the unique market and political context in China is worth the investigation of knowledge transfer in collaborative innovation projects. For instance, the Chinese government has established numerous national technology development zones and business incubators across the country (Zhang *et al.*, 2009). However, China is regarded as a volatile business environment, in particular considering its intense competition of skilled workers (Newman *et al.*, 2011), lingering intellectual property (IP) issues (Hu and Jefferson, 2009), limited knowledge base of firms (Awate *et al.*, 2012) and high risk involved in innovative activities (Wu, 2007).

Establishing business incubation centers is a crucial strategy to help Chinese SMEs understand and manage these challenges. It also demonstrates that China has intensified its efforts to make its economy globally competitive, striving to improve technological and innovation capacity. For example, the Chinese government has encouraged SMEs to increase their technological capacity by collaborating with research labs and partners in business incubation centers, especially within designated technology development zones (Wu, 2007). Central, provincial and local governments offer companies perks such as free or reduced rent, tax holidays and even direct subsidies to locate research operations in specific locations in China. The rationale for selecting business incubation centers as the site for this study is related to the purpose of the research. First, there are still few studies examining business incubation centers as one of the complex and emerging organizational sectors (Rice, 2002), an area worth examining in the field of knowledge management studies. Second, the managerial committees of the studied incubation centers employ highly specialized personnel who work in structurally differentiated departments. This high level of structural differentiation has led to boundary challenges in the context of collaborative programs (Bess and Dee, 2008; Kezar and Lester, 2009). Third, comparing knowledge flow and practices in business incubation centers located at different regions in China provides

first-hand empirical data for examining boundary issues and the impact of SME features on knowledge transfer across boundaries in emerging economies. Building upon previous scholarly discussion on knowledge transfer across boundaries and combining this with insights from the entrepreneurship literature, we aim to provide answers to the following research questions:

- RQ1.* What types of boundaries and knowledge transfer are relevant in the context of collaborative innovation in emerging markets?
- RQ2.* What factors contribute to knowledge transfer given the identified boundary conditions in the emerging markets?

To obtain empirical data to support our research questions, we undertook three separate field visits to incubation centers and conducted in-depth interviews of the SMEs employees and staff. Our results contribute to the literature of knowledge transfer and in particular to our understanding of the relationship between boundary conditions and knowledge transfer in emerging economies. The results highlight the role of organizational factors and contextual factors in influencing knowledge transfer in the cultural context of China. In particular, we found that shared values and interests help build trust among different actors (both within a company and across companies located in the same incubation centers) to facilitate the knowledge transfer process across pragmatic boundaries. Furthermore, we found that the entrepreneurship orientation of SMEs in China and their use of information-rich media positively impact the knowledge transfer as well. The findings illustrate the specific business environment and dynamic of business incubation centers in emerging markets.

Knowledge transfer across boundaries

Knowledge transfer is an intricate process through which an organization purposefully learns from another (Milagres and Burcharth, 2019). It consists of a series of sub-processes including search, access, assimilation and integration. Understanding knowledge transfer helps organizations to design a better strategy to respond to growing uncertainties in the market, the intensified globalization, and the increase in research and development complexity and costs (Powell *et al.*, 1996; Argote and Ingram, 2000).

There have been accumulated studies on different approaches to manage knowledge transfer across boundary conditions to achieve innovation (Jantsch, 1980; Carlile, 1997, 2002, 2004; Inkpen and Tsang, 2005). Scholars have identified three progressively complex boundary conditions: syntactic, semantic and pragmatic (Carlile, 2004). The first is the syntactic approach, which argues that it is crucial to establish a shared and stable syntax to process information across a given boundary (Galbraith, 1973). The syntactic approach to boundary spanning is the dominant one in conventional organizational research, built upon the assumption that more information and communication is always better for knowledge transfer (Brown and Eisenhardt, 1995; Ancona and Caldwell, 1992). Compared to the traditional syntactic approach, a semantic approach recognizes the need that individual, context-specific aspects of creating and transferring knowledge must be taken into consideration (Dougherty, 1992; Nonaka and Takeuchi, 1995). For instance, Nonaka (1994) emphasizes the generation of “mutual understanding” through interactions among communities. This makes tacit knowledge explicit across boundaries when people walk through semantic differences.

The third approach is the one that we apply to this study, a pragmatic approach. It highlights the importance of understanding the differences in practices of actors that are involved in knowledge transfer and their consequences, which may generate additional costs (Carlile, 2004; Van Der Meer *et al.*, 2013). The pragmatic approach highlights that knowledge is embedded and localized in practices, which builds upon the insights from

Polanyi that tacit knowledge resides in the doing of the activity. It also assumes that the conditions of difference, dependence and novelty are all present and required in an overall process for transforming existing knowledge (Carlile, 1997; Schrage, 1999; Iansiti, 2000). Therefore, the pragmatic boundary is the most complex one within which innovative or creative outcomes are desired. To effectively manage knowledge transfer across pragmatic boundaries calls for a more engaged and deeper sharing, rather than a simple transfer or translation of knowledge between different contexts. In another words, knowledge needs to be actively transformed to better suit the specific situation (Carlile and Reberntisch, 2003).

These boundaries can be navigated through three increasingly complex knowledge processes: transfer, translation and transformation (Carlile, 2002; Bechky, 2003). These distinctions also specify that the level of novelty in a situation affects the type of boundary conditions. Novelty refers to the amount of newness or unfamiliarity that individuals perceive in a situation (Carlile, 2004). As the level of novelty in the situation increases, boundary issues become more complex and difficult to address. While pragmatic boundaries are likely related to high levels of novelty, moderate and low levels of novelty are associated with semantic and syntactic boundaries, respectively. The discussions on pragmatic boundaries recognize that managing knowledge transfer across such boundaries needs to create new knowledge; as a result, current knowledge used at the boundary has to be negotiated and transformed. Developing and maintaining a complex process of transforming knowledge can be challenging to organizations as they need to be able to identify and represent differences and dependencies between actors at the boundaries.

Crossing pragmatic boundaries requires all actors to identify the differences and dependencies, negotiate alternatives at the boundary and then collectively transform the knowledge currently being used in new ways for solution development (Carlile, 2002, 2004). Guided by the same perspective, Tippman *et al.* call for a repetitive and iterative approach to build boundary capacity. This process involves trying new alternatives, testing knowledge and accepting that some knowledge may be abandoned (Carlile, 2004). Therefore, the knowledge used at pragmatic boundaries becomes a “transformed mixture” of the knowledge deemed valuable and of consequence to the specific situation (Carlile, 2004, p. 559). This process may involve negotiation of trade-offs among different actors.

The literature highlights that the knowledge transfer approach has to match the type of boundary in order to create new knowledge efficiently. However, it is not unusual to observe a mismatch between a pragmatic boundary and a transfer approach for both political and practical reasons (Huber, 1991; Hargadon and Sutton, 1997). When novel conditions arise, individuals often intend to re-use their current knowledge because of the strong pressure toward efficient work. Under these circumstances a mismatch often occurs because novelty is hard to recognize and costly to represent. This mismatch between types of boundary and approach goes deeper when one group recognizes novelty on their side but cannot represent its consequences to the other side. This type of practical breakdown often leads to a political breakdown at the boundary (Carlile, 2002, 2004). Groups would need to create and explore the gap of knowledge, where practical and political abilities go hand in hand in transforming knowledge and generating new knowledge at a boundary. This issue becomes more challenging in emerging economies where there is a high degree of uncertainty and risk taking in innovative practices in a volatile business environment. Therefore, we examine the following research question:

RQ1. What types of boundaries and knowledge transfer are relevant in the context of innovative activities in emerging markets?

