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Title: Interfirm knowledge transfer: A review of research methodologies

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Summary

Managers are more and more concerned with the effective management of knowledge generation and its deployment. As a result over the last decade issues concerned with knowledge generation and management has attracted the attention of many researchers. Interfirm knowledge transfer is an important vehicle in knowledge generation and deployment. As far as the authors have been able to ascertain the research methods used in interfirm knowledge transfer studies have not been subjected to a systematic review. In this paper the results of content analysis of research methodologies of 83 empirical studies examining interfirm knowledge transfer published in peer-reviewed journals from 1990 to 2005 are presented. The paper provides a specific description of research methods and analyses employed by prior researchers. It reveals the general patterns of the research methodologies deployed and their limitations. By combining the methodological review with the analysis of main theoretical concepts, the paper offers an explanation for the relationship between the research methodology deployed and the aspect of interfirm knowledge transfer studied. The possible gaps in the current empirical studies of interfirm knowledge transfer from both methodological and theoretical perspectives are identified. A number of possibilities for future studies are proposed. The content analysis is conducted following the classification criteria introduced by Podsakoff and Dalton (1987) with the help of contingency tables and chi-squared tests.

Introduction

Rapid technological change fuelled by convergence of discreet technologies, increased market instability, and better-informed and demanding customers have combined to significantly alter the traditional business models. As a result, knowledge generation and management are among key management concerns. Over the last decade, the increasing attention by practitioners has been matched by an increasing interests and focus by academics on issues surrounding knowledge creation and knowledge deployment in organizations (Grant, 1996; Hult, 2003). According to the resource-based view (RBV) of firm the inimitable resources and their bundling are sources of sustainable competitive advantage (Barney, 1991; Peteraf, 1993; Wernerfelt, 1984). Grant (1996) extended the RBV theory by suggesting that in knowledge economy a firm's core competencies revolve around creating, storing and applying knowledge. Thus, the ability to create, leverage, and manage knowledge is an important enabler of sustainable competitive advantage (Conner & Prahalad, 1996; Kogut & Zander, 1992).

Nevertheless, there is also increasing recognition that knowledge generation solely from within inside the firm is likely to be limited in its impact on performance improvement (Cohen & Levinthal, 1990; Inkpen, 1998). Knowledge from external sources is an important contributor to firms' effort to develop and deploy knowledge in pursuit of gaining sustainable competitive advantage (Mowery, Oxley, & Silverman, 1996). Organizational learning and inter-organizational relationship researchers argue that interfirm relationship is an important conduit to valuable know-how and capabilities, which are difficult to generate efficiently within the firm (e.g. Hamel, 1991; Inkpen, 1998; Khanna, Gulati, & Nohria, 1998). Thus, interfirm learning and knowledge transfer across firms' boundaries are viewed as an important means to enrich the knowledge base of the firm.

The recognition that knowledge can potentially underpin a firm's effort to gain sustainable competitive advantage and the important role of knowledge transfer between firms in the development of know-how has attracted the attention of a growing number of researchers for the past decade. The empirical research has focused on examining the strategic importance of interfirm knowledge transfer, the identification of internal and external contextual factors that enable firms to acquire and exploit knowledge from outside, the nature and type of knowledge being transferred, and mechanisms for knowledge transfer.

The study of interfirm knowledge transfer is of critical significance to the progress of a practice considered important to the development of competitive advantage, and this field of study is relatively new. As far as we are able to ascertain there has been no substantial effort to systematically examine the methods used for the study of interfirm knowledge transfer. Therefore, key questions remain unanswered. For example, the range of methodologies deployed. Do these studies rely on a broad or narrow range of methodologies? What are the commonalities between the research methods? What are the general limitations of the interfirm knowledge transfer research? The answers to these questions are important to the conduct of future research in this important field of study and the potential contribution of the research to the effective development of the practice. In this paper we present the outcome of a systematic analysis of the content of the peer-reviewed journal articles examining interfirm knowledge transfer in order to generate a holistic view of patterns and limitations of methodologies deployed in the recent years.

The aim of the paper is four fold. First, it seeks to examine the general patterns in the use of research methodologies in the study of interfirm knowledge transfer. Second, it seeks to examine the relationship between the types of research methodology deployed and the facet of interfirm knowledge transfer studied. This is achieved by combining the methodological review with the analysis of main concepts and themes covered in the interfirm knowledge transfer studies. Third, it seeks to examine and identify the potential limitations of the prior interfirm learning studies. Fourth, we intend to identify the potential conceptual gaps in the existing empirical studies. The analysis presented in this paper will offer future researchers methodological guidelines. Furthermore, it helps to identify future research avenues.

Research methods

We identified and analyzed empirical papers (including survey, field-based, and archival analysis based research) published in peer-reviewed journal between 1990 and 2005, which directly examined the concept of interfirm learning or knowledge transfer. We also reviewed those empirical studies which included interfirm knowledge transfer as one of the main concepts and hence indirectly examined interfirm knowledge transfer related issues. In total we analyzed 83 empirical papers.

The contributions reviewed were published in multiple recognized journals in strategic management, operations management, and industrial marketing management, such as Decision Sciences, Organization Science, Management Science, Strategic Management Journal, Academy of Management Journal, Omega, Journal of Management Studies, Journal of Operations Management, etc. Our aim was to examine a significant proportion of papers published in highly regarded peer-refereed journals. The rationale for this choice was three fold. First, the strict peer review procedures of these journals means that the published papers have been scrutinized for the vigor and quality of their theoretical underpinning, propositions, arguments, data collection, and data analysis. Second, the works published in these journals are more likely to represent the cutting edge of the normative research taking place. Third, it would be easier to replicate the study. It was not our intention to review every published empirical research examining interfirm knowledge transfer, and we do not claim that we have included every empirical paper published. Nevertheless, by targeting and including the significant majority, if not all the papers, published in the top journals, we contend that the review presented in this paper is representative of the main stream of empirical research in the field.

Content analysis is the most appropriate methodology for the study presented in this paper. Weber (1990, p. 9) defined content analysis as “a research method that uses a set of procedures to make valid inferences from text”. From this definition it is clear that content analysis is compatible with the objectives of the study presented in this paper. In content analysis a priori design is a part of meeting the requirement of objectivity-intersubjectivity (Neuendorf, 2002, p. 11). To this end we adopted the framework proposed by Podsakoff and Dalton (1987) because of similarity between this study and the study of Podsakoff and Dalton (1987). They used the following 12 dimensions to analyze the research methodology of papers in the field of organizational studies:

- (1) Main Setting of Data Collection
- (2) Unit of Analysis
- (3) Sample Size
- (4) Type of Sample

- (5) Occupation of Subjects
- (6) Primary Means of Data Collection
- (7) Type of Dependent Variable
- (8) Number of Dependent Variables
- (9) Type of Analysis
- (10) Time Frame of Study
- (11) Nature of Construct Validation Procedure
- (12) Nature of Results Verification

We augmented the above framework by adding: *Geographic Location of the Study*, *Range of Analysis*, *Type of Interfirm Knowledge Transfer*, *Nature of Interfirm Relationship*, and *Process of Knowledge Transfer*. These dimensions enabled us to meet the objectives of this study more fully, and in particular, identify theoretical gaps in the existing studies, and the link between methodology and different facets of interfirm knowledge transfer. In a third of cases we used multiple coders (two) and compared the outcome to assure inter-coder reliability. Following section gives the results generated from the systematic review.

