

## CHAPTER 3

# GENERAL ISSUES IN MANAGEMENT

### MICRO Contracting for Tacit Knowledge – A Study of Contractual Arrangements in International Technology Transfer

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#### Abstract

To protect their tacit knowledge in international technology transfers, transferors generally selected ownership-based hierarchical control. Related research also argued that hierarchical contracting helped to economize transaction costs in tacit knowledge transformation. However, the interests of transferees and the nature of tacit knowledge transformation were not adequately considered in the control-oriented hierarchical contracting. This paper explores how transferees in China used innovative contractual arrangements to acquire tacit knowledge while they have to succumb to the dominant strategy of hierarchical control by transferors. Our research results challenge the rigid application of hierarchical contracting in tacit knowledge transformation. By synchronizing transaction cost economics and knowledge management in the study of tacit knowledge transformation, our research also provides empirical support to the call by Williamsons to push beyond generic governance to address strategy issues faced by particular firms, and include dynamic transaction costs and learning (Williamson 1999).

#### Introduction

Tacit knowledge diffused from knowledge-advanced parties to knowledge-deficient ones in international economic exchanges, such as international trade, technology transfer, and foreign direct investment. This diffusion has been a highly concerned issue, because it embodies commercial value, directly related to competitive advantages, underpins dynamic capabilities, but extremely difficult to protect (Winter, 2003; Barney, 1991; Williamson, 1995; Teece, 1977; Nonaka, 1994, 1998; Simonin, 1999, Winter, 2003; McEvily and Chakravarthy, 2002; Bloodgood et al., 1997; Hall, 1993, 1998.) There is a general consensus that the diffusion of tacit knowledge helped in explaining the rapid development of productivity and industrial capabilities in Japan of 1970s, South Korea of 1980s, Taiwan of 1990s, and in mainland China most recently (Kim, 1997; Yu, 1996; Makino et al., 1996). However, in contractual arrangements that helped to manage an effective tacit knowledge transformation, the arguments remain to be settled. With the increasing role of tacit knowledge in global competition, lack of effective contracting of tacit knowledge and escalating problem of knowledge spill-over attracted serious attention (Blomstrom & Kokko, 2000; Aitken, Brian, Hanson, and Harrison, 1997; Coe and Hoffmaister, 1999; Okabe, 2002.)

Studies from the perspective transaction cost economics (TCE) argued for a control-oriented hierarchical contracting while the level of tacit knowledge increased in the transaction (Oxley, 1997, 1999; Williamson, 1985, 1996; Arora, 1991; Song, 2002; Dutta and Weiss, 1997; Geringer and Hebert, 1989.) In line with this perspective, ownership-based foreign direct investment (FDI) was the most preferred governance structure when international transaction involved high degree of tacit knowledge. However, this argument was questioned from two fronts: (1) when transferors had the tacit knowledge advantages, how could hierarchical contracting mitigate hold-up and shirking hazards while transferees were on the disadvantageous side of the information asymmetry? (2) was there specific evidence to support the claim that hierarchical contracting, ownership-based FDI specifically, contributed to tacit knowledge transformation? The simplified

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recommendation on hierarchical contracting was inherently inconsistent with the fundamental propositions of TCE. According to Williamson, effective governance not only needs to mitigate potential hazards from both sides of the transaction, but also should act to facilitate cooperative relationship between the two parties as much as possible (Williamson, 1995, 1996, 1999.) The transaction would not be contracted in its entirety if transferees' original interests were compromised under the stringent control of transferors; its transaction cost would not be economized accordingly if the performance of tacit knowledge transformation was not assured. The most recent research on hold-up hazard of transferors and a comprehensive survey on FDI's impact over technology transfer cast substantial doubts over the effectiveness of hierarchical contracting in tacit knowledge transformation (Bao, 2000; Kullti and Takalo, 2002; Saggi, 2002). The above concerns naturally raise the question: what would be effectiveness contractual arrangements if hierarchical contracting is not the solution?

At the same time, some companies in the emerging market demonstrated tremendous success in acquiring tacit knowledge from foreign partners, such as companies in China (Farris, 2003). Their robust growth in productivity, international trade, manufacturing capabilities and increasing competitiveness in global market are evidences of successful acquisition of advanced technologies from international trading partners (Okabe, 2002). The puzzle is: how did Chinese companies successfully acquire advanced technologies from international trading partners? How did they overcome the difficulties in acquiring tacit knowledge embedded within the advanced technologies?

These two questions are two sides of one coin: we don't know what are the effective contractual arrangements; but we do know some Chinese companies must arrange the contract right. Logically, if we study the tacit knowledge transformation between Chinese companies and their international partners appropriately, we may detect their successful arrangements. We may be even able to generalize the results into the applications of other cases with the similar attributes. This turns to be our research motivation of this paper.

Our paper based on consecutive research surveys over 300 Chinese companies and field-trip interviews on 12 Chinese companies during the period of 1999-2003. In our research, we've found out some private contractual arrangements by Chinese companies to facilitate the tacit knowledge transformation. Because they sat over the disadvantageous side of information asymmetry regarding tacit knowledge, Chinese companies often dissolved transferors' control intention or accommodated their risk aversive tendency involving tacit knowledge. Their specific arrangements were summarized into the research variable construction as transaction-specific methods, incentives, contexts, relationships, and organized absorptive capabilities (MICRO in abbreviation). We used case studies and surveys to elaborate the specifics of MICRO contracting by Chinese companies.

During the process of elaboration, we've found tacit knowledge transformation had its unique transactional attributes such as sensitive, interpersonal, simultaneous, and experiential ones. These idiosyncratic attributes cannot be understood only within the discussion of generic governance of TCE. They are more suitably explained by the experimental view of knowledge management (Krogh, 1995; Krogh and Roos, 1996; Krogh and Nonaka, 2002.) By synchronizing transaction cost economics and knowledge management in the study of tacit knowledge transformation, our research results also provide empirical support to the call by Williamsons to push beyond generic governance to address strategy issues faced by particular firms, and include dynamic transaction costs and learning (Williamson, 1999).