Factors influencing knowledge transfer across boundaries

Knowledge transfer involves the migration of knowledge between different organizational actors (Beamish and Berdrow, 2003). It is essentially a multilevel phenomenon. The literature

has identified a variety of factors that would influence knowledge transfer across boundaries. At the macro level, studies have focused on factors including industrial characteristics and policy, competition policies, macroeconomic policies, and IP regime and price regulations (Guennif and Ramani, 2012; Grimpe and Sofka, 2016). At the inter-organizational level, literature has examined how motivations behind knowledge sharing alliances (e.g. cost sharing and synergy seeking), partnership structure (equity based or non-equity based) and contract form and scope affect knowledge transfer (Lee *et al.*, 2010; Jiang and Li, 2009). At the individual level, characteristics of people who engage in knowledge transfer could also influence knowledge transfer (e.g. their motivations, cognitive styles, emotions, learning behaviors, and individual absorptive capacity and resistance) (Milagres and Burcharth, 2019). In addition, studies have examined how contextual factors and organizational level factors influence knowledge transfer. In the following section, we provide a review of these key factors and connect the literature to the crossing of pragmatic boundaries and to the context of emerging markets.

Contextual factors

Knowledge transfer occurs among organizational actors engaged in different types of networks including intra-firm networks, strategic alliances and industrial districts (Inkpen and Tsang, 2005). Companies located in a business incubator center can be viewed as actors in an industrial district, which is “a network comprising independent firms operating in the same or related market segment and a shared geographic locality, benefiting from external economies of scale and scope from agglomeration.” Given the specific environment these companies are embedded in, a series of contextual factors need to be accounted for when analyzing how these companies can tap into a larger knowledge resource base for knowledge transfer.

In the context of industrial districts, knowledge of primary interest is highly tacit, difficult to replicate and not easily purchased (Inkpen and Tsang, 2005). To start with, shared values and interests can facilitate knowledge transfer (Maas *et al.*, 2016). Shared understanding of values and interests among different stakeholders (e.g. coworkers, suppliers, clients, partner organizations, etc.) helps to reduce the large cognitive distance between two parties that may create barriers to communication and the transfer of knowledge from one group to another (Sturdy *et al.*, 2009). At the pragmatic boundary, it clarifies dependencies between domain-specific areas and provides a means for making trade-offs between different interests (da Silva *et al.*, 2017). In addition, it helps to build shared perceptions of mutual benefits (Hong and Nguyen, 2009).

Another contextual factor is trust among stakeholders involved in the knowledge transfer process (Zhang, 2019; Hsu and Chang, 2014; Chou *et al.*, 2014). It captures the relational aspect of knowledge transfer. Trust is defined as “the conviction and belief in another party in a risk situation in which the possibility of opportunistic behavior exists (Milagres and Burcharth, 2019, p. 40). As an outcome of the relationship between actors and the institutional context, trust affects how much time different actors are committed to the process, and their disposition to take risks (Inkpen and Tsang, 2005). When crossing pragmatic boundaries, trust is an evolutionary element of the knowledge transfer process, meaning that it will evolve as stakeholders engage in interactions and negotiations (Inkpen and Currall, 2004). The presence of trust will minimize the need for control by a particular party, facilitate mutual understanding and foster cooperation (Dyer and Nobeoka, 2000; Mellewigt *et al.*, 2007).

Developing trust and developing shared interests and values are interconnected, as a higher level of trust could lead to shared understanding of mutual interests, and vice versa (Obal, 2013; Seppänen *et al.*, 2007). Both involve a process that is built upon mutual understanding and good will from all parties that are involved in knowledge transfer. These two factors

become more relevant in emerging markets where there are constricting regulations, inefficiencies and uncertainties. In the context of China, they are crucial as it is a country where *guanxi* is embedded in the culture. *Guanxi* is viewed as interpersonal bonds that are cultivated through long-term relationship building to create certain expectations and duties in daily interactions, business activities and organizational behaviors (Wang *et al.*, 2012). Existing literature about Chinese firms has found that in situations where there is a highly trustful relationship or there is perceived shared understanding of interests and common values, parties are more willing to engage in social exchange and cooperative interactions such as knowledge transfer (Wang *et al.*, 2012; Qian *et al.*, 2019).

Organizational factors

Another set of factors that could influence knowledge transfer is the organizational factor. This section draws from the literature on pragmatic boundary and knowledge transfer and focuses on two important aspects: a firm's characteristics and its use of information-rich media. Both factors are connected to a firm's proactiveness in initiating and engaging knowledge transfer. To begin with, a fundamental firm-level characteristic is the degree to which a firm is strategic in making decisions related to enacting organizational purposes, achieving its vision and creating competitive advantages (Lumpkin and Dess, 1996; Wiklund and Shepherd, 2003; Venkatraman, 1989; Covin and Slevin, 1991). Literature has conceptualized this factor as entrepreneurial orientation, which allows firms to "reconfigure internal and external competencies to address rapidly changing environments" (Teece *et al.*, 1997, p. 516). It is an important driver of product development and reformulation, innovation in manufacturing and channel design, new approaches to competitive strategy and firm performance (Cowden *et al.*, 2016).

As a multi-dimension concept, entrepreneurial orientation captures a firm's innovativeness, risk taking and proactiveness (Fadda, 2018; Miller, 1983; Burgelman, 1984; Hart, 1992; MacMillan and Day, 1987; Venkatraman, 1989). Innovativeness refers to engaging in creativity and experimentation through the introduction of new products/services as well as technological leadership via R&D in new processes; risk taking involves taking bold actions by venturing into the unknown, borrowing heavily and/or committing significant resources to ventures in uncertain environments; proactiveness is an opportunity-seeking, forward-looking perspective characterized by the introduction of new products and services ahead of the competition and acting in anticipation of future demand. Lumpkin and Dess (1996) added two more dimensions to entrepreneurial orientation: competitive aggressiveness and autonomy. Competitive aggressiveness refers to the intensity of a firm's effort to outperform rivals by aggressively responding to competitive threats and holding a strong offensive posture; autonomy refers to independent action undertaken by entrepreneurial leaders or teams to bring about a new venture. However, there has been debate in the literature concerning the conceptualization of entrepreneurial orientation. Some scholars argue that the construct is best viewed as unidimensional (e.g. Knight, 1997; Lee *et al.*, 2001; Naman and Slevin, 1993; Walter *et al.*, 2006; Wiklund and Shepherd, 2003), and consequently, the different dimensions of entrepreneurial orientation should relate to performance in similar ways. On the other hand, some researchers argue that the dimensions may relate differently to a firm's performance (Stetz *et al.*, 2000), as each dimension represents a different and independent aspect of the multidimensional concept of entrepreneurial orientation.