Results

Main settings of the study

In this review, three main settings of data collection are highlighted, namely survey-based, field-based and archival-based. According to Bryman (1989, p.104), “Survey research entails the collection of data on a number of units and usually at a single juncture in time, with a view to collecting systematically a body of quantifiable data in respect of a number of variables which are then examined to discern patterns of association”. This definition highlights the cross-sectional nature of survey design. However, Robson (2002) argued that nothing in principle against the use of surveys in longitudinal design. Therefore, in this review we conceive the survey in a broader sense to include both cross-sectional and longitudinal research.

The field-based studies reviewed are those conducted by researchers who actually going into the research subject and collecting primary data through various data collection techniques, such as interview, observation, action research, etc. To be noticed, survey based research could also be based on interviews. In this case, what makes the survey and field-based study different is whether researchers have personal communication with the respondents during the course of data collection. For instance, those in which independent interviewers were employed to collect data based on formulated interview scripts will be considered as survey rather than field-based study.

As oppose to survey and field-based studies, the archival-based studies are those, which mainly based on the data collected from secondary sources, such as documentation, organization archives or published database. For example, Mowery, et al. (1996) employed the patent data drawn from Micropatent database (contains all information recorded on the front page of every patent granted in the U.S. since 1975) to examined the interfirm knowledge transfer within strategic alliances.

Table 1. Main setting of data collection

| Main setting | Frequency | Percent |
|--------------|-----------|---------|
| Survey | 37 | 44.6 |
| Field | 25 | 30.1 |

| | | |
|----------|----|-------|
| Archival | 21 | 25.3 |
| Total | 83 | 100.0 |

As shown in table 1, from those 83 studies included in the review, nearly half of the studies (44.6%) relied on information derived from survey. The rest of the studies were based on either field (30.1%) or archival (25.3%) studies. Hence, researchers tend to be in favour of using survey-based methods to carry out the interfirm knowledge transfer research.

Sample characteristics

Characteristics of the research samples examined by prior studies collection were categorized in terms of industry sectors, occupation of respondents, and region of data. As shown in table 2, relatively more studies covered multiple sectors (24.1%). Higher proportions of the interfirm knowledge transfer studies have collected information from either high-tech (15.7%) or manufacturing industries (14.5%). However, given high-technology and manufacturing sectors are broadly defined, researchers may have ignored the highly differentiated nature of those sectors. Consequently, the generalizability could be affected. Moreover, when row percentages are compared to the overall figures, it is indicated that relatively more survey and archival-based studies have been focusing on multiple sectors. Given survey-based or archival-based studies are more likely to include larger collection of organizations, the sectors they study also tend to be diversified.

More than half of the informants (51.8%) are either company executives or managers with relevant experience or background. Particularly, a good number of survey based studies deployed higher level respondents or respondents with relevant experience. Since the archival-based studies rely on secondary sources, most of those studies are unable to report the characteristics of respondents.

Most of the studies collected data from more advanced countries, such as U.S. and U.K. Only small proportions of studies relied on the data collected from Asian countries, although most of these studies collected data from Japan, Hong Kong and Taiwan, which themselves are more technologically developed. This somehow reflected the fact that the concept of interfirm knowledge transfer is adopted much less in other countries.

Table 2. Sample characteristics of research in organizational studies

| | Main setting of data collection | | | |
|--------------------------------|---------------------------------|--------|-------|----------|
| | Overall | Survey | Field | Archival |
| <i>Industry Sectors</i> | | | | |
| Multiple | 24.1% | 32.4% | 8.0% | 28.6% |
| High-technology (Broadly) | 15.7% | 27.0% | 12.0% | - |
| Manufacturing | 14.5% | 10.8% | 16.0% | 19.0% |
| Semiconductor | 9.6% | 8.1% | 4.0% | 19.0% |
| Automotive | 7.2% | 2.7% | 16.0% | 4.8% |
| Transportation | 4.8% | 10.8% | - | - |
| Service | 4.8% | 5.4% | 4.0% | 4.8% |
| Food | 3.6% | - | 12.0% | - |
| Electronics | 3.6% | - | 8.0% | 4.8% |
| Biotechnology | 3.6% | 2.7% | - | 9.5% |
| Construction | 2.4% | - | 8.0% | - |
| Pharmaceutical | 1.2% | - | 4.0% | - |
| Steel | 1.2% | - | - | 4.8% |

| | | | | |
|---|--------|--------|--------|--------|
| Plastics | 1.2% | - | 4.0% | - |
| Education | 1.2% | - | - | 4.8% |
| Audio-video | 1.2% | - | 4.0% | - |
| Total | 100.0% | 100.0% | 100.0% | 100% |
| <i>Occupation of Respondents</i> | | | | |
| Executive/CEO/Managing Director | 20.5% | 40.5% | 8.0% | - |
| Senior manager/Manager with relevant experience | 31.3% | 35.1% | 48.0% | 4.8% |
| Other middle level manager | 15.7% | 8.1% | 36.0% | 4.8% |
| Employee | 2.4% | 2.7% | 4.0% | - |
| Non-reported | 9.6% | 13.5% | 4.0% | 9.5% |
| N.A. | 20.5% | - | - | 81.0% |
| Total | 100.0% | 100.0% | 100.0% | 100.0% |
| <i>Region of Data Collection</i> | | | | |
| U.S | 36.1% | 40.5% | 24.0% | 42.9% |
| U.K | 9.6% | 8.1% | 20.0% | - |
| Japan | 4.8% | - | 8.0% | 9.5% |
| Sweden | 2.4% | 2.7% | 4.0% | - |
| Netherlands | 2.4% | 2.7% | 4.0% | - |
| Taiwan | 2.4% | 2.7% | 4.0% | - |
| Italy | 2.4% | 2.7% | - | 4.8% |
| Canada | 1.2% | - | - | 4.8% |
| Spanish | 1.2% | 2.7% | - | - |
| Finland | 1.2% | 2.7% | - | - |
| Hungary | 1.2% | 2.7% | - | - |
| Hong Kong | 1.2% | - | 4.0% | - |
| Denmark | 1.2% | - | 4.0% | - |
| German | 1.2% | - | - | 4.8% |
| India | 1.2% | - | - | 4.8% |
| Multiple | 28.9% | 32.4% | 24.0% | 28.6% |
| Not reported | 1.2% | - | 4.0% | - |
| Total | 100.0% | 100.0% | 100.0% | 100.0% |

Methods of data collection

Data collection methods were compared between different research settings in terms of sample size, means of data collection, number of respondents, and time frame of study. Archival-based and survey-based studies tend to have larger sample sizes, while field-based studies normally collect data from a small sample of cases. Within the 83 studies reviewed, 41% has used questionnaire as the main data collection method, 21.6% combined two or more methods to get data (see Table 3). Unsurprisingly, most of the survey-based studies employed questionnaire as the main data collection methods, although some have combined other methods such as archival data or interview to form triangulation of data. Archival-based studies relied mainly on archival data, while some used secondary data collected from existing surveys. Although interview is the main data collection method for field-based studies, these studies tend to use richer source of data, in that more than half (52%) of studies combined two or more sources of data, such as questionnaire, interview, observation, and archival. Moreover, most of field-based studies (84%) collected data from more than one respondent. On the contrary, most of the survey-based studies (86.5%) collected data through key informant method. Given the smaller sample sizes of field-based studies, researchers are more able to have access to a larger number of informants.

