

Building a MNC Knowledge Structure: the Roles of Knowledge Sources, Complementarities, and Organizational Context

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Abstract

We develop a view of the MNC as a knowledge-creating and utilizing entity, building on the extant literature on the differentiated MNC as well as on Lyles and Schwenk's work on corporate knowledge structures. The starting point for this conceptualization is that MNC management through choices regarding organizational control, motivation and context can influence the development, characteristics and transfer of knowledge. This extends existing literature. For example, in most of the literature, the characteristics of knowledge are seen as exogenous rather than endogenous variables. However, to the extent that management chooses a specific way of sourcing knowledge, it also implicitly chooses the characteristics of the sourced knowledge and the ease with which it can be transferred inside the MNC. This is because knowledge from different knowledge sources have different characteristics and are thus transferred at different cost. The six hypotheses that we draw from the main argument are tested on the basis of a unique and very rich dataset on subsidiary knowledge development (including information on the organizational setting, sources of subsidiary knowledge and the extent of knowledge transfer to other MNC-units) that has been constructed in connection with a cross-national project Centres of Excellence (Holm and Pedersen 2000a). The dataset covers more than 2.000 subsidiaries located in seven different European countries.

I. Introduction

Although the role of knowledge and learning in gaining and sustaining competitive advantage has been a central field of research in several literatures in strategic management for more than a decade,¹ rather little is known about some of the central aspects, mechanisms and contextual factors in the relevant processes. In much research simplistic taxonomies of knowledge - usually centering on the tacit-explicit distinction - are applied, and there is seldom a recognition of the extent to which, for example, the tacitness of knowledge is a choice variable. Moreover, the literatures on the connection between knowledge and competitive advantage have paid rather little attention to the organizational aspects of the connection. For example, little attention is being paid to those organizational mechanisms that may decrease "internal stickiness" and help diffusing valuable knowledge inside the firm, while still keeping knowledge inimitable to would-be imitating rivals. As a somewhat crude generalization, the development, characteristics and transfer of knowledge are thus seldom consistently taken to be endogenous to organizational processes and arrangements. In the literature, it is — again as somewhat crude generalization — rather the other way around: Organizational arrangements are seen as rational responses to the requirements implied by different characteristics of knowledge.

Arguably, the literature has paid some attention to the organizational aspects of the development, characteristics and transfer of knowledge. On the overall level, there is a well-known argument that the differentiated MNC is in fact *more* favorably positioned than the non-differentiated MNC or the purely domestic firm with respect to mobilizing knowledge in the development and renewal of competitive advantage, simply because of its access to more knowledge networks (Hedlund 1986; Bartlett and Ghoshal 1989). Important work has addressed the organizational dimensions of such MNC knowledge mobilization (Gupta and Govindarajan 1991, 1995). Moreover, recent research has led to a renewed conceptualization, understanding and appreciation of subsidiaries which are now seen as potential sources of MNC-wide strengths (Bartlett and Ghoshal 1986, 1989; Birkinshaw 1996; Forsgren, Pedersen and Foss 1999), and perhaps even as "centers of excellence" (Moore and Birkinshaw 1998; Holm and Pedersen 2000a). Thus, the organizational dimensions of knowledge creation and transfer of knowledge are certainly not completely neglected. However, what is true of the strategic management literature in general is also true of the international business literature: There are still significant gaps in the understanding of central aspects, mechanisms and contextual

¹ Work on these issues arguably began with Lippman and Rumelt (1982). Since then a cottage industry has emerged on the various characteristics of knowledge that may hinder the imitability of rent-yielding knowledge assets, such as causal ambiguity (Mosakowski 1997), complexity, and tacitness (Winter 1987). Much of this has taken place in the context of resource-based (Wernerfelt 1984; Barney 1991), knowledge-based (Grant 1996), and evolutionary theories of the firm (Nelson and Winter 1982; Foss, Knudsen and Montgomery 1995).

factors of the process of managing knowledge, notably developing, transferring and influencing the characteristics of knowledge. Most fundamentally, there is no coherent view of what it means to say that the MNC is a knowledge-based entity. The present paper represents an attempt to address and contribute to remedying some of these weaknesses.

We take our starting point in the notion of a corporate knowledge structure (Lyles and Schwenk 1992), and argue that the MNC may be understood as consisting of core and more peripheral systems of beliefs, values, etc. that influence processes of acquisition, accumulation, utilization and transfer of further knowledge. These knowledge processes are partly endogenous outcome of management decisions relating to, for example, the relations between subsidiaries, and between subsidiaries and the center, how many and which decision-making rights that are granted to subsidiaries (Jensen and Meckling 1992), the sources of knowledge that subsidiaries tap into (Foss and Pedersen 2001), and how many resources are invested in codification efforts — all given complementarities between knowledge elements in the MNC, the characteristics of knowledge (complexity, tacitness, etc.) and knowledge sources (internal, external) and pre-existing organizational arrangements. In particular, we shall focus on managerial choices relating to knowledge sources and organizational control and motivation.