Firms with high entrepreneurial orientation need to make strategic decisions, which involve risk taking and allocation of scarce resources (Pfeffer and Sutton, 2006; Rousseau, 2006). However, the effect of entrepreneurial orientation may differ considering the dynamic cultural and social environment of emerging markets (e.g. Knight, 1997; Thomas and Mueller, 2000). The effect of entrepreneurial orientation has been mainly examined in the North American context (Miller, 1983; Lumpkin and Dess, 1996). It raises the question as to whether entrepreneurial orientation indeed leads to more willingness to engage in knowledge transfer.

In the emerging economic environment, which features uncertainty and risk taking, China provides a potential cultural context to examine how entrepreneurial orientation affects knowledge transfer. SMEs in China need to constantly seek out new opportunities responding to fast changing and volatile business environments, and the government plays a specific role in this dynamic environment (Guo *et al.*, 2017). As a result, firms may benefit from a high degree of entrepreneurial orientation as they are more likely to engage in innovative activities while taking risks in marketing strategies (Miller and Friesen, 1982). Research has also identified that firms with high EO are more adaptive and tend to outperform other organizations in volatile environments (Farja *et al.*, 2016; McKee *et al.*, 1989; Covin and Slevin, 1991; Miller and Friesen, 1984).

Another organizational factor is the communication technology use, which has been found to positively influence knowledge transfer through the support of knowledge sharing and distribution, and interpersonal communication, and in particular in handling tacit knowledge. In organizational settings, knowledge transfer involves the processing and transfer of information to reduce uncertainty and equivocality. Uncertainty describes the challenging situation of organization due to the absence of information and equivocality refers to the existence of multiple and conflicting interpretations about an organizational situation (Daft and Lengel, 1986). Different communication technologies carry different level of information richness, defined as “the ability of information to change understanding within a time interval” (Daft and Lengel, 1986, p. 560). Rich communication media can overcome different frames of reference or clarify ambiguous issues to facilitate understanding in a timely manner, while communication media low in richness requires a long time to enable understanding or it cannot overcome divergence of perspectives (Daft and Lengel, 1986).

The impact of communication technology use on knowledge transfer should be studied in specific contexts (Daft *et al.*, 1987; Schmitz and Fulk, 1991; Kock, 2005). We argue that the effect of media richness on knowledge transfer is relevant to crossing the pragmatic boundary which requires a shared syntax, individual ability and multiple interaction (Maznevski and Chudoba, 2000; Klitmøller and Lauring, 2013). For example, Ahmad *et al.* (2018) found that SMEs make a proactive choice to adopt social media as it helps entrepreneurs to redefine their goals clearly and to obtain information that would not be available otherwise. Media of low information richness (such as written or text-based media) are suitable for the exchange of explicit knowledge (such as pure fact or codified information) while rich media (such as face-to-face meetings, synchronous media like telephone and live chat and social media platforms) are more effective when exchanging tacit knowledge and can even help transform tacit knowledge to explicit knowledge (Herschel *et al.*, 2001; Panahi *et al.*, 2012; Murray and Peyrefitte, 2007; Rice and Shook, 1990). In the setting of knowledge transfer in emerging economies, unpacking how media richness influences knowledge transfer across boundaries helps with our understanding of communication challenges and how to handle the expected uncertainty and equivocality (Grover and Davenport, 2001).

After reviewing how both contextual factors and organizational factors could influence knowledge transfer in emerging markets with high uncertainty and risk taking, we propose the following research question:

RQ2. What factors could facilitate knowledge transfer given the identified boundary conditions in emerging markets?

Method

Research site

This study addresses the boundary issues that emerge in knowledge transfer by examining SMEs registered in the business incubation centers. To explore how knowledge transfers

across boundaries through collaborative programs, two incubation centers were chosen: the Suzhou Industrial Park (SIP) incubation center in Suzhou and the Zhongguancun Science Park incubation center (ZGC) in Beijing. These two were selected as the case study sites mainly because: they represent nationally recognized innovation development zones in China; Zhongguancun Science Park is considered to be the most successful one in China, while SIP was established through international government-to-government collaborations between Singapore and China; they are in different regions of China, representing the Beijing–Tianjin–Tangshan Industrial zone and Southern/Yangtze river delta economic development zone; and there are significant differences between the two incubation centers in terms of their approaches to knowledge transfer practices and management.

Zhongguancun Science Park incubator is a business incubator under the municipal governance of Beijing (the capital city of China). This incubator had started an innovation-and-collaboration program (IAC) to engage in a strategic planning processes that sought to strengthen collaboration and innovation, as strategic planning processes are likely to stimulate the knowledge transfer associated with organizational learning, and reveal blockages and impediments to such transfers (Vaara and Whittington, 2012). The other incubation center studied is located at SIP. The management committee of this incubation center initiated a one-stop service unit to provide multiple services to SMEs registered in the incubator.

Data collection

The researchers made three field visits to Beijing and Suzhou respectively to gather documents and information from the studied incubation centers and other sources. We followed previous studies which define SME as a size between 10 and 500 employees. We invited managers from the management committee of incubation centers and SMEs registered in the incubation centers to participate in this research project. We conducted 39 interviews through both phone and face-to-face format.

We conducted semi-structured interviews in two stages. In the first stage, we gained in-depth insights by interviewing managers and key employees of SMEs operating in the incubation centers, and important stakeholders including employees of other local companies operating in the incubation centers, officials working for the incubation centers, and government officials from local districts. In total, 19 face-to-face interviews with managers from SMEs and the management committee of the incubation center were conducted during three visits to the studied incubation centers. The main purpose of this round of interviews was to understand the innovative programs and practices of business incubation centers at different locations and explore the boundary issues of knowledge transfer. In the second stage, to gather insights on knowledge transfer of SMEs registered in studied incubation centers, we collected data by interviewing 20 managers from SMEs in the two incubation centers over a subsequent four months period. For instance, we invited interviewees to describe their experiences collaborating with the management committee of the business incubator, in particular the experiences of participating in innovative programs supported by the business incubators. We also asked the participants questions including their daily practices to learn new knowledge and manage knowledge through collaborations with the incubation center, barriers of knowledge practices, as well as their perceptions of the context of incubation centers, etc.

The sampling approach at both stages was purposive and through personal networks and snowball sampling (Noy, 2008). Interviewees were invited and identified on a voluntary basis. This allowed us to select participants from a range of different industries and sectors, as well as different roles. Among the interviewees, the roles include founders, CEOs, marketing and business development managers, project managers, public relation manager, government relations managers, as well as managers working at the incubator

management committee. In total, 30.76 percent ($n=12$) were female while 69.23 percent ($n=27$) were male. Regarding interviewee education level, 5.12 percent ($n=2$) held an EMBA, 28.20 percent ($n=11$) held a master's degree/MBA, 48.71 percent ($n=19$) held bachelor degrees and 17.95 percent ($n=7$) had diplomas. Regarding interviewee age, 2 were under 25 years old, 12 between 25 and 35 years, 12 between 35 and 45 years old, 13 between 45 and 55 years old and 0 were above 65 years old. We tried to maximize variation of interviewee's backgrounds in order to obtain a rich view of managers working in the incubation center. Interviews lasted between 60 and 90 min and all were recorded and transcribed. The interviews were conducted in Chinese or English, as chosen by the interviewees so they could better express their thoughts with their mother tongues. Those interviews conducted in Chinese have been translated into English and transcribed.

