

**MANAGING KNOWLEDGE CONVERSION  
PROCESS ACROSS BORDERS:  
TOWARD A FRAMEWORK  
OF INTERNATIONAL KNOWLEDGE  
MANAGEMENT**

**by**

**K. ASAKAWA\***

**95/91/OB**

- \* Phd Candidate, at INSEAD, Boulevard de Constance, 77305 Fontainebleau Cedex, France; Lecturer in International Management, at Keio University, 2-1-1, Hiyoshi-honcho, Kohoku-ku, Yokohama 223, Japan.

A working paper in the INSEAD Working Paper Series is intended as a means whereby a faculty researcher's thoughts and findings may be communicated to interested readers. The paper should be considered preliminary in nature and may require revision.

Printed at INSEAD, Fontainebleau, France

**MANAGING KNOWLEDGE CONVERSION PROCESS ACROSS BORDERS:  
TOWARD A FRAMEWORK OF INTERNATIONAL KNOWLEDGE MANAGEMENT**

**Kazuhiro Asakawa  
INSEAD  
Boulevard de Constance  
77305 Fontainebleau Cedex  
France  
33-1-60 72 40 00 (phone)  
33-1- 60 72 42 42 (fax)  
ASAKAWA@INSEAD.FR (internet)  
and  
Keio Business School  
2-1-1, Hiyoshi-honcho, Kohoku-ku,  
yokohama 223, Japan  
81-45-562-1185 (phone)  
81-45-562-3502 (fax)  
asakawa@nwgw.kbs.keio.ac.jp**

-----  
- The former version of this paper was presented in the International Management Division at the 1995 Annual Meeting of the Academy of management, Vancouver (August 8, 1995).

**MANAGING KNOWLEDGE CONVERSION PROCESS ACROSS BORDERS:  
TOWARD A FRAMEWORK OF INTERNATIONAL KNOWLEDGE MANAGEMENT:**

**Abstract**

Development of a general framework on the way firms convert and transfer overseas local knowledge across borders is attempted. It is argued that the organizational arrangement of international knowledge conversion is not only contingent on structure and type of local knowledge but is also influenced by managerial and institutional factors.

-----  
The author is particularly grateful to Profs. Yves Doz and Arnoud De Meyer for their helpful comments in the earlier version of this paper. This research was partially funded by INSEAD and the Sasakawa Foundation.

One of the major purposes for companies to localize R&D abroad is to tap into local knowledge and innovation (Terpstra, 1977; Cheng and Bolon, 1993; Pearce and Singh, 1992a,b; Behrman and Fischer, 1980). How do companies approach local knowledge abroad? In reality, companies approach local knowledge in different ways. At first glance, we can see some general differences at several different dimensions. The first dimension is of **geography**: For instance, the way the Japanese firms approach Western local knowledge seems to be different from the way the Western firms approach Japanese local knowledge. For example, while the Japanese firms, if any, generally prefer to set up their wholly-owned local subsidiaries in the West, the Western firms tend to prefer contract research with local Japanese organizations (Westney, 1993). If so, why? The second dimension is of **research task**: The way firms approach local knowledge in basic research seems to be different from the way firms approach local knowledge in applied research. For example, the way firms coordinate their local basic research labs seems to be looser than the way firms coordinate local development labs. If so, why? The third dimension is of **industry**: The way firms approach local knowledge seems to be different across industries. For example, the way firms coordinate local R&D labs in pharmaceutical industry seems to be looser than the way firms coordinate local R&D labs in electronics industry. If so, why? What factors affect companies approaches to local knowledge in such different ways at each dimension?

This paper will address such an issue and attempt to develop a general framework on the way companies process overseas local knowledge in terms of **organizational arrangement** by associating it with the structure and the type of knowledge.

The structure of knowledge: The way the local knowledge is organized (i.e. where the knowledge lies, how easy to access it, etc.) varies across geography and the type of knowledge. While some knowledge is less organizationally-exclusive and is more accessible through individuals or through public data source, other type is so organizationally-exclusive that high barriers exist for the outsiders to access that knowledge. For example, scientific knowledge at universities is more accessible than scientific knowledge in private firms, since it is considered a public good. Geographically, it is said that Japanese knowledge on industrial research tends to be more organizationally-exclusive than its Western counterpart, since the staff mobility across companies is

so low that the scientists generally join and stay at the companies for the long term and therefore accumulate scientific knowledge that is more company-specific. How does such difference in knowledge structure affect the way firms approach the local knowledge? Such a geographical difference in the way firms approach local knowledge will be explained in terms of different structure of local knowledge.

The type of knowledge: The recent "globalization of knowledge" (Badaracco, 1991) doesn't necessarily mean the universalization of knowledge. While some local knowledge is more articulated and more easily transferrable across borders, some knowledge remains to be more tacit, locally-specific, lumpy, harder to get access from distance (Westney, 1993), and more costly to be transferred to other parts of the world. In general, if scientific knowledge is considered more articulated and market knowledge is more tacit, how do companies approach such different types of knowledge abroad? Do they approach them in different ways? What kind of arrangement-organizational, structural and managerial- do they make according to different types of knowledge? The arrangements may include such dimensions as entry mode, degree and nature (formal/informal) of external research collaboration, and recruitment patterns. The ways firms approach different types of local knowledge (i.e. articulate or tacit) may vary across research task (basic/applied) and industry. How and why would they be different? Such contrasts will be explained in terms of the different types of local knowledge.

After examining closely the impact the structure and type of local knowledge have on the way firms approach the local knowledge independently, the next step will be to integrate these factors to show how the firms take a particular approach to the local knowledge contingent on different combinations of the structures and the types of the local knowledge, and home and host country factors. Such an attempt will be made at three different levels: **rational, managerial, and institutional** (Parsons, 1960; Thompson, 1967)<sup>1</sup>.

---

---

insert Figure 1 about here

---

---

---

<sup>1</sup> Each of them corresponds to Scott's (1987) rational, natural, and open systems respectively.

At the rational level, the firms' organizational approach to local knowledge will be investigated in the contingent relations with the structures and the types of knowledge. At the managerial level, it will be investigated in the context of the managerial dilemmas in the organizational tension inherent in overseas R&D management, such as **autonomy-control and integration-responsiveness tensions**. At the institutional level, it will be investigated in the context of institutional, cultural impacts. In all, the goal of this paper is to develop a comprehensive organizational framework of local knowledge processing which could explain, for example, why the Japanese and the Western approaches are different on the one hand, and which could present the underlying logic behind such a difference.

## CONCEPT OF KNOWLEDGE APPROPRIATION AND CONVERSION

### Definition of knowledge

Knowledge: The concept of knowledge is drawn from Nonaka (1994) which defined it as "justified true belief." From the knowledge creation perspective, knowledge is "a dynamic human process of justifying personal beliefs as part of an aspiration for the truth." "While information is a flow of messages, knowledge is created and organized by the very flow of information, anchored on the commitment and beliefs of its holder" (Nonaka, 1994; 15). Kogut and Zander (1992) classified knowledge into information and knowhow. Information is defined as "knowledge which can be transmitted without loss of integrity once syntactical rules required for deciphering it are known." Information includes "facts, axiomatic propositions, and symbols." Knowhow is defined as "the accumulated practical skill or expertise that allows one to do something smoothly and efficiently (Von Hippel 1988)." According to Kogut and Zander, "knowledge as information implies knowing what something means, and know-how is a description of knowing how to do something." In this paper, the term "knowledge" is used instead of "information" because the way the firms organize themselves to extract relevant information out of a flow of local messages, to add value by conversion, and to integrate it into the firm's belief system is of major concern here.