## **Tacit Knowledge in International Technology Transfer**

Tacit knowledge has been an issue from the earlier studies over international technology transfer (Teecce, 1977). In fulfilling the purchasing contract of hardware, sellers have found out that they must train the buyers on how to operate the hardware. To carry out the training, sellers must extract related know-how, convert that into instructional materials, and share with buyers. By doing this, sellers faced several problems: (1) it cost sellers extra to share the knowledge, but they didn't know how to charge for the efforts; (2) it would give buyers portions of sellers' unique

know-how that they would not be able to obtain them through other channels, but buyers didn't know how to pay for it; (3) dynamic expertise that was hard to be described in written manuals could be very difficult to extract from the seller, as well as to be absorbed by the buyers, due to the lack of standardized formats or collective codification for these kinds of knowledge.

When more process knowledge and management know-how were involved in international technology transfers, the situation got even more complicated and difficult. The subject of trading was embedded knowledge and its impacts on improved capabilities of the users. As for the embedded knowledge, it was not only intangible and needed tangible formats, software or manual, to embody its contents, but also impossible to transfer in its entirety by regular trading mechanisms, such as purchasing software package or operational manual. The traditional spot transaction failed to accommodate the trades involving increasing portion of intangible knowledge.

In recognition of the increasing trades for knowledge, researchers studied formats of knowledge and their easiness for identification, standard codification, and separable teaching and learning (Nonaka, 1994, 1998). Their studies helped to differentiate knowledge into explicit and implicit categories. The explicit one is comparatively easier to be singularized for conventional trading, because its performance and value can be decided a priori between trading parties; while trading arrangements for the implicit one remains to be controversial.

The difficulty in dealing with implicit knowledge comes from more than its format. The implicitness is partially related to the cognitive limitations of human mind (Reber, 1989, 1993; Pinker, 1999); specific requirements for communication in its entirety (Polanyi, 1958, 1983); limitations on human language in conveying subtle message, written as well as oral; and strategic treatment on valuable expertise by individuals or organizations (Pinker, 1999). Meanwhile, researchers admitted that the most valuable expertise in all trades was actually rooted in the implicit portion of related knowledge. The expertise always consisted of both implicit and explicit portions of knowledge. The dynamic interaction of the two portions helped the experts to make better decisions in identifying problems and constructing solutions. When all other types of production factors were easily available in business competition, that capability in making better decision was the source for competitive competencies of business organizations. Unfortunately, users could not extract the explicit while still keep the power of expertise. Both the difficulty of acquisition and the distinctive value underscored the uniqueness of implicit knowledge. To reflect its multiple characteristics, tacit knowledge was appropriately named for this unique phenomenon. However, an effective framework for the transaction of tacit knowledge still remained to be seen.

## **Tacit Knowledge and Transaction and Transaction Cost Economics**

Transaction costs economics (TCE) treated the challenge of tacit knowledge transaction as the issue of measurement. TCE considered the impossibility in measuring tacit knowledge during transaction as the cause for a series of contractual hazards, moral hazards as well as agency problems. To mitigate the hazards and economize the transaction, research based on TCE suggested hierarchical contractual arrangements that accommodated transferors' concerns on non-measurable and uncompensated effort in transferring tacit knowledge, an effort that had high degree of asset specificity.

Research based on TCE argued that transferors needed tremendous effort to externalize tacit knowledge into formats for a teaching purpose. This kind of effort often incurred great costs on transferors. More than that, when recipients changed, the instruction must be adjusted accordingly. Such customized effort could be re-deployed without bearing substantial sunk costs. Therefore, it is a very asset-specific investment for transferors.

Even the externalization was successful, the performance of tacit knowledge transaction was not automatically guaranteed, because recipients absorbing capability also affected the performance. Depending on each transactional situation, transferors needed to allocate different degrees of instructing efforts to convey the externalized tacit knowledge. These efforts consisted of another portion of the asset specific investment.

Having the asset-specific investments clearly measurable, the issue of tacit knowledge transaction would be handled by any contractual arrangements that matched the return with the

investment, or no trade would be conducted. A clear measurement was not available because of the lack of standard codification of tacit knowledge and its transactional performance (how much is sent and received).

The dilemma is that transferors could not separate tacit knowledge from other formats of technology they were selling. Tacit knowledge was always embedded within the hardware, software, management know-how, and other operational manuals. When something as valuable as tacit knowledge could not be measured, the self-interested recipients could take advantage of the uncertainty and absorb it as much as they could without appropriately compensating the transferors. The adverse incentives in over-consumption and under-payment represent a typical case of moral hazard.

Worse than that, lack of effective measurement often followed impotent monitoring and enforcement of intellectual property rights associated with the tacit knowledge. Recipients might distribute the acquired tacit knowledge to extensive usages without the consent of transferors, let alone paying royalties. In many cases, transferors had to extract their internal know-how and instruct their foreign partners (transferees) to the level that the recipients were capable in executing the joint projects. Later on, transferors found out the precious business know-how was extended into unlawful usages by transferees. In any similar contracting relationship, the transferees were legally bounded to be restrictive in using the acquired business know-how from transferors. However, for pursuing their own agenda, the transferees often went out of the line since they knew it would be difficult for transferors to pinpoint the unlawful spill-over of acquired business know-how. Behavior like this gave rise to another contractual hazard as agency problem: when it is difficult to detect the spill-over usages, transferees would extend the acquired know-how for their own benefits, but at the costs of the transferors.

Any transferors would balk from the contract, when they had to face the situation that they must cast asset-specific investment, but could be harmed by moral hazard and agency problem during the transaction. In cases like these, the potential contractual hazards increased transaction costs, costs spent on extra measurement, negotiation, conflict arbitration, reinforced monitoring and other legal and administrative safeguards. In other words, the transaction would never be effective if the related contractual hazards were not mitigated.

Hierarchical contracting was suggested to be the effective contractual arrangements for transactions involving tacit knowledge (Oxley, 1999; Dutta, 1997). Hierarchical contracting was often referred to ownership-based administrative control in which the economic incentives of trading parties were aligned, the information on transactional performance of tacit knowledge was effectively circulated, and the needs as well as the costs of measuring, monitoring, and enforcing the contract on tacit knowledge were minimized. With the minimized costs in conjunction with the aligned incentives, the transactional costs would be economized by the standard TCE logics. Cited empirical evidences, research based on TCE further argued that there was a spectrum of hierarchical contracting matched with different level of tacit knowledge in knowledge transactions (Oxley, 1999; Shelanski et al. 1993). In general, the higher degree of tacit knowledge involved, the higher level of hierarchical contracting would be required for economizing the transaction costs.

