

**A KNOWLEDGE SYSTEM APPROACH TO THE MULTINATIONAL COMPANY:
CONCEPTUAL GROUNDING AND IMPLICATIONS FOR RESEARCH**

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Abstract

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ABSTRACT

The role of knowledge, organizational learning, and innovation as levers of competitive advantage is now a commonly acknowledged insight in research in international management. However, while the agglomeration of insights of described as the “knowledge-based view” is a promising theoretical lens, insights are not organized into a unifying framework and there are significant holes in the understanding of how knowledge may be turned into a source of competitive advantage for MNCs. In order to advance the knowledge-based theory of the MNC, we develop the notion of the MNC as a global knowledge system linking local knowledge structures and combining local knowledge elements that are complementary to confer strategic advantage, and relate this to the theory of complex systems deriving from the work of Herbert Simon. These ideas are used to frame the changing environments, strategic intents, and learning stances that characterize MNCs, and to derive a set of research challenges for MNC research.

KEYWORDS

Knowledge-based view of the MNC, knowledge structure, complementarities, complex systems.

INTRODUCTION: THE KNOWLEDGE CHALLENGES TO INTERNATIONAL MANAGEMENT RESEARCH

Knowledge as a factor influencing the growth and competitiveness of the multinational company (MNC) has been apparent in theories of foreign direct investment (e.g., Hymer, 1974) and theories of the firm (Penrose, 1956, 1959) from the start of international management as a research field (Buckley and Casson, 1976). However, the recognition of its centrality to strategic advantage (e.g., Winter, 1987; Grant, 1996) and to the growth of MNCs (e.g., Kogut and Zander, 1993, 1996) is more recent. Indeed, the last decade has seen a shift of conceptual lens from internationalization theories towards a knowledge-based view of the MNC (Tallman, 2003). In this article, we argue that this shift still has to coalesce into an organizing, coherent framework; the knowledge-based turn in international management is for this reason still an unfinished revolution. We propose a knowledge-based approach to the MNC that synthesizes important strands in existing research, and offer a number of suggestions for research in the MNC that aim at bringing us closer towards such a framework.

An important starting point is the clarification of the challenge of obtaining and turning knowledge into a source of strategic advantage for MNCs. Traditionally, MNCs, relied on home-based knowledge leadership, both in market development and in technology (Vernon, 1966; Johansson and Vahlne, 1977). To access foreign markets companies often applied a standard formula. Thus, they “projected” a bundle of carefully packaged knowledge, often in the form of “best practices” and usually created, tested, and honed at home (Doz, Santos and Williamson, 2001). However, in many industries, national efforts to promote local science and innovation, the diffusion of technology triggered by MNCs’ manufacturing and outsourcing overseas, the emergence of local skills from the combination of imported techniques and local customs, and even the local spillover effects from military

and other local government-led activities have implied increasing knowledge dispersion world-wide (e.g., Dunning, 2002).

This has led managers of global firms to seek knowledge whenever and wherever it is to be found (Cantwell, 1989; Dunning, 1996, 2002). This dispersion of knowledge also has made relying solely on home-base knowledge increasingly competitively risky: Companies that are able to access distributed pockets of local knowledge, and combine and meld such knowledge from global sources into innovative products and new business concepts gain an advantage over those that remain dependent on home base knowledge (Doz, Santos and Williamson, 2001). Such companies engage in knowledge sensing worldwide and seek to capitalize on not only distributed intra-firm (MNC) knowledge (Ghoshal and Bartlett, 1990; Nohria and Ghoshal, 1997), but also on distributed inter-firm knowledge through alliances and partnerships, namely with customers, suppliers, and competitors (Badaracco, 1991; Doz and Hamel, 1998), and distributed knowledge from other organizations (namely local universities and research institutes). In so doing each firm may develop a unique knowledge network worldwide that its competitors find it hard to match, especially when they still rely mainly on knowledge emanating from their home bases (Doz, Santos and Williamson, 2001).

As the above summary of recent thinking on knowledge in the context of international management suggests, many of the basic ideas and principles that seem necessary for building a knowledge-based theory of the MNC have been identified (Hedlund, 1994; Kogut and Zander, 1992, 1993, 1995; Grant, 1996; Easterby-Smith and Lyles, 2003). Thus, knowledge as a core ownership-specific asset, organizational learning as a core capability, the MNC as a network that accesses, produces, transfers, and combines knowledge, and innovative skills as levers of renewal are now established concepts and insights in research on international management.

However, it remains questionable whether these add up to a coherent whole. Do insights mesh? Are constructs valid? Are causal relations on and between various levels of analysis properly identified and theorized? On the level of conceptualization, knowledge-based approaches in international management still need to develop a coherent and well-founded conceptualization and theory of the MNC as a knowledge-based entity and of how this entity interacts with its environment. Most fundamentally, what exactly does it mean theoretically to say that the MNC is a “knowledge-based entity”?

In this article we seek to address some of the fundamental issues in the development of a knowledge-based conceptualization of the MNC. Specifically, we develop a view of the MNC as a geographically distributed system of local knowledge structures. We base our reasoning on earlier contributions to the *knowledge system view of firms* (Loasby 1976; Lyles and Schwenk, 1992; Hedlund, 1994; Doz, Santos and Williamson, 2001; Foss and Pedersen, 2002, 2004; Yayavaram and Ahuja, 2008), and to the part of *complex systems theory* that has taken its cues from Herbert Simon’s work (1962, 1973) and from evolutionary biology (Wright, 1930; Kauffman, 1993).¹ Combining these perspectives makes it possible to understand the existence, scope and performance of MNCs by conceptualizing MNCs as searching for local knowledge structures, and connecting these into systems that map into peaks in some performance landscape (Levinthal, 1997; Fleming, 2001; Ethiraj and Levinthal, 2004; Nickerson and Zenger, 2004; Yayavaram and Ahuja, 2008).