Knowledge type: The distinction between "tacit" and "articulated" knowledge (Polanyi, 1966;

Hedlund and Nonaka, 1993; Nonaka, 1994) is adopted here and called the types of knowledge. Tacit knowledge is defined as "knowledge which is intuitive, non-verbalized and yet unarticulated," whereas articulated knowledge is "specified either verbally or in writing, computer programmes and the like" (Hedlund and Nonaka, 1993: 118).

**Knowledge structure:** The structure of knowledge is defined as the way the local knowledge is organized (i.e. where the knowledge lies, how easy to access it). It is "open" if the local knowledge is shared among individuals or can be publicly accessible, and it is "closed" if it is organizationally exclusive and high access barriers exist for non-organizational members. This distinction is very important to make because we often hastily equate tacit with organizationally exclusive. The openly accessible yet tacit knowledge should not be overlooked.

### Knowledge appropriation

Appropriation of knowledge is defined as the acquisition of existing local knowledge out of a flow of local information<sup>2</sup>. The firms first need to identify the existence and availability of a particular knowledge. This process may take various different forms.

The firms need to identify if the kind of knowledge they are looking for actually exists. This step includes not only their search for the knowledge itself but also their search for any raw data which could be converted to the knowledge later. If a particular kind of knowledge actually exists, they then need to identify if that is available. The availability depends primarily on the structure (open/closed) and secondarily on the type (tacit/explicit) of the knowledge they look for. ~~It may well~~ be that the knowledge exists but difficult to get access to because of its closed structure. It may also be the case in which the knowledge exists but so tacit and contextual that it is difficult to appropriate. In the former case, the firms may try to penetrate the closed knowledge structure through some forms of close inter-organizational arrangement: joint R&D venture, research contract, etc. In the latter

---

<sup>2</sup> While Hedlund and Nonaka (1993) differentiate "appropriation" (i.e. knowledge input from related organizations) from "assimilation" (i.e. knowledge input from the extraorganizational environment), we simply call them both knowledge appropriation, as "the taxonomy is a matter of taste and convenience," as Hedlund and Nonaka (1993) pointed out.

case, the firms may try to understand the tacitness. In each case, it requires extra effort on the part of the firms to appropriate such closed and/or tacit local knowledge relative to the open, explicit local knowledge. This requirement for such extra effort is called knowledge appropriation cost.

### Knowledge conversion

Conversion of knowledge refers to the switching mechanism from locally-appropriated knowledge to the firm-specific knowledge. Once local knowledge is appropriated at the local R&D labs, it may be converted and most commonly be transferred to elsewhere within the firm, either to the HQ or to other subsidiaries. The knowledge conversion takes many different directions: from locally-specific to more standard; from locally-specific to another locally-specific; from basic to applied; from applied to basic; from basic to basic; from applied to applied; from tacit to explicit; from tacit to tacit; from explicit to tacit; or from explicit to explicit (Nonaka, 1994). Via knowledge conversion process, new knowledge is created, whether basic or applied, for the firm's own use.

Nonaka's (1994) four modes of knowledge conversion (socialization, internalization, externalization, and combination) represent a knowledge creation process. Knowledge conversion is a rather wider concept which signifies not only from locally-appropriated knowledge to the internal application but also to a further knowledge creation as well.

### Organizational conformity

Organizational conformity refers to the similarity between knowledge transfer units in terms of organizational forms, structure, nationality, cultural background, languages, etc, both at explicit and implicit levels. For example, host country national may increase external conformity with the local environment while decreasing internal conformity with the headquarters and the rest of the company. Expat managers, on the other hand, may increase internal conformity while decreasing external conformity with the local environment. Internalization of local operations may increase external conformity at the expense of internal conformity, since that may bring about heterogeneity within the organization.



## THREE DIMENSIONS: RATIONAL, MANAGERIAL AND INSTITUTIONAL

### **Rational Organization-Knowledge Contingency**

At the first, **rational level**, the mechanistic logic of organization-knowledge contingency will be explored. Unlike the traditional contingency theory (Lawrence and Lorsch, 1967), this contingency model deals with the link between the degree of internal/external organizational conformity and the knowledge structure and type. The way firms organize their overseas R&D activities for the purpose of local knowledge access is assumed to be defined largely by the structure and the type of the local knowledge. "Under the norms of rationality" (Thompson, 1967), how do the firms make the organizational arrangements contingent upon the structure and the type of the local knowledge?

The structure and the type of the local knowledge may determine, to some extent, the level of knowledge appropriation and conversion cost, which may, in turn, determine the internal/external organizational conformity. External conformity becomes important when the local knowledge is hard to get access. Internal conformity becomes important when the appropriated local knowledge is so locally-specific that it requires internal communication. How do the structure and the type of local knowledge affect the costs of the local knowledge appropriation and conversion? How do the local knowledge appropriation and conversion costs affect the internal/external organizational conformity? Through such an inquiry, the contingency relations between the structure and the type of knowledge and the internal/external organizational conformity will be identified.

-----  
insert figure 2 about here  
-----

While such a mechanistic organizational logic alone doesn't capture the whole localization pattern of the overseas R&D, it will provide a core organizational mechanism under which different firms under the different conditions localize their R&D differently.

The local knowledge may be converted either to the standard form for general use, or to a particular form for specific use, or to another different form for future knowledge creation. While some knowledge may be purely "local-for-local", a large portion of the locally-appropriated knowledge is usually meant to be used either at the centre or for standard use, i.e. the "locally-leveraged" innovation process (Bartlett and Ghoshal, 1990). In that case, knowledge conversion efficiency, i.e. the efficient conversion from locally-specific to standardized knowledge becomes important. Even the outstanding knowledge appropriated locally might become a loss if the cost of conversion outweighs the merit of knowledge appropriation. Knowledge conversion efficiency is determined by the level of knowledge appropriation cost and knowledge conversion cost.

The level of each type of cost is determined by the combination of the type and structure of the local knowledge the firms are seeking. The following four patterns are the first set of propositions.

**Proposition 1.1.** When the local knowledge is tacit and closed, both the knowledge appropriation cost and the knowledge conversion cost are very high.

**Proposition 1.2.** When the local knowledge is tacit and open, both the knowledge appropriation cost and the knowledge conversion cost are high.

**Proposition 1.3.** When the local knowledge is articulated and closed, the knowledge appropriation cost is high and the knowledge conversion cost is low.

**Proposition 1.4.** When the local knowledge is articulated and open, both the knowledge appropriation cost and the knowledge conversion cost are low.

