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Small and Medium-sized Enterprises Involved in Technology Transfer to China

What do their Partners Learn?

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Technology transfer is a frequent component of foreign direct investment and cross-border cooperative agreements. Little is known concerning the comparative effectiveness of technology transfer accomplished by small and medium-sized enterprises (SMEs) in developing countries. The goal of this study is to compare small and large organizations on measures of learning accomplished by their respective partners during technology transfer. Twenty-eight Canadian manufacturing firms involved in technology transfer to China were surveyed and seven case studies were conducted in China. Learning in recipient firms was not significantly associated with the size of their Canadian transferors. The case study results revealed other factors that seemed to influence learning.

KEYWORDS: comparative studies; learning; small business; technology transfer

1. Introduction

Technology transfer is a frequent component of foreign direct investment and cross-border cooperative agreements. Statistical data reported by Saggi (2002) show that technology payments and receipts have risen steadily since the mid-1980s, reflecting the role of technology in international production. For example, from 1985 to 1997, the USA's receipts of royalties and license fees increased from US$6bn to US$33bn. For Germany, the increase was from US$0.5bn to more than US$2bn. These global royalty payments and fees include the ones made from subsidiaries to their parent firms as well as the ones made by independent firms involved in technology agreements such as licensing and technical services. The largest part of this technology flow involves firms operating in developed economies (Freeman and Hagedoorn, 1994). Developing countries seem to

receive relatively little technology transfer, presumably because of the lack of indigenous capabilities to capitalize on the learning process that comes with technology transfer.

Although such macro-level data inform us about the direction of technology flows and the overall impact of international technology transfer on productivity levels and economic growth in the host country, they do not tell us much about the factors that may influence the effectiveness of the transfer at the firm level. One of these factors that have been suggested in the literature is the size of the supplier firms. Some researchers have hypothesized that smaller organizations from industrialized countries are less effective than larger ones in transferring their technology abroad (Buckley, 1997; Eden et al., 1997). This hypothesis was based on data published in a United Nations Conference on Trade and Development (UNCTAD) survey, which concluded that small and medium-sized enterprises (SMEs) usually transfer incomplete packages of technological and organizational information (UNCTAD, 1993). According to the survey, SMEs do not transfer enough codified information through blueprints and other written documents. Another obstacle to technology transfer in the SMEs sampled in the survey is the lack of financial and managerial resources. These presumably interrelated sets of problems may be aggravated when the transfer is done in developing countries. The technological and organizational gap between recipients from developing countries and their technology suppliers, as well as the differences in the sociocultural environments of these firms, might require the transfer of even more complete elements of knowledge and the investment of greater resources.

Other researchers have pinpointed some specific advantages of SMEs that may serve them in technology transfer to developing countries. Thus, Niosi and Rivard (1990: 1530) reported that 'SMEs, as niche producers with a smaller range of technologies to offer, may provide easier learning opportunities to industrial firms in developing countries'. Similarly, Gomes-Casseres and Kohn (1997) concluded that the competitive advantages of smaller US firms, which derived mostly from their technological leadership, allowed them to adapt and evolve with changes in the international economy, particularly in the industrializing parts of the world.

This study aims at empirically verifying if the size of transferors influences the effectiveness of technology transfer. Effectiveness is defined as the actual learning accomplished by recipient firms. A survey was used to measure levels of learning achieved by the Chinese partners of Canadian transferors. We also did a case study to complement the results of the survey.

In the first section of the article we propose a definition of technology transfer based on knowledge. This concept has been identified in the literature as central to the definition and analysis of technology transfer. Defining technology transfer in terms of transfer of knowledge allows us to define effectiveness of transfer as the learning of new knowledge and skills. The second section focuses on the arguments that have been presented in the literature to explain why smaller organizations might be less effective than large ones in transferring their technology. Counterarguments will be examined in section three: some advantages in international operations have been attributed to smaller firms. The context and

objective of the study are explained in section four. The methodology is described in section five. In section six we provide and interpret the results. Implications of results are discussed in the concluding section.

2. International Technology Transfer and the Knowledge Factor

The concept of technology transfer is frequently defined in the literature by the organizational modes agreed upon by the firms involved in international operations. These modes are divided in two categories: the investment modes (joint ventures and wholly-owned subsidiaries) and the non-equity agreements such as licensing and technical assistance. However, the sole use of any of these modes at the international level is not in itself an indication that technology is actually and effectively transferred across national boundaries. In order to know what is really transferred and to assess the effectiveness of transfer, we may conceptualize technology as a set of knowledge elements. Technology transfer is then defined as 'the transfer of systematic knowledge for the manufacture of a product, for the application of a process or the rendering of a service and does not extend to transactions involving the mere lease or sale of goods' (UNTCAD, 1985: 1). The knowledge that is transferred may be organizational or technical. Effectiveness of technology transfer is then defined as the actual learning of transferred knowledge by recipient firms (Dahlman et al., 1987; Madeuf, 1984; Mytelka, 1985; Lall, 1992).