In this perspective, recent MNC evolution may be understood in terms of an expanding knowledge search space: The change from “projecting” knowledge-based artifacts (from a product to a business strategy and its respective activity-system) developed in an national base (Vernon, 1966), to improving such home-base artifacts through transnational innovation

¹ Recent applications to business administration include Levinthal (1997), Gavetti and Levinthal (2000), Fleming (2001), Ethiraj and Levinthal (2004), Nickerson and Zenger (2004), and Yayavaram and Ahuja (2005).

(Bartlett and Ghoshal, 1989), to creating new artifacts through “learning from the World” and metanational innovation (Doz, Santos and Williamson, 2001) is one that involves addressing a much expanded set of possible knowledge sources and combinations. While this represents many new opportunities, it also raises considerable problems for MNC organization and management, as search behavior, absorptive capacity, and learning are challenged by the heavily expanding set of knowledge structures and of possible combinations of knowledge elements across these structures. The firms that succeed in the emerging global competition are those that best match their search and learning strategies to the changing landscape of knowledge sources and combinations. Increasingly, leaders of major MNCs realize that sustainable globalization also calls for a different relationship with the various locations in which the MNC operates, shifting from a resource exploitation to a knowledge exploration and combination mode (e.g., Palmisano, 2006).

We argue that the conceptualization of the MNC as a knowledge system of differentiated local knowledge structures unifies a number of recent insights in MNC strategy and organization, challenges the emphasis on knowledge sharing in the literature, and allows for new insights into the management of MNCs. A knowledge system framework not only allows for a theoretical unification of existing insights in the knowledge-based approach to the MNC, it also facilitates the identification of what still needs to be done. Fifteen years ago Peter Buckley argued that what is required in the core theory of international management research is “... careful redefinition of the relationship between key explanatory variables so that new developments grow organically from the theory rather than being added in a piecemeal and arbitrary fashion” (Buckley, 1990: 663). Today, such a statement may justifiably be applied to the knowledge view in international management. We attempt to constructively meet Buckley’s statement as it applies to the knowledge view.

THE MULTINATIONAL COMPANY AS A KNOWLEDGE SYSTEM:

CONCEPTUALIZATION

Significant parts of the MNC literature are taken up with knowledge transfers between subsidiaries, often with a focus on obstacles to such flows, and sometimes with an explicit consideration of the role organizational structures and systems play in the process of knowledge transfer. It is arguable that this kind of research has really been the “paradigm case” of MNC research within the last decade or more. However, it is similarly arguable that this research is not embedded in an overall, coherent conceptualization of the MNC as a knowledge-based entity.

This is the case even of the literature that conceptualizes the MNC as a “differentiated network” (e.g., Hedlund 1986; Bartlett and Ghoshal 1986, 1989; Birkinshaw 1996; Gupta and Govindarajan 1991, 1995, 2000; Holm and Pedersen 2000). To be sure, it is recognized in this literature that flows emerge *from* some knowledge stock, such as particular technological or marketing competencies controlled by MNC headquarters. However, little analytical attention has been devoted to systematically addressing how MNC knowledge flows emerge from the distribution of knowledge in the different locations where the units (or “sites”) of the MNC reside across the world. In fact, there is a separate treatment of knowledge stocks and flows in the literature. Thus, in his eclectic framework and OLI model, Dunning (1988) emphasizes stocks by acknowledging the importance of national subsidiaries and their knowledge creation and repository role with the notion of location-specific advantages (cf. also Rugman, and Verbeke, 2001). Ghoshal (1987), Bartlett and Ghoshal (1989), and Hedlund (1994) furthermore consider the importance of worldwide learning and intra-MNC knowledge sharing (e.g., of “best practices”), and therefore put the main emphasis on flows. However, flows emerge from stocks, and they change other stocks.

Which flows emerge is partly dependent on the composition of the knowledge stock — that is, the set of local knowledge structures — just as the outputs that emerge from the overall stock of capital in society are dependent on the composition of that stock (Lachmann, 1956). But, in turn, knowledge flows within the MNC change the local knowledge structures and the MNC’s ability to exploit them (Vayavaram and Ahuja, 2008). Therefore, a time-dimensioned, knowledge-based understanding of the MNC *requires* that analytical attention be paid to both flows and the composition and geographic distribution of the knowledge stocks.

The MNC as a Knowledge System: Terminology

To integrate stocks and flows of knowledge, we define a *knowledge system* in terms of (geographically defined) local knowledge structures and the relations between them. The MNC knowledge system is not given, but malleable and changing, as firms absorb new knowledge elements into local knowledge structures, augmenting their knowledge stocks, and link existing knowledge structures in novel ways, creating innovations from enhanced knowledge flows. We can thus conceive the MNC as a system with knowledge *links* connecting local knowledge structures.

To describe the MNC more formally, let K_{ij} refer to knowledge element i in geographic location j . We define the quality of K_{ij} as its (maximum) value creation potential. Therefore, if the quality of K_{ih} is superior to K_{it} , then the performance of a firm in h is potentially superior to that of a similar firm in t . A “location” is not just a geographic point in space, but also a short-hand for a set of contextual features (such as a national culture that reflects the identity and history of a particular people) that make local knowledge both different and hard to transfer. “Location” is thus a point in space (geography) *and* time (history and the evolution of a culture). The set of knowledge elements that exist in a location constitute the

substantive part of the local knowledge structure. A local knowledge structure is expressed as a set of local knowledge elements that are readily connected by the pre-existing links among the knowledge holders.

A very simple firm would be constituted by the combination of two knowledge elements, K_1 and K_2 . Suppose further that both K_1 and K_2 exist in location h (home) and location t (host). If $K_{ih} \equiv K_{it}$ for $i = 1, 2$, the knowledge at the two locations is identical and there is no reason for a MNC to exist on the basis of combining these two knowledge elements. However, if K_2 does not exist in t , an indigenous firm cannot exist there either. If the firm in h is able to transfer (internally) K_2 from h to t , and combine K_1 and K_2 there, it becomes a MNC. Per implication it will realize a superior performance over any indigenous firm (i.e., the motive for becoming a MNC). With the knowledge transfer direction set from the location with superior knowledge to that of inferior knowledge, then the theory of the MNC in this case is also a theory of strategic advantage. In general, we assume that a MNC will attempt to combine the relevant K_{ij} ($i = 1, \dots, n$) by choosing j ($j = 1, \dots, m$) in order to maximize its performance.