Data analysis

The data gathered from interviews were analyzed and categorized using a qualitative, thematic analysis method (Strauss and Corbin, 1994) with NVivo software. We conducted the data analysis using a "systematic" combining of both inductive and abductive steps (Dubois and Gadde, 2002; Strauss and Corbin, 1994). While a reasonable conclusion was drawn from inductive steps of data analysis, abductive steps characterized as inference to the best explanations led researchers to refer to an appropriate premise such that the conclusion is a valid consequence of the given premise.

We examined the interview transcripts and conducted a process of open coding of the data. During the first round of coding, we identified a number of themes were identified associated with boundary conditions and knowledge across boundaries. In the second round of coding, we reduced the themes by combining similar themes and using more abstract and analytic categories. We identified numerous impacting factors on knowledge across boundaries. Those themes include "shared culture," "mutual interest," "trust," "localized," "risk taking," "forward thinking," "active creativity," "entrepreneurial spirit," "dialogs" "multiple interactions," etc. In the third step, we matched all of the identified themes against theoretical concepts through the process of abduction to develop a list of third order themes. For instance, we identified pragmatic boundary by contrasting and analyzing the second order themes associated with boundary conditions which include high level of novelty, differences and interdependence. We also categorized and identified a few contextual and organizational factors which impact knowledge across pragmatic boundaries (Table I).

Results

This study identified 29 cases of knowledge transformation from the interview data. See Table II for the detailed coding of these cases. We summarize three main findings from the data analysis. First, we found that pragmatic boundary is the main boundary condition associated with knowledge transformation in the context of business incubation centers in China, considering the novelty, dependence and differences presented at the knowledge boundary. Second, we found that contextual factors including shared value and interests and trust facilitate knowledge transformation across pragmatic boundaries. Third, we found a number of organizational factors impacting knowledge transformation. In the following sections, we discuss these findings in detail (Figure 1).

Pragmatic boundary in business incubators in the context of China

The data shed light on *RQ1* regarding which types of boundaries and knowledge transfer are relevant in the context of business incubation centers in emerging markets. From the interview data, several themes emerged to describe the knowledge boundary from the practices of business incubators. The key themes include "newness," "novelty," "learning,"

Table I.
Summary of
thematic coding

Activity	Purpose	Outcome
Induction: First order themes	Open coding of all data to identify themes associated with boundary conditions and types of knowledge across two locations	Locations: Beijing/Suzhou Emerging themes include Knowledge boundaries, knowledge transfer, sharing of knowledge, collaborative projects, creativity, innovation, novelty, different types of knowledge, learning, practices, knowledge replacement, assessing knowledge, consequences, connections of knowledge Context, shared value, understanding, trust, relationship, common interests, multiple interactions, cross-functional interactions, team interactions, face-to-face communication, reduce uncertainty, local, embedded Innovative project, creative activity, forward looking, risk taking, proactiveness, aggressiveness
Induction: Second order themes	Identification of second order themes describing the characteristics of boundary conditions and impacting factors on knowledge across boundaries	Knowledge boundary: novelty (low – high), differences in types of knowledge (low – high), dependence in knowledge (low – high) Knowledge transfer: representing – learning – transforming Local knowledge, embedded, community practice, context, cultural context Contextual factors: localized, shared value, trust, mutual understanding, multiple interactions Organizational factors: active and forward thinking, risk taking, entrepreneurial spirit, rich dialogs
Abduction: Third order themes	Comparison of second order themes to theoretical constructs	Boundary conditions – pragmatic boundary – high novelty Knowledge transfer – information processing/knowledge translation/knowledge transformation Localized, embedded, shared value and context, differences in knowledge, dependence Entrepreneurial orientation and spirit – novelty at the pragmatic boundaries Information-rich media, multiple interactions – knowledge transformation at pragmatic boundaries

“negative consequences,” “solution development,” etc. These themes describe the high novelty as a main feature of boundary condition faced by actors engaged in knowledge transfer practices. As an interviewee from the management committee of the incubation center at the Suzhou Industry Park put it:

Those SMEs registered at our incubation center might have limited capacity to gather new sources and knowledge in some highly specialized areas, e.g. high-tech, industry, regulation and policy. As an information hub and service unit, our one-stop service program of the incubation center collaborated with firms to start their practices in this incubation center in an innovative and effective manner. (Interviewee 7, staff from the management committee of incubation center)

As described, the one-stop service program was established to provide knowledge services to help SMEs navigate their innovative activities in business incubators. It could be costly for SMEs to develop their new knowledge in certain highly specialized areas, in particular regarding procedure, policy, technology and professional knowledge. SMEs need to face high novelty at a knowledge boundary which incurs not only the cost of learning about what is new, but also the cost of adjusting or transforming their “current” ways of doing things (e.g. based on the existing knowledge and practices) to accommodate the novelty at a boundary (e.g. how to register and operate in the studied incubation center). In other words, it requires the actors to try new alternatives and put their current knowledge “at stake” as some of the knowledge may need to be changed or abandoned to cross pragmatic boundaries.

Case	Location	Description of condition of knowledge boundary	Influencing parameters
Case 1: participating in ZGU incubator innovative program, and creating a new corporate communication platform	ZGU incubation center	Novelty (new technology), dependence between ZGU and the SME, differences in knowledge practices	Proactive; multiple, face-to-face interactions
Case 2: application of AR technology in new product	ZGU incubation center	Novelty (new technology), dependence between the SME and local technology supplier, differences in interests	Forward thinking, risk taking; multiple, face-to-face meetings, telephone meetings
Case 3: collaborating with ZGU to set up a student internship program	ZGU incubation center	Novelty (new process), dependence between the SME and the management committee, differences between existed and new process	Forward thinking, proactive, risk taking; face-to-face meetings and dialogs
Case 4: participating in ZGU innovative program and creating a new employee award program	ZGU incubation center	Novelty (new process), dependence between the SME and the management committee, differences between existed and new practices	Proactive; face-to-face meetings, telephone meetings, workshops, live chat and social media
Case 5: collaborating with a local university (in Zhongguancun) for AI simulation project	ZGU incubation center	Novelty (high-technology), dependence between the university lab and the SME, differences in knowledge domain	Forward thinking, proactive; face-to-face/telephone meetings, live chat and WeChat
Case 6: introducing a new ads framework to local partner	ZGU incubation center	Novelty (new idea), dependence between the SME and local partner; differences in practices	Proactive, risk taking, face-to-face conversations, social media, live chat
Case 7: adopting a new employee appraisal system which was introduced by management consultant	ZGU incubation center	Novelty (new system), dependence between the SME and local partner; differences in knowledge domain and practices	Forward thinking, risk taking, proactive; visual meetings and face-to-face meetings
Case 8: collaborating with municipal IPR association to promote IPR in the industry	ZGU incubation center	Novelty (knowledge), dependence between the SME and local partner; differences in knowledge domain	Forward thinking, proactive, risk taking; face-to-face meetings and conversations
Case 9: an experiment to apply AI technology in robots design	ZGU incubation center	Novelty (technology and knowledge), dependence between different units of the company; differences in knowledge domain	Forward thinking, proactive, risk taking; telephone meetings, visual meetings, social media, WeChat
Case 10: introducing flexible working schedule to employees	ZGU incubation center	Novelty (process and practices), dependence between different units; differences in practices	Risk taking, proactive, forward thinking; face-to-face conversations, WeChat and live chat
Case 11: developing a media campaign on new product	ZGU incubation center	Novelty (idea), dependence between different departments of the company; differences in practices	Proactive, forward thinking; face-to-face meetings, social media
Case 12: doubling product manufacturing plan due to introduction of new technology	ZGU incubation center	Novelty (technology), dependence between manufacturing and sales team; differences in knowledge domain	Proactive, forward thinking, risk taking; face-to-face/visual meetings, regular conversations