In the field of international business, the role of knowledge as a determinant of international operations was acknowledged by Dunning, who referred to the total stock of knowledge in international firms as the 'knowledge capital ingredient of direct investment' (Dunning, 1970: 147). More recently, that 'ingredient' was integrated in his extended version of the eclectic paradigm of international production (Dunning, 1993: 98–101). Both forms of knowledge – codified and non-codified – are part of ownership-specific advantages that Dunning attributes to international firms. These ownership advantages arise not only from the exclusive possession of tangible and intangible assets such as knowledge, but also from the ability of firms to internalize these assets and the advantages of doing so rather than transferring them to independent firms (Dunning, 1999: 70–1). Such advantages are also influenced by location-specific variables such as the industrial structure and the economic and institutional environment in which the firms operate.

The existence and nature of distinct ownership-specific advantages in international enterprises have been questioned by Buckley (1983), who claimed that these advantages might not rest on some static capabilities of the firms to exploit and protect their unique knowledge. This static view, according to Buckley, is partially based on the premise developed by Johnson (1970) that knowledge is a public good, in the sense that it can be transferred at zero marginal cost. As a result, the firm that created it faces the difficulty of protecting it and appropriating a return to its use. Kogut and Zander (1993) argued against the static public good conception of knowledge in technology transfer and suggested that

multinationals specialize in the transfer of knowledge that is difficult to understand and codify. Rather than giving rise to defensive measures, technologies that are difficult to codify provide opportunities for international expansion.

The public good conception of knowledge is akin to the concept of codified knowledge. Such knowledge results from the process by which firms record their expertise and knowledge in symbolic forms. Written documents such as blueprints and drawings can then be used to transfer such knowledge. Conversely, tacit knowledge (Polanyi, 1966) is made of the unique expertise and skills that have been acquired over the years and that has not been codified in documents. Members of the supplier firm have to personally teach such knowledge and skills to the employees of the foreign firm, making the process more complex and costly.

To what extent can transferors codify their knowledge for technology transfer? Teece (1981) reported that technology transfer frequently involves the transfer of employees from the supplier firms:

> In some cases the transfer of a formula or a chemical compound, the blueprints for a special device, or a special mathematical algorithm may be all that is needed to effect the transfer. However, more is frequently needed . . . Know-how cannot always be codified, since it often has a tacit dimension . . . In short, the transfer of knowledge may be impossible in the absence of the transfer of people. (Teece, 1981: 86)

More recently, Teece et al. (1997: 512) claimed that 'replication and transfer are often impossible absent the transfer of people, though this can be minimized if investments are made to convert tacit knowledge to codified knowledge. Often however this is simply not possible'. For example, in a study on technology transfer to China, Marcotte and Niosi (2000) found that tacit knowledge constituted a substantial part of the total knowledge transferred by Canadian firms to China.

According to Teece (1981), the resource costs of transferring tacit knowledge are higher than for codified knowledge. This is due to the obligation to send supervisory personnel abroad. The personnel has to provide technical assistance to the employees of the recipient firm and adapt the technology to local conditions. These resource costs are important when the transfer is done through joint ventures or wholly-owned subsidiaries, but they may also be quite high with contractual forms such as licensing. Teece (1976) estimated the resource costs of transfer to independent firms to represent 9% of the total costs of the projects, whereas these costs were 5% when the transfer mode was a joint venture.

3. The Role of Tacit Knowledge and Resources in Internationalization: Small and Medium-sized Enterprises as Less Effective Transferors of Technology

Until the 1990s, the literature on international technology transfer made very few allusions to the role and impact of SMEs as transferors of technology. As was mentioned by Reddy and Zhao (1990: 286) in their exhaustive review of the literature: 'There is little debate in the literature that the primary agent of

technology transfer from the home country is the multinational corporations'. Their article did not mention the involvement of SMEs in technology transfer. Small and medium-sized firms were then perceived as less effective than large businesses in transferring their technology abroad – effectiveness being defined here as the actual learning of new knowledge and skills by recipient firms.

Two interrelated arguments may explain why foreign partners who receive their technology from SMEs learn less than those who acquire it from large firms. The first one is the prevalence of tacit knowledge in smaller organizations, which makes technology transfer more costly. The second one is the shortage of financial and human resources, combined with the lack of managerial skills in SMEs.