Figure 1 depicts a simplified model on tacit knowledge, causes of contractual hazards, and proposed arrangements to economize the transaction costs. Research based on TCE usually started with the assumed involvement of tacit knowledge, suggested proxies that indicated the degrees of tacit knowledge involvement, and then tested the correlation between the proxies and the levels of internal control. The empirical results generally supported the proposition that hierarchical contracting accommodated tacit knowledge transaction.

The effectiveness of hierarchical contracting was challenged by both theoretical disagreements and empirical evidence (Shelanski et al., 1993; Bao, 2000). The theoretical challenge pointed to the narrow and incomplete interpretation of transaction cost economics in the empirical applications. Our survey over 150 Chinese companies between 1999 and 2000 also provided no support to the conclusion on hierarchical contracting.

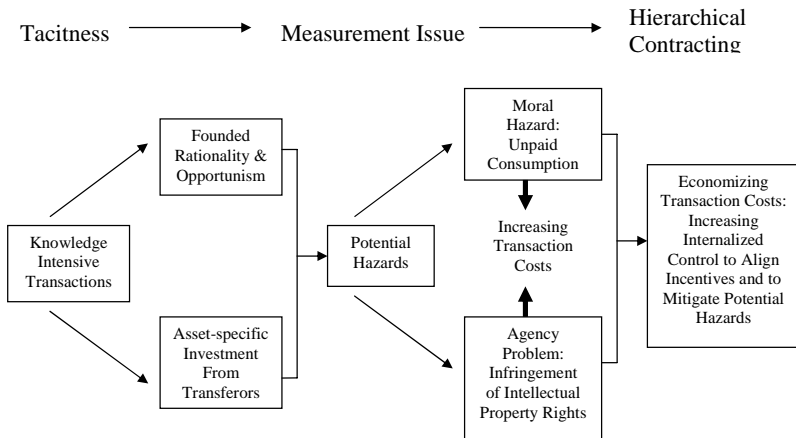


Fig. 1. A Simplified Model of Tacit Knowledge and Hierarchical Contracting

The theory of TCE emphasizes several systematic tenets. Two of them are: (1) Its fundamental purpose is to promote cooperative behavior among participants that consequentially leads to better usage of economic resources of the society; (2) TCE studies the transaction as the unit of analysis, and focuses on economizing transaction costs through comparatively effective governance, or contractual arrangements. The effectiveness of governance is judged by its power in mitigating contractual hazards and aligning incentives of contracting parties. The better are the mitigation and alignment, the more effective the governance is (Williamson, 1995, 1996).

In the existing studies, the general background of analysis is based on transferors' interests, namely, how to mitigate the contractual hazards from transferors' point of view. The cooperative behavior of transferors was assumed under the hierarchical contracting. Another untenable assumption is the automatic alignment of incentives between transferors and transferees once the transferors gained the internal control matched with tacit knowledge involvement. None of them could be assumed without controversy.

Empirical studies exposed the similar kinds of moral hazards and agency problems from the side of transferors. Transferors could hold-up their promised transfer of tacit knowledge while still enjoyed the benefit from increased internal control, when transferees had no measuring instruments to tell the causes of ineffective absorption. The ineffectiveness could be the insufficient instruction of transferors as well as the low learning capabilities of transferees. This moral hazard could not be detected unless transferees had the same level of knowledge capability as the transferors. Unfortunately, like the double faces of Janus, explicit know-how to transferors could be tacit knowledge for transferees due to the knowledge gap and related information asymmetry. Furthermore, transferors might misuse the internal control for their own agenda, such as market expansion and new distribution channel for parent company's products, at the cost of transferees. Our fieldtrip interviews over 12 joint ventures in China exposed a consistent pattern that foreign companies used the internal control advantage to promote the products from parent companies rather than facilitating tacit knowledge transaction. This is obviously another kind of agency problem under hierarchical contracting.

Hierarchical contracting failed to consider neither the moral hazard nor the agency problem caused by transferors, let alone mitigation of the hazards. If the original purpose of transferees was considered, the hazards from transferors' opportunistic behavior and its negative impacts on transferees' acquisition of tacit knowledge were at least neglected in the discussion of hierarchical contracting.

Some questions were also raised on the self-fulfilling and non-falsifiable test design of the existing studies. Few studies directly tested the transactional performance of tacit knowledge. The

empirical tests started with the identification of proxy measures of the tacit knowledge degree and indicators of internal control, and then tested the correlation between the proxy measurements of tacit knowledge and indicators of internal control. The level of internal control was considered as the same indicator of hierarchical contracting. When a positive correlation was verified, the studies concluded that the transaction costs were economized, assumingly the transactional performance was guaranteed. Our survey and case studies in China consistently revealed the opposite outcome, if transferees' intention for effective acquisition of tacit knowledge was fairly included in the calculation of transactional performance ( Bao, 2000).

Although TCE remains to be the powerful analytical framework on the issue of tacit knowledge, both the theoretical and empirical challenges were serious and provoked further exploration for effective arrangements for tacit knowledge transaction.

## Tacit Knowledge and Organizational Learning

Research on organizational learning provided some useful insights in answering the challenges over TCE-based analysis. According to organizational learning, knowledge is the most important factor for the survival and development of a firm. Knowledge learning is a critical activity in transactions among firms. The unique attributes of tacit knowledge add difficulties to the learning. However, if facilitating factors are appropriately organized, learning can be successful. Consequentially, the capability of organization will be improved, and the competitive advantages will be obtained as well.