Note that there is no need to assume that, say, K_2 moves from h to t to be combined there; indeed, the combination mode could involve a “virtual team,” with members holding K_2 in h and members holding K_1 in t and producing an innovation that would originate from the MNC, without each local sub-team learning the knowledge of the other local sub-team. Put differently, knowledge elements can be combined without being transferred or shared across locations. By providing relatively similar internal contexts to knowledge held in h and t , contrary to independent entities or alliance partners whose organizational contexts would likely be deeply different, the MNC is a common ground which facilitates the combination of knowledge without having to attempt to share or even transfer such knowledge across locations. The continuity and reliability in the provision of combined knowledge that a single

ownership and common administrative structure encourages, may be the constitutive characteristics of the MNC form, rather than its superior ability to transfer knowledge.

In fact, the MNC does not necessarily have to transfer knowledge, but only to represent knowledge from various locations effectively enough to allow the development of new products or processes that rely on knowledge from various locations, thus allowing one to transcend the location-specificity of knowledge. Some economists (e.g., Stiglitz, 2003) argue that knowledge is a global public good, equating knowledge to information. However, a key tenet in large parts of diverse literatures, such as international management, strategic management, organizational studies, and economic geography, is exactly that much knowledge that is commercially relevant to MNCs is context-dependent and rooted in local circumstances. A knowledge-based theory of the MNC must take this fundamental stylized fact into account.

The MNC as a Hierarchical Knowledge System

The definition that we have articulated conceptualizes the MNC as a global knowledge *system* linking local knowledge *structures* and combining local knowledge *elements* that are complementary to confer strategic advantage. We use the word *structures* at the local level to denote that the knowledge elements available in any particular location constitute a set that while characterized by possibly ambiguous interaction between the elements is characterized by enduring interaction. At the global level we use the word *system* to denote the fact that the configuration of linkages between locations within a MNC can evolve more rapidly, but through a set of complex systemic interactions and purposefully built. We now develop the three constructs in greater detail.

Knowledge elements. The basic unit in the knowledge structure conceptualization of the local MNC unit is the knowledge element. Examples of knowledge elements are: a

particular expertise embodied in individuals; personalized client relationships; a technological capability (typically at the level of a department or a plant); etc. As these examples suggest, knowledge elements may exist on different levels in an organization. They may be personal knowledge (as in the case of tacit knowledge) (Polanyi, 1962) or they may belong to the realm of objective knowledge (Popper, 1972). However, knowledge elements are discrete in the sense that they have boundaries, although such boundaries are not always apparent.² Extant literature (e.g., Winter, 1987; Kogut and Zander, 1993) suggests that knowledge elements possess a number of different attributes. The attributes that are of the essence here are those that bind a knowledge element with a location: for example, the extent to which a knowledge element is tacit or the extent to which a knowledge element is collective (that is, embodied in a co-located team rather than in an individual).

Of particular importance is the location-specificity of a knowledge element, that is the extent to which its quality depends on other, complementary knowledge elements in the same location, especially those elements that are tacit and collective (e.g. components of the local culture). For example, the skills in design for manufacturability of printers in Vancouver, US, in Singapore, and in Barcelona, Spain (three sites of Hewlett-Packard) are differentiated knowledge elements. The reason for such difference lies in the contextual nature of knowledge (Doz and Santos, 1997; Brannen, Liker and Fruin, 2002). Knowledge, contrary to information, is location-specific, embedded in a particular context (physical and social) that characterizes one location (city, district, country, depending on the relevant unit of geography) at a particular moment of time. However, scientific knowledge, deemed

² Of course, how “discrete” is a matter of degree. For example, a patent may look highly discrete, but often builds on several other patents.

universal, is not bound by location ($K_{i,j}$ is the same for all j). Arts and craft knowledge, on the other extreme, can be highly differentiated across locations ($K_{i,j} \neq K_{i,m}$ for $m \neq j$).

Knowledge elements are the basic building blocks of knowledge structures. The structure's property primarily emerges from the knowledge elements' co-location. The knowledge structure provides itself a crucial part of the context in which each one of its knowledge elements becomes meaningful.

Knowledge structures. A knowledge structure is defined as a set of knowledge elements available in a given location, and the interaction among them. Local units of a MNC (i.e., the MNC "sites" in the location), as well as local (indigenous) firms, constitute knowledge structures. A knowledge structure is bound to its location insofar as some or all of its interconnected knowledge elements are embedded in the local context. If this were not the case — that is, if all knowledge elements were non-excludable in geography — there would be no special case for the MNC. If all knowledge elements would exist everywhere, the knowledge structure of a "local" company and of a "global" company could be the same.

A location can be understood as a set of (local) knowledge structures. For example, Badaracco (1991:95) refers to "knowledge and capabilities [residing] in geographic regions — in the interstices of social, financial, technological, and managerial relationships that can link *nearby* organizations" (italics added). So does Saxenian (1994), looking at Silicon Valley and Route 128. The location-dependency of knowledge lies on the observation that knowledge elements and knowledge structures that are meaningful, useful and valid (i.e. high quality) in a particular location may be meaningless, dysfunctional and not valid (i.e. low quality) in other locations. Szulanski (1996), studying the intra-firm transfer of best practices, found that the eventfulness of best practice transfer was induced by the very "stickiness" of knowledge. Tyre and von Hippel (1997) present evidence of "situated"

knowledge, knowledge that depends on the physical elements of context. For instance, organizational routines are “... executable capabilities for repeated performance in *some context*, that have been learned by an organization in response to selective pressures” (Cohen et al., 1996: 683; italics added). The dimension of location-dependency considered here exhibits an embeddedness that extends beyond social embeddedness (Granovetter, 1985).

A local knowledge structure (\mathbf{K}_j) can be characterized in two dimensions:

- *scope* (or breadth), defined as the number n of different types of knowledge in the structure (K_{ij} , $i=1,n$)
- *density*, defined as the number of linkages or interactions between the different knowledge elements (as a ratio to the total possible number of such linkages)

The knowledge interactions (or relations) that form the structure of knowledge elements give meaning to a $K_{i,j}$ by indicating which other knowledge elements are complementary to $K_{i,j}$ – that it, would be comprehended in a full rendition of $K_{i,j}$. We call these linkages *explanatory relations*.