Table 3. Method of data collection and number of respondent

| | Main setting of data collection | | | |
|--|---------------------------------|---------|--------|----------|
| | Overall | Survey | Field | Archival |
| <i>Sample Size (N)</i> | | | | |
| Mean | 181.31 | 175.70 | 11.48 | 393.38 |
| Std. Deviation | 315.188 | 122.109 | 17.576 | 544.760 |
| Range | 1-1976 | 25-555 | 1-69 | 1-1976 |
| <i>Means of data collection</i> | | | | |
| Questionnaire | 41.0% | 83.8% | - | 14.3% |
| Archival | 20.5% | - | - | 81.0% |
| Interview | 16.9% | 5.4% | 48.0% | - |
| Two methods | 10.8% | 8.1% | 20.0% | 4.8% |
| More than two methods | 10.8% | 2.7% | 32.0% | - |
| Total | 100.0% | 100.0% | 100.0% | 100.0% |
| <i>Number of Respondent</i> | | | | |
| Single | 44.6% | 86.5% | 12.0% | 9.5% |
| Multiple respondents | 32.5% | 13.5% | 84.0% | 4.8% |
| N.A. | 22.9% | | 4.0% | 85.7% |
| Total | 100.0% | 100.0% | 100.0% | 100.0% |
| <i>Time Frame</i> | | | | |
| Cross-sectional | 67.5% | 94.6% | 56.0% | 33.3% |
| Cross-sectional time-series | 16.9% | 2.7% | - | 61.9% |
| Longitudinal | 15.7% | 2.7% | 44.0% | 4.8% |
| Total | 100.0% | 100.0% | 100.0% | 100.0% |

Three main categories of time frame of data collection is used in this review: cross-sectional, cross-sectional time-series, and longitudinal. To be noticed, cross-sectional time-series study is normally regarded as one type of longitudinal study (Saunders, Lewis, & Thornhill, 2000). However, they are distinguished in this review, since cross-sectional time-series study relies more on historical archrivals to generate repeated measures from research units over predefined time interval, while other types of longitudinal studies could generate more varied and flexible information overtime. A high proportion of studies are cross-sectional (67.5%). Survey based studies are more likely to collect cross-sectional data (94.6%), whilst archival-based data tend to use cross-sectional time-series data (61.9%). Not surprisingly, relatively higher proportions of field-based studies (44%) have collected longitudinal data compared to survey-based or archival-based studies. One reason could be that researchers tend to spend longer time with fewer numbers of cases during field-based studies.

Interfirm relationships classified

Literature suggests that interfirm alliance is generally regarded as the mediate form of interfirm relationship in the relationship spectrum ranged from arms-length to vertical integration (e.g. Gardner, Cooper, & Noordewier, 1994; Golicic, Foggin, & Mentzer, 2003; Lambert, Emmelhainz, & Gardner, 1999). It is generally commented that alliances between firms can take place through a variety of different arrangements, including relationships with suppliers, intermediaries, and customers, and even with potential or current competitors (Mohr & Sengupta, 2002; Sornn-Friese & Sorensen, 2005). Typically,

interfirm alliances encompasses a wide range of equity or non-equity arrangements, including joint ventures, collaborative advertising, R&D partnerships, lease service agreements, shared-distribution, cross-manufacturing, and cross-licensing, etc. (for list and examples of each type of strategic alliances see Pekar & Allio, 1994). Thus, interfirm alliances may take various forms and characteristics. Consequently, when studying interfirm knowledge transfer, researchers could concentrate on various forms of relationship in order to give more specific theoretical implications.

As shown in table 4, a good proportion of studies focused on interfirm knowledge transfer in buyer-supplier relationship (28.9%) or strategic alliance (27.7%). It is interesting to see more researchers got interested in knowledge transfer issues under the context of supply chain or buyer-supplier relationship (e.g. Beecham & Cordey-Hayes, 1998; Dyer & Chu, 2000; Heide & Miner, 1992; Hult, Ketchen, & Slater, 2004; Kotabe, Martin, & Domoto, 2003). Given buyer-supplier relationship is mainly to do with vertical interfaces between firms, many researchers view the buyer-supplier relationship as an important platform for knowledge transfer.

It is worth noting, that almost half of the studies (47%) focused on either strategic alliance in general (e.g. Mowery et al., 1996; Simonin, 1999) or did not specify the interfirm relationship within which the knowledge transfer has taken place. According to Koka and Prescott (2002), the number and type of alliances, nature of the partners and their alliance structures as well as relationship dynamics determine firm's access to knowledge spill-over and its ability to leverage information. Thus, the usefulness and amount of knowledge available to firms and the mechanisms of knowledge transfer tend to be varied with respect to the alliance structure and the relationship arrangement. In this sense, without clearly define the interfirm relationship the theoretical underpinnings derived from those studies could be vague. Particularly, higher proportions of archival-based studies covered strategic alliance or haven't specified the interfirm relationship. Although researchers tend to have larger sample size based on archival study, they often ignore the influence of specific nature of interfirm relationship on interfirm knowledge transfer. For example, Mowery et al. (1996) pointed out the trend of firms establishing various forms of strategic alliances, but the lack of justification on why their empirical work was based on a general collection of strategic alliances could largely bias the result.

Table 4. Interfirm relationship

| | Main setting of data collection | | | |
|-----------------------------|---------------------------------|--------|--------|----------|
| | Overall | Survey | Field | Archival |
| Buyer-supplier relationship | 28.9% | 32.4% | 40.0% | 9.5% |
| Strategic alliance | 27.7% | 27.0% | 16.0% | 42.9% |
| Joint-venture | 9.6% | 8.1% | 12.0% | 9.5% |
| Regional interfirm network | 7.2% | 8.1% | 8.0% | 4.8% |
| R&D alliance | 3.6% | 2.7% | 4.0% | 4.8% |
| Franchise | 2.4% | - | 8.0% | - |
| Interfirm acquisition | 1.2% | 2.7% | - | - |
| Non-specified | 19.3% | 18.9% | 12.0% | 28.6% |
| Total | 100.0% | 100.0% | 100.0% | 100.0% |

Types of interfirm knowledge transfer

It is recognized that prior studies tend to focus on knowledge transfer practices under different circumstances or with various purposes. Inkpen and Tsang (2005) have examined the interfirm knowledge transfer from four perspectives. These four perspectives disclose the main types of interfirm knowledge transfer that may attract the interests of researchers. First, firms learn from an alliance partner when acquiring knowledge from the partner by gaining access to the skills and competencies the partner brings to the alliance. Second, firms learn with an alliance partner when the partners jointly enter a new business area and develop new capabilities. Third, firms learn to manage alliance when acquiring knowledge useful in the design and management of current or future alliances. Fourth, firm may acquire knowledge about an alliance partner that supports the firms' ability to manage the collaborative task. These perspectives were adopted in this paper, so that interfirm knowledge transfer studies are analysed according to these four types of interfirm knowledge transfer, namely learning from, learning together, learning to manage interfirm relationship and learning about the partner.