In the following we proceed as if top-MNC management confronts a well-defined multivariate optimization problem with respect to the development and transfer of knowledge.² Thus, norms of (strong) managerial rationality are assumed throughout, as are a top-down approach. Specifically, the organizational design problem is to choose organizational instruments of control, motivation and context in such a way that some objective function (e.g., the total value of the MNC network, sustainability of competitive advantage) is maximized. This is accomplished by choosing organizational instruments such that 1) knowledge is optimally developed, 2) knowledge is optimally transferred, and 3) the optimal MNC-wide mix between tacit and explicit knowledge components is achieved, all given the relations of complementarity between knowledge elements in the MNC, the characteristics of knowledge in terms of tacitness, complexity etc., and pre-existing organizational arrangements. Thus, our fundamental point is that a full picture of the MNC as a knowledge creating and using entity should treat the sources, transfer and mix of knowledge as endogenous variables.

We distinguish between knowledge sourced from internal development of knowledge in the subsidiary and the MNC network, knowledge sourced from network relations and knowledge sourced from local clusters. We argue that these knowledge sources are managerial decision (control) variables. Moreover, we argue that the success of developing knowledge from such sources is influenced by the degree of autonomy that is granted to the subsidiary, as well as the extent to which

² Although an evolutionary conceptualization of the role of management in the differentiated MNC as one of “steered evolution” (cf. Lovas and Ghoshal 2000) may be the most appropriate one, because of the sheer complexity and partial unpredictability of the process.

interdependence with other MNC units is promoted. Finally, we argue that the extent to which knowledge can be transferred within the MNC network reflects prior managerial choices with respect to the choice of source of knowledge and the way in which subsidiaries are organized. This is because the choice of knowledge sources and of MNC organization influences the characteristics of knowledge (e.g., tacit vs explicit).

In sum, our contribution in this paper are, on the overall level, to explicitly argue that the development, characteristics and transfer of knowledge can be influenced by MNC management through choices regarding organizational control, motivation and context. Indeed, we suggest that the choices regarding the development, characteristics and transfer of knowledge is really part of the same optimization problem; for example, to the extent that management chooses a specific way of sourcing knowledge, it also implicitly chooses the characteristics of the sourced knowledge and the ease with which it can be transferred inside the MNC. This is because knowledge from different knowledge sources have different characteristics and are thus transferred at different cost. These arguments are, to our knowledge, novel to the literature. The empirical setting of this paper is the MNC, however, as seen from the perspective of the subsidiary. The hypotheses that we draw from the main argument are tested on the basis of a unique and very rich dataset on subsidiary knowledge development (including information on the organizational setting, sources of subsidiary knowledge and the extent of knowledge transfer to other MNC-units) that has been constructed in connection with a cross-national project Centres of Excellence (Holm and Pedersen 2000a). The dataset covers more than 2.000 subsidiaries located in seven different European countries.

II. Theoretical Model and Hypotheses

In this section, we develop the theoretical arguments that intra-MNC knowledge creation and transfer are influenced by managerial choices relating to 1) the sources of knowledge, 2) organizational instruments and 3) the mix of tacit and explicit components in the MNC knowledge structure. These determinants are placed in the context of a view of the MNC as a knowledge structure. We begin by briefly explaining this conceptualization and then discuss the determinants *seriatim*.

The MNC as a Knowledge Structure

Much of the recent MNC literature has stressed the role of MNCs as networks that facilitate MNC-wide learning processes (e.g., Hedlund 1986; Gupta and Govindarajan 1995). However, it is fair to say that this literature is not based on explicit theories of organizational knowledge. Reference is sometimes made to organization-level “higher-order organizing principles” that exist for the purpose of easing organizational learning and “combinative capabilities” that create new applications of existing knowledge (e.g., Kogut and Zander 1993), however, these notions are seldom thoroughly explained. For the purposes of this paper, we need

to take a slightly more detailed look at organizational knowledge. This will ease the understanding of processes of knowledge development and, in particular, knowledge transfer.

For the purpose of better understanding organizational knowledge, a pertinent contribution is Lyles and Schwenk (1992). They introduce the notion of an “organizational knowledge structure” to refer to shared beliefs at the organizational level about “... goals, cause-and-effect beliefs, and other *cognitive* elements.” An attraction of their discussion is that they are quite explicit that inside firms, there exists a differentiation in the degree to which consensus exist with respect to these beliefs. Thus, in the firm’s “core” the degree of consensus is high, while in the “periphery” it is low. They further argue that the organizational knowledge structure is characterized by *complexity* which refers to “... the amount of information ... within a knowledge structure” (p.163) and “... the degree to which cognitive units are interrelated” (p. 164), as well as by *relatedness* which refers to the degree of coupling (tight vs. loose) between elements in the core and periphery of knowledge structures. Though not developed for this purpose, an advantage of these distinctions is that they provide some content to attractive, but often not very specific notions of firms as repositories of knowledge, capabilities, competencies and the like.