Knowledge system. Essentially, our view of the MNC is a hierarchical one. According to Simon (1962), “hierarchies” are systems composed of interrelated (complementary) subsystems where each of the subsystems (e.g., a knowledge structure) is hierarchical in nature, until some elementary subsystem is reached at the lowest level (e.g., the knowledge element). “In hierarchic systems,” Simon explains, “... we can distinguish between the interactions *among* subsystems on the one hand, and the interactions *within* subsystems — i.e., among the parts of those subsystems — on the other” (1962: 473). In decomposable systems the interactions among the subsystems are negligible; in non-decomposable systems the interactions among the subsystems are substantial; and in nearly

decomposable systems the interactions among the subsystems are weak (or weaker than within-subsystem interaction), but not negligible (1962: 129). This categorization can be seen to mirror classic classifications of MNCs as multi-domestic or global respectively, with transnational or heterarchic MNCs corresponding to partly decomposable and recomposable systems, where the level of systemic integration may vary.

The knowledge interactions that exist in a MNC are of two types:

- *explanatory relations*, in part firm-specific (that is, inexistent in the local knowledge structures and forming knowledge sets that exist only inside the MNC) and in part location-specific (that is, acquired with sets of $K_{i,j}$ from local knowledge structures);
- *combinatory relations*, also specific to the MNC, that allow for new combinations of knowledge (innovations) by the MNC.

Dimensions of the MNC knowledge system. If the MNC is conceived of as a knowledge system, how can the knowledge system itself be dimensionalized? Answering this is important to the extent that (as we believe to be the case) there are systematic relations between dimensions of the knowledge system and MNC corporate strategy, organization, and performance. Because the interest in developing a knowledge-based conceptualization of the MNC ultimately lies in putting forward better answers to questions concerning MNC strategy, organization, and performance, the relevant dimensions are those that are likely to impact these aspects of the MNC.

One important dimension is the degree of *knowledge specialization*; for example, how many different knowledge elements or sets (e.g., technological disciplines) are required for optimal performance of the MNC and how different these are (cf. Brusoni, Pavitt and Prencipe, 2000). The higher a degree of knowledge specialization within a MNC, the higher the degree of knowledge asymmetry across the sites of the MNC and the knowledge

structures they are part of. A second dimension is the degree of *location specialization*, the inverse of the number of locations where it is possible to find all the knowledge elements that compose a MNC. In the case of a location specialization of one, a particular location contains all the knowledge that the MNC needs: the MNC can start as a indigenous firm in that location and then expand internationally from its home base – and most MNCs have done. If location specialization is very low (close to zero) MNCs can only exist if they are metanational (or “homeless”).

A third dimension is the *complexity* of the knowledge system. Knowledge systems that lie near the non-decomposable end of the spectrum are characterized by a high degree of “complexity,” where “by complexity we mean the degree to which cognitive units are interrelated, creating a complex internal structure” (Lyles and Schwenk, 1992: 164). Simon (1962: 161) defines a complex systems as one that is “... made up of a large number of parts that interact in a non-simple way ... In such systems ... given the properties of the parts and the laws of their interaction, it is not a trivial matter to infer the properties of the whole.” Complex knowledge systems have high levels of structural uncertainty, as they exhibit large number of potential combinations of knowledge elements and unpredictable performance implications of such combinations (Ethiraj and Levinthal, 2004: 161). Structural uncertainty increases the sustainability of a firm’s strategy and has been associated with dispersed knowledge (Minkler, 1993). As Lyles and Schwenk (1992: 167) suggest, the performance outcomes of search and learning efforts are dependent on the complexity of the knowledge system: “The complexity of the knowledge structure influences the ability of organizational members to retrieve [knowledge] elements.”³ They furthermore suggest that the complexity

³ Since their work does not explicitly refer to multi-site companies one can infer that by knowledge structure they mean knowledge system if in a multi-site corporation.

of the firm's knowledge system will influence its "ability to adjust to change and be flexible" (p.167).

THE MULTINATIONAL COMPANY AS A KNOWLEDGE SYSTEM: SEARCH AND LEARNING BEHAVIOR

Work on search in complex systems (Levinthal, 1997; Fleming, 2001) demonstrates how the overall performance of the search effort is highly dependent on the characteristics of the system, for example, whether it is decomposable, non-decomposable, or nearly decomposable. In particular, search in systems that lie close to the non-decomposable end of the spectrum is a tough undertaking, even more so when the search methods are primitive (e.g., gradient search), because in such systems the "landscape" of knowledge combinations from multiple structures will have multiple peaks (in extreme cases, this may produce a "complexity catastrophe", Kauffman, 1993).⁴ In strongly decomposed systems, the landscape may be single-peaked, so that even simple learning modes may quickly reach the peak. In more concrete terms what knowledge is needed for a particular innovation will be easily located and the relevant combination established.

Knowledge Combination

Knowledge elements are combined to solve problems of any kind, from mundane daily operations to ambitious innovation projects (Nickerson and Zenger, 2004). Solutions to problems may become embodied in routines and capabilities (Nelson and Winter, 1982) spanning knowledge structures and applied to recurrent problems. Or, knowledge elements may be combined for the purpose of solving a one-shot problem. Intermediate cases exist. In all cases, however, knowledge elements are complementary. The notion of complementarity between knowledge elements here simply refers to whether potential gains exist from

⁴ The height of peaks may here be taken as a measure of the strategic advantage implications of a certain combination of knowledge elements.

combining knowledge elements (Thompson, 1967; Buckley and Carter, 1999). For example, knowledge elements pertaining to marketing controlled by one subsidiary or site (or the MNC headquarters) may be a useful addition to existing marketing knowledge in another subsidiary, so that the relevant knowledge elements are *additive* (Buckley and Carter, 1999). Alternatively, subsidiary knowledge may be an input prior to the building of knowledge in another part of the MNC, as when knowledge of local tastes are transferred to centralized R&D functions, so that the relation of complementarity is *sequential* (ibid; Thompson, 1967). Finally, dependencies may go both ways (Milgrom and Roberts, 1990). For example, knowledge gained from combined marketing knowledge in a number of subsidiaries may be transferred back to these as best practice knowledge. Thompson's (1967) notions of pooling, sequential and parallel coordination mirror, organizationally, the three types of relationships between knowledge elements.