Table 5. Types of interfirm knowledge transfer

| Type of Learning | Main setting of data collection | | | |
|------------------|---------------------------------|--------|--------|----------|
| | Overall | Survey | Field | Archival |
| Learn from | 60.2% | 64.9% | 44.0% | 71.4% |
| Learn together | 28.9% | 29.7% | 48.0% | 4.8% |
| Learn to manage | 10.8% | 5.4% | 8.0% | 23.8% |
| Total | 100.0% | 100.0% | 100.0% | 100.0% |

From the studies reviewed, most concerned with “learn from” (60.2%) or “learn together” (28.9%) type of knowledge transfer (see table 5). Only a small proportion of studies concentrated on the “learn to manage alliance” (10.8%). None of the studies reviewed focused on “learn about” as the main type of interfirm knowledge transfer. Although some important studies could be missed from the review, the small proportions presented in this review still indicate that relatively less research has been conducted to examine “learn to manage” and “learn about” types of knowledge transfer.

It is found that relatively more survey-based studies focused on “learn from”, whilst relatively more field-based studies focused on “learn together”. On the contrary, few archival-based studies examine “learn together”, rather more of archival-based studies fall into the category of “learn from” and “learn to manage alliance”. A possible reason might be there is a lack of archival information available on how firms enter into new areas jointly. To study “learn together” researcher may find it more helpful to examine all the parties involved at the same time. Heide and Miner (1992), for example, suggested that studying both parties simultaneously allowed them to acknowledge possible differences in viewpoint between exchange partners with respect to the variables of interest. However, such information explaining all the parties is more difficult to be found in secondary archrivals. Thus, researchers generally turn to field-based or survey-based methods for more primary data.

Process of knowledge transfer

According to Wiig (1997), knowledge transfer is to bring knowledge from the various sources to where it can be utilized or its value otherwise realized through a complex

process that takes many paths depending upon the nature of particular knowledge, how it will be applied to deliver products and services, and the preferences or capabilities of the enterprise. It is found that from the 83 studies reviewed most (83.1%) treated the knowledge transfer as a black box without explicitly examining the dynamic process of interfirm knowledge transfer (see table 6). Only 14 out of 83 studies have examined the process of knowledge transfer explicitly. Specifically, when row percentages are compared to the overall figure, relatively more field-based studies have examined the multiple-stages of knowledge transfer explicitly. It seems that scholars tend to use field-based methods to handle the complexity involved in multiple stages of knowledge transfer.

Table 6. Knowledge transfer process

| Examined or Not | Main setting of data collection | | | |
|-----------------|---------------------------------|--------|--------|----------|
| | Overall | Survey | Field | Archival |
| No | 83.1% | 83.8% | 76.0% | 90.5% |
| Yes | 16.9% | 16.2% | 24.0% | 9.5% |
| Total | 100.0% | 100.0% | 100.0% | 100.0% |

Nevertheless, several studies highlighted the dynamic process of knowledge transfer in their theoretical discussions, although they did not explicitly and empirically examined the knowledge transfer process. Generally, most of the studies that discussed about the knowledge transfer process roughly view knowledge transfer as three main stages: knowledge acquisition, knowledge internalization, and knowledge utilization (see Table 7).

First, acquisition refers to the process of getting access to and having an initial understanding to the desired skills and knowledge by members of organizations through direct or indirect contact or interaction with the source of the skills and knowledge. The knowledge-based view (KBV) posits that an organization's relative ability to acquire and develop knowledge differentiates its high and low performance (Grant, 1996). The acquisition is commonly regarded as the first step of knowledge transfer (e.g. Albino, Garavelli, & Schiuma, 1999; Hult et al., 2004; Inkpen & Dinur, 1998). Second, internalization is the process of storing, disseminating and combining existing knowledge with new knowledge in the organization. Mowery et al. (1996) suggested that interfirm alliance offers the opportunity to access knowledge, but knowledge that is not internalized is unlikely to enhance organizational capability. A firm's ability to absorb knowledge influences whether or not the acquired knowledge can be successfully exploited (Cohen & Levinthal, 1990). Accordingly, internalization is essential to the process of knowledge transfer. Third, utilization refers to the process of getting acquired skills and knowledge institutionalised into the organization's internal processes and implementing such skills and knowledge into appropriate operation areas. It is at this stage acquired knowledge is going to realize the potential value to improve processes, practices, and products or services (Wiig, 1997). Even though not every new knowledge will be applied, a firm could use the stored knowledge to enhance its "dynamic learning capability" (Dyer & Nobeoka, 2000) by improving its innovative capabilities and / or capacity for future knowledge creation (Calantone, Cavusgil, & Zhao, 2002; Cavusgil, Calantone, & Zhao, 2003).

Table 7. Knowledge transfer process in prior studies

| Author(s) | Knowledge Transfer Process |
|-----------|----------------------------|
|-----------|----------------------------|

| | Acquisition | Internalization | Utilization |
|--|-------------------------|-------------------------------------|---|
| (Cohen & Levinthal, 1990) | Recognize | Assimilate | Apply |
| (Inkpen & Crossan, 1995) | Interpreting | Integrating | Institutionalizing |
| (Ritcher & Vettel, 1995) | Perception | Internalisation | Abstraction |
| (Inkpen & Dinur, 1998) | Acquisition | Sharing within organization | |
| (Lane & Lubatkin, 1998) | Recognize | Assimilate | Utilize |
| (Albino et al., 1999) | Acquisition | Communication | Application; acceptance; assimilation |
| (Andersen & Christensen, 2000) | Absorption | Communication | |
| (Hult, Hurley, Giunipero, & Nichols, 2000) | Information acquisition | Information dissemination | |
| (Kale, Dyer, & Singh, 2001) | Capture | Codify; Communicate; Coach | |
| (Lane, Salk, & Lyles, 2001) | Recognize | Assimilate | Apply |
| (Cummings & Teng, 2003) | Acquiring | Internalizing | |
| (Hult, Ketchen, & Nichols, 2003) | Acquisition | Distribution | Interpretation; Memory |
| (Johnson & Sohi, 2003) | | Dissemination of information | of Shared interpretation of information |
| (Hult et al., 2004) | Acquisition activities | Information distribution activities | |

Unit of analysis and range of analysis

Unit of analysis is the element on which data are analysed and for which findings are reported (Neuendorf, 2002). It is the major entity that is studied and to which the result will be applied. Six units of analysis are adopted in this review ¹:

- (1) Corporation – An organisation with subsidiary and/or several operating units / divisions;
- (2) Division – An operating unit of a corporation, which in turn controls one or more operating units;
- (3) Plant – A single unit or site where manufacturing takes place. A plant may belong to a corporation or a division or it may be an independent operation (company/firm);
- (4) Department – A subunit of a plant, which carries out a specific function or is responsible for a specific area of activity;
- (5) Project – a transient activity with a specific end point;
- (6) Individual – An individual member of the organization, such as an employee or a manager.

¹ Some researchers claimed that they have used strategic alliance as the unit of analysis (e.g. Chen 2004, Muthusamy & White, 2005, Spekman, Spear, & Kamauff, 2002, Kale, Singh, & Perlmutter, 2000), but they actually have plant as the main unit of analysis.

To be noticed, the project unit of analysis is differed from department, in that project is normally temporary and one-off in nature, whilst the department is more continuous and established for long-term business purposes.