Thus, inspired by Lyles and Schwenk (1992), we adopt a conceptualization of the MNC as a knowledge-based entity where the MNC knowledge stock is structured along a number of different dimensions. This conceptualization is entirely consistent with, but adds to, the basic perspective in recent work on the differentiated MNC, which we take to be that subsidiaries control heterogeneous stocks of knowledge, and that the MNC may obtain competitive advantages from orchestrating knowledge flows between MNC units in such a way that knowledge is transferred to those MNC units where it will increase value-added. Our conceptualization adds to this by more comprehensively identifying those dimensions according to which the MNC knowledge structure may be classified and by explaining how such an exercise leads directly into issues of transfer of knowledge.

To begin with, we argue that the distinction between core and peripheral knowledge and the dynamics between these make much sense in the context of MNCs. Thus, as described by Lyles and Schwenk it is mainly in the periphery that new perspectives are developed. The relatively recent discovery in the MNC-literature of the role of subsidiaries as sources of new ideas, perspectives, etc. (e.g., Moore and Birkinshaw 1998; Holm and Pedersen 2000a) reflects a similar recognition that new sources of strength may arise outside the presumed core of the MNC. On the other hand, knowledge that is built in the context of the core is less costly to transfer to other parts of the MNC network than knowledge that arises in the periphery because it can rely on greater bandwidth communication channels (Heimann and Nickerson 2002). Thus, there is a possible tradeoff between the novelty of ideas and the costs of communication. In turn, costs of communication are

positively influenced by the extent to which the knowledge structure is characterized by complexity (including the tacitness and the distance from the core). Finally, relations of complementarity (our counterpart to Lyles and Schwenk's "relatedness") characterize knowledge elements within the overall MNC knowledge structure. By "complementarity" we refer to the extent to which combining different knowledge elements increases the potential gains to firms (Milgrom and Roberts 1990; Buckley and Carter 1999).

These notions are descriptively richer with respect to characterizing the MNC knowledge structure than most other discussions. Moreover, they are attractive, because they not only allows us to characterize an existing knowledge structure, but also opens the door to an understanding of knowledge development and transfer in the context of MNCs. Thus, from this perspective, we may characterize the managerial decision problem with respect to management of MNC-wide knowledge as a matter of balancing expected benefits from transferring knowledge, as determined by complementarity, against the expected costs of this, where these costs are determined by complexity, tacitness, and the distance from the core. We expand on this in the following, and then discuss how management may influence the costs and benefits of developing and transferring knowledge.

Developing and Transferring Knowledge as Key Managerial Decision Problems

Although it is very often argued in the literature that the MNC owes its existence to its superior ability (relative to markets) to transfer knowledge and that this superior ability may at the same time be a source of competitive advantage (relative to purely domestic firms), it is also widely recognized that the resource costs of developing and transferring knowledge may often be substantial. With respect to the transfer of knowledge, Teece (1981) estimated that transfer costs for the intra-MNC technology transfer cases he examined ranged from 2, 24 percent to 59 percent with a mean of 19,16 percent. In the view of Kogut and Zander (1993: 630) "... these costs are derived from the efforts to codify and teaching complex knowledge to recipient."³ On the other hand, the benefits from transferring knowledge are often very substantial as suggested by Subramaniam and Venkatraman's (2001) finding that transnational product development capability is highly dependent upon the transfer of knowledge in MNCs.

Given that both the costs and benefits of developing, transferring, codifying, teaching, etc. knowledge are so substantial, we submit that MNC management will not only build and transfer knowledge so that the benefits from these activities are balanced against their costs. Management will also seek to control the determinants of these benefits and costs, aiming at increasing benefits while reducing costs. This

³ Similarly, Szulanski (1996) showed that his findings imply that the barriers to knowledge transfer were only to a very small extent motivational (at least in the sense of, for example, agency theory). Rather, the barriers to knowledge transfer had to do with causal ambiguity, the receiver's absorptive capacity and the general atmosphere in the relation between sender and receiver. However, his findings did not relate to the context of cross-border knowledge transfer.

may be accomplished, among other things, through managerial choices relating to knowledge sources and organizational controls, motivation and context. In terms of our earlier discussion of the MNC knowledge structure these managerial choices influence and are influenced by the complexity of the knowledge structure, the core-periphery distinction, relations of complementarity between knowledge elements and the degree of tacitness of knowledge elements. We assume that management will choose subsidiary knowledge sources and organizational mechanisms for transferring knowledge in such a way that the overall value of the MNC is maximized. However, in spite of their obvious empirical as well as theoretical importance, rather little is known about the determinants of intra-MNC knowledge flows⁴ in spite of some attention to knowledge characteristics (e.g., Hamel 1991; Kogut and Zander 1993; Simonin 1999), organizational controls, and motivational factors (Gupta and Govindarajan 1991, 1995). The next sections consider the determinants of, first, knowledge sources of MNC subsidiaries and, second, organizational mechanisms in some detail and discuss their implications for the transfer of knowledge in MNCs.