Much of the know-how in small firms seems to remain tacit (Buckley, 1997; Eden et al., 1997; UNCTAD, 1993). Thus Buckley (1997) reported that:

> The channel of written instructions is used much less frequently in SMEs than MNEs [multinationals], partly because of lack of personnel to codify the technology and partly because many of the skills in SMEs are acquired through personal experience. Sending technical experts abroad to aid in technology transfer is much more difficult for SMEs (the high opportunity cost of technical personnel is crucial here) and written instructions are used much less frequently. Manuals and technical handbooks are used by a minority of SMEs and even blueprints and drawings are only used in 51% of cases. Buckley (1997: 75)

Eden et al. (1997: 63) identified the shortage of financial and human resources in SMEs as one explanation of the relative ineffectiveness of SMEs in technology transfer. In comparison with large firms, smaller organizations cannot devote as many employees or as much funding to aiding the transfer process, which results in frequent 'difficulties alleviating the concerns and addressing the assimilation deficiencies of foreign affiliates and/or alliance partners'. In addition to the shortage of resources, a lack of managerial expertise in the area of international business has also been observed in SMEs (Buckley, 1997). It is usually the owners themselves who launch and supervise international projects. It is very difficult for them to find the time to collect sufficient information about the complex issues involved in international technology transfer. The lack of managerial resources in SMEs might explain why SMEs are less likely than large organizations to properly manage the transfer process when problems occur.

4. The Potential Advantages of Small and Medium-sized Firms in International Technology Transfer

Smaller organizations have also been described as possessing certain characteristics that may be advantageous in international technology transfer. Small and medium-sized firms may distinguish themselves by highly specialized technological and human assets. Many innovating SMEs have developed technologies that are very attractive on the international market. In a study on technology transfer to developing countries by Canadian SMEs, Niosi and Rivard (1990) found that most of these enterprises could be described as small oligopolists, occupying a large proportion of the domestic market in their respective niche.

Paradoxically, the specialized skills in smaller firms have been attributed to their capacity to capitalize on their tacit knowledge, which is viewed by the proponents of the 'SME advantage' as a source of competitive advantage rather than a constraint (Chew and Yeung, 2001). As was mentioned previously, much of the know-how in small firms seems to remain tacit. Only a fraction of that knowledge and skills acquired by employees through learning-by-doing is codified in written instructions and documents. However, rather than being only a source of teaching and transaction costs, this tacit knowledge may also constitute a source of opportunity and competitive advantage. Foreign partners located in developing countries are often looking for this type of complementary knowledge in order to understand and use effectively the blueprints and related documents. In fact, one of the major complaints from Chinese partners involved in technology transfer agreements was that not enough tacit knowledge was provided by firms from industrialized countries (Lan and Young, 1996; Warhurst, 1991). In-house training is one of the ways of teaching tacit knowledge. Being used to communicate their knowledge and skills through demonstration and modeling rather than through written documents, employees in small firms may be in a good position to teach these elements of tacit knowledge to their colleagues in the host country. Their less formalized, more personal approach might compensate for the relative scarcity of financial and human resources in SMEs.

Besides this direct, face-to-face communication style, smaller firms also differ from larger enterprises by organizational characteristics that may be advantageous during internationalization. Their flexibility and capacity to react quickly to environmental changes are considered assets in the effective management of foreign operations (Marcotte and Julien, 1995; Storey, 1996). Communicational skills and cultural adaptation are particularly important when firms from industrialized countries transfer their technology to partners located in developing countries. The latter are usually characterized by different cultural values such as collectivism and high power distance (Hofstede, 1980). The managerial and technical differences that frequently exist in these firms also require adaptation on the part of transferors. In a previous study on technology transfer to China, Marcotte (1999) found that Canadian managers who acknowledged these differences and interpreted them correctly were able to transfer their technology more effectively.

5. Context and Objective of the Study

This study is part of a larger and ongoing research on the learning aspects of technology transfer to China. The theoretical and empirical foundations of learning by recipient firms during technology transfer were explored in a previous study (Marcotte and Niosi, 2000). The present research focuses on the relationship between firm size of transferors and learning by recipient firms.

Little is known concerning the comparative effectiveness of technology transfer accomplished by SMEs in developing countries. Thus Fujita (1997: 9) mentioned that 'although several studies have taken note of the general

phenomenon of SMEs, there is a need to assess whether small and medium-sized transnational corporations differ from large transnational corporations (TNCs) in their behaviour and in their effects on home and host country economies'. The goal of this study is to compare SMEs and large organizations on measures of learning accomplished by their respective partners during technology transfer. Also, because of the exploratory nature of the study, we wanted to verify if other factors than firm size of transferors were influencing learning in recipient firms. Control variables were included in our questionnaire and a case study was done in order to complement the survey.

6. Methodology

Methods

A multi-method approach was used in order to unravel the tangible and intangible aspects of learning. A survey was conducted in the first phase of the study, and then a case study was implemented. In the first phase, we personally administered a questionnaire to the respondents of the Canadian firms. The questionnaire consisted of closed questions regarding the factual characteristics of the Canadian firms (size, age, sector and products), the skills acquired by the Chinese firms during the transfer, and also the following control variables: the transferors' previous acquaintance of the Chinese partner, their previous experience in international technology transfer, the organizational forms of transfer, and the level of involvement of the Chinese firms during the transfer.