To classify the studies with different scope of interfirm relationship focuses, ‘range of analysis’ is introduced, including unilateral, dyadic, and network. Unilateral range of analysis means that researchers focus only on one party in the context of interfirm knowledge transfer (even if they intend to study the knowledge transfer taking place between the two). Studies with dyadic range of analysis are those look at both counterparts in an interfirm dyad.² For example, studies of Heide and Miner (1992) and Muthusamy and White (2005) collected data from both side of the dyadic relationship in a survey based study. Network range of analysis could be found in those studies, which examine more than two firms involved in an interfirm relationship simultaneously. As an example of network range of analysis, Hult et al. (2004) examined the supply chains of a fortune 500 firm, the study examined the corporate buyer, internal user, and external suppliers at the same time to explore the interfirm learning effects on firm performance.

Table 8. Range of analysis and unit of analysis

| | Main setting of data collection | | | |
|---------------------------------|---------------------------------|--------|--------|----------|
| | Overall | Survey | Field | Archival |
| <i>Unit of Analysis</i> | | | | |
| Plant | 84.3% | 81.1% | 88.0% | 85.7% |
| Department | 8.4% | 13.5% | 4.0% | 4.8% |
| Project | 4.8% | 2.7% | 8.0% | 4.8% |
| Individual | 2.4% | 2.7% | - | 4.8% |
| Total | 100.0% | 100.0% | 100.0% | 100.0% |
| <i>Range of Analysis</i> | | | | |
| Unilateral | 66.3% | 70.3% | 44.0% | 85.7% |
| Dyadic | 14.5% | 8.1% | 32.0% | 4.8% |
| Network | 19.3% | 21.6% | 24.0% | 9.5% |
| Total | 100.0% | 100.0% | 100.0% | 100.0% |

Most of the studies (84.3%) used plant or firm as the main unit of analysis, while small proportions of studies relied on department, project, or individual as the unit of analysis (see table 8). None of the studies has used corporate or division unit of analysis. This more or less implies the deficiencies of existing research methods to give more comprehensive view of the target organization. Especially for survey based studies, given key informant method is normally used, the representativeness of the information collected could be widely criticized. Again, when row percentages are compared to the overall figures, it is found that although plant is the main unit of analysis for all settings, there is slight variation between each setting. For instance, relatively more survey-based was studied at the department level, while no field-based studies at individual unit but relatively more at project level.

As shown in table 8, two thirds of studies focused on unilateral range of analysis, i.e. they examine only one party when study interfirm learning issues. Slightly more studies have network range of analysis (19.3%) than dyadic range of analysis (14.5%). Higher proportions of survey-based and archival-based studies tend to have unilateral range of

² Examining joint ventures is not treated as dyadic range of analysis, unless the study explores both parent firms at the same time.

analysis (70.3% and 85.7%, respectively), whilst more than half of the field-based studies (56%) focused on more than one party involved the interfirm knowledge transfer. The reason that field-based research is more likely to be of dyadic or network range of analysis could be that researchers are able to concentrate on a small number of research objects but at the same time explore more parties participated in the same interfirm knowledge transfer process.

Question remains on whether enough justifications were provided on why certain unit of analysis is chosen and why certain range of analysis is focused. From the 83 reviewed studies, it is found that a good number of studies lacked such explanations. The defection could be viewed from three perspectives.

First, researchers generally omitted to give explanations on why certain unit of analysis is appropriate to answer the research question (e.g. Hult, Ferrell, & Hurley, 2002; Hult et al., 2000; Wu & Cavusgil, 2006). For instance, Hult et al. (2000) examined the interfirm learning between supply chain partners, SBUs (Strategic Business Units) were chosen as the main unit of analysis. However, authors did not explain why SBUs other than firms are legitimate to represent the nodes of the supply chain.

Second, some researchers were unable to link the unit of analysis to the actual object of study (e.g. Chen, 2004; Kale, Singh, & Perlmutter, 2000; Muthusamy & White, 2005). Specifically, some researchers claimed that their unit of analysis is dyadic relationship, but they actually collected the information from only one side of the alliance or unilateral firm to carry out the analysis. Although, several researchers reported that respondents were asked to choose one of the most significant partnerships to answer the questionnaire (Chen, 2004), the unilateral information collected may not be justifiable to represent the dyadic relationship. Therefore, there seems to be misconception of using unilateral entity and dyadic relationship as the unit of analysis. Researchers tend to overlook that to have dyadic relationship as the unit of analysis, it is important to collect information from both side of the relationship. The dyadic information is necessary to generate balanced information and findings applicable to the dyadic interfirm units.

Third, there is also a lack of explanations on why certain range of analysis is focused. For example, several studies (e.g. Anand & Khanna, 2000; Mowery et al., 1996; Simonin, 1999) explored the knowledge transfer practices between strategic alliances, but automatically chosen unilateral company as the unit of analysis without sufficient justifications. Although some of those studies used joint ventures as the source of data collection, without having information from both parent firms, they are still focusing on unilateral firms as the main research objects. The benefit of examining both sides of the alliance is widely advocated (e.g. Heide & Miner, 1992; Lam, 1997; Muller, Johansen, & Boer, 2003), focusing only on one party in the relationship need to be further clarified in terms of whether the unilateral information is able to give balanced view of the relationship as well as answer the research questions.

To find out more about the pattern of range of analysis, the relationship between range of analysis and other aspects of knowledge transfer issues are examined (see table 9). To be noticed, most of studies with network range of analysis are found to be focusing on either buyer-supplier relationship (50%) or regional interfirm network (37.5%). Given buyer-supplier relationship is more likely to involve a chain of firms, it is reasonable to find more network range of analysis in this category of interfirm relationship. When row percentages are compared, relatively more studies with unilateral range of analysis didn't specify the

nature of relationship. Typically, these group of studies were dealing with how focal firms learn from external knowledge sources generally, without specifying the relationship nature (e.g. Almeida & Phene, 2004; Appleyard, 1996; Calantone et al., 2002; Feinberg & Gupta, 2004; Menon & Pfeffer, 2003; Song, Almeida, & Wu, 2003; Uzzi & Lancaster, 2003). As mentioned above, given that a focal firm may have multiple relationships with external organizations, readers might be interested in having more information on how results could vary with the change of different relationship.

Table 9. Range of analysis and other interfirm learning issues

| | Range of Analysis | | | |
|--------------------------------------|-------------------|------------|--------|---------|
| | Overall | Unilateral | Dyadic | Network |
| <i>Interfirm Relationship</i> | | | | |
| Buyer-supplier relationship | 28.9% | 21.8% | 33.3% | 50.0% |
| Strategic alliance | 27.7% | 34.5% | 33.3% | - |
| Joint-venture | 9.6% | 10.9% | 16.7% | - |
| Regional interfirm network | 7.2% | - | - | 37.5% |
| R&D alliance | 3.6% | 1.8% | 8.3% | 6.3% |
| Franchise | 2.4% | 3.6% | - | - |
| Interfirm acquisition | 1.2% | 1.8% | - | - |
| Non-specified | 19.3% | 25.5% | 8.3% | 6.3% |
| Total | 100.0% | 100.0% | 100.0% | 100.0% |
| <i>Type of Learning</i> | | | | |
| Learn from | 60.2% | 67.3% | 41.7% | 50.0% |
| Learn together | 28.9% | 20.0% | 41.7% | 50.0% |
| Learn to manage | 10.8% | 12.7% | 16.7% | - |
| Total | 100.0% | 100.0% | 100.0% | 100.0% |

More than two thirds of unilateral studies focused on “learn from” type of knowledge transfer (see table 9). Same proportions of dyadic studies (41.7%) focused on learn from and learn together types of knowledge transfer. Similarly, same proportions of network studies (50%) focused on these two types of interfirm knowledge transfer. It is interesting to find out whether there is association between types of knowledge transfer and range of analysis of studies, so a chi-squared test is carried out (see table 10). The significant result ($p=0.042$) indicates certain evidence that there is association between type of learning and range of analysis. Specifically, when the contingency table is examined, it is found that slightly more studies of “learn from” and “learn to manage alliance” types of knowledge transfer tend to be examined by unilateral range of analysis. On the other side, more “learn together” studies tend to be examined by looking at both counterparts simultaneously or networks of firms in the interfirm relationship. The underlying reason could be that “learn together” type of knowledge transfer is more likely to involve firms all contribute to the learning relationship or benefit from the relationship. Therefore, researchers may find it more helpful to collect data from more than one side of the interfirm relationship (e.g. Capello, 1999; Dyer & Nobeoka, 2000; Hallikas, Puumalainen, Vesterinen, & Virolainen, 2005; Heide & Miner, 1992; Holt, Love, & Li, 2000).