How does organization respond to the high knowledge appropriation cost? How does organization respond to the high knowledge conversion cost? How does organization respond to the high knowledge appropriation and conversion costs simultaneously? And finally how does organization respond to the low knowledge appropriation and/or conversion costs? Here the appropriation and transfer of knowledge will be connected to the organizational context. The following is a set of the related propositions:

**Proposition 2.1.** When the knowledge appropriation cost is high, the need for external organizational conformity is high.

**Proposition 2.2.** When the knowledge conversion cost is high, the need for internal organizational conformity is high.

**Proposition 2.3.** When these knowledge costs are high, organizational conformity, whether external or internal, becomes essential to facilitate communication for the benefit of knowledge appropriation and conversion.

If these are true, the requirement of external and internal organizational conformity can be specified according to the combination of the type and the structure of local knowledge:

**Proposition 3.1.** When the local knowledge is tacit and closed, the requirement for both the external and internal organizational conformity is very high.

**Proposition 3.2.** When the local knowledge is tacit and open, the requirement for both the external and internal organizational conformity is high.

**Proposition 3.3.** When the local knowledge is articulated and closed, the requirement for the external organizational conformity is high but the requirement for the internal organizational conformity is low.

**Proposition 3.4.** When the local knowledge is articulated and open, the requirement for both the external and internal organizational conformity is low.

=====  
insert Figure 3 about here  
=====

**Managerial Factors Influencing Organizational Arrangement**

At the second, **managerial** level, more organic aspect of determinants of a certain organizational arrangement will be investigated. While the way the firms make different organizational arrangements of their overseas R&D activities may largely be determined by the underlying organizational logic as presented above, there are other factors which may also influence the way the firms approach the local knowledge. The organizational logic will be constrained by other organizational factors. Then what are the organizational constraints? The challenge of acquiring local knowledge lies in the fact that the fundamental managerial dilemmas associated with overseas R&D management need to be dealt with. Contrary to the organizational logic, the managerial dilemmas perspective takes into account managerial discretion, with the assumption that managers don't always behave according to the norms of rationality.

Contrary to such a mechanistic contingency between structure and type of knowledge and the need for internal/external organizational conformity, the actual decision and implementation of the organizational arrangement involves a highly organic managerial actions. The actual organizational arrangement often doesn't reflect the need for conformity specified by the contingency model. What are the managerial factors? How do they influence the actual organizational arrangement?

The managerial factors consist of the interpretation of the need for organizational conformity, the managerial devices to arrange the conformity, and the response to organizational tensions the managers face at the time of implementation.

**1. Interpretation:** First, the need for organizational conformity needs to be interpreted by managers with the boundary role (Tushman, 1977). While the accurate environmental scanning or gate-keeping (Allen, 1977) of the knowledge environment is required to the managers, the degree of accurateness varies across individuals. Therefore:

**Proposition 4.1.** The degree of actual organizational conformity reflects managers' interpretation of the need for organizational conformity.

**2. Devices for conformity:** Once the need for conformity is interpreted by managers, what would be the managerial devices to cope with such needs for the external and internal organizational

conformity?

First, the device for the external organizational conformity: The prime need for this type of device arises from the high knowledge appropriation cost associated with the organizationally-exclusive (closed) knowledge structure. What would be the effective devices to penetrate into such closed local knowledge structure? The following devices need to be examined among others: the long-term socialization device vs. the short-term contract device.

Second, the device for the internal organizational conformity: The prime need for this type of device arises from the high knowledge conversion cost associated with the tacit knowledge type. What would be the effective devices to transfer such knowledge efficiently as well as effectively? The following devices need to be examined among others: modes of communication, integrating mechanisms, shared value and mission, etc.

Finally, the device for both external and internal organizational conformity: The prime need for this type of device arises from the high knowledge appropriation and conversion costs associated with the combination of tacit and closed knowledge. What would be the effective devices to meet the requirement for both external and internal organizational conformity simultaneously?

While this point is closely related to the challenge for simultaneous organizational pressure for global integration (I) and local responsiveness (R) (Prahalad and Doz, 1987), this paper intends to advance the concept of multinational tension by looking at the relations between the I-R tension at the knowledge dimension and the I-R tension at the organizational dimension simultaneously. Rather than looking at the I-R tension at each dimension separately, our main interest here is to identify the way a certain knowledge configuration affects the organizational configuration.

**Proposition 4.2.** The degree of actual organizational conformity reflects the availability of managerial devices for the organizational conformity.

3. Response to organizational tensions: The way managers implement organizational conformity based on their interpretation and on their managerial devices is also defined by the way they deal with the fundamental organizational dilemmas they face during their local knowledge appropriation process.

The challenge of acquiring local knowledge lies in the fact that the following fundamental managerial dilemmas associated with overseas R&D management need to be dealt with: While successful appropriation of local knowledge requires local scientists' formal and informal interaction with local research community (Von Hippel, 1987,1988), excessive "knowledge-link" (Badaracco, 1991) might potentially endanger protection of core knowledge and corporate governance; Creative research requires autonomy, but certain degree of control is also required to maintain organizational unity; Excessive commitment to acquisition of local tacit knowledge might sacrifice internal tacit knowledge caused by lack of internal communication; Basic research requires long-term intangible investment, but it has to respond to short-term bottom-line oriented pressure from the business side.

Why do such dilemmas exist? The source of such dilemmas can be traced back to the uniqueness of international R&D management. First, unlike other functions, R&D embraces its dual nature: on the one hand, R&D (especially R) is strongly driven by what we call "Scientific logic" (thereafter S-logic), i.e. the logic of quest for truth, the pressure from "Business logic" (thereafter B-logic), i.e. the logic of profit maximization, is not trivial. The companies ultimately expect the potentially useful research findings even from the very basic research labs, for otherwise there would be no difference from the pure research at the universities. While appropriating state-of-the-art local knowledge is encouraged, excessive pure research with no potential commercial application whatsoever even in the long term is supposed to be discouraged. The period of recession may accelerate such bottom-line oriented pressure from the business side of the company. However, the real difficulty lies in the fact that no one is sure whether the particular research would be totally useless or not when the research is conducted.

Second, regardless of company's formal external research links, the scientists always maintain informal research networks. This makes organizational boundary blur in the knowledge dimension. While companies sense the need for control and coordination to some extent for the sake of corporate unity, traditional control mechanisms wouldn't apply well to S-logic-driven organizations. Not only bureaucratic control but also social (cultural, normative) control doesn't seem to work as much, since under the norms of S-logic, scientists feel more strongly attached to their profession than to their employers.

Third, this tendency becomes augmented in the international dimension in which the cost of internal communication caused by geographical distance, language difference may outweigh the cost of communication with local partners. The international dispersion of R&D (especially R) signifies the shift in locus of knowledge from center to periphery. Such decentralization of knowledge may enhance relative status of local R&D labs, which makes central corporate control further difficult. On the other hand, the possible alternative control mechanisms remain to be unclear.

**Proposition 4.3.** The degree of actual organizational conformity reflects the way the managers deal with the fundamental organizational dilemmas they face during their local knowledge appropriation process.

### **Institutional/Cultural Isomorphism**

At the third, **institutional** level, the impact of the institutional/cultural factors on the way the firms approach local knowledge will be explored. The institutional/cultural environments include both home and host countries, and the extent to which the firms' organizational approaches to the local knowledge are isomorphically-pulled to the host or home country environment will be important here (DiMaggio and Powell, 1983).