Sources, Characteristics and Transfer of Knowledge

As a general matter, impediments to knowledge transfer may be classified as either motivational or cognitive barriers (Cohen and Levinthal 1990; Zander and Kogut 1995; Gupta and Govindarajan 2000). In this section, we are primarily taken up with cognitive barriers to transfer, reserving motivational factors for later treatment. Cognitive barriers to transfer are usually conceptualized in terms of such constructs as causal ambiguity, complexity, tacitness, absorptive capacity, and the like. Although they make perfect theoretical sense, these variables may be hard to operationalize and measure.⁵ A more operational approach is to start directly from the *sources* of subsidiary knowledge and argue that these sources result in knowledge with different characteristics. Given this, sources of knowledge may be treated as choice variables, so that under norms of managerial rationality, the MNC wide development and transfer of knowledge is optimized through the choice of knowledge sources (and organizational controls and motivation).

Although an internal element necessarily enters into the production of all subsidiary knowledge, it makes sense to distinguish between the following types of knowledge, derived from different knowledge sources:

⁴ Thus, Crossan and Inkpen (1994: 271) point out that "... while much of the MNC research has dealt with static theories of the firm and investigations of structural questions, very little research has delved into the process of knowledge transfer and the barriers to successful intraorganizational learning." And as late as in 2000, Gupta and Govindarajan (2000: 474) observed that with some notable exceptions (e.g., Zander and Kogut 1995), "... very little systematic empirical investigation in the determinants of intra-MNC knowledge transfers has so far been attempted." See also Buckley and Carter (1999: 81) for similar observations.

⁵ Although successful attempts do exist, for example, Cohen and Levinthal 1990; Kogut and Zander 1993; Simonin 1999; Gupta and Govindarajan 2000.

- 1) *Internal knowledge* — that is, knowledge that is produced mainly through investing in the internal production of knowledge (e.g., much R&D).
- 2) *External knowledge* — that is, knowledge that is to a large extent created on the basis of knowledge inputs from relations to external partners (customers, suppliers, etc.) or on the basis of knowledge inputs from a local cluster (e.g., a well educated work force, high quality research institutions, etc.).

The first category of knowledge is the kind of internal knowledge that has been highlighted in resource- and knowledge-based theories of the firm (Foss 1997). In this literature, the focus has been on production and organization knowledge that is embodied in bundles of routines of a highly tacit and social nature. Teams of individuals operate it for some strategic purpose. Because of its characteristics, such knowledge is strongly intertwined with the organization itself and is therefore hard (very costly) to trade in the market. It may, however, be transferable at much lower cost inside the MNC network than across markets, particularly to the extent that internal knowledge is developed within the core of the MNC knowledge structure and is developed explicitly as a complement to other knowledge elements in the MNC network. This leads us directly to the conventional argument for the existence of the MNC, which asserts that MNCs exist because of their comparative advantages (*vis-a-vis* markets) of transferring knowledge. Though arguably correct, that argument fails, however, to distinguish between the transfer of knowledge that differs in terms of sources.⁶ In contrast, we argue that the ease of transfer of knowledge is likely to be influenced by the sources of the knowledge.

Of course, no knowledge is entirely internally accumulated (Nohria and Eccles 1992; Foss and Eriksen 1995; Kogut 2000); in fact, as we later elaborate, there may be significant relations of complementarity between internal and external knowledge sources. Nevertheless, it makes conceptual and empirical sense to say that some knowledge is largely internally produced, while some other knowledge is strongly based on external knowledge inputs. Conceptually, one may distinguish between two external sources of knowledge that may be available to subsidiary firms. The first category may be called “network-based knowledge.” We here have in mind the gaining of knowledge from long-lasting interaction with specific external parties, notably customers or suppliers, and the use of that knowledge in the firm’s activities (Ford 1990).⁷ The second category may be called “cluster-based knowledge.” This kind of external knowledge is not to the same extent the result of long-lasting interaction with specific parties. Rather, it is based upon knowledge inputs from, for example, a well educated work force or local knowledge institutions, such as

⁶ Of course, the literature has introduced distinctions between, for example, R&D capabilities and marketing capabilities. However, this doesn’t go to the heart of the matter of the sources of knowledge.

⁷ For example, Dyer and Nobeoka (2000) examine Toyota’s production network, and argue that Toyota’s ability to create, manage and take advantage of network-based knowledge flows is a strong explanation for the many productivity advantages enjoyed by Toyota (as well as its suppliers).

technical universities, etc. (Porter 1990; Porter and Sölvell 1999). In this paper, we treat both categories as one, namely as “external knowledge.” External knowledge constitutes the peripheral part of the MNC knowledge structure.