Table 10. Chi-squared test of type of knowledge transfer and range of analysis

| Type of Knowledge Transfer | Range of Analysis | Total |
|----------------------------|-------------------|-------|
|----------------------------|-------------------|-------|

| | Unilateral | Dyadic or Network | |
|--------------------------|------------|-------------------|----|
| Learn from | 37 (33.1) | 13 (16.9) | 50 |
| Learn together | 11 (15.9) | 13 (8.1) | 24 |
| Learn to manage alliance | 7 (6) | 2 (3) | 9 |
| Total | 55 | 28 | 83 |

Note: (.) expected count;

1 cells (16.7%) have expected count less than 5, the minimum expected count is 3.04;

Pearson Chi-Square=6.354, df=2, p=0.042; Likelihood Ratio=6.173, df=2, p=0.046;

Linear-by-Linear Association=0.914, df=1, p=0.339.

Nature of dependent variable and number of dependent variable

Table 11 gives the nature and number of dependent variables covered by the studies reviewed. Three categories of dependent variables emerged from the reviewed studies, namely learning performance, organizational performance, and relationship performance. First, studies with learning performance as the main dependent variable is mainly examining the extent, effectiveness or efficiency of interfirm knowledge transfer between firms. Second, organizational performance is mainly to do with performance of the research objects result from various interfirm knowledge transfer activities. Third, relationship performance measures the extent of interfirm relationship building or improvement of interfirm relationship. Majority of studies examines single dependent variable (60.2%). There are also studies examine more than one facet of these performance measures. About one third of studies examined more than one dependent variable in the same study (33.7%). Relatively more studies have learning performance as the main dependent variable (39.8%), indicating that improving interfirm learning is still the main concern of researchers. A small number of survey-based and field-based studies have no explicit dependent variables, since they are mainly descriptive or interpretative in nature.

Table 11. Nature of dependent variable

| | Main setting | | | |
|--|--------------|--------|--------|----------|
| | Overall | Survey | Field | Archival |
| <i>Nature of Dependent Variable</i> | | | | |
| Learning Performance | 39.8% | 43.2% | 32.0% | 42.9% |
| Organizational Performance | 26.5% | 27.0% | 16.0% | 38.1% |
| Relationship Performance | 10.8% | 5.4% | 12.0% | 19.0% |
| Multi facets | 16.9% | 21.6% | 24.0% | - |
| N.A. | 6.0% | 2.7% | 16.0% | - |
| Total | 100.0% | 100.0% | 100.0% | 100.0% |
| <i>Number of Dependent Variable</i> | | | | |
| Single | 60.2% | 51.4% | 56.0% | 81.0% |
| Multiple | 33.7% | 45.9% | 28.0% | 19.0% |
| N.A. | 6.0% | 2.7% | 16.0% | - |
| Total | 100.0% | 100.0% | 100.0% | 100.0% |

Note: N.A. refers to studies without explicit dependent variable

It is interesting to find out whether there is association between type of knowledge transfer and nature of dependent variable studied. Due to the limit in number of cases, chi-squared test is not conducted. The contingency table shows that there is more “learn from” studies have learning performance as the main dependent variable, while relatively more “learn to manage alliance” studies have relationship performance as the main dependent variable (see table 12). “Learn together” studies tend to concentrate on various dependent variables. Thus, researchers appear to have more interests in particular performance issues when studying certain type of interfirm knowledge transfer. It is worth noting that, few “learn from” studies focused on relationship performance and none of the “learn to manage alliance” studies examined learning performance as dependent variable. This leaves the room for further research possibilities. For example, it is interesting to find out more about how do interfirm relationship evolve when a firm learn from its partner. It is also interesting to find out how effective the learning could be and what are the determinant factors to the learning process when a firm acquires knowledge to manage its partners.

Table 12. Nature of dependent variable and nature of learning

| | Nature of Learning | | | |
|----------------------------|--------------------|------------|----------------|--------------------------|
| | Overall | Learn from | Learn together | Learn to manage alliance |
| Learning performance | 39.8% | 52.0% | 29.2% | - |
| Organizational performance | 26.5% | 28.0% | 20.8% | 33.3% |
| Relationship performance | 10.8% | 4.0% | 12.5% | 44.4% |
| Multi facets | 16.9% | 12.0% | 29.2% | 11.1% |
| N.A. | 6.0% | 4.0% | 8.3% | 11.1% |
| Total | 100.0% | 100.0% | 100.0% | 100.0% |

Note: N.A. refers to studies without explicit dependent variable

Analytical methods

Main analytical methods employed by the reviewed studies were examined in this paper. As shown in table 13, relatively more survey-based studies used multiple regression as the main method of analysis (22.9%). Most of the studies employed the methods examines one dependent variable at a time (e.g. multiple regression and logistic regression). Majority of the field-based studies used interpretative or descriptive methods to analyse the data, while majority of archival-based studies used panel regression to examine the time-series data (see table 13). As also pointed out by Podsakoff and Dalton (1987), when studying multiple dependent variables, it is more preferable to use analytical methods capable of handing multiple dependent variables simultaneously, such as canonical correlation, MANOVA, MANOCOVA, etc. Although 33.7% of all the studies reviewed have multiple dependent variables, only 10.7% of those studies used more comprehensive multivariate analytical methods, in this case the structure equation models (SEMs), to analyse the data (see table 14). To be noticed, relatively more of the studies with multiple dependent variables (25%) used interpretative method. This indicates that researchers relied heavily on the qualitative capability of interpretative method to handle more complicated research questions.