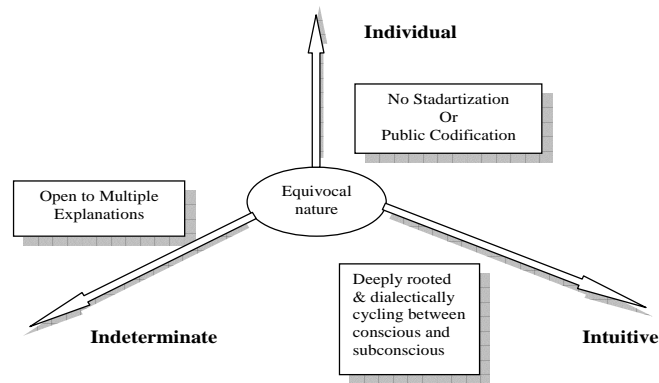


Fig. 2. Equivocal Nature of Tacit Knowledge

The facilitating factors include the recognition of the equivocal nature of tacit knowledge, an accommodating process, and organizational and contextual variables. As shown in Figure 2, the tacit aspect of knowledge was not confused with ambiguity, but defined by its equivocal nature, which in turn is explained by three attributes. They are as follows:

- The *individual attribute* explains the lack of public codification and standardization for tacit knowledge, and tacit knowledge is often captured within personal experiences.
- The *indeterminate attribute* shows the power of tacit knowledge relates to its openness for multiple explanations, which demonstrate the span and depth of its possible applications and at the same time, demand appropriate judgment.
- The *intuitive attribute* deciphers where the power and judgment come from.

They are from an integrated utilization of cognitive resources, at both conscious and subconscious levels.

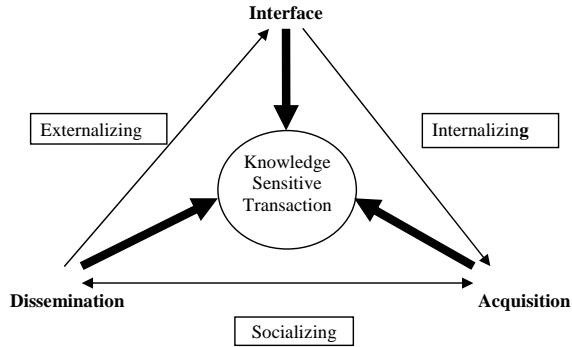


Fig. 3. Critical Processes of Tacit Knowledge Transaction

To accommodate the equivocal nature of tacit knowledge, the learning process must be designed rather than assumed. As shown in Figure 3, the transaction of knowledge is considered as a process of learning. The entire process consists of three parts: externalization (by transferors), internalization (by transferees), and socialization (between the two). Each part carries out a specific function of the learning. Externalization is for the function of dissemination of knowledge from transferors, internalization is for the function of acquisition of knowledge by transferees. The socialization process will guarantee an indispensable interface between the two for the learning purpose (Krogh et al., 1996).

To execute the learning process effectively, some organizational and contextual variables must be installed at the right time in the right place. Organizational variables include incentives for disseminating and acquiring and capabilities for externalizing and internalizing. Contextual variables can be the openness of the organization, relationship between the trading parties, and other background conditions.

When the process design and execution variables are all in place, organizational learning is expected to be effective. An effective learning will help the transferees to imitate the knowledge of transferors as much complete as possible. A good imitation contributes to the augment of new knowledge in transferees' organization, organizational capability and competitive competencies accordingly. Figure 4 is a graphic illustration of the causal relationship described above.

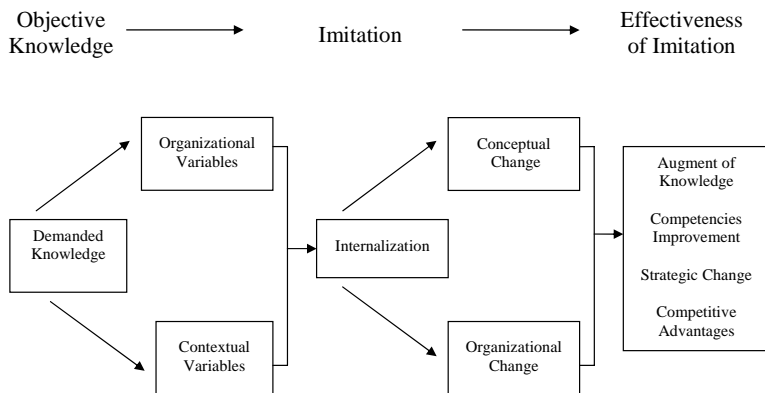


Fig. 4. A Simplified Model of Organizational Learning

The perspective of organizational learning substantially compensated the weakness of TCE-based analysis on the critical dimensions of tacit knowledge transaction. Unlike a general treatment in TCE-based analysis, organizational learning takes the transaction as a process of learning, and advocates specific features of the process. Therefore, any effective arrangements must do more than incentive alignment, they must accommodate the learning process as well. However, the illustration of the significance of the learning process also drew scrutinizing attention to itself. Is the learning a process of imitation? Should the transferees simply duplicate transferors knowledge? Could the knowledge be imitated precisely? All these questions challenged the assumption that there existed objective knowledge for representative duplication.

### Tacit Knowledge and Cooperative Experimentation

The most recent development on knowledge management responded to the imitation issue with a different answer. From the cooperative experimentation perspective, knowledge is never imitatively acquired, but actively experimented. When learners acquire knowledge, they more or less compare the knowledge with existing mental models and selectively deposit “useful” portion into their mind. An effective learning is not to imitate what is there, but creatively interpret what could be there (nothing there objectively, everything is interpreted already when entering into your mind). For instructors, the same experimentation mindset helps. Rather than thinking about duplicating the knowledge into the learners’ mind, instructors should pursue a more interactive route for mutually participated learning experimentation. In that sense, both learners and instructors are engaged into a process of making new knowledge for both of them through cooperative experimentation (Krogh et al., 1995, 1996; Weick, 1995).

As Figure 5 indicated, this cooperative experimentation requires direct participation, immersed experience, and creative utilization of multiple communication medias, such as story, scenario, heuristics, scripts, and different language instruments (rewording the learned in your own language, using analogy to capture different phenomena, etc.).