Our distinction between internal and external sources of knowledge in the subsidiary knowledge base is different from the conventional distinction between, for example, production, marketing or R&D knowledge; the latter types of knowledge may all in principle have both internal and external components, to varying degrees. The advantage of our distinction is that it may be *more* plausibly discussed in terms of general characteristics of knowledge than the activity-based definitions of knowledge. For example, it is hard to argue on *a priori* grounds that, for example, production knowledge is inherently more complex, ambiguous or tacit, and therefore harder to transfer, than marketing knowledge. In contrast, we consider it more justified to make this kind of arguments with respect to our distinction, although with considerable cautiousness.

Sidestepping motivational issues (which we deal with later), the success of knowledge transfer is primarily a matter of cognitive matters, such as the existence and richness of transmission channels (Bartlett and Ghoshal 1989; Ghoshal, Korine and Szulanski 1994), the characteristics of the transferred knowledge in terms of such dimensions as tacitness, ambiguity, etc. (Zander and Kogut 1995; Szulanski 1996), and the absorptive capacity of the target unit(s) (Gupta and Govindarajan 2000). We submit that these cognitive dimensions are systematically related to knowledge sources. Specifically, internal knowledge is likely to be more easily transferable than external knowledge, fundamentally because it is more likely to lie in the core of the MNC knowledge structure and is more likely to be at least partly developed through interaction with other MNC units. Internally accumulated knowledge may be relatively easily transmitted through existing transmission channels, and although it may contain, for example, tacit elements, the absorptive capacity of target units is likely to be relatively high. Therefore, we propose the following hypothesis:

Hypothesis 1: Internal subsidiary knowledge will be positively correlated with knowledge transfer from subsidiaries to other MNC units.

In contrast, external knowledge which tends to be of a more peripheral character in the MNC knowledge structure, is likely to be less easily transferable than internal knowledge. This is because this type of knowledge is to a large extent derived from specific, perhaps very specific, problems and needs of the external parties with which the subsidiary interacts, and/or it consists of knowledge of local skill levels, tastes, regulatory authorities, etc., much of which may be hard to transfer or of no or little use for other MNC units. External knowledge thus largely lies outside of the core of the MNC knowledge structure. Therefore, it contains many elements that makes it hard to transfer to other MNC units.⁸ In fact, we argue that the more a

⁸ This is admittedly somewhat counter-intuitive, since it may be argued that some kinds of external knowledge may be less characterized by tacit elements than internal knowledge. For example,

subsidiary is prone to accumulate external knowledge, the less knowledge will it transfer to other MNC units. Given the above discussion, we can put forward the following hypothesis:

Hypothesis 2: External subsidiary knowledge will be negatively correlated with intra-MNC knowledge transfer, because external knowledge is not (or only weakly) complementary to knowledge in other MNC units.

However, a key point of the literature on the differentiated MNC is that important knowledge may develop in what we call the periphery of the MNC knowledge structure - knowledge that when transferred and combined with complementary knowledge in other MNC units will yield a high value-added. However, in order for such knowledge to be transferable and combinable with complementary knowledge in other MNC units, it has to be interpreted and formulated in such a way that it will be accessible to other units. In terms of the distinction between external and internal knowledge, this may be accomplished by bringing external knowledge in more direct contact with internal knowledge. Remember that we have defined internal knowledge to also include knowledge developed in the interaction between MNC units, that is, as also including the "codes" (Arrow 1974) through which communication may take place, and to include more core knowledge than peripheral knowledge. Thus, we are not denying a key point of the literature on the differentiated MNC, but rather refining it. Given this, we can put forward our third hypothesis:

knowledge inputs from local universities may have a high explicit knowledge content. However, knowledge inputs from local universities may constitute a rather small part of cluster knowledge, given that the tendency in most MNCs is to source this kind of inputs in centrally placed R&D departments and not in local subsidiaries (Gassman and von Zedtwidtz 1999). Moreover, the emphasis is not so much on tacit knowledge as a barrier of transfer as on whether the relevant knowledge lies within the core of the MNC knowledge structure. Tacit knowledge may lie within this core.

Hypothesis 3: When brought in contact with internal knowledge, external knowledge is highly correlated with knowledge transfer from subsidiaries to other MNC units. In more formal terms, the interaction effect between internal and external knowledge is positively correlated with knowledge transfer from subsidiaries to other MNC units.

Because internal and external knowledge are associated with different costs of transfer (different degrees of complexities and different tacit knowledge content) and with different complementarities, MNC management will influence the sources of knowledge that subsidiaries tap into in such a way that net benefits are maximized. However, influencing these sources through, for example, locational decisions, is not the only means of optimizing the accumulation and transfers of knowledge that is available to MNC management. It can also make use of mechanisms of organizational control and motivation.