The second phase consisted of case studies conducted in China. Four of the cases involved large Canadian transferors, and three involved SMEs. We visited five Chinese-Canadian joint ventures and one Chinese enterprise involved in a non-equity technology transfer agreement with a Canadian firm. A seventh case was studied when we returned to Canada. Since our study was exploratory, we wanted to remain open to less tangible factors that could have an impact on learning. The case studies were conducted according to the descriptive and hypothesis-generating approach (Yin, 1989) rather than the hypothesis-testing model. The cases were not selected on the basis of pattern-matching, but on the basis of logistics and willingness of both the Canadian and Chinese parties to participate in the interviewing process. We did unstructured interviews with the respondents, trying to obtain from them as many facets as possible of the learning process. Since the factors that may influence the outcome of technology transfer are possibly numerous, and the data that might help us in hypothesizing regarding these factors are rare, we did in-depth interviews with Canadian and Chinese managers and technicians in order to have a deeper understanding of the learning process and its factors. We wanted to study the phenomenon of technology transfer in its real-life context, using triangulation – as many sources of evidence as possible – in order to increase the validity of our study (Kirk and Miller, 1986). Our purpose was to make fine-grained observations that would possibly generate hypotheses on learning factors at play in technology transfer. A similar hypothesis-generating approach was used by Hamel (1991) in a qualitative study of learning in international strategic alliances.

Sample

Survey The authors interviewed personally the respondents of 28 Canadian manufacturing firms. These respondents were the presidents in the case of smaller firms or managers in charge of the transfer operations in larger enterprises. All the sampled firms were already transferring their technology to China. The names of the companies were obtained from publications (newspapers, business magazines and governmental publications). According to the Department of Foreign Affairs and International Trade, Government of Canada (2003: 1), 'over 400 Canadian firms have a permanent presence in China and are establishing commercial and technological linkages with Chinese companies'.

Ten firms were active in electronic and telecommunication equipment; eight were producers of electrical equipment, transportation equipment, industrial machinery and controls. The remaining companies were active in metal products and chemicals. The industrial spectrum of the sample tends towards high and medium technology intensity, as measured by their research and development (R & D)/Sales ratio. Twelve companies were small and medium-sized enterprises with 250 employees or less. Both SMEs and large organizations were well established and had accumulated numerous years of experience in international activities. The average age of the firms was 40 years, and the median was 28 years. On average, firms exported 72% of their production. Twenty-four of them were already exporting to Asia and 16 were exporting to China when they decided to transfer their technology to China. They were on average frequent transferors of technology: the average company had transferred its technology to three different countries before transferring it to China. Only six SMEs and six large firms had previously transferred their technology to less than three countries. The median transfer happened in 1991. There was no noticeable difference between small and large organizations on the time elapsed since the beginning of the transfer. Six SMEs and nine large firms had started their transfer operations before 1991. The agreements were for an average duration of 11 years. Twelve of the sampled firms – five SMEs and seven large firms – used non-equity forms of transfer. Fifteen others implemented joint ventures and one created a wholly-owned subsidiary. All transfers were done to large state-owned firms.

Case Studies The characteristics of the cases are described in Table 1. The industrial sectors in which the seven firms operate are: primary metal manufacturing, computer and electronic products, and machinery manufacturing, as described in the North American Industry Classification System (Industry Canada, 2003).

The first case was a large Canadian producer of aluminum products. The technology that it transferred to China – aluminum extrusion profiles and manufacturing of aluminum windows and doors – belongs to the primary metal manufacturing sector. The organizational mode of transfer was a joint venture that was implemented with two large Chinese state-owned firms that also specialized in aluminum production. For cases two, four and seven, the products for which the technology was transferred are classified in the computer and

Table 1. Characteristics of the Cases

Case Number	*Products for which Technology was Transferred*	*Size of Transferor*	*Organizational Mode of Transfer*
1	Aluminum extrusion profiles, dies and billets. Manufacturing of semi-finished goods for aluminum windows and doors	Very large (44,000 employees)	Joint venture
2	Design and manufacturing of telecommunication equipment	Very large (63,000 employees)	Joint venture
3	Machinery for production of capsules (pharmaceutical industry)	Small (25 employees)	Joint venture
4	Equipment and software systems for management of operations in transportation, gas, water, electricity	Small (27 employees)	Licensing and technical services
5	Pulp, paper and board mill equipment	Small (105 employees)	Licensing
6	Sewing machines	Large (4000 employees)	Joint venture
7	Microwave telecommunication equipment	Large (350 employees)	Joint venture

electronic products sector. Case 2 was a large manufacturer of telecommunication equipment involved in a joint venture with a large Chinese state-owned manufacturer. Case 4 was a small Canadian firm that specialized in the design, manufacturing and installation of systems for the management and control of operations in transportation, gas, water and electricity. The Chinese partner in this case was a large service state firm in charge of the distribution of electricity in the Shanghai area. The organizational mode selected by that SME was licensing and technical services. In case seven, the Canadian firm was a large manufacturer of microwave telecommunication equipment involved in a joint venture with a large Chinese manufacturer of telecommunication products.