The impact of institutional/cultural factors on the way firms approach local knowledge is both direct and indirect: It is direct in that the organizational arrangement itself is embedded (Granovetter, 1985) in the social context. It is indirect in that the institutional/cultural factors also influence the managerial and the rational factors listed above, since the managerial approach is highly culturally-determined, and the rational contingency model is determined by the structure and the type of knowledge which are socially constructed (Berger and Luckmann, 1966).

The organization-knowledge contingency model had the structure and the type of knowledge as input variables and the external/internal conformity as output variables. The institutional/cultural factors have strong impact on both input and output variables.

1. Impact on the structure/type of local knowledge: Both the structure and the type of

knowledge is locally-embedded (Badaracco, 1991; Granovetter, 1985). As for the structure of the local knowledge, it is said, geographically, that the Japanese industrial knowledge tends to be more organization-specific than its Western counterpart (Westney, 1993). At the R&D level, the Japanese scientists tend to stay in the same companies for long-term base, and their interaction with their colleagues within their own organizations is assumed to be thicker than their interaction with someone outside of the organizations. The knowledge to be accumulated within the organizations become more organization-specific. Scientists pay a huge cost of switching companies because even a large portion of R&D knowledge is company-specific. Through dense ties with other functional divisions over several decades, the R&D researchers become "intra-company specialists" (Nishida, 1993), who create company-specific knowledge.

In contrast, the Western knowledge is said to be less organization-specific than its Japanese counterpart. The Ph.D scientists don't seem to rush into long-term employment contract. After Ph.D, they usually spend several years as post-doctoral fellow at either academic or private institutions until they formally get jobs, which may not be as long-term based as in Japan. In this type of system, a large portion of scientific knowledge belongs to individual scientists on the one hand, and to the local research community through informal interaction among scientists, academic conference and publication, etc., on the other hand.

As for the type of local knowledge, it is said, geographically, that the Japanese R&D knowledge tends to be more tacit than the Western R&D knowledge (Hedlund and Nonaka, 1993). While it seems to be very difficult to verify such a general statement, the dialogue across units at different levels (individual, group, organization, and inter-organizational) may take place more frequently at tacit knowledge level in Japan than in the West (Hedlund and Nonaka, 1993). Such a difference may correspond to the distinction in high/low context culture (Hall, 1976), and even to the structural differences between the Western and Japanese languages. Therefore;

**Proposition 5.1.** The type and the structure of local knowledge are institutionally embedded in local environment.

2. Impact on organizational arrangement: The extent to which firms maintain internal/external



organizational conformity and the way they make organizational arrangements (ranging from wholly-owned local R&D labs to contract research) are also influenced by the institutional environments, both of the host and the home countries.

To what extent are the firms' approach to the local knowledge pulled toward home country environment versus toward host country environment (Rosenzweig and Singh, 1991)? On the one hand, one could argue that the overseas R&D is more isomorphically-pulled to local environment for mimetic and normative reasons (DiMaggio and Powell, 1983): it is mimetically pulled to local environment because of the uncertain relationship between means and ends in the local R&D; it is normatively pulled to local environment because of the extent of professionalization (i.e. greater reliance on academic credential, the greater participation in professional associations, greater dependence on scarce local resources, etc.). On the other hand, one could also argue that the way the firms conduct overseas activities is largely determined by home country institutional/cultural practice (Laurent, 1983), defined as a "set of highly established and culturally sanctioned action patterns and expectations" (Lincoln et. al. 1986), or the technological performance of the foreign countries is closely correlated with the technological performance of their home country (Patel and Pavitt, 1992; Pearce and Singh, 1992a,b).

This paper suggests that we examine the way a combination of home and host country environments influences the firms' overseas R&D localization patterns. More concretely, different ways of overseas R&D arrangement between the Western and the Japanese firms could be explained based on the institutional characteristics of the home and host countries.

With the impact of the institutional/cultural factors on these two elements above combined, the following are some contrasts to capture different arrangements of local R&D between the Western and the Japanese firms, building on Westney, 1993:

**Contrast 1: the type of knowledge: articulate vs. tacit:**

a) The Western firms tend to form R&D contract with the local Japanese partners more often than vice versa, reflecting their home-country practice based on the assumption that the knowledge is articulated enough to be obtained through contract.

b) The Japanese firms tend to set up their wholly-owned local subsidiaries in the West more than vice versa, reflecting their home-country practice based on the assumption that the

knowledge is so tacit that one cannot obtain it by mere contract.

**Contrast 2: the structure of knowledge: open vs. closed:**

a) The Western firms tend to form R&D contract with the local Japanese partners more often than vice versa because the local Japanese knowledge tends to be more company-specific than publicly pooled. Since the knowledge tends to belong more to organizations than to individuals, they could obtain better information through inter-organizational contract than through interactions with individual Japanese scientists.

b) The Japanese firms tend to set up their wholly-owned local subsidiaries in the West more often than vice versa because the local Western knowledge is more individualized or publicly pooled than company-specific. Therefore they could obtain sufficient information from the local Western individual scientists, who are tightly integrated into local research community, by recruiting them in their local subsidiaries.

**Contrast 3: high vs. low context culture:**

a) The Western firms tend to form R&D contract with the local Japanese partners more often than vice versa because even the contracted local Japanese scientists are more inclined to associate their research to the overall business mission (high context culture, Hall, 1976), hence low need for the internalization of contract.

b) The Japanese firms tend to set up their wholly-owned local subsidiaries in the West more often than vice versa because the Western local scientists are less inclined to associate their research to the overall business mission (low context culture, Hall, 1976), hence high need for internalization of contract.

**Contrast 4: contract vs. trust:**

a) The Western firms tend to form R&D contract with the local Japanese partners more often than vice versa because the contract-based social logic is institutionalized in the firms' behavior. As a result, they may end up overutilizing contract at the expense of long-term integration to local research community that is indispensable for true absorption of tacit local knowledge.

b) The Japanese firms tend to set up their wholly-owned local subsidiaries in the West more often than vice versa because the trust-based social logic is institutionalized in the firms' behavior. As a result, they may end up over-internalizing local research activities to replicate their domestic companism atmosphere abroad at the expense of short-term efficiency of absorbing the articulate local knowledge.

In sum,

**Proposition 5.2.** The way firms make organizational arrangements is institutionally embedded in both host and home country environments.

## TOWARD A FRAMEWORK OF CROSS-BORDER KNOWLEDGE CONVERSION

### Integrated Framework

Now that these three dimensions of the local knowledge conversion framework have been presented separately, the dynamic process across each dimension will be framed in an integrated way.

As has been discussed, the structure (closed/open) and the type (tacit/articulate) of local knowledge would influence knowledge appropriation and conversion costs, respectively. The levels of such costs define the need for organizational conformity: High knowledge appropriation cost would increase need for high external conformity, whereas high knowledge conversion cost would increase need for high internal conformity. Such needs for external/internal conformity, in turn, would influence the mode of organizational arrangement for overseas R&D, such as the choice between establishment of wholly-owned local subsidiary and contract research.