(continued)

Table II.
Cases of knowledge
transformation

Case	Location	Description of condition of knowledge boundary	Influencing parameters
Case 13: implementing a new marketing strategy collaborating the ZGU management committee	ZGU incubation center	Novelty (idea), dependence between the SME and ZGU; differences in practices	Proactive, risk taking; face-to-face meetings, conversations, social media and WeChat
Case 14: developing a new energy technology collaborating with municipal government	ZGU incubation center	Novelty (technology), dependence between the SME and local government; differences in practices and interests	Proactive, risk taking, forward thinking; face-to-face meetings and conversations, social media
Case 15: participating in a new material experiment collaborating with local university in Zhongguancun	ZGU incubation center	Novelty (technology), dependence between the SME and university lab; differences in knowledge domain and practices	Proactive, forward thinking, risk taking; visual meetings, face-to-face meetings, interpersonal conversations, social media, live chat
Case 16: collaborating with municipal communication department to develop a new cellphone program	ZGU incubation center	Novelty (knowledge), dependence between the SME and the local partner; differences in knowledge domain and interests	Risk taking, forward thinking; face-to-face meetings, visual meetings; in-depths conversations, social media and live chat
Case 17: testing a mobile phone feature collaborating with a local partner	SIP incubation center	Novelty (knowledge), dependence between the SME and the local partner; differences in practices	Forward thinking, proactive; face-to-face meetings, visual meetings; conversations, social media
Case 18: participating in SIP incubator innovation program, and developing a new cellphone app	SIP incubation center	Novelty (technology), dependence between the SME and the local partner; differences in practices and interests	Proactive, competitive, forward thinking; face-to-face meetings; conversations, social media, e.g. WeChat
Case 19: developing new packaging of products	SIP incubation center	Novelty (knowledge), dependence among the different departments; differences in practices and knowledge domain	Proactive, risk taking; face-to-face meetings, visual meetings; regular conversations, WeChat and other social media
Case 20: developing new communication plans for clients in other cities	SIP incubation center	Novelty (idea), dependence among different departments; differences in practices and knowledge domain	Proactive, competitive; visual meetings, telephone meetings, regular conversations of phone and through social media
Case 21: testing a new software development collaborating with local university labs	SIP incubation center	Novelty (technology and knowledge), dependence between the SME and local research lab; differences in knowledge domain and practices	Risk taking, cost; face-to-face meetings, visual meetings; regular conversations, and social media
Case 22: upgrading product responds to the needs of consumers from Chinese market	SIP incubation center	Novelty (knowledge), dependence between different departments; differences in practices and process	Competitive, proactive; face-to-face meetings; regular conversation and group communication via WeChat
Case 23: participating in SIP incubator innovation program and developing a studio with AR technology	SIP incubation center	Novelty (technology), dependence between the SME and local partner; differences in practices	Forward thinking, risk taking, proactive; face-to-face meetings, visual meetings; communication via WeChat

Table II. (continued)

Case	Location	Description of condition of knowledge boundary	Influencing parameters
Case 24: developing a communication system for local clients	SIP incubation center	Novelty (knowledge), dependence among the different departments of the company; differences in process and practices	Forward thinking, competitive; face-to-face meetings, visual meetings; communication via online platform, social media, etc.
Case 25: introducing an energy saving technology to the local corporate client	SIP incubation center	Novelty (technology), dependence between the SME and local corporate clients, differences in knowledge domain	Forward thinking, aggressive, proactive; face-to-face meeting, telephone meeting; group communication on WeChat
Case 26: manufacturing cellphone fittings with a double size target	SIP incubation center	Novelty (practices), dependence among different departments; differences in practices and process	Aggressive, proactive, risk taking; face-to-face meetings; conversations via internal communication platform and channels
Case 27: a media campaign to promote company mission collaborating with a local PR firm	SIP incubation center	Novelty (practices), dependence between the SME and local partner; differences in knowledge domain	Aggressive, proactive; face-to-face meetings; regular conversations via social media, WeChat
Case 28: developing a municipal animation park plan collaborating with local government	SIP incubation center	Novelty (idea), dependence between the SME and local collaborator; differences in practices	Forward thinking, risk taking, proactive; face-to-face meetings, regular conversations, group chat via WeChat
Case 29: participating in innovation program of the incubator and testing a new materials for product	SIP incubation center	Novelty (knowledge), dependence between the SME and the incubation center, differences in knowledge domain and interests	Forward thinking, proactive, risk taking; face-to-face meetings, regular conversations, social media including WeChat

Table II.

On the other hand, several interviewees from the studied incubation centers described the practices of dealing with novelty at a pragmatic boundary. It also speaks to the nature of knowledge itself, that is, knowledge can be a source of innovation. As the following interviewee from a SME registered in Zhongguancun industrial park incubation center described:

This innovation-and-collaboration program started two years ago, and was initiated by the incubation center to facilitate collaborative innovation activities of registered companies there. It provided policy and information support for our company to adopt a new technology collaborating with a university research center. The most significant challenge we were facing was to modify our current knowledge to combine the new ones. In order to achieve this, we had to develop a new process map to collaborate with the university research center. Our company was one of the top five innovators recognized and awarded by the incubation center. (Interviewee 19, Manager)

In the case described above, participating in the IAC program provided actors an opportunity to experiment with a new technology collaborating with a local university research lab. The collaboration mechanism facilitates new knowledge (e.g. new technology in this case) transformation to accommodate trade-off between different actors and community of practices. (e.g. SMEs and university research center in this case). The new knowledge served as a source of innovation, which speaks to the novelty presented at the pragmatic boundaries for knowledge transformation within or across organizations.

As a result, we conclude this in:

P1. Pragmatic boundary with a high degree of novelty provides the condition for knowledge transformation in business incubators.