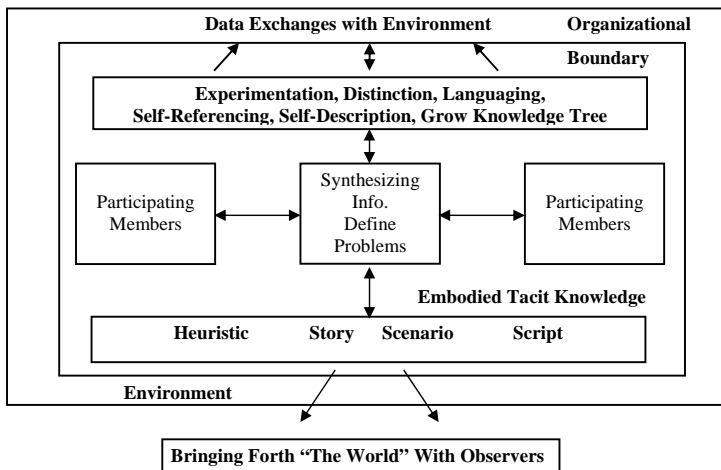


Fig. 5. A Knowledge Development Model from Autopoiesis Perspective



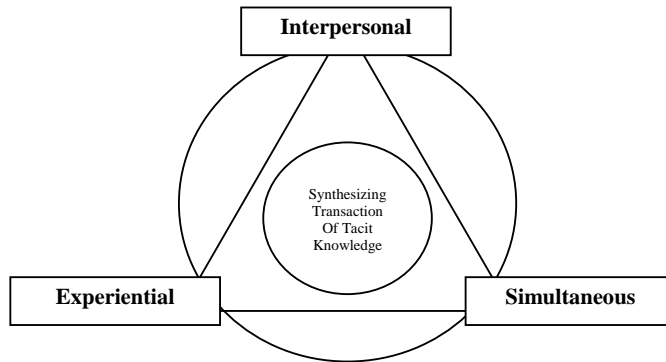


Fig. 6. Transactional Attributes of Tacit Knowledge

Inspired by the autopoiesis perspective (a perspective of cooperative experimentation), the transactional attributes of tacit knowledge are now more specific. Tacit knowledge could not be conveyed without personal interaction, and any efforts in codifying tacit knowledge would only succeed partially; tacit knowledge could not be separated from the context that it was supposed to apply, therefore must be taught and learned during practices; tacit knowledge could only be acquired in its entirety when its cognitive model corroborated with practical evidences, namely the experience. As shown in Figure 6, the transactional attributes of tacit knowledge must encompass interpersonal, simultaneous, and experiential learning.

From the cooperative experimentation perspective, we found some major enhancement in the course of our understanding of tacit knowledge transaction: (1) the critical dimension of tacit knowledge transaction is not simply a learning process, but a synchronizing process participated by both transferors and transferees; (2) any effective contractual arrangements must include designs that facilitate experiential, interpersonal, and simultaneous learning of tacit knowledge.

Going through the three different perspectives, we have gained extensive and in-depth understanding of tacit knowledge transaction. Each perspective contributed critical points to the understanding.

From TCE-based analysis, we now learn that (1) the transaction is the basic unit of analysis; (2) to economize transaction costs, we must have a contractual arrangement that can mitigate potential contractual hazards and align incentives of trading parties for cooperative behavior; (3) such a contractual arrangement can only be found along the clear identification of the critical dimension of the transaction as well as thorough understanding the major attributes of the transaction; and (4) effective arrangements are often innovative designs that may not exist in textbook solutions.

Learned from organizational learning perspective, we now understand that (1) the critical dimension of tacit knowledge transaction is the process of knowledge learning; (2) the learning process is rather complicated with three portions, and each portion matches a functional role in the learning process; (3) any effective arrangements must include factors that facilitate the learning process; and (4) the equivocal nature of tacit knowledge creates a much unique process of learning with its unusual attributes, comparing to regular learning.

The autopoiesis perspective not only provides answers to the unusual attributes of tacit knowledge transaction, but also pinpoints the nature of the learning process as synchronization of knowledge by participating parties. After integrating the findings from the three perspectives, the remaining question is now much simpler: are there contractual arrangements that would enable incentive alignments and facilitate tacit knowledge learning at the same time?

## MICRO Contracting for Tacit Knowledge Transaction: Variable Measurements and Hypotheses

In search for this new kind of arrangement, we used two criteria that serve the purpose of incentive alignment and learning facilitation: (1) unlike previous analysis that only emphasized the hazard mitigation on transferees, the new arrangements must mitigate the hazards on both sides; (2) to accommodate the transactional attributes of tacit knowledge, the new arrangements must include specific designs that enable interpersonal, experiential, and simultaneous learning.

We carried out a pilot survey in 1999 among 30 Chinese companies who had international technology transfers during the past five years. We also took four fieldtrips for case study between 1999 and 2002. Table 1 listed the first four companies we visited and interviewed in 1999, and Table 2 listed the second six companies where we conducted case study in 2000.

Table 1

A List of Companies for Case Study in 1999

Case Company	Region	Area	Origin	Contractual Features
Lucent Technologies of Shanghai	Shanghai Chao He Jin Economic Zone	Telecommunication equipment and parts	USA	50/50 percent Joint venture
Siemens Business Communication of Shanghai	Shanghai Pudong Economic Zone	Telecommunication equipment, switch board	Germany	40/60, foreign partner as minority shareholder
ICI Painting Materia Inc.	Guangzhou	Painting materials	Britain	30/70, foreign partner as majority shareholder
Shanghai GM Automobile Inc.	Shanghai Pudong	Assemble Buick 97 model	USA	Foreign company is majority shareholder

Table 2

A List of Companies for Case Study in 2000

Case Company	Region	Area	Origin	Contractual Features
Shanghai Belling Micron Electronic Inc.	Shanghai Chao He Jin Economic Zone	Micron chips	Belgium	Converting technology investment into non-voting shares
Shanghai Bell Inc.	Shanghai Pudong Economic Zone	Telecommunication products	Belgium	60/40 joint venture with Chinese majority
Shanghai EK Chor General Machinery Co.	Shanghai	Air-pressure machine	USA Britain	Technology certificate
Shanghai Tire & Rubber Co.	Shanghai	Tires	USA	Equipment purchasing
Wuxi Little Swan company Ltd.	Wuxi City	Household electronic appliances	Japan Italy	Equipment, trademark, technology certificate
Sunta Network Service Inc.	Shengzhen	Network integration and service	Israel	Key components supply and expert support