The remaining three cases belong to the machinery production sector. The Canadian SME in case 3 produces specialized machinery for the production of capsules in the pharmaceutical industry. A joint venture was implemented by this SME. In case 5, a small Canadian producer of pulp and paper equipment licensed its technology to a large Chinese state-owned firm. Finally a large manufacturer of sewing machines transferred its technology through a joint venture to a large Chinese manufacturer.

Definition of Variables

Firm Size of Transferors Small and medium-sized firms were defined as those having less than 250 employees. This criterion is consistent with other Canadian studies and with the definition of SMEs used by a large number of policy makers in Canada (Filion, 1990).

Learning in Recipient Firms The measures of learning were based on a previous model (Marcotte and Niosi, 2000). Two learning phases were identified in Chinese recipient firms during technology transfer. Each phase is characterized by the acquisition of specific technological and organizational skills, and also by the sharing of different types of information.

Phase 1: Learning by Adapting The first phase is the capacity of recipient firms to adapt the technology to local conditions – adaptation to local raw materials or adaptation of production scale. Thus the technical skills that are learnt by recipient firms concern the adaptation and not the improvement of the acquired technology. Recipient firms must also develop their production efficiency through learning-by-doing. In this first phase, partners mostly share information on how to solve immediate problems with the new technology. The organizational skills acquired by recipient firms are thus very specific (production efficiency), and do not yet concern other functions such as marketing and Research and Development.

Phase 2: Learning by Modifying In this second phase, recipient firms learn how to implement minor innovations by modifying and improving the technology. They also modify their organizational structure and strategy in order to integrate these new technological developments. For example, recipient firms may create a department of Engineering or Research and Development. Information exchange between suppliers and recipients is more global and concerns most functions of the organization, including marketing and research and development. Coordination between these functions is improved so that recipient firms derive more benefit from the acquired technology.

Control Variables

Previous Acquaintance with the Chinese Partner The choice of a local partner with which western firms can build strong social as well as business relationships has been identified in the literature as an important determinant of performance in China (Abramson and Ai, 1999; Luo, 1997; Sutton and Ge, 1996). China has been described as a society that places a high emphasis on merging business and personal relations. The term 'guanxi' is often used to refer to this aspect of social and business networking. To evaluate this variable, we asked the Canadian respondents if they had had previous business relationships with the Chinese firm and if so, what type of relationships they were (e.g. supplier, distributor).

Organizational Forms of Transfer The choice of an investment mode, particularly joint venturing, has been hypothesized as more conducive to effective transfers than non-equity forms when the indigenous technical capacity of the host country is low (Tsang, 1997). Even though it has made progress in technology absorption during the last 20 years, China's ability to absorb technological knowledge has been rated as low (Conroy, 1992; Shiguo, 1997). In this case, transfer modes, such as joint ventures, that require higher resource commitments on the

part of the technology supplier (Tsang, 1997), might be more likely to promote close interactions between the parties involved in the transfer and to increase learning in recipient firms. Thus we asked if the transfer involved equity participation on the part of the Canadian firm.

Involvement of the Chinese Partner Tsang (1997: 159) argued that 'a successful technology transfer needs the active participation of not only the transferor, but also the transferee. Recipients would normally be obliged to devote substantial resources to assimilate, adapt and integrate the technology into its production system'. What was the role and involvement of the partner – in terms for example of local R & D efforts – in the process of technology transfer and assimilation: very significant or not very significant?

Experience in International Technology Transfer Teece (1981: 84) reported that experience with international technology transfer appears to be a key consideration with respect to the ease with which technology can be transferred abroad. This experience effect was reflected in decreasing costs with each subsequent transfer of technology. So we asked the Canadian respondents how many international transfers they had done previous to the one in China, and the number of months or years elapsed since the beginning of the transfer operations in China.

Statistical Analysis of Questionnaire Data

Because of the small size of our sample and the nominal nature of our data, we used non-parametric statistics in analyzing questionnaire data.

7. Results

Questionnaire Data

Firm Size and Learning As Table 2 shows, learning in recipient firms was not significantly associated with the size of their Canadian transferors. Recipient firms that acquired their technology from Canadian SMEs learnt to adapt or modify the technology in the same proportion as those who received it from large firms. Seventeen Chinese recipients had acquired phase one skills: 6 of them had Canadian SMEs as partners and 11 had larger partners. Only 8 Chinese firms had acquired phase 2 capacities and among those, 3 had small or medium-sized partners.