Combinations of knowledge elements map into a performance landscape. Strategically, firms search for combinations that are high in appropriable value. Among the determinants of the net value from combining complementary knowledge elements are such factors as the characteristics of the relevant knowledge elements (e.g., what kind of complementarity is involved, tacitness, etc.); the governance costs implied by these characteristics, that is, the costs of motivating organization members to transfer and absorb knowledge; and the direct costs of transferring knowledge. Many of these factors have been extensively discussed in the MNC literature (e.g., Kogut and Zander, 1993; Szulanski, 1996; Buckley and Carter, 2004). However, what is usually not considered is that a new knowledge combination may have to be fitted into existing knowledge structures and span across them, and that this may give rise to additional costs and benefits (a further exemplification of the point above on stocks and flows).

Optimizing the MNC Knowledge System

A MNC seeks to optimize its knowledge system in the sense that it wishes to maximize the appropriable value stemming from this system over some time horizon. It does so in three ways; first, by modifying the set of knowledge structures that it may link (i.e., searching for added locations); second, by modifying the linkages between knowledge elements that reside in different knowledge structures (i.e., searching for new combinations), and, third, by drawing on the evolving knowledge structures (i.e., learning new knowledge elements).

Searching for added locations. Any location that the MNC will add to its existing set of knowledge structures has to bring either knowledge elements that are new to the MNC or knowledge elements of a superior quality (i.e. higher value creation potential) relative to those that the MNC has already. What determines such search is the way companies make a trade-off between the benefits of added diversity of knowledge elements and the cost of combining such knowledge elements from an expanded set of knowledge structures. Adding locations increases the landscape of new combinations. The optimal choice of new locations implies maximizing the diversity of knowledge structures, subject to physical and contextual distances not exceeding the levels dictated by the knowledge transfer costs and overall MNC routines and capabilities.

Searching for new combinations. MNC value creation stems from new combinations of knowledge elements from multiple structures. Such combinations map into a performance landscape; for example, some new knowledge elements (like the proverbial “missing piece of the puzzle”) create enormous value, and some combinations of existing knowledge elements may be very high in appropriable value, some may be small, and some may be negative. However, search is necessary to identify the relevant knowledge elements (Lyles and Schwenk, 1992) and to ascertain their relations (Vayavaram and Ahuja, 2008). As Lachmann (1956: 3) noted in his discussion of the theory of capital, “[t]he ‘best’ mode of

complementarity is ... not a 'datum'. It is in no way 'given' to the entrepreneur who, on the contrary, as a rule has to spend a good deal of time and effort in finding out what it is." In that sense the entrepreneurial dynamics in the MNC (i.e. individual managers and teams of managers) becomes essential in our framework.

Search efforts give rise to certain outcomes in terms of finding solutions to problems (Nickerson and Zenger, 2004). Problem-solving activity can be local or global. In local search, managers of specific sites (i.e. in given local knowledge structures) look for complementary knowledge elements within the local structure's stock. In global search, managers of multi-site activities (say a global product development project or a corporate officer) look for knowledge elements in the set of locations susceptible to provide missing elements. How to access and appropriate such new knowledge elements is a subsequent decision (for example, between acquisition or an alliance with a local entity that controls the relevant knowledge element).

Learning new knowledge elements. The knowledge structures from which a MNC can draw knowledge change over time, albeit relatively slowly as they typically co-evolve with a complex local context that itself changes only slowly.

The knowledge structure of a MNC at each location will be augmented through its normal business activities. There are four possibilities for such normal development: new knowledge elements can be created internally in the MNC local site (e.g., a local R&D project); new knowledge elements can be created jointly with other firms locally (e.g. in a learning alliance); new (to the MNC) knowledge elements can be acquired externally from other local knowledge structures (e.g. from a lead customer or a supplier (von Hippel (1988))); new knowledge elements can be acquired externally from new knowledge elements created in other knowledge local structures (e.g. a local university). Doz, Santos, Williamson (2001: Chpt. 6) provide an analysis and empirical evidence of such "sensing" activities.

A local knowledge structure is also changed over time through learning-by-doing in the local context. Such improvement (i.e., higher value creation potential) of existing knowledge elements (e.g. the skills of design for manufacturability) — which may have been initially transferred (internally) by the MNC from another location — will be different in different local contexts and will add to the diversity of knowledge elements in the MNC system. The contextual differences that will create such diversity over time may be internal to the MNC units (e.g. different product lines in different sites) or external (e.g. different education and training systems in each location).

Antecedents to search. The antecedents to search outcomes include the mode of search (Levinthal, 1997), for example, whether search takes place through incremental, trial-and-error search (“gradient search”) or whether it takes place based on explicit theories of causes and effects (“heuristic search”) (Gavetti and Levinthal, 2000). Firms may have different dominant logics for their search efforts (Lyles and Schwenk, 1992) and this will influence paths of knowledge stock augmentation.

Another antecedent of local search is the knowledge structure itself. Thus, Vayavaram and Ahuja (2005) argue that a firm’s (a site’s, in the terminology proposed here) knowledge structure influences which interdependencies between knowledge elements are searched for, recognized and established. In other words, it influences the process of search for new valuable combinations of knowledge elements. Knowledge is thus embodied not just in the knowledge elements, but also in ties between these (Lyles and Schwenk, 1992; Langlois, 2002; Baldwin and Clark, 2000). For example, marketing knowledge may have to be closely coordinated with R&D (von Hippel, 1988; Dierickx and Cool, 1989); the ties between two such knowledge elements are also part of the site’s knowledge structure. The site’s knowledge structure influences search and learning for at least two reasons. First, the knowledge structure is an antecedent of absorptive capacity: If sites do not already control

knowledge elements that are in some dimensions related to the knowledge they seek to absorb, or if they do not understand how external knowledge elements may complement internal elements, they will likely not succeed in the absorption task. Second, knowledge elements that are discovered through search efforts may simply not fit into the site's knowledge structure.