Our pilot survey and case studies supported our earlier conceptualization of tacit knowledge transaction, and also revealed some emerging patterns on contractual design for tacit knowledge transaction. Some interesting findings were consistent with theoretical discussions above, but

with more specific features. For example, we found that companies which were successful in acquiring tacit knowledge often inserted creative designs in the contract. These creative designs often allow transferors to have sufficient financial compensation with their matched commitment to disseminating tacit knowledge to Chinese companies. Some designs also went beyond conventional norms of intellectual property rights. One of the companies we investigated volunteered inspection on all their product lines and accepted total license control in order to assure transferors their commitment to intellectual property rights protection. Other designs were made to facilitate the absorption of tacit knowledge, such as foreign language training and mixed team with expatriates. Our initial findings illustrated several insightful phenomena that allow us to develop a comprehensive questionnaire for further survey. These emerging phenomena were: (1) transferors would commit to tacit knowledge transaction if transferees made it clear that their intellectual contribution would be compensated and protected; (2) transaction would be effective if facilitating factors were specifically included, even tacit knowledge itself could not be specified directly; (3) interpersonal relationship mattered a lot. Good relationship promoted effective communication between expatriates and Chinese team members; (4) what differed tacit knowledge transaction from other types of knowledge transaction was the sensitivity both sides demonstrated during the transaction. Transferors were sensitive to fair compensation and protection of their expertise; transferees were sensitive to committed behavior from transferors to disseminate their expertise; (5) a combination of designs helped to improve the commitment from both sides and facilitate the results of tacit knowledge transaction.

Following specific designs found from different cases, we conjectured that the incentive alignment and learning facilitation were accommodated by a combination of contractual designs on transactional methods, incentives, contexts, relationship, and organized absorption during tacit knowledge transaction (MICRO contracting as the acronym).

We proposed that any effective contractual arrangements would include the five components in tacit knowledge transaction, although the specifics of each component might be different from case to case.

Figure 7 demonstrates the five components and their transaction-specific designs inspired by the pilot survey and case studies.

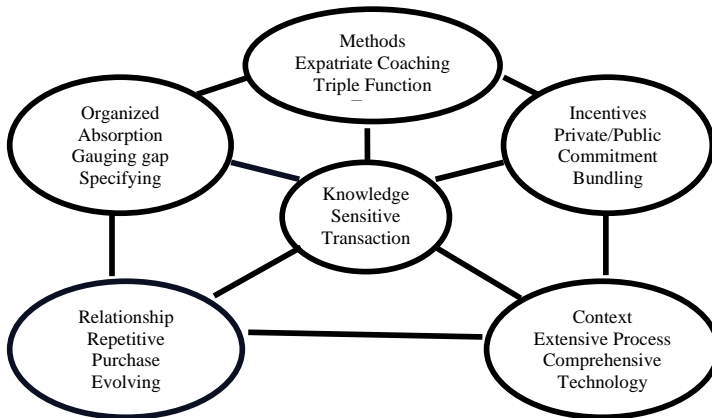


Fig. 7. Representative Designs of MICRO Contracting

H1: Transaction-specific methods are positively related with the performance of tacit knowledge absorption

H2: Transaction-specific incentives are positively related with the performance of tacit knowledge absorption

H3: Transaction-specific contexts are positively related with the performance of tacit knowledge absorption

H4: Transaction-specific relationship are positively related with the performance of tacit knowledge absorption

H5: Transaction-specific organization of absorptive capability is positively related with the performance of tacit knowledge absorption

H6: The combined designs of transaction-specific methods, incentives, contexts, relationship, and organized absorption have positive correlation with the performance of tacit knowledge transaction

## Design of Empirical Study

Errors in quantitative studies often arise from mismatch among cognitive model of subject understanding, contextual attributes of the subject, and measurements of representative indicators. To avoid the similar problem, we went through the following steps for our study:

**Step One:** Conducting case studies to “feel” out the subject.

**Step Two:** Conducting pilot statistical surveys. As described above, both steps helped us to postulate causal relationships among potential explanatory variables and the performance of tacit knowledge transformation.

**Step Three:** Tuning survey questionnaires. Based on the results of pilot survey and case studies, we consulted experts in related fields, and conducted further literature reviews for in-depth researcher knowledge, and revised the questions in the survey to match the contexts of the subject and related domain knowledge. For example, absorptive capabilities were originally measured by the educational level and experiences of the transferee team. Our preliminary research showed both educational background and experiences could be too vague in measuring the dynamics of the absorptive capabilities. Our case studies indicated that strategic gauging of the knowledge gap, and specific commitment to fill in the gap by the transferees could be a better indicator of the intentional and strategic organization of absorptive capabilities. We then revised the measurement accordingly.

**Step Four:** Collecting data from over 300 companies for factor and regression analysis. The confirmatory factor analysis is used to verify the validity of the five identified dimensions. Multiple regression analysis is used to test the six hypotheses.

To directly measure the performance of tacit knowledge transformation, questions on the impacts of technology transfer over the productivity, procedural knowledge, and problem-solving techniques were applied in the survey. To test the validity of these measures, we also asked questions about the impacts over very specific aspects of management, such as process management, human resources, management of R&D, etc. We assume the two kinds of impacts should correlate with each other in the same direction.

Transaction-specific methods were measured by the extent of using expatriate coaching, and triple-function team design which help to create effective learning network required for tacit knowledge transformation (Bessant, 1999.) The expatriate coaching method was also widely practiced by Chinese companies. When expatriates played the role of coaches, the teacher-student mentality facilitated both the dissemination and acquisition of tacit knowledge. Also, through our case studies, we found out that successful companies often assign three functions to the transfer team, namely, working with transferors to complete the project, digesting the knowledge and skills during the transfer, and sharing the knowledge with other departments after the transfer. We believed these two contributed to effective communication of tacit knowledge, especially the intercultural requirements of effective communication are considered (Harvey and Griffith, 2002).