=====  
insert Figure 4 about here  
=====

The knowledge-organizational conformity contingency itself is a rational, mechanistic model, which processes the input of the structure and type of knowledge. However, companies often divert from such rational model. Why? The reason is that the link between the need for external/internal conformity and actual organizational arrangement of local R&D also involves institutional and managerial factors. The actual organizational arrangement involves a tension between rational contingency need for conformity on the one hand and the institutional/managerial forces on the other. It is **institutional** in that the modes of organizational arrangement (such as wholly-owned local subsidiary or joint R&D alliance, etc.) are largely institutionally-embedded (both in home/host

country). It is **managerial** in that the managerial responses to organizational tension would influence the actual organizational arrangement.

Furthermore, the organizational arrangement (i.e. internal/external conformity; mode of external linkage), in turn, would define the level of knowledge appropriation/conversion costs. The performance is determined by the efficiency of the knowledge cost minimization.

### Positioning of This Framework in the Literature

How is this framework different from Hedlund and Nonaka (1994), Kogut and Zander (1992), Teece (1991), Pisano (1990), Cohen and Levinthal (1989), and others? Such a question may be raised, especially because this framework uses the concept named “knowledge appropriation cost,” which instantaneously reminds of transaction cost economics (TCE). TCE’s main argument is internalization of transaction by efficiency criteria (Williamson, 1975, 1985; Pisan, 1990). Knowledge has long been considered a public good which is easy to transfer, which involves zero transfer cost (McGee, 1977), therefore no need to internalize it (Buckley and Casson, 1976). Teece (1977) was a pioneer of claiming the significance of knowledge transfer cost arguing that technology is not a public good. By distinguishing technology into two types- embodied and unembodied-, he called attention to the latter. Since Teece (1977), transfer of technology and knowledge has been associated with efficiency in transaction.

My argument extends the dependent variable to include organizational arrangement in the form of conformity, which is a broader concept than internalization. In my framework, internalization (i.e. local hire; set-up or acquire local subsidiary) is only one solution for organizational conformity.

Kogut and Zander (1993) defined firms as social community that specializes in the creation and internal transfer of knowledge. While their argument is not based on TCE, as they argue for efficiency in internal knowledge transfer as an organizational vehicle *relative to other firms*, not relative to market failure. Still, their argument is yet for internalization based on rational efficiency

model. My framework is to show other factors than efficiency that divert from the rational model. In other words, my main point is to show how companies *divert* from the efficiency-based rational model. Cohen and Levinthal's (1990) concept of "absorptive capacity" is insightful for developing my organizational conformity in the context of knowledge transfer, since their concept, absorptive capacity, is based on prior related knowledge and diversity of background. They pointed out the trade-off between inward-looking and outward-looking absorptive capacities, and trade-off between diversity and commonality of knowledge across individuals. Here we can see the link between absorptive capacity and knowledge type. However, the argument remained general and hasn't specified when and under what condition are they more effective than others.

In most studies on knowledge management, efficiency-based rational approach and cultural approach (non-rational, institutional, social constructionism) are done separately. My framework is to combine them, to reintegrate them into one single framework, and to examine the tension among them.

### Concrete Examples

This framework can be better captured by applying some concrete examples of cross-border knowledge conversion. Since this paper is primarily meant to be conceptual rather than empirical, only the most typical cases from our field data will be summarized here.<sup>3</sup> Although we have only referred to R&D-related knowledge so far, in this section, we draw on concrete examples that include not only R&D-related knowledge but also market-related knowledge to attain more intuitive illustration.

How do companies actually process different type and structure of local knowledge? As shown In Figure 2, we have roughly classified local knowledge into four types according to different combination of type and structure. Our attention here goes to the way companies follow or depart

---

<sup>3</sup>This paper represents the conceptual part of our empirical research on international knowledge management between European and Japanese firms.

from rational model in each of these types.

Type 1: tacit and closed knowledge:

This type of knowledge includes any kind of knowledge that is not only locally-specific but also company-specific. For example, a large portion of new product development knowhow in Japanese firms is considered rather company-specific. Fragrance and colour composition techniques in Europe involve not only country-specific nuance but also cross-company differentiation in subtlety. How do European firms process tacit and closed Japanese knowledge? How do Japanese firms process tacit and closed French knowledge?

According to our proposition, both needs for external and internal conformity are very high. If we take the example of the Japanese companies trying to absorb fragrance composition knowhow from Europe, they face the following dilemma: Whether they should send the Japanese expat fragrance specialists to Europe and let them learn and transfer the European-specific knowhow back home, or they should hire European local specialists and let them convey the local tacit knowledge to the Parent. While the former option would strengthen internal conformity, the latter option would increase external conformity. The rational contingency model would suggest that they use both the Japanese expat and the local specialists extensively.

In reality, however, the companies may **not necessarily** follow that path. **Managerially**, it is difficult to obtain closed local knowledge through individual local hires unless they engage in contract with local firms, but such an inter-firm linkage would make firms' internal consistency fragile. It is also managerially challenging to manage European and Japanese specialists with different background and taste. On top of that, **institutional** factors specific to home/host country practices would give some bias to the way they use the local hires and the Japanese expats.

In the case of Japanese firms, management practice is pulled more toward the home-country practice (Kenney and Florida, 1993), thus they prefer to use their Japanese expat specialists to their local counterpart. Even if the firms look for tacit knowledge, their administrative heritage (Bartlett and Ghoshal, 1989) makes the Japanese firms to prefer to maintain internal consistency through extensive use of expats. And in spite of the need for inter-organizational arrangement such as joint venture or contract to appropriate closed local knowledge, the Japanese firms tend to stick to the

internal solution.

Similarly, the way the European firms approach company-specific knowledge in Japan doesn't always conform to the **rational** contingency model. Instead of strengthening both external and internal conformity through extensive use of their own expats and the local hire, they generally tend to rely on joint venture and contract agreement with the local Japanese partners to appropriate closed local knowledge. While it seems more efficient in the short run, the very tacitness cannot easily be obtained through such inter-organizational arrangement. Nevertheless, **managerially** it makes sense to minimize cost and risk of local knowledge appropriation through contract and joint venture given their relatively shorter-term orientation for output, and **institutionally** the Western firms are more used to external knowledge linkage than the Japanese firms (Pearce and Singh, 1992a).

#### Type 2: tacit and open knowledge:

This type of knowledge includes local market needs and taste, consumer preference, and any kind of locally-specific management and research practice. While such knowledge is not organizationally exclusive, it is so tacit that an extra effort is required to appropriate it, to convert it, and to use it. While our rational contingency model suggests that there are needs for both external and internal conformity, firms may **not necessarily** conform to this model.

For example, the Japanese firms have sent their expats to absorb tacit Western knowledge rather than relying on the local hire. This approach lacks external conformity while securing internal conformity. An anecdote tells that a famous Japanese automotive company sent a group of its employees to the West with the assignment to study how the Western people use cars. The group of employees spent a month walking around in big cities to observe people, and they discovered that the Western women have longer fingernails than the Japanese women, therefore in order to sell their cars in the Western market the car door should be designed differently; the sufficiently deeper space behind the door handle should be created so that nobody would have a problem of opening the door regardless of the finger size.