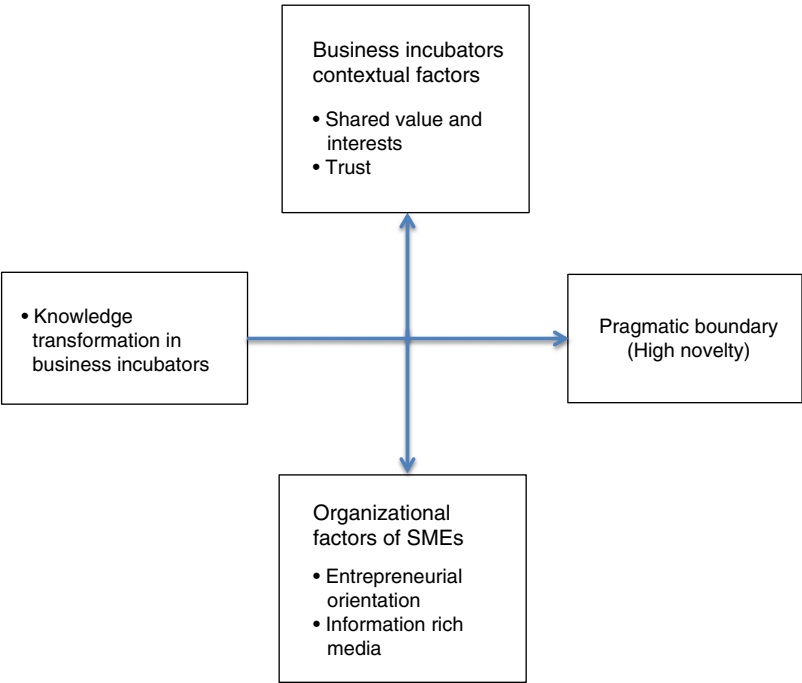


Figure 1.
Proposed model

Contextual factors: knowledge transformation across pragmatic boundary

The results confirm that transforming knowledge across pragmatic boundaries requires understanding the conditions of a boundary in order to develop a process which could be re-used in the next cycle, as knowledge is understood as localized, embedded and invested in the tasks, processes and outcomes of a specific practice. To develop and maintain such a complex boundary crossing process, interpretation of differences in knowledge and creation of shared meanings are embedded in local contexts. Shared values create common interests between actors in the incubation centers, generating a positive effect on knowledge transformation across a pragmatic boundary. For instance, one of the following interviewee from a tech company described:

I feel although we are a small high-tech company, there is not much difference of value between us and the management committee of the incubation center, when it comes to innovative projects. It was one of the concerns of our top management team before we registered in this incubation center. Actually we figured out that we share many values, such as efficiency, sustainability on the top of innovativeness. I guess this really helped our company to reduce uncertainty to work with the incubation center for technology development. (Interviewee 4, General Manager)

In the above case, several managerial committee members of the incubation center have nominated by the local municipal government, which partly speaks to the nature of an incubation center which is supported by innovation policies in China. In the current study, both studied incubation centers in Beijing and Suzhou are government initiatives at the national level. As a result, the managerial committee members bring government-oriented cultural elements to the knowledge context and to form a “community of practice” which shares different cultural features, comparing with the SMEs in the business incubator. Those perceived “differences” between different communities of practices in an industrial district (in our case business incubators) may include differences between lay and

professional knowledge communities, government-oriented and entrepreneurial oriented cultures, practical orientation and research orientation, professional commitment (managers vs technical experts), as well as social or cultural preferences, etc. Those all result in conflicting interests and cultures among actors in the incubation centers, competing for access to knowledge resources in an industrial district. It increases the challenges to transfer knowledge across pragmatic boundaries among knowledge actors.

However, the interview results revealed that common interests in innovative practices which were reformed by underlying shared values set up the context for knowledge transformation to accommodate novelty presented at the pragmatic boundaries. These common interests increase the capacity to specify, negotiate, transform and validate knowledge of problem solving among communities of practices. The following interviewee expands this point:

We were encouraged by the management committee of the incubation center to try a high-tech energy saving program. It is new practice to us. We participated in several sessions learning about the sustainability principles and values and see a perfect alignment with the value of our firm. Although it is a government initiated program, the similar value and interests brought us to develop a process so we successfully implemented this new energy saving program and win the annual award. (Interviewee 9, Business Development Manager)

The results also show that trust serves as the mechanism for actors to develop common interests, which facilitate the knowledge transformation among knowledge communities. As the following interviewee put it:

I think it is trust developed during those years that helped our firm to go through the most challenging situations. Our firm invested in the artificial reality technology application to develop a new communication platform, responding to the technology trends in recent years. It is not the technology per se, rather the application process takes longer than had expected. The trust relationship between us and the local technology vendor helped us succeeded eventually.

As elaborated in this example, long-term trust developed from pervious collaborative experiences between the SME and the management committee helped actors to negotiate and co-create an application plan for new AR technology application. This trust relationship facilitated the actors to identify common interests in a complicated context and led to knowledge (e.g. technology in this case) to be interpreted and transformed across pragmatic boundaries. Therefore, we propose the following proposition based on our findings:

P2. Shared value and interests created a context for knowledge transformation across a pragmatic boundary of high novelty.

Organizational factors and knowledge transformation across pragmatic boundary

When interviewees described the innovative activities and practices the companies initiated, several themes emerged including “risk taking,” “creativity,” “entrepreneurial spirit,” “explore opportunity,” “proactive,” “aggressiveness” and “forward-looking.” Those themes described factors impacting knowledge across boundaries at an organizational level, which also speak to the features of SMEs registered in the incubation center.

One of the interviewees described below:

As an internet technology company, we are facing fierce competition in the local market in recent years. Our CEO has a vision that we have to be among the first ones to adopt new internet technologies to develop competitive advantage. I think it is also related to our high entrepreneurial spirit which leads us more willing to take risk. For instance, there have been several rounds of discussions on whether we should collaborate with a local VR (virtual reality) technology center, considering the quick growth of VR in China. While we are excited about the new possibility, it also involves high risk – think about the financial and time investment for the collaboration process, even not to mention the uncertainties related to the future of the technology product. Eventually our company made the decision to step into the VR field and I am quite proud of being part of this process. (Interviewee 17, Business Manager)

For knowledge transformation across pragmatic boundaries in innovative projects, actors are required to commit significant resources when risk is presented. The above example lends further support to the idea that firms that are more willing to take bold actions with higher risks provide helpful conditions for knowledge transformation across pragmatic boundaries. In the above case, the collaborative project of VR technology created pragmatic boundaries for companies to engage in the learning and sharing of knowledge. The project involves transfer of new technology, and increases the novelty of the pragmatic boundary of knowledge transform. Through collaborating with a local VR technology firm, the SME stepped into the VR area. The willingness to take risk shows the entrepreneurial orientation of the firm, which facilitated knowledge transformation across pragmatic boundaries.

In the past two decades, China has been experiencing an environment of rapid changes and shortened product and business model lifecycles. Chinese SMEs have needed to continually seek out new opportunities and take a proactive position to engage in forward-looking business activities. The research results confirm that SMEs with high entrepreneurial orientation are more likely to respond to business environment stimuli by actively forming alliances with other organizations and engaging in information seeking to pursue, identify and create new venture opportunities. This proactive attitude and willingness to take bold actions helps SMEs to transform knowledge across pragmatic boundaries; the entrepreneurial orientation of firms is also demonstrated in organizational vision and culture development as well, which affects how knowledge share and transfer occurs within an organization. The following example elaborates on this:

I think our company is really driven by the vision to be at the leading position of the market. Every employee was invited to share their ideas about the future of the company at our weekly department meetings, and people feel more energetic and inspired. We work together to develop the vision of our firm, which is the crucial step of organizational visioning process. I think it is also a good method to motivate our employees to learn and grow their individual knowledge which contributes to collective learning. (Interviewee 14, HR Manager)

As elaborated above, entrepreneurial orientation and proactive engagement position firms in the knowledge boundary context, where knowledge transformation happens simultaneously at different levels as individual knowledge transforms to collective learning between teams and within organizations. It facilitates knowledge transformation across pragmatic boundaries where knowledge communities create shared values and interests. The above discussions lead to the next proposition:

- P3. Firms which are more proactive to engage in creative and forward-looking activities involving risk taking are more likely to engage in knowledge transformation at pragmatic boundaries.