Transaction-specific incentives were represented by the general arrangements of favorable treatments according to public policy, such as tax exemption and tariff reduction for transferors, specific arrangements on bundling contract for profit-sharing and intellectual property protections. Policy related treatments are considered the public incentives in general. Firm-level arrangements on profit sharing based on the projected improvement of productivity and revenues are considered the private incentive. Transferees often yielded the projected future profit through a bundling contract with promised purchasing of more hardware and replacement parts at the prices above the market level. Another private incentive was to include specific mechanisms for monitor-

ing and enforcing the intellectual property right protection. For example, a Chinese air conditioner manufacturer voluntarily accepted the licensing arrangement on all of its assemble lines, even the company only imported two assemble lines from the U.S. company. This voluntary term allowed total inspection from a U.S. company, and eliminated the concern of internal spill-over of the transferred technology. Private enforcement of intellectual property rights was found to be effective in China before (Clarke, 1998).

The variable of transaction-specific context was measured by the comprehensiveness of the transferred technology and process extensiveness of the transfer. In viewing technology as a system, the more components of the system are transferred, the more comprehensive the transfer is. Additionally, transfer process can be divided into multiple phases: installment activities, operational management activities, upgrade activities, etc. The more phases in the contract, the more extensive the transferors would involved in the process at personal level. Both contribute to the enrichment and incarnation of the original context for tacit knowledge.

Transaction-specific relationship was measured by the functional interactions as repetitive transaction and evolving purchasing. The functional attributes were considered the indispensable in knowledge transfer (Albino, 1999; Kotabe, Martin and Domoto, 2003). Both measures point to a long-term relationship. Repetitive transaction refers to the purchasing of the same level technology more than once. The evolving purchasing refers to the purchasing from the simple version to the sophisticated version of technologies during a period of time from the same transferors.

Organized absorptive capabilities were measured by the gauging of knowledge- gap and specific commitment to fill in the gap. In the course of preliminary case study and pilot survey, we found out both the intention and capability in gauging of knowledge gap were better representatives of the capability at the cognitive level than educational and experiential indicators of the Chinese employees. Education and experience could be quite irrelevant with the transfer contexts and therefore show less validity in measuring the absorptive capabilities. If gauging indicated the planning part of the cognitive capability, the implementation part of the absorptive capabilities could be reflected in specific commitments, such as specific structure and compensation policy, to fill in the gap (Anderson, 1981; Lane and Lubatkin, 1998). It indicated the absorptive capabilities in action.

All variables are measured on a 7-point Likert scale. For example, we ask participants to evaluate "the impacts of technology transfers over the problem-solving capabilities of participating employees" on a 1 to 7 Likert scale. 1 represents the least evident impact, 7 represents the most evident impact.

During the period of 1999-2003, we distributed over 300 survey forms, and collected 159 valid ones. These survey forms were collected from three different regions of China in order to maintain randomness in sampling.

We also include control variables in the size of the transferee companies, and the country origin of the transferor companies in our analysis. We suspected the larger the transferee was, the more effective would be the transfer, simply because large companies would have more resources to commit in the tacit knowledge acquisition. We included the country origins as Asian, North American, and European, because North American and European transferors were generally considered to be more open and generous in knowledge sharing by Chinese managers in our case studies.

## **Results and Discussion**

### ***Factor Loading Analysis***

To make sure the five dimensions of MICRO contracting mutually distinctive, and to detect any overlapping measurements of the five dimensions, we run a factor loading analysis. The results reported in the factor loading table (Table 3) support the distinctiveness of the 5 identified dimensions.

Table 3

## Factor Loading Illustration Based on Component Matrix of Factor Analysis

	Incentive-Specific Factor	Method-Specific Factor	Org. Capability-Factor	Relation-Specific Factor	Context-Specific Factor
Absorb Capacity	<u>.505</u>	.110	<u>.802</u>	.295	-.050
Extensive Process	.134	-.010	.000	.061	<u>.349</u>
Compreh. Technology	.306	-.035	.106	-.014	<u>.848</u>
Expatriate Coaching	<u>.389</u>	<u>.657</u>	-.036	-.264	-.106
Triple Function	.210	<u>.452</u>	.003	.122	-.051
Repetitive Purchasing	.139	.035	-.132	<u>.339</u>	.211
Evolving Purchasing	<u>.310</u>	<u>.380</u>	-.227	<u>.591</u>	.016
Restrict Policy	.265	.040	.249	.004	.265
Knowledge Gap Gauging	.036	.080	<u>.403</u>	.078	.271
Bundled Profit sharing	<u>.536</u>	.105	.112	.029	.181
Intellectual Protection	<u>.399</u>	.118	.146	<u>-.425</u>	.059

Initial Eigenvalues: 4

Extraction Method: Principal Component Analysis

5 Components Extracted Based on Scree Plot

Rotation Method: Unrotated.

Total Variance Explained: 85.9% variance explained by 5 components.

\_\_\_ indicated significant factor loading for this study

### ***Correlation Matrix***

Table 4 presents the correlation matrix for dependent, independent and control variables. The purpose of correlation matrix analysis is to detect any potential multicollinearity between variable measures. Results from Table 4 indicate an expected multicollinearity between expatriate coaching and country origins of transferor ( $\beta = .735$ ). In our case studies, we found that companies from North America were more willing to provide hands-on coaching than those from Japan. Another interesting finding from the matrix is the significant correlation between tacit knowledge transformation and most of the independent variables, except bundling contracting and joint working team arrangements. These significant relationships between dependent and independent variables show high measurement reliability in the statistical model.

Table 5 lists the results of the multiple regressions. The statistical results confirmed the validity of the model of MICRO contracting at the significant level of .000 with R2 equals to .56. Four of the five variables of MICRO contracting were confirmed at least on one design at the significant level of .05. The transaction-specific incentives failed to be confirmed on all designs at the significant level of 0.05.