Table 2. Firm Size of Transferors and Learning Phase of Partners

Firm Size	*Phase One*[a]		*Total*	*Phase Two*[b]		*Total*
	Yes	*No*		*Yes*	*No*	
SME	6 (50%)	6 (50%)	12 (100%)	3 (25%)	9 (75%)	12 (100%)
Large	11 (68.7%)	5 (31.3%)	16 (100%)	5 (31.3%)	11 (68.7%)	16 (100%)

Notes: [a]Chi square = 1.01; Significance = 0.31; [b]Chi square = 0.13; Significance = 0.71

Control Variables Among the control variables, only the level of involvement of Chinese recipients in the transfer process was significantly associated with learning. Chinese firms that played an active role learnt more often than passive recipients to adapt and modify the technology. It was particularly surprising to find out that the previous experience of transferors in international technology transfer was not related to learning. The case study results provided us with some possible explanations for these questionnaire data.

Case Study Results Table 3 presents the case study results. Six of the cases were at phase one. Only in the first case did we observe the characteristics of phase two. The organizational form in this case is a joint venture that manufactures semi-finished aluminum products. The activities of the firm consist in extruding and anodizing aluminum components that are used for the manufacture of doors and curtain walls. The organizational and technological skills acquired by the managers and employees of the joint venture in this case have been partially diffused to the Chinese partner, a state-owned firm active in the aluminum industry.

The organizational skills acquired in the joint venture are as follows:

- The Chinese and Canadian managers collaborated in the implementation of a much flatter structure than the one found in Chinese firms of comparable size (450 employees). There is also a minimal level of departmentation: the core units of this joint venture are the departments of production and marketing, and a small Research and Development unit. The director of the joint venture reported that 'to achieve the same level of production, a state-owned firm would have twice as many employees and levels of authority'. Constant communication and versatility among workers are encouraged. The employees were selected on the basis of their motivation and capacity to adapt to the new organizational culture of the joint venture. Training was provided to more than 100 employees in Canada and Japan, with these words from the director of the joint venture: 'These Canadian and Japanese firms are your future competitors. Examine how they operate if you want to be competitive in a few years from now.' Constant communication between production workers and engineers was particularly emphasized by the director of the joint venture: 'We want to operate like an entrepreneurial firm, both at a domestic and international level.' This less formalized, more personal approach is in fact more typical of a dynamic SME. The fact that both partners were large organizations may be surprising from that point of view. However, as we shall see, the key person in that transformation is the executive director of the joint venture, who was a very dynamic manager.
- The Chinese managers have progressively assumed more responsibility, and the joint venture is now totally managed by a local director. The progressive empowerment of Chinese managers was part of the Canadian partner's objectives from the beginning of the joint venture operation. For the first five years of operation, the executive director was a Canadian. Then Chinese managers took over.

Table 3. Case Study Results

Case Number (Transferor Size)	*Learning in Recipient Firms*				
	Learning Phase	*Information Exchange*	*Organizational Skills*	*Technical Skills*	*Factors Associated with Learning*
1 (large)	Two	General; intensive	Flexibility; streamline production; communication; autonomy	Capacity to design	Approach of transferor: participative, emphasis on face-to-face communication and autonomous learning. Specific cultural experience and adaptation of joint venture director
2 (large)	One	Specific technical information (quality control)	Quality control. Management still dependent on supplier	Adaptation of technology	Approach of transferor: non participative, formal, structured. Lack of cultural adaptation of Canadian technicians and managers
3 (SME)	One	General information searched, but limited information transfer	Quality control	Adaptation efforts, but remains dependent on supplier	Lack of human resources in supplier firm: personal but limited communication. Lack of cultural adaptation of Canadian partner. Lack of R & D skills in recipient firm
4 (SME)	One	Technical information	No new organizational skills acquired	Adaptation efforts, but remains dependent on supplier	Lack of resources and experience of supplier. Lack of R & D and technical capacity of recipient
5 (Large)	One	Technical and marketing information	Specific production skills	Little adaptation of technology. Supplier solved adaptation problems	Lack of initiative and R & D of recipient. R & D performed at Chinese University and results repatriated in Canada
6 (large)	One	Technical information	Specific production skills (assembly work)	Adaptation of technology	Strategic decision of supplier firm: only assembly work done in China
7 (SME)	One	General information	Specific production skills (assembly work)	Adaptation and beginning of R & D	Face-to-face communication. Disagreement between supplier and recipient on strategic orientation

- The joint venture has demonstrated its capacity to remain flexible and to react quickly to environmental changes, such as the changes in the Chinese policy regarding aluminum products and the corresponding increase in the level of domestic and international demand for its products, which are now exported in 10 countries in Asia and North America.
- Learning-by-using is given a high priority. Customers' feedback is solicited and has been used to improve and modify the technology acquired from Canada.
- The Chinese partner is closely monitoring these changes in the joint venture. It has started to adopt the learning-by-using approach and also the international orientation developed in the venture.

At the technological level, the accomplishments of the joint venture, excepted the International Organization for Standardization (ISO) certification, have been already diffused to the Chinese partner:

- The aluminum extrusion press acquired from the Canadian partner has been substantially modified in order to obtain better results.
- The engineers now have the capacity to design new products from the acquired technology. New product lines have been developed in order to meet a more diversified demand. Both the joint venture and the Chinese partner have the capacity to customize their products. Research and development is done in a small scale in both organizations.
- The joint venture has acquired the ISO certification.