A basic organizational problem is to motivate the subsidiary to actually transfer knowledge that may be useful to other subsidiaries. One problem concerns who should bear the resource costs of transferring knowledge and how the parties to the knowledge exchange are to be compensated. We shall abstract from this problem, and assume that the subsidiaries and the headquarters through structuring compensation in the right way can handle it. A rather different motivational problem is that to the extent that a subsidiary possesses a knowledge monopoly it controls a lever of bargaining power in the MNC, since it controls a crucial complementary asset (Hart 1995). Transferring knowledge is tantamount to giving up this power (Forsgren, Pedersen and Foss 1999; Holm and Pedersen 2000b). Gupta and Govindarajan (2000) briefly point to such a problem. Foss and Pedersen (2001) argue that repeated know how exchange may act as a mechanism that keeps this bargaining problem at bay. In this paper, as in Foss and Pedersen (2001), we deal with subsidiaries that are involved in lengthy relations with headquarters and other subsidiaries and, hence, engage in repeated interaction with these. Thus, we believe it is justified to assume that in fact subsidiaries will be motivated to transfer knowledge. However, one point that has not been dealt with concerns the organizational mechanisms of control and motivation that may be applied, not just to the transfer of knowledge, but also to the *development* of knowledge.

Organizational Control and Motivation and Developing Knowledge

Many contributions to the MNC literature recognize that the process of knowledge transfer is likely to be supported by different organizational means of control and motivation (e.g., Bartlett and Ghoshal 1989; Gupta and Govindarajan 1991, 1995; Buckley and Carter 1999). Indeed, a key theme in many recent contributions is that interdependencies (complementarities) between knowledge flows strongly condition the choice of types of management systems and processes for managing subsidiary relations (e.g., Gupta and Govindarajan 1995).

We agree with the basic thrust of this literature. However, we add two points. First, the choice of organizational mechanisms of control and motivation also

influence the accumulation of knowledge in the sense that the application of different mechanisms lead to different kinds of knowledge being accumulated. Second, causality may go in the reverse direction in the sense that the choice of organizational mechanisms of control and motivation also influence the transferability of knowledge. Consider these points in turn.

The knowledge structure of the MNC contains shared elements as well as local elements (in the sense of Hayek 1945), for example, knowledge about local tastes, technologies, regulators, suppliers, etc. In order to efficiently utilize the local elements of the knowledge, it will often be necessary to delegate rights to make decisions that involve such local knowledge to those decision-makers that best know how to turn the relevant knowledge to productive uses. Along such lines, it may be argued that granting more decision rights to a MNC subsidiary — giving it more autonomy — improves the incentives of the subsidiary to engage in the accumulation of local knowledge (cf. Aghion and Tirole 1997). Local knowledge is more likely to be of the external kind than of the internal. If subsidiary knowledge is mainly based on external knowledge, it is hard for MNC headquarters and top-management to direct the subsidiary's acquisition of such knowledge because of the knowledge asymmetry (Jensen and Meckling 1992) and because the subsidiary is distant from the core in the knowledge structure. Thus, stimulating the development of external knowledge in a subsidiary — for example, in the hope of increasing local marketing and product development — may involve granting a high degree of autonomy to the subsidiary. This leads to our fourth hypothesis:

Hypothesis 4: The development of external knowledge in MNC subsidiaries is positively influenced by the degree of autonomy granted to the subsidiary.

In contrast to external knowledge, internal knowledge is produced mainly through investing in the internal production of knowledge (e.g., much R&D) or from learning by doing, using, etc. in the subsidiary itself, or developed through interaction with other units in the MNC network. The emphasis is on developing knowledge that is at least potentially transferable. Such knowledge will typically lie within the core of the MNC knowledge structure. Also, the accumulation of internal knowledge in a subsidiary will strongly reflect perceived complementarities with knowledge elements in other parts of the MNC; more precisely, developing such knowledge takes place with an eye to these potential benefits. Thus, we put forward the following hypothesis:

Hypothesis 5: Developing internal knowledge in MNC subsidiaries are positively influenced by the perceived interdependencies (complementarities) between the focal subsidiary and other MNC units.

Further, the development of internal knowledge is likely to be stimulated by the transfer of goods and/or services between MNC units. This is because the transfer of goods and/or services, that is, intra-MNC trade, is in itself a force pulling in the direction of a widening of the bandwidth of communication channels. This prompts

the discovery of new opportunities for realizing complementarities between knowledge components (Kirzner 1973). Thus:

Hypothesis 6: Developing internal knowledge in MNC subsidiaries is positively influenced by the amount of trade between the focal subsidiary and other MNC units.

The hypotheses are summarized in the following model.

XXXXXX INSERT FIGURE 1 HERE XXXXXX

III. Data and Method

Data Collection

The data has been collected as part of the Centres of Excellence-project that engaged researchers in the Nordic countries, the United Kingdom, Germany, Austria, Italy, Portugal and Canada. The CoE-project was launched in May 1996 with the purpose of investigating headquarter-subsidiary relationships and the internal flow of knowledge in MNCs. A leading priority was to get proper data for the project, and in order to collect quantitative data on acquisition of subsidiary knowledge it was decided to construct a questionnaire that could be applied in all the involved countries. After several project meetings and extensive reliability tests of the questionnaire on both academics and business managers, this was accomplished.⁹

For practical reasons, it was decided that each project member should be responsible for gathering data on foreign-owned subsidiaries within their own country. Thus, all subsidiaries in the database belong to MNCs. In the data gathering, subsidiary managers, rather than headquarters, have been respondents. One advantage of choosing subsidiary respondents is that they are directly engaged in the market and therefore are more acquainted with its characteristics. Although we can expect that the subsidiary have a reliable awareness of its own competencies, it would be an advantage to gather information on intra-MNC knowledge flows from other corporate units as well. However, it would be an unmanageable task first to identify the subsidiaries in each country and then to identify the relevant management units in the foreign MNCs.