While they could live with this approach to this extent, they would find it difficult with this approach, beyond a certain level, to process extremely tacit knowledge which would require local expertise. Here is an anecdote: In Kao's lab in Germany, a Japanese expat specialist developed a

fragrance of woods, but for the European specialists, it was more of the *miso-soup* than of the woods! In another Japanese cosmetic company, a Japanese fragrance specialist was sent to France to select a certain composition which may appeal Japanese consumer taste as well, and he was pleased with his choice. However, the moment he came back to Japan, he regretted his own choice made in France. A certain preference is so embedded in local climate such as humidity that even the most respected expert couldn't help changing his taste in a different natural environment. Here the firm couldn't maintain not only external conformity but also internal conformity as well. Furthermore, since the basic research practice involves tacitness embedded to local environment, the companies seem to rely more on locally-hired scientists rather than sending their own Japanese scientists abroad. However, by doing that the companies are taking a risk of losing internal conformity at the expense of external conformity.

Similarly, the Western firms have been experimenting whether extensive use of local hire would be more effective than the use of the Western expats in Japan. Given the higher failure rate of the Western expat assignment than that of the Japanese case (Tung, 1988), particularly in the case of the Western expats in Japan, they have tried to rely on the local Japanese staff. However, they have been facing the problem of internal communication, i.e. between the Western headquarters and the Japanese locals, which inhibited smooth transfer of local tacit knowledge to the headquarters. Recently, many Western multinationals have been successful in recruiting the new Japanese MBAs willing to bridge the gap between them, but still with the limited extent, and only within the range of non-specialized type of knowledge.

Here again, we have seen that both the Japanese and the Western firms do **not necessarily** follow the rational contingency model, largely because of the managerial and institutional factors.

### Type 3: articulated and closed knowledge:

This type of knowledge includes any knowledge that is explicit and easy to transfer but so organizationally-exclusive that difficult to appropriate. For example, national scientific project for military purpose would produce articulated yet highly closed knowledge. Industrial R&D produces articulated scientific knowledge, but the companies try to protect it from knowledge erosion. The rational contingency model tells that the need for external conformity is higher than the need for



internal conformity.

In this case, both the Western and the Japanese firms we look at don't seem to have any other option but to increase the level of external conformity through extensive commitment to local research and business community, in the forms of participation in joint research venture, R&D consortium, government-sponsored research project, and various other informal linkages with local research community. However, the degree of external conformity may vary according to different managerial and institutional factors.

#### Type 4: articulated and open knowledge:

This type of knowledge includes any explicit and publicly available knowledge. Public data and information that can be obtained from library, data base, conference and other source represent this type of knowledge. As defined by the rational contingency model, neither external nor internal conformity is required to obtain this type of knowledge.

### A FURTHER RESEARCH AGENDA

The discussion thus far points to a number of factors that influence the way firms appropriate, convert, and transfer overseas local knowledge with various types and structures. We have only begun to investigate the causal relations among knowledge structure, knowledge type, knowledge appropriation/conversion cost, need for external/internal conformity, and managerial and institutional factors. We need to know a good deal more about the specific link among these constructs. Especially, a good deal more research is needed on when, how and why do companies depart from our rational contingency model assumption.

For that purpose, all these highly abstract constructs need to be operationalized, so that we could examine more precisely how these variables affect one another. (A preliminary attempt to operational definition of constructs is shown in appendix.)

Although at a very preliminary stage, we begin to see some interesting and important implications to management. For example, to what extent should a company rely on its expats or on

local hire in order to appropriate local knowledge? If the company sends the expats abroad and to appropriate local knowledge through them, internal communication should be more efficient and there should be lesser problem in knowledge transfer. But this approach may be less effective in the case of trying to obtain highly locally-specific tacit knowledge. On the other hand, if the company relies on the local hire with the host-country nationality, appropriation of local tacit knowledge should be secured. But this approach may be less efficient in terms of cross-border knowledge transfer. The former case involves high risk of knowledge appropriation loss, whereas the latter case involves high risk of knowledge conversion loss. We know very little about the mechanism under such a phenomenon. If we could find out more about the clear causal link among all these constructs discussed above, we might be able to say something useful about such a managerial decision which may be more generalizable even beyond the R&D function..

In the same token, such managerial decision as to whether the company should rely on inter-organizational arrangement (such as contract and joint venture) or on its own wholly-owned subsidiary might benefit from this line of research. Perhaps both the Japanese and the Western firms are missing something in each other's market. The Japanese may need to realize their efficiency loss caused by their preference for over-internalization of local activities even when they could save cost through contract arrangement. The Western firms may need to realize their effectiveness loss caused by excessive use of contract research which doesn't always capture locally-embedded tacit knowledge sufficiently. The Western firms may need not only more external organizational conformity but also more internal organizational conformity when they attempt to appropriate local tacit knowledge in Japan. The Japanese firms may need to "unlearn" the general benefit of internal conformity in order to be truly efficient. Moreover, we need to advance our argument beyond the static conformity to more dynamic connectivity/linkages of organizational arrangement as a strategic variable.

This paper represents only a beginning of our further research effort in that direction.

## APPENDIX

### Some Suggestions for Operationalization of the Constructs

**Knowledge structure:** Openness and closedness can be measured at both the objective and the subjective levels. **Objectively**, the knowledge location will be the key indicator of the degree of openness and closedness. Knowledge at universities is classified as more open than knowledge at private firms; Knowledge held by the individuals who are independent or loosely tied with their organizations is classified as more open than knowledge held by the individuals who are tightly linked to their organizations; The Japanese individual knowledge holders tend to be more tightly linked to their organizations than the Western individual knowledge holders. **Subjectively**, the respondents' perception of the openness/closedness of the knowledge needs to be measured.

**Knowledge type:** Since the demarcation between tacit and articulated knowledge is difficult to be identified in the knowledge spectrum, the construct needs to be measured both at the objective and the subjective ways. **Objectively**, the dimensions of industry and research task can be used: For instance, knowledge dealt with in pharmaceutical research could generally be classified as more articulated than knowledge in electronics research; Knowledge in basic research is classified as more articulated than knowledge in applied research. **Subjectively**, the respondents' perception of each specific knowledge they are dealing with would complement and modify the rough generalization to be made at the objective level.

**Knowledge appropriation cost:** It consists of all the costs of identifying existence and location of the knowledge, of learning the new knowledge, and of arranging the infrastructure which enables the learning to take place. For the purpose of operationalizing this construct, both quantitative and qualitative measurement need be introduced: **Quantitatively**, the amount of time and people it takes to appropriate the particular knowledge can be measured; **Qualitatively**, the respondents' perception as to the barriers to local knowledge appropriation can be asked. The latter includes the respondents' perception as to the cost-benefit balance sheet of the knowledge appropriation.

**Knowledge conversion cost:** It consists of all the costs of transferring the locally appropriated knowledge to other parts within the firm, of converting the knowledge from one type to another, such as from locally-specific knowledge to standardized knowledge. For the purpose of operationalizing this construct, again the quantitative and qualitative measurement needs to be introduced: **Quantitatively**, the amount of time it takes for various modes of communication (meeting, written and oral communication, translation, etc.) can be measured; **Qualitatively**, the respondents' perception as to the barriers to internal conversion of the locally-appropriated knowledge can be

asked.