One reason that seems to explain these accomplishments is the participative teaching approach used by the large Canadian transferor. The latter appointed as the first executive director of the joint venture a Canadian from Chinese descent who had many years of experience in China. He knew that some ways of doing things had to be changed from the beginning. He had clear objectives in mind when taking charge of the joint venture: progressive empowerment of managers and employees, flexibility, communication and international competition. He made sure that the Chinese partner understood his requirements, particularly at the level of employee selection and training. This culture-specific knowledge appeared determinant in the teaching and learning process. He acknowledged the cultural specificities of China, but at the same time he insisted on the changes that were necessary if the joint venture was to be profitable. Chinese managers and technicians were progressively empowered to take more initiatives and responsibilities in the direction and operations of the joint venture. 'We give our Chinese managers and employees as many responsibilities as possible. We want them to take initiatives. The management of the joint venture is now totally assumed by the Chinese.'

The teaching approach in the second case was less participative. This is a joint venture created by a large Canadian multinational in the field of telecommunication equipment – in this case, the manufacturing of private branch exchange products – and a large Chinese state-owned firm also operating in the telecommunication sector. The Canadian firm did not have the same willingness as

the one described above to empower the Chinese managers and engineers of the joint venture. The latter were asking for more information on international marketing for their telecommunications equipment and also on product development, but the feedback from the Canadian partner was unsatisfactory according to the Chinese respondents. Research and development was done by the Canadian firm in its laboratories in Canada or in one of its affiliated centers in China. The information shared with the Chinese partner concerned the aspects of adaptation of the technology and problems of equipment and service. Due to numerous problems in these areas, the Canadian transferor could not delegate many responsibilities to the Chinese managers and technicians. One of the Canadian respondents said: 'Our Chinese employees do not have sufficient qualifications and I am not sure if they really want to learn them. I have a hard time understanding why they do not learn faster: Is it a lack of motivation? I do not know.' Another difficulty that Canadian respondents faced in China had to do with the concept of 'face'. It is very difficult for supervisors to tell Chinese employees that their job is not properly done. Losing face is something to be avoided. This was one of the cultural factors that appeared particularly difficult for Canadian managers and supervisors. Even though the Canadian managers and technicians had numerous years of experience in other foreign markets, they lacked specific knowledge and familiarity with the Chinese cultural context and they had serious difficulties interpreting the behaviors of the Chinese employees. Managers and technicians in this case as well as in case three mentioned that their previous experience in transferring technology to other countries could hardly be generalized and used in China due to cultural differences.

In cases three, four and five, lack of R & D in recipient firms constituted one of the two major obstacles to learning – the other being the resource constraint faced by the Canadian SMEs. The lack of R & D skills in recipient firms was due to the division between production enterprises and external R & D centers in China, which prevents recipient firms from participating in the technology improvement process. Communication and coordination between recipient firms and R & D centers were poor. Firms could hardly rely on R & D centers to help them solve their technical problems and upgrade the transferred technology. One unfortunate result of this barrier could be observed in case five, where the Canadian partner was able to repatriate and use all the results of R & D projects conducted by a Chinese University, whereas its Chinese partner did not benefit from these results.

In the last two cases, strategy was the main issue. In case six, the strategy of the Canadian firm was to use China as a base for assembly work without transferring more sophisticated knowledge. For case seven, the Canadian partner had made plans to transfer more advanced knowledge, but because of a disagreement with its Chinese partner over long-term goals and investment, it terminated the joint venture and created a wholly-owned subsidiary. These data on strategic issues were different from those available in the literature. In current studies on strategy and international technology transfer, the concept of strategy is broadly defined in terms of entry mode – investment versus non-investment modes (Martin and Salomon, 2003; Tsang, 1997), and it is viewed as the outcome of

some static determinants such as resources, or it is studied in relation to commercial performance rather than learning. Our qualitative data suggested that the strategies of transferors, when analyzed at a finer level than entry modes, have an impact on learning. The transferors' decisions not to share sophisticated knowledge with their partners, or their incapacity to do so because of disagreements over strategic issues, appeared to be serious obstacles to learning.

8. Conclusion

This study aimed at comparing small and large Canadian manufacturers on measures of learning accomplished by their partners during technology transfer to China. The results of the survey showed no differences between SMEs and large transferors on these measures. However such results must be interpreted with caution, considering the small size of our sample. Further studies that would include a larger number of firms are needed to explore this issue of firm size and learning. Another advantage of including a larger sample will be the possibility to include more variables in the analysis and to do a multivariate analysis of the data.

The case study data showed that although resource constraint in smaller organizations was an important element in some of the cases, it did not appear to be the main factor associated with learning. The factors that we identified as predominant are the capacity of recipient firms to take some initiative in organizational change and technological improvement, the capacity of transferors to adapt to the Chinese cultural context, and their willingness to share their knowledge as well as their capacity to do so even when disagreements occur with their partners. Future studies will confirm if the combination of these factors explains a significant part of the variance in learning among recipient firms.