Information-rich media and knowledge transformation: presenting differences and interdependence

A learning process about differences and dependencies of knowledge between actors at a pragmatic boundary was described in numerous cases from the interviews. Differences in knowledge refer to differences in the amount of knowledge accumulated as well as differences in the type of domain-specific knowledge accumulated. As differences between actors increase, the amount of effort required to adequately share and assess knowledge also increases. Dependence between actors describes the condition where knowledge actors need to take each other into consideration in order to meet their own goals while creating a shared context.

Taking the SIP incubation center as an example, the ability to represent and specify differences and dependences allows the registered SMEs and the management committee of the SIP incubator to identify what is most consequential, and then to collectively prioritize their time and resources to resolve those consequences, e.g. creating new knowledge for

business practices or shared agreements about what a specification means. Actors at the pragmatic boundary need to present their current knowledge within their own practices (i.e. cutting edge technology, technical requirements and preferences of registered SMEs; knowledge about supportive services for the management committee of an industrial park incubator), resulting in specifying different needs and preferences among knowledge actors. For instance, one SME interviewee expressed the preference from his unit:

As a startup that just started the practice in SIP incubator, we would really love to get more legal information and services from the one-stop service unit, i.e. intellectual property related legal services or information on tax policy. However, these are very specialized knowledge, and it seems there is not enough resource for SIP incubator to provide these information and knowledge. Those information we can get from them is kind of limited and not up-to-date. (Interviewee 3, Product Manager)

As described above, the gap of current knowledge and the need for shared knowledge could result in barriers between the actors involved, which impede knowledge transfer. However, the knowledge gap could also be a stimulus to trigger the development of new knowledge if the boundary conditions meet the requirements of knowledge transformation across a pragmatic boundary.

In addition to presenting differences, identifying dependencies across these different actors (e.g. registered SMEs, the management committee of the industrial park incubation center or local partners) is also a necessary requirement in transforming knowledge at a pragmatic boundary. The dependency is mostly an existing relationship between the registered SMEs and the industrial park incubator, while SMEs need to establish new relationship with their local partners in some cases. Being located in an industrial park incubation center, the practices of SMEs could be impacted by the policy, support and resources of the incubators to a large extent.

It was found that rich dialog and in-depth conversations happening at both the individual and organizational levels increase the ability of both registered companies and industrial park incubators to present their knowledge differences and dependencies faced at a pragmatic boundary. For instance, the regular face-to-face meetings between SME managers and the management committee of the industrial park incubator allow them to identify knowledge gaps by creating a shared knowledge context. In addition, informal interpersonal conversations between SME managers and the management committee of the incubation centers help both parties to realize how one's action could impact the other's action and develop shared interests to achieve goals. Some of those interpersonal conversations and interactions were happening through social media, e.g. WeChat, instant messenger, Weibo, etc. Those media extend interpersonal interactions to visual space, both in the formal (e.g. visual meetings) and informal formats (e.g. casual conversations). Those connections and interactions developed through rich media, with which knowledge actors co-develop a cooperative approach for shared context, and facilitate knowledge transformation across pragmatic boundaries. As a result, we conclude our findings in the following proposition:

P4. Firms that use information-rich media more are likely to engage in knowledge transformation, by presenting difference and dependence at pragmatic boundaries.

Information-rich media and knowledge transformation: reducing uncertainty and equivocality

We also found in the interviews that rich dialogs could help to reduce uncertainty, due to the absence of information for predictability. "Personal connection" or *guanxi* was mentioned by numerous interviewees, as a main feature of information-rich media. In the case of ZGU incubation center, regular conversations and meetings between SMEs and the management committee of incubation centers not only provided occasions for sharing knowledge, but

also facilitated the building and maintaining of personal connections through interpersonal dialog and interactions. As a result, knowledge embedded in the interpersonal communicative context was transformed across pragmatic boundaries. As the following interviewee expressed:

I sometimes run into product managers from other companies, and we will stop for a quick chat. It is fascinating to realize how much new information I could get from those conversations, e.g. new product development trends, industry conference and workshops, etc. As we are all working in SMEs, there is not much chance to attend professional training and conferences. When new product knowledge was introduced into work, my existing knowledge doesn't allow me to grasp it quickly, as I always need to devote more effort to update my knowledge. (Interviewee 13, Product Manager)

Furthermore, personal interactions and dialogs help to build understanding and trust among coworkers and other collaborators at the incubation centers, as information-rich media offer tools and platforms to clarify and interpret policies and regulations, in order to develop deep connections and relationships. Uncertainty was reduced in the process of knowledge transformation because trust among coworkers and peers from other companies enables the sharing of tacit skills which are useful for creating and transforming knowledge. This point was clearly demonstrated from the following interview:

It has been a few years working in the incubation center, and we know the person working at the incubation center office very well. We usually get update of policies and regulations from the incubator management committee. We have been working together for several years and our company trusts their professionalism, in particular, they provided timely interpretations of latest industrial regulations. It really helped us in an effective manner. (Interviewee 21, General Manager)

As described in this case, trustworthy relationships between actors facilitate information sharing and reduce equivocality of policy interpretations; as a result, it facilitates knowledge transformation across pragmatic boundaries. The process of transforming knowledge across a pragmatic boundary could be complex, as multiple and conflicting interpretations could exist which would lead to equivocality and ambiguity. The confusion and lack of understanding cannot be resolved with one-try, but requires an iterative process to shape alternatives and solutions overtime. Our results suggest that information-rich media provide a context to develop an iterative and interactive process which helps to reduce ambiguity and equivocality at pragmatic boundaries. The following interviewee supports this point:

Working together with the management office of the incubator, we figured out together a operational plan which is well aligned with the mandate of the IAC program. We set up a group chat via Wechat including our colleagues and staff from the management office, so we can exchange message simultaneously. Our production procedure meets both the industrial standard of raw materials and the specific requirement from the management office. It is helpful that the management office provides subsidy policy interpretations, as there are several experts in the office who followed the policy development in those years. Being aware of the latest policy change and possible future trends helps us to make better decisions and develop our competitive advantages. (Interviewee 16)

As demonstrated above, knowledge actors (e.g. the registered company and the management committee of the incubator) participate in the iterations, and they become better at co-interpreting the industrial standards and requirements of the management committee, in order not to cause misunderstanding due to equivocality at the knowledge boundary. Since knowledge is localized and embedded in a given context, such an iterative capacity is what allows knowledge to be re-localized in new knowledge through each iteration. As a result, we propose the following proposition:

P5. Firms that use information-rich media more are likely to engage in knowledge transformation, by reducing uncertainty and equivocality at pragmatic boundaries.