External conformity: This construct consists of organizational structure and behavior. In the **structural** dimension, the extent to which the inter-organizational arrangements (ranging from wholly-owned local R&D labs to contract research) are isomorphically-pulled to the particular local environments (country, industry, research task, etc.) needs to be measured with reference to the institutional-wide data on the way they do in the local environment. Pearce and Singh's (1992a) data, for example, indicating the different patterns of inter-organizational arrangement between R&D and external parties in the US, Europe and Japan, will be used as the basis. In the **behavioral** dimension, the extent to which the way firms approach local knowledge is isomorphically-pulled to the particular local environments can be measured with reference to the institutional-wide data on the way they do in the local environment. Hedlund and Nonaka's (1993: 129) Western and Japanese archetypical models of knowledge-creation process, which incorporate the knowledge type (tacit/articulated) and the different units (from individual to inter-organizational), can be used as the basis for comparison.

Internal conformity: This construct also consists of organizational structure and behavior. In the **structural** dimension, the extent to which intra-organizational arrangements are internally-consistent needs to be measured by comparing all the organizational units which send and receive the particular knowledge. In particular, the extent of internal consistency in hierarchical structure, responsibility, and background among the senders and receivers of the particular knowledge needs to be examined. In the **behavioral** dimension, the extent to which the ways firms process the appropriated knowledge are internally-consistent can be measured by comparing between the behavioral process of senders and receivers of the knowledge in the context of Hedlund and Nonaka's (1993) process model.

FIGURE 1  
THREE LEVELS OF ANALYSIS

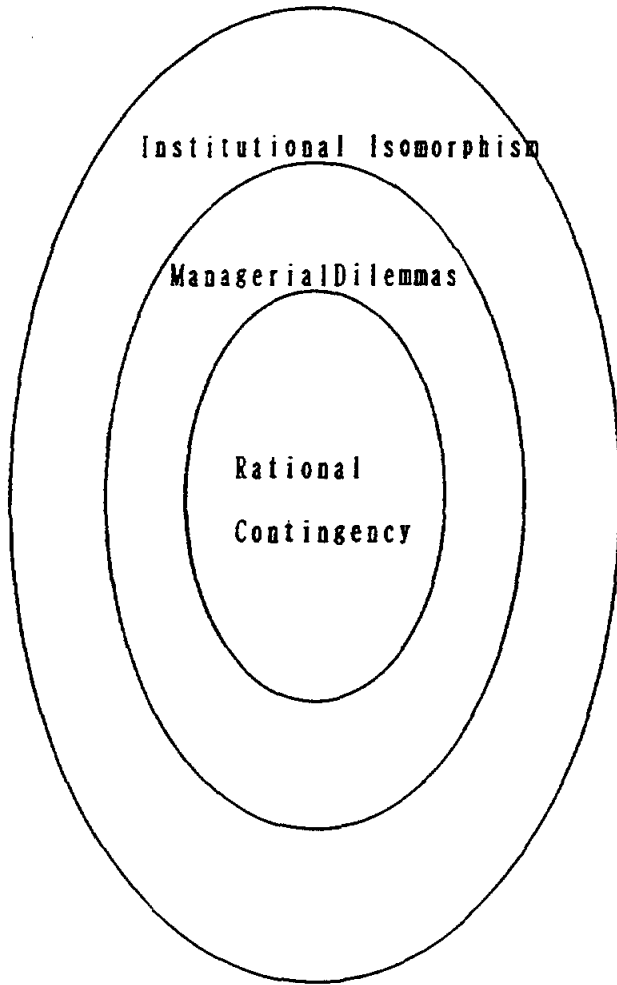
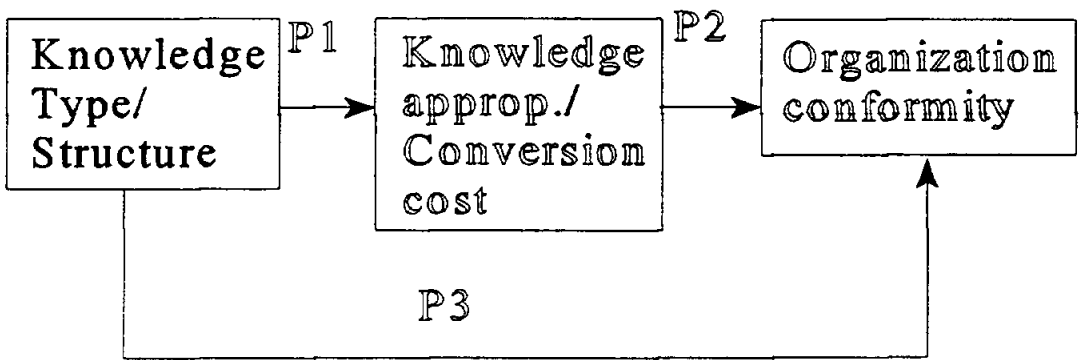


FIGURE 2  
RELATIONS AMONG THE HYPOTHESES



**FIGURE 3**  
**MATRIX OF RATIONAL ORGANIZATIONAL-KNOWLEDGE CONTINGENCY**

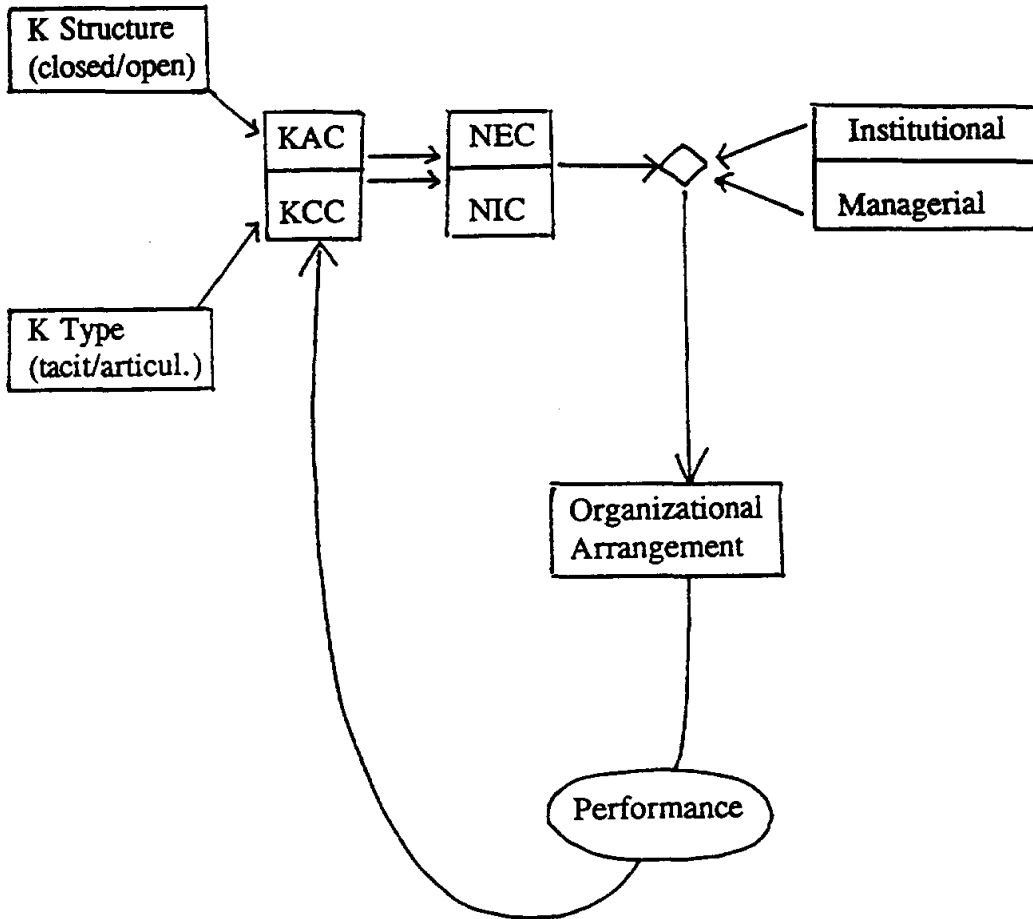
Type	Tacit	<p><b>Proposition 1.1.</b>          KAC: very high          KCC: very high</p> <p><b>Proposition 3.1.</b>          NEC: very high          NIC: very high</p>	<p><b>Proposition 1.2.</b>          KAC: high          KCC: high</p> <p><b>Proposition 3.2.</b>          NEC: high          NIC: high</p>
	Articulate	<p><b>Proposition 1.3.</b>          KAC: high          KCC: low</p> <p><b>Proposition 3.3.</b>          NEC: high          NIC: low</p>	<p><b>Proposition 1.4.</b>          KAC: low          KCC: low</p> <p><b>Proposition 3.4.</b>          NEC: low          NIC: low</p>
		Closed	Open
		Structure	