The Nature of the MNC Knowledge System and its Optimization

With time, the MNC can expand its knowledge system (add locations with new or improved knowledge elements) or search for new knowledge elements in the locations where it is – and establish new relations between the new elements and the existing ones. Here, the complexity of the knowledge system is determinant. If the system is decomposable, then learning can occur sequentially or in a pooling mode.

If the system is not decomposable, then learning is problematic: each new knowledge element in a knowledge structure may change the outcome of existing relations with knowledge elements in other knowledge structures. This implies that in a non-decomposable structure, learning itself needs to be guided – either by entrepreneurial insight or by an organizational artifact (“magnet”) such as a global lead customer or a product platform which “calls for” certain knowledge elements available only in specific sites (Doz, Santos, and Williamson, 2001). Similarly, innovation arising from new knowledge combinations between distinct structures needs to be guided, except perhaps in early stages where random encounters between hitherto separate knowledge elements can lead to creative discoveries (Nonaka, 1991).

While establishing new complementarities may bring local innovation, it also brings complexity (Doz, Angelmar, and Prahalad, 1985). The reason lies in the interdependent nature of the overall knowledge structure itself. Thus, a new complementarity likely impacts

other ones. In highly integrated knowledge systems, this can mean that overall performance becomes very difficult to predict and control (Baldwin and Clark, 2000). Small changes in the knowledge system can result in structure-wide perturbations that "... inhibit the ability of a system to systematically improve and exploit the intelligence of prior learning efforts" (Ethiraj and Levinthal, 2004: 160). The performance landscape underlying such knowledge structures is highly rugged.

Consistent with complexity theory and knowledge structure theory we can therefore characterize knowledge systems in terms of complexity, this being a composite measure of the number of knowledge elements and their relations. Thus, in a strongly decomposed (modular) knowledge system, learning (search) is more likely to take place within individual structures (i.e., specific sites) than as recombinant search over knowledge elements from different structures. The landscape that decision makers confront is flat. Simple (gradient) search often suffices to find the optimum.

As knowledge systems become less decomposed, multiple peaks of varying heights emerge, and finding the optimal combination of knowledge elements becomes more complicated. A search in a "simple search mode" makes no *a priori* assumptions about which knowledge elements are in the search space, how they may be connected, and what are the value implications of this begins at an essentially arbitrary place and proceeds by means of trial and error. Search and innovation become increasingly sophisticated as decision makers make explicit assumptions about which elements are relevant and how elements connect. The insight that finding the optimal (highest) peak is far from trivial is consistent with the findings that firms often find it difficult to comprehend "architectural" knowledge, that is, knowledge of the multiple links between product components (Henderson and Clark, 1990) and that technological innovation with many interdependencies among knowledge elements are particularly hard to implement for MNC firms (Doz,

Angelmar and Prahalad, 1985; Santos, Doz and Williamson, 2004). Such assumptions are usefully summarized in, for example, the distinction between MNCs as “global teachers” and MNCs as “global learners.” In terms of the knowledge structure view, the former firms define the landscape of knowledge combinations that they can search over more narrowly than the latter firms.

From the standpoint of MNC management research we can suggest that MNCs are particularly relevant governance forms for knowledge combinations at intermediate levels of knowledge systems’ decomposability. If the knowledge system required for an innovation is both novel and non-decomposable a single knowledge structure holding all the relevant knowledge elements may well be a condition for the innovation to emerge, and will in any case outperform a MNC knowledge system.⁵ If the knowledge system is decomposable, then a less onerous form of governance than an MNC is feasible.⁶

CHALLENGES AND IMPLICATIONS

In the preceding sections, we have developed a knowledge-based conceptualization of the MNC, and we have discussed the possible theoretical support for such a conceptualization. In the following, we suggest how these ideas can be turned into researchable themes in MNC research.

The Search for Knowledge Structures

Three advantages derive from MNCs accessing multiple knowledge structures: 1) the drastic increase in the number of potential unique knowledge combination opportunities

⁵ Note, though that this does not necessarily disqualify a MNC as the innovator, but only provided it does not act as one in crucial phases of the innovation. IBM, for instance, when it developed the IBM 360 series, integrating knowledge from dispersed and differentiated structures, assembled its core development task force in a single location, to establish the architecture of the computer product family and of its development process, making the knowledge system of the project decomposable, and allowing subsequent development work to take place at different sites (annals of computing)

⁶ A local firm in the location where all the relevant knowledge elements exist

available to a MNC; 2) the increasing diversity of the knowledge elements it accesses; and 3) the ability to exploit contextually dependent knowledge. However, these advantages need to be created by the MNC, beginning with searching for knowledge. In this regard, MNCs' search behavior, that is, their search rules, constraints and search optimization, and how such search is constrained by the MNC knowledge system, need more research.

Ideally, accessing wide knowledge structures optimizes the MNC's knowledge system: A full complement of knowledge elements can be found, while limiting the number of knowledge structures to be added. Furthermore, serendipitous knowledge creation may take place more easily in wide knowledge structures, taking advantage of co-location. Yet such knowledge structures may not exist in an emerging industry or in a new field, or be so much sought after to be hard to access effectively (due to some crowding out effect, providing access only perhaps for a few leading firms), or so widely accessed as to hardly provide any advantage. Existing literature suggests that the search for added locations is mostly driven by search rules determined by a focus on specific knowledge elements (Doz, Santos, and Williamson, 2001; Almeida, Song and Grant, 2002; Asakawa and Lehrer, 2003). There seems to be little search by MNCs conducted with the intent of accessing wider or superior quality knowledge structures. Regulatory barriers in sensitive areas (e.g., nuclear energy) and concerns with under-defined or un-enforced regulatory regimes provide added constraints to search, externally- or self-imposed.