The paper is based on empirical data from seven countries: Austria, Denmark, Finland, Germany, Norway, Sweden and the UK. All countries are located in the northern part of Europe, and the four Nordic countries are considered to be relatively small, while Germany and the UK are among the largest in Europe. Approximately 80 per cent of the questionnaires were answered by subsidiary executive officers, while financial managers, marketing managers or controllers in

⁹ For more information on the CoE-project, see Holm and Pedersen (2000a).

the subsidiary answered the remaining 20 per cent. The response rate varies between 20 (UK) and 55 per cent (Sweden), depending on the country of investigation. The quality of the data is quite high with a general level of missing values of not more than 5 per cent.

XXXXXXXXX *INSERT TABLE 1 HERE* XXXXXXXXX

As shown in table 2, the total sample covers information on 2.107 subsidiaries. It comprises all kinds of subsidiaries in all fields of business. Between countries, the sample ranges from 202 (UK) to 530 (Sweden). With the exception of Sweden, the size of the sample is rather similar in the other six countries. The average number of employees in the subsidiaries is 742 and the median is 102. Within the five smaller countries, the average size of the subsidiaries are very similar, while Germany and UK — due to their larger market sizes — comprise substantially larger subsidiaries. As we expect larger subsidiaries to comprise more knowledge and therefore more potential for knowledge transfer we need to control for this bias in the data material when conducting our tests of the hypotheses.

For all these subsidiaries are covered information on the level of subsidiary competencies, the sources of this competence, organizational context variables, and to what extent the knowledge has been transferred to other MNC-units. The subsidiaries were asked to indicate the level of competence for six different activities performed by the subsidiary on a seven-point Likert scale, from 1=very weak competence to 7=very strong competence. The six activities are research (basic and applied), development (of products and processes), production (of goods and services), marketing and sales, logistics and distribution and purchasing. The average score on the seven-point scale of the level of competence is shown in table 3.

XXXXXXXXX *INSERT TABLE 2 HERE* XXXXXXXXX

In general, the subsidiaries are indicating that they comprises a relatively high level of competence for all activities with average values ranging from 4 to 6 in the upper level of the seven-point scale. The pattern is very similar for all the six countries with the highest competence levels for production and marketing/sales and somewhat lower levels for the four other activities. As expected, the larger German and UK subsidiaries have higher competence levels than the other subsidiaries in the sample. They have slightly higher values than the total sample for all six activities.

Measures

All data were collected through the questionnaire and most variables are multi-item measures that were measured using seven-point Likert scales. However, items such as the number of employees were measured using actual values. The following sections provide the exact wording used for questionnaire items.

Knowledge transfer. Following, Foss and Pedersen (2001) our definition of knowledge transfer is capturing the application rather than the physical transfer of

the subsidiary knowledge in other MNC units. Accordingly, in the questionnaire the subsidiaries have been asked to what extent the subsidiary knowledge has been of use to other MNC units. Respondents have indicated this on a seven-point Likert scale, where 1 was defined as "to no use at all for other units" and 7 was defined as "very useful for other units" for all the six above-mentioned activities. *Knowledge transfer* is a multi-item construct calculated as the average score reported by respondents across these six items ($\text{Alpha}=0.74$).

Internal knowledge. The construct of internal knowledge is capturing both the subsidiaries own effort of knowledge production and the knowledge developed through interaction with other MNC units. The subsidiaries own knowledge production was measured by asking respondents to assess the level of investments in the subsidiary in the past three years, where 1=very limited, 7=substantial. The level of investments was assessed for all the six above-mentioned activities. In order to measure the knowledge developed through interaction with other MNC units the respondents was asked to assess the impact of various internal organizations on the development of the subsidiary's competencies, where 1=no impact at all, 7=very decisive impact. Three organizations were identified: internal MNC customers, internal MNC suppliers, and internal MNC R&D units. In the models used to test our hypotheses we use a composite measure, *Internal knowledge*, based on the average across all nine items ($\text{Alpha}=0.73$).

External knowledge. The variable of external knowledge is capturing both the importance of external counterparts (like customers and suppliers) and the local cluster as sources of knowledge development in the subsidiary. The inputs from external partners was measured by asking respondents to assess the impact of various external organizations on the development of the subsidiary's competencies, where 1=no impact at all, 7=very decisive impact. Four organizations were identified: external market customers, external market suppliers, specific distributor and specific external R&D unit. Building on the elements of Porter's (1990) diamond model, respondents were asked to assess the business environment in which they compete along the following dimensions: Availability of business professionals; availability of supply material; quality of suppliers; level of competition; government support; favorable legal environment; and existence of research institutions (1=very low, 7=very high). In the diamond model, the items are presented as different dimensions, however, Porter's (1990) own emphasis on the holistic nature of the model and the high inter-correlation between many of the items motivated us to construct a composite index. *External knowledge* is calculated as the average score reported by respondents across these eleven items ($\text{Alpha}=0.68$).