Finally, when comparing the present results with data obtained in other parts of the world, it is important to consider the peculiar situation of technology transfer in China. Contrary to the situation that prevails in many other emerging and developing regions, the majority of technology transferors in China are SMEs, while the largest proportion of recipients are large state-owned firms (Huang, 2003). Even though the Chinese government is implementing policies aimed at privatizing some of the smaller state-owned firms, and the number of small private firms in China is increasing (Hassard et al., 1999), very few of these private firms participate in the important technology importation programs of this country. The size imbalance between technology transferors and recipients might be an obstacle to technology assimilation and learning according to Donckels and Lambrecht (1995). In their study of joint ventures between SMEs from industrialized and developing countries, these authors found that these ventures were better means of learning for entrepreneurs in developing countries. Small and medium-sized firms from industrialized countries, because they invested considerable time and money, seemed to make every effort to ensure that the venture is a success. By comparison, large firms might not be as preoccupied by the success of their joint venture and could consider their local partners as political alibis in their global strategy. Although we did not witness that kind of strategy in the large firms that we interviewed for this study, such a possibility

has to be explored in future studies. When firms from industrialized countries have equal possibility to transfer their technology to large or small Chinese firms, this issue of balance between the size of transferors and recipients should be addressed.

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Les petites et moyennes entreprises engagées dans le transfert de technologies en Chine

Quels sont les avantages qu'en tirent leurs partenaires?

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Nous le savons tous, le transfert de technologies est un élément bien souvent apparentés aux accords de coopération transfrontaliers et aux investissements directs à l'étranger. Par contre, on en sait peu sur l'efficacité comparative du transfert des technologies réalisé par les PME (petites et moyennes entreprises) dans les pays en développement. Le but que se propose donc cette étude est d'établir une comparaison entre les petites et les grandes organisations, au niveau de l'apprentissage suivi par leurs partenaires respectifs à l'occasion de ces transferts de technologies. Nous avons procédé à une enquête auprès de vingt-huit (28) entreprises manufacturières canadiennes, engagées dans le transfert de technologies en Chine, et avons également mené sept (7) études de cas en Chine. Nous nous sommes aperçus que l'apprentissage au sein des entreprises bénéficiaires n'était pas vraiment lié à la taille des auteurs de transfert canadiens, et il est ressorti des résultats de ces études de cas que d'autres facteurs semblent influencer le processus d'apprentissage.

Mots clés: Études comparatives, Apprentissage, Petites entreprises, Transfert de technologies

Pequeñas y medianas empresas participantes en la transferencia de tecnología a la China

¿Qué aprenden sus asociados?

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La transferencia de tecnología suele ser un elemento constitutivo de los acuerdos de cooperación transfronteriza e inversiones extranjeras directas. Se sabe poco sobre la eficacia comparativa de la transferencia de tecnología llevada a cabo por las pequeñas y medianas empresas (PYME) en los países en desarrollo. El objetivo de este estudio es establecer una comparación entre las pequeñas y grandes organizaciones en lo relativo al aprendizaje logrado por sus respectivos socios durante la transferencia de tecnología. Se llevó a cabo una encuesta de 28 industrias manufactureras canadienses comprometidas en la transferencia de tecnología a la China y se estudiaron siete casos prácticos chinos. El aprendizaje en las empresas beneficiarias no estaba vinculado en gran medida con el tamaño de sus beneficiadores canadienses. Los resultados de los estudios de casos prácticos revelaron otros factores que parecen influir en el aprendizaje.

Palabras clave: Estudios comparativos; aprendizaje; pequeña empresa; transferencia de tecnología.

Klein- und mittelständische Betriebe an Technologietransfer an China beteiligt

Wie sieht der Lernerfolg ihrer Partner aus?

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Der Technologietransfer ist häufig ein Bestandteil direkter Auslandsinvestition und grenzüberschreitender Kooperationsvereinbarungen. Über die verhältnismäßige Wirksamkeit des durch kleine und mittelständische Betriebe erzielten Technologietransfers in Entwicklungsländern ist allerdings nur wenig bekannt. Ziel dieser Studie ist es, kleine und große Organisationen im Hinblick auf das Maß des Lernerfolges ihrer jeweiligen Partner während des Technologietransfers zu vergleichen. Achtundzwanzig kanadische Fertigungsunternehmen, die an einem Technologietransfer an China beteiligt waren, wurden untersucht und sieben Fallstudien wurden in China durchgeführt. Das Lernen in den Empfängerunternehmen hing kaum mit der Größe der übertragenden Unternehmen in Kanada zusammen. Die Fallstudienergebnisse zeigten andere Faktoren auf, die das Lernen zu beeinflussen scheinen.

Schlüsselwörter: Vergleichsstudien, Lernen, Kleinunternehmen, Technologietransfer