The above means that the optimal deployment or concentration of knowledge structures, for a given MNC, and the heuristics that should guide the search for an optimal configuration deserve more research. Marginal cost and value frameworks (e.g., Santos et al., 2004) need further development and empirical investigation. We need to investigate how managers represent local knowledge structures (beyond the notion of "right location" or "right cluster" for some activity or business).

Moreover, it is unclear how global firms mobilize their functions, such as human resources, to seek and obtain knowledge from multiple locations. Access to locally differentiated knowledge by MNCs is contingent upon knowledge entrepreneurship at the local subsidiary level, unless it is a distinct CEO-driven corporate process (but such a separate process may not allow access to context-dependent knowledge which requires the legitimacy and co-practice opportunity of an operational local presence).

Put differently, subsidiary managers are expected to develop an original, differentiated, valuable set of knowledge that can make contributions from their local environment to the global network (Birkinshaw, 1997). In fact, ironically, inter-unit knowledge transfer, or system-wide organizational learning in a MNC becomes self-defeating, insofar as they homogenize the knowledge bases across locations within the MNC. Differences in local knowledge structures within the MNC knowledge systems are key: Ultimately, the value of an organization lies in the fact that the members do not have to hold the same knowledge in order to produce something together.⁷ Only insofar as new externally driven local knowledge creation, or learning, takes place to enrich and augment local knowledge structures does the value of knowledge transfers between such structures endure. For a MNC, learning means getting access to a K_i that it did not have, that is, augmenting its knowledge structures. The members of the MNC have, on average, an increased knowledge asymmetry as the MNC local units learn more (in different and/or more locations). New elements may be added to existing structures or new structures added to the system, e.g., via acquisitions.

Alliances are also a means to search and acquire elements of knowledge that exist in a location and which are not public (they exist inside a local company or a local unit of another MNC). The very existence of alliances has been equated with knowledge links

⁷ See, for example, Prahalad and Conner (1996) and also Alchian and Demsetz (1972) and Demsetz (1991).

between firms (Badaracco, 1991). Learning alliances may constitute a privileged conduit for linking knowledge structures around specific projects, or capabilities to be acquired, provided partners put in place appropriate mechanisms, and their learning intents are mutually acceptable or sufficiently surreptitious to go undetected (Hamel, Doz & Prahalad, 1989; Hamel, 1991).

Another area that begs for understanding is the role of voluntarism in the management of knowledge search. Do firms seek for new knowledge structures (say, by establishing a new site in a particular location) because the optimal performance in a business forces them to do so or because they want to explore the feasibility of some new combination of knowledge elements (innovation) that may optimize the firm's performance? These different perspectives, external determinism and internal strategic choice, may even be present in the same MNC under some circumstances. For example, the rationale that drives IBM towards India may be of a very different nature that has driven the location of an IBM center in Finland: matching lower costs and high quality of emerging global competitors from India, such as Infosys or Wipro vs. discovering new business creation opportunities around aging and wellness in an intensely connected society willing to engage in social experiments. Even in the same country the same MNC can follow very different logic, Hewlett Packard in India for instance follows both the usual cost reduction quality enhancement approach and also attempts to discover, via a separate HP Labs investment, new business models for low income, low literacy mass markets, in education or public transportation.

Unit of analysis

The focus on “national subsidiaries” in the MNC and specially in international business research may be detrimental to the search for knowledge structures, or for access. The focus needs to shift from countries to sites, and thus local knowledge structures, such a clusters or

knowledge hubs. Research also needs to identify how firms seek and obtain new knowledge, how local access spans boundaries between the firm's local unit(s) and the external knowledge, who is likely to take on the role of "knowledge activist," or knowledge entrepreneur, and how the reporting, communication processes and modes of interaction (Dhanaraj et. al., 2004) of dispersed locations influence these processes. The social embeddedness of managers, in the local context and in the global NMC knowledge system, may influence how knowledge is obtained, and then made available to the MNC.

One national subsidiary may be composed of a number of sites. Instead of having a local subsidiary as the unit of analysis, we should have the local "site" as the relevant unit⁸. The better we understand the rules of site location by MNCs, the more we will realize how present is the search for different knowledge structures in location decisions by MNCs. We need to improve our understanding of the relation between a particular location and its characteristics and the knowledge structure in it. How do attributes of a location, such as "tolerance" (cf. Florida, 2002), shape the local knowledge structure? How do they facilitate or impede awareness and access by a MNC to the local knowledge elements? For example, are MNCs myopic in that they do not seek for new knowledge structures but rather for specific knowledge elements or is it that such structures are invisible from a distance?

Understanding the Local Knowledge Context

Current academic research is slow in addressing these challenges when applied to complex context-dependent knowledge. Most research addresses more stable conditions and simple tasks when relying mainly on explicit knowledge, such as in software development projects, is possible. Yet the more difficult, and often the more relevant, areas involve complicated learning processes as well as tacit knowledge identification and mobilization. In

⁸ The emergence of the knowledge-based view of business activities has already induced a number of studies on multi-site R&D.

this vein, there is a need to develop a deeper understanding of the context-specificity of knowledge (Doz and Santos, 1997; Brannen, Doz and Santos, 2007). While few will dispute the simple proposition that “context matters”, how it matters, and how to define and characterize the context of knowledge most effectively still remains an unsolved issue.

Learning about new locations and new knowledge combinations in the context of MNCs is a relatively under-researched area in the IB literature, except incidentally through the narrow and potentially distorting lens of the foreign market entry literature (Hill, Hwang, and Kim, 1990), and the also limiting lens of learning through strategic alliances, in which cross-border cross-context knowledge access and learning is subclass of research issues, but seldom center-stage (Hamel, Doz and Prahalad, 1989; Hamel, 1991). We submit, however, that the widening knowledge landscape that MNCs can draw from necessitates a sustained research effort in the search and learning behavior that MNCs can undertake in this wider knowledge landscape.

A different way in which learning may be seen to be dependent on a knowledge context is that successful learning also requires unlearning, in particular to reframe past success programs to fit with changing environments and contexts (Nystrom and Starbuck, 1984; Lyles, 1988). Mistakes, failures, organizational and personal discontinuities and performance crises may trigger unlearning. Unlearning may also stem from challenges that originate from the periphery of the organization, and help trigger a shift from an existing frame of lower level learning (Doz and Hunter, 2003). Thus, global learners may have a greater ability to use challenges from the periphery to adapt dominant frames (Regner, 2004).