---

KAC: knowledge appropriation cost  
 KCC: knowledge conversion cost

NEC: need for external conformity  
 NIC: need for internal conformity

FIGURE 4  
ORGANIZATIONAL MODEL OF LOCAL KNOWLEDGE CONVERSION



---

KAC: knowledge appropriation cost  
KCC: knowledge conversion cost

NEC: need for external conformity  
NIC: need for internal conformity



## Profile

**Kazuhiro Asakawa** is Lecturer of International Management at the Graduate School of Business Administration, Keio University, Japan. His Ph.D dissertation at INSEAD focuses on multinational tension in international R&D network. He received his MBA from Harvard University and his BA *summa cum laude* from Waseda University, Japan. His research interest includes interface between organization theory and multinational management, international knowledge management, as well as international human resource management.

## REFERENCES

- Badaracco Jr., J.L. (1991) The Knowledge Link: How Firms Compete Through Strategic Alliances, Boston: Harvard Business School Press.
- Allen, T. J. (1977) Managing the Flow of Technology, Cambridge, MA: MIT Press.
- Bartlett, C.A. and S. Ghoshal (1989) Managing Across Borders: The Transnational Solution, Boston: Harvard Business School Press.
- Bartlett, C.A. and S. Ghoshal (1990) "Managing innovation in the transnational corporation," Bartlett, C.A., Y. Doz and G. Hedlund, (eds.) (1990) Managing the Global Firm, London and New York: Routledge.
- Behrman, J.N. and W.A. Fischer (1980) Overseas R&D Activities of Transnational Companies, Cambridge, MA.: Oelgeschlager Gunn & Hain, Publishers, Inc.
- Berger, P. and T. Luckmann (1966) The Social Construction of Reality: A Treatise in the Sociology of Knowledge, London: Penguin.
- Cheng, J.L.C. and D.S. Bolon (1993) "The management of multinational R&D: a neglected topic in international business research," JIBS, first quarter.
- DiMaggio, P. and W. Powell. (1983) "The iron cage revisited: institutional isomorphism and collective rationality in organizational fields," American Sociological Review, 48.
- Granovetter, M. (1985) "Economic action, social structure, and embeddedness," American Journal of Sociology 91: 481-510.
- Hall, E. T. (1976) Beyond Culture, Garden City, NY: Anchor/Doubldway.
- Hedlund, G. and I. Nonaka (1993) "Models of knowledge management in the West and Japan," in P. Lorange et.al., (eds.) Implementing Strategic Processes, Change, Learning, and Cooperation, London: Basil Blackwell.
- Kenney, M. and R. Florida (1993) Beyond Mass Production: The Japanese System and its Transfer to the US, New York: Oxford University Press.
- Lawrence, P. and J. Lorsch (1967) Organization and Environment, Boston: Harvard Business School Press.
- Laurent, A. (1983) "The cultural diversity of Western conceptions of management," International Studies of Management and Organization, vol.XIII. no. 1-2 (Spring-Summer): 75-96.

- Lincoln, J., M. Hanada & K. McBride, 1986. Organizational structures in Japan and US manufacturing. Administrative Science Quarterly. 31: 338-364.
- Nishida, K. (1993) Kurieitibu Jushi no Shoguu Kakushin, Tokyo: Diamond.
- Nonaka, I. (1994) "A dynamic theory of organizational knowledge creation," Organization Science vol.5. no.1. February:14-37.
- Parsons, T. (1960) Structure and Process in Modern Societies. Glencoe, Ill.: Free Press.
- Patel, P. and K. Pavitt (1992) "Large firms in the production of the world's technology: An important case of non-globalization," in Granstrand, O. et.al., (eds.) Technology Management and International Business: Internationalization of R&D and technology, Chichester: John Wiley and Sons.
- Pearce, R. and S. Singh (1992a) Globalizing Research and Development, London: MacMillan.
- Pearce, R. and S. Singh (1992b) "Internationalization of research and development among the world's leading enterprises: survey analysis of organization and motivation," in Granstrand, O., L. Hakanson and S. Sjolander (eds.) (1992) Technology Management and International Business: Internationalization of R&D and Technology.
- Polanyi, M. (1966) The Tacit Dimension, London: Routledge and Kegan Paul.
- Prahalad, C.K. and Y.L. Doz, (1987) The Multinational Mission: Balancing Local Demands and Global Vision, New York: Free Press.
- Rosenzweig, P. and J. Singh (1991) "Organizational environments and the multinational enterprise," Academy of Management Review vol.16. no.2: 340-361.
- Scott, (1987) Organizations: Rational, Natural, and Open Systems (second ed.), Englewood Cliffs, NJ.: Prentice Hall.
- Terpstra, V. (1977) "International product policy: the role of foreign R&D," Columbia Journal of World Business, Winter.
- Thompson, J.D. (1967) Organizations in Action, New York: McGraw-Hill.
- Tung, R. (1988) The New Expatriates: Managing Human Resource Abroad, Cambridge, MA: Ballinger.
- Tushman, M. (1977) "Special boundary roles in the innovation process," Administrative Science Quarterly, 22: 587-605.

Von Hippel, E. (1987) "Cooperation between rivals: informal know-how trading," Research Policy, 16.

Von Hippel, E. (1988) "Trading trade secrets," Technology Review, February/March.

Westney, D.E. (1993) "Cross-pacific internationalization of R&D by US and Japanese firms," R&D Management, 23, 2.