Table 13. Method of analysis

| | Main setting | | | |
|--------------------------------------|--------------|--------|--------|----------|
| | Overall | Survey | Field | Archival |
| Multiple regression | 22.9% | 32.4% | 8.0% | 23.8% |
| Interpretative | 18.1% | 5.4% | 48.0% | 4.8% |
| Panel regression | 14.5% | 2.7% | - | 52.4% |
| SEM | 12.0% | 27.0% | - | - |
| Comparative case study | 9.6% | - | 32.0% | - |
| Descriptive | 6.0% | 5.4% | 8.0% | 4.8% |
| Hierarchical multiple regression | 3.6% | 8.1% | - | - |
| Cluster Analysis | 2.4% | 5.4% | - | - |
| Partial likelihood estimation | 2.4% | 5.4% | - | - |
| Path analysis | 2.4% | 5.4% | - | - |
| T-test | 2.4% | 2.7% | - | 4.8% |
| Discrete time event history analysis | 1.2% | - | - | 4.8% |
| Cross tabulation | 1.2% | - | 4.0% | - |
| Logistic regression | 1.2% | - | - | 4.8% |
| Total | 100.0% | 100.0% | 100.0% | 100.0% |

Table 14. Method of analysis and number of dependent variable

| | Number of dependent variable | | | |
|--------------------------------------|------------------------------|--------|----------|--------|
| | Overall | Single | Multiple | N.A. |
| Cluster Analysis | 2.4% | 2.0% | 3.6% | - |
| Comparative case study | 9.6% | 14.0% | 3.6% | - |
| Cross tabulation | 1.2% | - | 3.6% | - |
| Descriptive | 6.0% | 4.0% | 3.6% | 40.0% |
| Discrete time event history analysis | 1.2% | 2.0% | - | - |
| Hierarchical multiple regression | 3.6% | 4.0% | 3.6% | - |
| Interpretative | 18.1% | 10.0% | 25.0% | 60.0% |
| Logistic regression | 1.2% | - | 3.6% | - |
| Multiple regression | 22.9% | 26.0% | 21.4% | - |
| Panel regression | 14.5% | 20.0% | 7.1% | - |
| Partial likelihood estimation | 2.4% | 2.0% | 3.6% | - |
| Path analysis | 2.4% | - | 7.1% | - |
| SEM | 12.0% | 14.0% | 10.7% | - |
| T-test | 2.4% | 2.0% | 3.6% | - |
| Total | 100.0% | 100.0% | 100.0% | 100.0% |

Validation and result verification

Central to the scientific approach is a degree of scepticism about the findings and their meaning (Robson, 1993, p. 67). The value of the research result largely depends on the adequate construct, which is both reliable and valid. Validity is concerned with whether the findings are really about what they appear to be about (Robson, 2002, p. 93). Different names were given to the concept of validity, but the main concerns is about whether the measurement is consistent or repeatable (reliability) and whether they are measuring what they intend to measure (construct validity). According to Podsakoff and Dalton (1987), although different validation methods exists, by one or the other is not enough to establish

validity of a construct. It is found that among the 83 studies reviewed more than half of studies (51.8%) did not report to use any kind of validation procedures. Within those that carried out the validation process, researchers tend to examine reliability (34.9%, either Cronbach's alpha or composite reliability or both), face validity (13.3%), discriminant validity (25.3%), convergent validity (24.1%), criterion validity (10.8%) and interrater reliability (7.2%). Relatively higher proportions of survey-based studies employed more methods of validation, while most of the field-based or archival-based studies did not report any validation procedures. Field-based and archival-based studies relied mainly on the criterion validity or interrater reliability³.

Table 15. Validation procedures

| | Main setting | | | |
|--------------------------------|--------------|--------|-------|----------|
| | Overall | Survey | Field | Archival |
| Reliability (Cronbach's alpha) | 19.3% | 43.2% | - | - |
| Composite reliability | 20.5% | 43.2% | - | 4.8% |
| Discriminant validity | 25.3% | 54.1% | - | 4.8% |
| Convergent validity | 24.1% | 51.4% | - | 4.8% |
| Face validity | 13.3% | 29.7% | - | - |
| Criterion validity | 10.8% | 5.4% | 16.0% | 14.3% |
| Interrater reliability | 7.2% | 5.4% | 4.0% | 14.3% |
| Non-reported | 51.8% | 21.6% | 80.0% | 71.4% |

Note: percentage in each cell is the proportion of studies used the corresponding validation method.

Podsakoff and Dalton (1987) also emphasized the importance of conducting various result verification methods to ensure that results are robust and generalizable. Generalizability refers to the extent to which the findings of the enquiry are more generally applicable outside the specifics of the situation studied (Robson, 2002, p. 93). In this review, majority of the studies (57.8%) have not reported the use of result verification. Survey-based and archival-based studies tend to employ relatively more means of result verification. Almost all the field-based studies haven't reported any result verification method. The reason could be that field-based studies tend to be more qualitative in nature, which does not allow the use of quantitative statistical methods to verify the results. However, the lack of adequate verification procedures could largely limit the generalizability of those studies.

Table 16. Result verification

| | Main setting | | | |
|------------------------------|--------------|--------|--------|----------|
| | Overall | Survey | Field | Archival |
| Confirmatory factor analysis | 19.3% | 40.5% | - | 4.8% |
| Exploratory factor analysis | 7.2% | 16.2% | - | - |
| Multi-method ⁴ | 7.2% | - | 8.0% | 19.0% |
| Subgroup analysis | 6.0% | - | - | 23.8% |
| Cross-validation | 2.4% | 2.7% | - | 4.8% |
| Non-reported | 57.8% | 40.5% | 92.0% | 47.6% |
| Total | 100.0% | 100.0% | 100.0% | 100.0% |

³ Interrater reliability is used in this paper, as oppose to Podsakoff and Dalton (1987) who employed the notion of 'interrater validity' as the measure of consistency across different raters.

⁴ Multi-method—where multiple statistical models or approaches are used with the same data to examine the robustness or consistency of the result

Discussion and Conclusion

According to the above analysis, following aspects of issues need to be highlighted, in terms of conceptualization of theories; links between research methods and theories; generalizability of research methods. Some possible limitations and gaps in the interfirm knowledge transfer studies could be pointed out, which could lead to certain implications for future researchers.

Conceptualization of interfirm knowledge transfer

- (1) A good number of studies haven't specified clearly the interfirm relationship within which knowledge transfer is taking place, especially for archival-based studies. Given the learning practice could be highly differentiated with the various arrangement and nature of interfirm relationship. The results generated from those studies are open to criticisms in terms of feasibility and applicability.
- (2) The highly differentiated nature of industry sectors tends to be ignored. Since the nature of industry determines the organizational structure and the operation process, it will also determine the mechanisms of knowledge transfer. Without clearly define the industry sectors, research findings tend to be vague and limited in practical value.
- (3) Majorities of studies treated learning process as a "black box" between inputs and outputs. It seems that many empirical studies built upon the assumption that the interfirm learning process is unlikely to be differentiated and lead to varied performance. However, the three main stages emerged from the review, implies that researchers are more likely to be limited by the incapability of research methods to deal with the complexity involved in the dynamic process of knowledge transfer, although they realized the importance of those process.
- (4) Although four main types interfirm knowledge transfer is introduced by the prior researchers (Inkpen & Tsang, 2005), no studies of "learn about" knowledge transfer were found in this review. Although we could have missed some importance studies during the review, the lack of such studies presented still implies that much more research efforts need to be taken to explore the issue more fully.
- (5) Ideally, researchers are expected to examine all the parties involved in the knowledge transfer process to generate comprehensive view of the subject. However, the lack of dyadic or network range of analysis employed largely limited the capabilities of those studies to give more balanced view of the interfirm relationship. Perceptions of only one party's is far from enough to represent all the parties involved.
- (6) Researchers are examining three main types of performance measures: learning performance, organization performance, and relationship performance. These performance measures represented the main stream of interfirm knowledge transfer research interests. Within these interests how to improving interfirm learning performance is the main concern of researchers.

Links between research methods and theory

Evidences were found that there is link between theoretical conceptualizations and use of research methods. It appears that interfirm knowledge transfer scholars have formed certain research conventions, which generate results more likely to be accepted by fellow researchers.