Discussion

This research sheds light on the discussions about knowledge transfer and boundary conditions by examining innovative practices of SMEs registered at business incubation centers in China. There are several major findings in this research. First, this research provides an opportunity to revisit how knowledge and pragmatic boundaries are defined through innovative practices in organizational settings. It lends support to the discussion on knowledge transfer mechanisms, that innovative practices generate pragmatic boundaries where knowledge transfer takes place. The results confirm that the knowledge transfer approaches have to match the boundary conditions, which are shaped by the amount of novelty (Carlile, 2002, 2004; Dick *et al.*, 2017), as well as dependence and differences presented at the knowledge boundaries. Second, this research reveals that shared values and interests among knowledge communities facilitate knowledge transformation, and in particular trust builds deep understanding and common interests among collaborating parties. Third, it explores the crucial role of entrepreneurial orientation in knowledge transformation across pragmatic boundaries, and lends support to the concept of entrepreneurial orientation as a multi-dimension construct which is applicable in the Chinese context as well (Lee *et al.*, 2001; Walter *et al.*, 2006; Wiklund and Shepherd, 2003). The results reveal the dynamic of how innovativeness, risk taking and proactiveness of SMEs impact knowledge transformation across pragmatic boundaries. Fourth, it finds that media richness plays a crucial role in the process of knowledge transform across pragmatic boundaries. Rich dialogs and in-depth conversations allow for immediate feedback and personal connections to build shared understanding and to reduce uncertainty and equivocality at the pragmatic boundary. As a result, information-rich media enable knowledge actors to interact and connect in order to shape alternatives and solutions across pragmatic boundaries overtime.

This research further discusses the mechanisms of knowledge transformation across a pragmatic boundary and extends the previous discussions on boundary conditions to the context of business incubators in China. The results confirm previous discussion on pragmatic boundary featuring high novelty (Carlile, 2002, 2004; Bechky, 2003; Hargadon and Sutton, 1997). Managing knowledge transformation across a pragmatic boundary not only requires creating new knowledge, but also current knowledge used at the boundary to be negotiated and transformed with possible high cost. The results confirm that shared values and common interests between knowledge actors at a pragmatic boundary facilitate knowledge transformation, as actors are able to specify, negotiate, transform and validate knowledge of problem solving at a pragmatic boundary. Furthermore, the results highlight the role of trust as a contextual factor in the Chinese culture, where trustful relationship leads to strong ties (Tortoriello *et al.*, 2012), so there will be less concerns for knowledge being misused (Krackhardt, 1999; Reagans and McEvily, 2003, 2008). This finding captures the relationship aspect of knowledge transformation, and further contributes to the literature on mechanism of knowledge transformation, as trustful relationship facilitates shared values and understanding of interests among knowledge actors so they are able to engage in knowledge transform at pragmatic boundaries (Wang *et al.*, 2012; Qian *et al.*, 2019).

Organizational factors of SMEs and knowledge across pragmatic boundaries

The current research advances the scholarship on impacting factors on the mechanism of knowledge transform across pragmatic boundaries. In particular, the findings reveal the positive influence of entrepreneurial orientation in knowledge transform process in the context of SMEs in emerging markets. It finds that SMEs more proactive to take risks and engage in creative and forward-looking activities are more likely to cross the pragmatic boundaries. This finding is consistent with previous research on the impact of SME entrepreneurship on organizational knowledge performance (Covin and Slevin, 1991; Wiklund and Shepherd, 2003). It examines the knowledge transform practices of SMEs registered at

business incubation centers and reveals the impact of entrepreneurship orientation on the dynamic of knowledge transform of SMEs in the dynamic context of China. It confirms the role of entrepreneurial orientation, as a crucial organizational parameter, in the process of knowledge transformation. In addition, it responds to the call of studies on whether the different dimensions of entrepreneurial orientation would relate to organizational performance in similar ways (Stetz *et al.*, 2000; Kilenthong *et al.*, 2016). While some researchers argue that different dimensions of entrepreneurial orientation impact firm performance in different ways (Stetz *et al.*, 2000; Fadda, 2018), this research lends support to the argument that each dimension impacts knowledge across pragmatic boundaries in the same direction. The discussions contribute to the literature on entrepreneurial orientation of SMEs by answering repeated calls to examine how it may influence knowledge practices (McKee *et al.*, 1989; Covin and Slevin, 1991). We call for further research on the dynamics and processes within which entrepreneurship orientation of SMEs could impact knowledge practices in emerging markets.

This research explains the context of rich dialog and multiple interactions and its impact on knowledge transformation across pragmatic boundary and highlights and extends the discussions on information-rich media (Daft and Lengel, 1986; Daft *et al.*, 1987; Schmitz and Fulk, 1991; Kock, 2005) to the context of knowledge sharing and transfer. It further illustrates that information-rich media increase the capacity to present the differences and dependencies faced at the pragmatic boundary (Carlile, 1997, 2002, 2004). The results also explain the dynamic knowledge transfer process where information-rich media reduce uncertainty caused by lack of information (Grover and Davenport, 2001; Maznevski and Chudoba, 2000; Klitmøller and Luring, 2013) and reduce equivocality through multiple interactions and the inclusion of verbal and non-verbal signs to overcome challenges related to capacity in understanding and making sense of equivocal cues (Daft *et al.*, 1987; Herschel *et al.*, 2001; Panahi *et al.*, 2012; Murray and Peyrefitte, 2007). Incorporating the discussions on information-rich media in the context of knowledge transfer furthers our understanding of effective boundary processes and explains the role of information-rich media in managing knowledge transformation across pragmatic boundaries in the context of China.

Conclusion

This research has several practical implications for organizations that face the need to advance understanding of knowledge practices and develop innovative practices. First, to create proper boundary conditions to facilitate knowledge transfer and innovative practices, organizations need to be aware of the importance of boundary conditions in managing knowledge transfer practices. A mismatch between boundary conditions and a knowledge transfer approach is not unusual in organizations for both political and practical reasons. To facilitate knowledge transfer within and between organizational actors, firms need to establish an effective process with tools to accommodate novelty. Second, organizations should be aware of the impact of entrepreneurial orientation on organizational innovative performance and in particular in the context of SMEs in emerging markets. Third, for organizations that face pragmatic boundaries with high novelty, adopting and integrating information-rich media could help decrease uncertainty and equivocality in understanding knowledge practices and managing innovative projects. It also helps to keep collaborating parties engaging in iterative interactions to develop trust and facilitate knowledge transfer at pragmatic boundaries.

This research examines innovative practices of SMEs registered at business incubators emphasizing knowledge and boundary issues within and across organizations. There are a number of limitations in the current study. First, to capture variances in knowledge practices in China, we chose SMEs registered in two different incubators at different cities. The dynamic relationship might vary in different regions and economic environments.

Second, we conducted in-depth interviews to gain insights about SMEs knowledge transfer and practices. Other research methods could be used in future studies to examine the dynamic process and practices of knowledge transfer, e.g. organizational studies with an anthropological approach would help to look into daily practice of organizational actors. Third, we emphasized entrepreneurial orientation of SMEs in the current study, and future research can further examine other organizational characteristics of SMEs and how these characteristics influence the pursuit of entrepreneurship from emerging markets. Further research can address the limitations of this type of research and provide answers to other research questions. For instance, how are boundary conditions of knowledge transfer demonstrated differently in a variety of organizations? What are other factors that impact the dynamic process of knowledge transfer? How does the unique setting of emerging markets matter? We hope future work can build on the current findings and examine these questions in a variety of contexts in the modern era where knowledge practices have become ubiquitous in the organizational settings.

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