Table 4

## Correlation Matrix

	Org. Absorb	Ext. Process	Comp. Tech.	Expt. Coach	Triple Team	Evolving Purchase	Repetitive Purchase	Restrict Policy	K. Gap Gauging	Bundle Incentive	Intellect Protect	Country Origin	Tacit Transform
Org. Absorb	1.000												
Ext. Process	.163*	1.00											
Comp. Tech.	.253*	.251*	1.00										
Expt. Coach	.477*	.138	.108	1.00									
Triple Team	.216	.138*	.206	.097*	1.00								
Evolving Purchase	.238	.191	.210*	.217	.240	1.00							
Repetitive Purchase	.150	.089	.021	.206*	.105	.283	1.00						
Restrict Policy	.323	.560	.178	.185	.274*	.144	-.060	1.00					
K. Gap Gauging	.240	.406	.211	.182	.184	.239	.119	.196	1.00				
Bundle Incentive	.195	.140	.452	.057	.147	.192	.069	.219	.121	1.00			
Intellect Protect	.290	.057*	.129	.319	-.061	.082	-.072	.149	.072	.207	1.00		
Country Origin	.434*	.116	.146*	.735*	.088	.185*	.329	.161*	.188	.152	.362	1.00	
Tacit Transform	.614*	.124*	.269*	.532*	.240	.314*	.232*	.194*	.215*	.111	.335*	.359*	1.00

\* significant at p = .05 level, one-tailed  
 \_high correlation and possible conellarity problem  
 Variable coding see appendix

**Multiple Regression Results**  
Dependent Variable: Tacit knowledge acquisition by transferees

Model	Independent Variables	Unstandardized Coefficients		Standardized Coefficients		Significant Level
		B	Standard Error	Beta	t	
<b>Organized Absorption</b>						
	Specific Commit.	.538	.115	.384	4.669	<b>.000</b>
	K Gap	.325	.164	.147	1.985	.097
<b>Context-Specific Variables</b>						
1.	Extensive Process	-.445	.162	-.063	-.719	.473
2.	Comprehensive	.513	.263	.148	1.952	<b>.050</b>
<b>Method-Specific Variables</b>						
1.	Expatriate Coaching	1.950	.459	.429	4.244	<b>.000</b>
2.	Triple Team	.641	.531	.086	1.207	.230
<b>Relationship-Specific Variables</b>						
1.	Repeating	1.101	.986	.081	1.117	.267
2.	Evolving	.327	.152	.162	2.150	<b>.034</b>
<b>Incentive-Specific Variables</b>						
1.	Restrictive Policy	-.299	1.185	-.022	-.252	.802
2.	Bundled Incentive	-.617	.438	-.106	-1.409	.162
3.	Intellect Protection	.656	.234	.206	2.809	<b>.006</b>
<b>Control Variables</b>						
1.	Country Origin	-.311	.432	-.284	-.2747	<b>.007</b>
2.	Size	.437	.549	.056	.795	.428

R = .744, R<sup>2</sup> = .56, adjusted R<sup>2</sup> = .49

Std. Error of the Estimated: 4.87

Df. 16; F = 8.5

Significant Level of the Model: .000

The final statistical results are consistent with our case studies. In our case studies, we found that few companies were able to skillfully utilize all five kinds of arrangements, although some were strong on certain arrangements but weak on the others. The interviewees commented that their innovative contracting is less a systematic arrangement, but more an impromptu action based on experiences. This also explained why each variable demonstrated strong correlation with tacit knowledge transformation separately, but few showed statistical significance when putted into a multiple regression model together.

At the same time, the significant results on specific arrangements corroborated our initial hypotheses. For example, specific commitment to fulfill the knowledge gap was proved to be a strong component of organized absorptive capabilities; Purchasing multiple components of tech-



nologies (comprehensive purchasing of technologies) also showed significant contribution to the enacting a learning context of tacit knowledge.

The most interesting findings are the significant relationship between expatriate coaching arrangement and evolving transactional relationship between the two parties. Direct personnel turn-over from one company to an other have been considered as the most effective method to acquire tacit knowledge. Our study showed that the value of the converted personnel was out of their coaching activities to other employees in the new organization, rather than a simply hiring of the talented. The significant role of evolving transactional relationship pointed to the importance of constructing social capital in international transaction. Our case studies revealed that evolving relationship often had a cooperative style. Unless transferees heavily depended on the transferors on technological supplies, transferees would not continue the relationship with transferors if it was not cooperative. Starting from simple engagement and gradually moving to more complicated transactions, the evolving path certainly demonstrated a much reliable process of tacit knowledge transformation.

The less expected result is the test on transaction-specific incentives. We later realized that each company experimented its own deals with its foreign partners based on specific attributes of each transaction. Because the composition of transactional attributes of each deal was different, it would be hard to detect a generally applicable incentive framework. It also called for extreme attention on the importance of idiosyncratic incentive arrangements (private incentive arrangements) in tacit knowledge transformation.

### ***Implications for Future Research***

There are multiple implications for further exploration on this topic. Firstly, it would be interesting to introduce this MICRO contracting to transferees as an experimental guiding framework, and conduct a longitudinal test on the effects of MICRO contracting. Secondly, simplified hierarchical contracting is certainly not the final answer to economic transactions involving tacit knowledge. There is still a lack of empirical studies on integrating generic TCE governance with the unique process of tacit knowledge dissemination and acquisition. Our research at least acted as a call to more research in this field. Another related field would be the study on social capital and its role in tacit knowledge transformation in international transactions. Recently, Blyler and Coff proposed that social capital played a role in rent generation and appropriation in the context of dynamic capabilities (Coleman, 1988; Winter, 2003; Blyler and Coff, 2003). At the same time, firms still lacked appropriate framework for external sources of technological capabilities, and mainly focused on internal ones (Das, 1987; Zahra and Nielsen, 2002). Given the direct relationship between tacit knowledge and dynamic capabilities and increasing role of external sources for dynamic capabilities, the study on social capital and its impact over tacit knowledge transformation would be fruitful. The last potentially valuable research could be related to the pricing of the externalities of tacit knowledge (Blomstrom, & Kokko, 2000; Aitken, Brian, Hanson, and Harrison, 1997; Coe and Hoffmaister, 1999; Okabe, 2002; Spencer, 2003). There are increasing concerns over the knowledge spill-over effects in international trades. Rather than narrowing our view on finding a better control mechanism, our research indicated the potential to creatively design a better sharing mechanism on the economic externalities of tacit knowledge transformation.

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