- (1) There is association between type of knowledge transfer and range of analysis, in that “learn together” studies are more likely to be studied based on information collected from more parties in the interfirm relationship. On the other side, researchers are more likely to collect unilateral information when studying “learn from” and “learn to manage alliance” issues.
- (2) There is also certain association between types of knowledge transfer and conceptualization of dependent variables. Researchers are more interested in learning performance when studying “learn from”, while relationship performance is normally studied under the context of “learn to manage alliance”. This indicates that researchers tend to have pre-specified conceptualizations over the main consequences of the knowledge transfer when dealing with various types of knowledge transfer. The mixed dependent variables in “learn together” studies implies that this type of knowledge transfer is more likely to involve multiple facets of performance, i.e. various performance improvement are likely to be resulted from this type of learning (e.g. Bessant, Kaplinsky, & Lamming, 2003; Heide & Miner, 1992; Lam, 1997).
- (3) Dyadic and network range of analysis are more likely to be found in field-based studies. It is obvious that the complexity of studies increases when more research objects are studied. Moreover, more field-based studies have examined the dynamic process of knowledge transfer. Therefore, researchers tend to agree upon the fact that field-based methods, which give researchers the chance to collect more detailed information from the research object, is more capable of handling complex research subjects. In this case they are more able to study more parties in the interfirm relationship and the stages of knowledge transfer.

Validity and generalizability of the study

Validity and generalizability form the center of the trustworthiness of social science research (Robson, 2002). They are largely affected by the research design and the methods of data collection. Therefore, whether interfirm knowledge transfer researchers used appropriate research methods varies the quality of the research findings. The review of the 83 studies indicates that:

- (1) Although some field-based studies tend to employ richer source of information, more studies collected data based upon single method and single respondent.
- (2) There is a lack of studies with corporation unit of analysis. Readers could doubt whether the information collected is enough to represent the whole organization. The point becomes weaker when only one informant is used, particularly in survey-based studies.
- (3) There is a lack of longitudinal studies among reviewed interfirm knowledge transfer studies. It is frequently argued that organizational learning is a dynamic process (Argyris & Schon, 1978; Cohen & Levinthal, 1990; Grant, 1996). Knowledge transfer and leaning in organizations often involve a series learning activities, which take time to be realized. Therefore, cross-sectional studies, which are normally retrospective and one-off, may not be sufficient to give accurate information about actual learning activities of firms. Nevertheless, it is noticed that the availability of large-scale databases has enabled the researchers to collect time-series data in archival-based studies. Moreover, more longitudinal information has been collected by field-based studies, which often focus on a small number of research units.
- (4) Interfirm knowledge transfer studies tend to be carried out in limited geographical areas. As most of the studies have been conducted in western countries, the suitability of research findings to be applied into wider geographical areas may be the limited.

- (5) There is a lack of adequate validation practices among interfirm knowledge transfer studies. The reason of this issue could be the absence of 'standard' means of assuring reliability and validity in field-based studies (Robson, 2002), and the ignorance of researchers when carrying out archival-based time-series studies (Didow & Franke, 1984).
- (6) Interfirm knowledge transfer researchers tend to ignore the importance of result verification, especially in field-based research efforts. Due to the lack of standard verification procedures and the complexity involved in the verification in qualitative findings, it is hardly to find any complete verification practices.
- (7) There is generally a lack of comprehensive analytical methods to examine the multiple dependent variables. Treating multiple dependent variables in a statistical model simultaneously has advantages recognized by various researchers (Bray & Maxwell, 1985; Hair, Anderson, Tatham, & Black, 1995; Podsakoff & Dalton, 1987). When multiple dependent variables are examined separately, the potential relationship between concepts is very likely to be overlooked.

Implications to researchers

The systematic review carried out in this paper somehow disclosed the common weaknesses of interfirm knowledge transfer studies. Some of those weak points are also commonly criticized in other social science areas. Researchers may find it very hard to have any methodological approaches, which are able to avoid all the weaknesses but at the same time handles the complex social issues. The argument also applies to the interfirm knowledge transfer studies. For example, field-based study allows researcher to collect richer information based on more means of data collection, from more respondents, for longer period of time. This type of studies is more likely to generate realistic information. However, the limited sample size and the lack of adequate result verification and validation procedures largely limited its generalizability, which is central to the value of social science studies. This calls for the researchers' capabilities to balance the advantages of various methodologies and the actual objectives of their studies.

At the research design stage, interfirm knowledge transfer scholars need to be careful with the choice of research objects and the unit of analysis. Given interfirm knowledge transfer normally involves more than one party, the complexity of the study increases correspondingly. When conducting empirical studies, clear definitions of the unit of analysis should be reached, as well as sufficient theoretical justifications should be provided, before deciding whether to collect information from one party or more parties in the interfirm relationship, and whether the chosen unit of analysis is appropriate to generate adequate information to answer the research questions. It is believed that sound research design and sufficient justification will not only enhance empirical power of the research but also make the study replicable to other researchers.

Although substantial research efforts have been taken to explore the interfirm knowledge transfer, there is still room for improvement in terms of the conceptualization and theory building. First, researchers could do more to conceptualize the knowledge transfer process and test the concepts empirically to enrich the theory building of interfirm knowledge transfer. Second, more attention should be paid to the conceptualization of interfirm relationship when conducting empirical research. Because the nature of interfirm relationship could substantially differentiate the mechanisms and process of knowledge transfer (Koka & Prescott, 2002), the research findings generated from one interfirm relationship could be highly context-specific. Researchers should clearly define the

interfirm relationship within which knowledge transfer is taking place before conducting empirical research to avoid the findings to be overemphasized in other research contexts. Third, more empirical efforts could be taken to examine the “learn about” type of knowledge transfer. Since firms are equally likely to have different types of knowledge transfer activities. In this sense, it is as interesting to have more insights of “learn about” knowledge transfer as of other types of knowledge transfer. Fourth, several aspects of relationship between knowledge transfer concepts could be explored further, such as the effect of knowledge acquisition from partner firms on the development of interfirm relationship. Moreover, factors influence the learning performance when firms acquire knowledge to manage the alliances could be studied more fully. Above-mentioned are just illustrations of new lines of inquiry which could be developed. Fellow researchers may develop different theoretical concerns when conducting their research.

Limitations

Following limitations of this review is worth to be pointed out:

- (1) Although it is argued at the beginning that the intention of this paper is not to review all the studies, the fact that only 83 studies were included could still leave the room for some important studies to be missed out. The neglect of certain important studies may bias the result of this paper.
- (2) The small sample size again limited the use of more sophisticated statistical tests to examine the association between multiple theoretical concepts and the use of research methods.
- (3) To be noticed, definitions of Inkpen and Tsang (2005) were used in this review to classify the possible types of knowledge transfer. Given that knowledge transfer research is still at its early stage, it is not the intention of this paper to argue that four types of knowledge transfer are collectively exhaustive and mutually exclusive. The classification could be oversimplified or some important perspectives of knowledge transfer are ignored. These four categories of knowledge transfer form an initial guideline of possible research focus of different types of knowledge transfer.
- (4) The highly differentiated aims and contents of studies and the varied logics and theoretical underpinnings followed by the prior knowledge transfer studies limited the ability of this paper to give highly accurate generalization about the methodological approaches followed by the existing studies. Hence, this paper only intends to give a bird's view of current interfirm knowledge transfer studies to help researchers to improve the empirical work and theory building in the future.

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