Improving the Understanding of Knowledge Transfer

The relative inattention to knowledge structures and the absence of a knowledge system conceptualization in the extant MNC literature imply certain shortcomings. First, an important shortcoming has to do with understanding the costs and benefits of knowledge transfer. The determinants of costs and benefits of knowledge transfer are hard to frame in the absence of an explicit theory of MNC knowledge structures. This is because the motive for combining knowledge elements in a new way, the need for actual knowledge transfer rather than mere juxtaposition, and the difficulties of knowledge transfer are all related to the specific characteristics of the knowledge and contexts of both the sending and receiving organizational units (Brannen, Doz and Santos, 2007). Thus, the relation between the transferred knowledge elements, the MNC “home” and “host” knowledge structures, and the overall knowledge system has implications for costs and benefits of knowledge transfer.

Improving the Understanding of the Quality of a Knowledge Element

We defined the quality of a knowledge element (K_i) as its value creation potential. This potential arises from the element intrinsic quality, its validity as knowledge: its truthfulness or effectiveness in action. However, the superior intrinsic quality of a knowledge element is not sufficient to determine its superior quality. If a MNC finds the “same” knowledge element in two or more locations, how can it predict the quality of K_i in each location? For example, if two locations h and t have a common knowledge element K_i (for example, a particular skill) such that K_{ih} and K_{it} are equally effective in action but the cost of acquiring K_{ih} is lower than that of K_{it} then the quality of K_{ih} is superior to that of K_{it} . Therefore, two elements of the same knowledge are identical—that is, have the same quality—if and only if they are both equal in validity and cost.

Connecting Knowledge Structures

The crucial value of the MNC as an organization is its capability to combine knowledge elements that exist in separated knowledge structures. In this respect, the evidence that MNCs tend to squelch the entrepreneurial behavior of distant subsidiaries (Birkinshaw, 1997) is far from the idea of heterarchy (Hedlund, 1986). We need to understand much better under what conditions managers of a MNC choose to create purposeful links between distant knowledge elements. Is this challenge of a political nature (and different knowledge structures seen as a threat to the power of the center unit) or is it just an expression of uncertainty avoidance? Or could it be simply that managers may not see the possible connections?

If the connection of knowledge structures would be there just to allow for the transfer of internal knowledge in a MNC (such as the findings of Gupta and Govindarajan, 2000, seem to indicate) it is not clear how the MNC can benefit from the external knowledge it encounters in a particular location. But it may also be that if a MNC is in a particular location for reasons other than local knowledge (say, lower wages or access to a local raw material), the coordination and control across units would justify the findings highlighting the flows of internal knowledge.

How is knowledge combined or melded at a distance? What is the role of the interactions between the individuals of a virtual team across-sites in a MNC? Is there always a need for some object that acts as a magnet of dispersed knowledge (Doz et al, 2001)? What is the nature of the shared context that minimizes the cost of knowledge integration at a distance?

CONCLUDING REMARKS

Research on the multinational firm is in need of a change of mindsets. Both corporate executives and academic researchers have been trained in an age of knowledge projection,

where the U.S., a few Western European countries, and later Japan, accounted for a totally disproportionate share of knowledge (and wealth) creation. The new challenges for managers in MNCs and researchers in international management have to do with an increasing knowledge dispersion globally, and an accompanying need to source knowledge from many more and more heterogeneous sites, and combine, integrate and utilize this knowledge subsequently.

Although knowledge flows between MNC units have surely been central in international management research over the last two decades, this focus has not been anchored in an overall knowledge-based conceptualization of the MNC, one that links together knowledge stocks and knowledge flows, and explains how stocks are structured and how this impacts flows. The contribution of this work has been to, first, develop a knowledge-based conceptualization of the MNC, and, second, and relatedly, to suggest a research agenda for knowledge-based research in the MNC that corresponds to the changed realities. Both our conceptualization exercise and the definition of the research agenda begins from noting that many of the right components are “there.” Thus, the search for strategic knowledge assets, the attempts to build distributed innovation networks, and engaging in strategic alliances and networks for the purpose of sourcing knowledge, are now key ideas in the (recent) MNC literature. Authors such as Prahalad and Doz (1987), Gupta and Govindarajan (2000), Almeida, Song and Grant (2002), Zhou and Frost (2005), Nohria and Ghoshal (1997) and others, have addressed this shifting of the learning field and how MNC strategies change to reflect this.

However, what is missing in the knowledge-based view is an overall organizing perspective. Such a perspective can be found in work on complex systems (Simon, 1962; Kauffman, 1993), and can be aligned with a conceptualization of MNCs as knowledge systems, that is, patterns of connections between dispersed knowledge structures. In addition

to the subsidiaries of the firm, knowledge structures can include local third parties and be accessed through various types of alliances and collaborative arrangements.⁹ The knowledge combination performance landscape may be rugged, with many peaks and valleys, or it may be more flat with few peaks. Success in identifying combinations of knowledge elements that are high in appropriable value is influenced not only by the characteristics of the landscape but also by the search mode of the firm.

In a “flat world”, the combination of external determinism, efficiency-seeking, and very low transaction costs would eradicate the MNC as an organizational form and governance mode in business. Paradoxically, in a global world where we can be anywhere, anytime, international trade would replace the international firm. Economies of scale would exist in local firms (in certain locations) serving distant local firms elsewhere. New combinations of local knowledge would be exploited by local firms elsewhere, the risk of distance addressed by a combination of licensing and partnerships. In such circumstances, the place for the MNC seems reduced to that of connecting distant and different knowledge structures. The MNC will remain as a organization specifically fit to align the views and interests of distant peoples between which markets fail. Above all, the MNC will be a knowledge system fit for innovation, while operations may increasingly rely on networks of local firms.

⁹ This is a significant distinction between the transnational (e.g., Bartlett & Ghoshal, 1989) approach and the metanational approach (Doz, Santos & Williamson, 2001)

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