Interdependence (Complementarity). This variable measures the extent to which the MNC units are dependent on the subsidiaries and *vice versa*. The MNC dependence on the subsidiary knowledge were assessed by asking the respondents the following question: "What would be the consequences for other units in the Foreign Company if they no longer had access to the competencies of the subsidiary?" (1=no consequences, 7=very significant consequences). In a similar

vein, the subsidiary dependence on knowledge from other MNC units was captured by the following question: "What would be the consequences for the subsidiary if it no longer had access to the competencies of other MNC units?" (1=no consequences, 7=very significant consequences). Taken together these two items reflects the interdependence between the focal subsidiary and other MNC units.

Intra-MNC trade. The level of intra-MNC trade is an indicator of the breadth of the internal trade links. It is measured as a single item, as the share of subsidiary sale going to other MNC units in 1996. The subsidiary sale to other MNC units includes both semi-products and final goods and services.

Autonomy. Based on the scale developed by Roth and Morrison (1992), respondents were asked to identify the level at which certain decisions were made, where 1=foreign corporate (HQ), 2=sub-corporate (e.g. division), 3=subsidiary level. Decisions were as follows: Hiring top subsidiary management; entering new markets within the country; entering foreign markets; changes to subsidiary organization; introduction of new products/services; approval of quarterly plan/schedules. Our measure, *Autonomy*, is based on the average of these six items (Alpha=0.61).

Controls. To control for structural characteristics of the subsidiary that might also influence the extent of knowledge transfer, we controlled for the following factors: Number of subsidiary employees in 1996 (a proxy for size), its mode of formation (a dummy: greenfield or acquisition), and the host country of the subsidiary (six dummies: using UK as a base case). We expect that larger subsidiaries will be more likely to transfer knowledge to other MNC units, consistent with our theoretical arguments of a cumulative process of knowledge development in foreign subsidiaries. We have no predictions on the role of entry mode and the country dummies for the extent of knowledge transfer.

IV. Results

Tests of Hypotheses

The six hypotheses may be summarized in three basic models as follows.

$$1) \text{ Internal knowledge} = \text{Interdependencies} + \text{Intra-MNC trade} + \text{Error}$$

$$2) \text{ External knowledge} = \text{Autonomy} + \text{Error}$$

$$3) \text{ Transfer of knowledge} = \text{Internal knowledge} + \text{External knowledge} + \text{Internal knowledge*External knowledge} + \text{Controls} + \text{Error}$$

Hypotheses 1-3 are reflected in model 3, while hypothesis 4 is expressed in model 2, and, finally, hypotheses 5-6 are expressed in model 1. However, since the above

models represent decisions that are interdependent (they have to be considered jointly), the use of single equation models may yield biased results and obscure interesting theoretical possibilities. Since the above models are interdependent, then it is possible that the joint optimization of all involved decisions may lead to suboptimization of one or more individual decisions. Statistically the interdependence might be reflected in that error terms of the three models are somehow correlated. Hence the correct model to estimate these decisions is a simultaneous equation model as three-stage least square, that circumvent the problem of interdependence by using instrument variables (often the exogenous variables) to obtain predicted values of the endogenous variables (in our case: knowledge transfer, internal knowledge, and external knowledge).

We have applied the three-stage least square regression techniques (3SLS) with instrument variables to test all six hypotheses simultaneously. All the exogenous variables (interdependencies, intra-MNC trade, autonomy, subsidiary employees, mode of formation, and country dummies) are used as instrument variables in the estimation of the model. The result of the total model is reported in Table 4. Numbers in parentheses represent standard errors.

XXXXXXXXX *INSERT TABLE 3 HERE* XXXXXXXXX

Overall, the system of the three equations (models) works well with a system weighted R-square of 0.44. This indicates that almost half of the observed variation in the extent of knowledge transfer is explained by the variables in the model. We turn now to the tests of our explanatory hypotheses.

Starting backwards with hypotheses 5 and 6, recall that they posited a relationship between the interdependence and intra-MNC trade and internal knowledge development. These hypotheses are tested in the first equation and they are strongly supported. Both organizational decision variables have a significantly positive relationship with the development of internal knowledge (both at 1 per cent level). Hypothesis 4, on autonomy determining the development of external knowledge is also supported with a significant positive relationship, although only at 5 per cent level.

Hypotheses 1-3 proposing that the development of internal and external subsidiary knowledge is facilitating the level of knowledge transfer are tested in the third equation. All three hypotheses are supported, indicating that development of internal knowledge has a positive effect (at the 1 per cent level), while the development of external knowledge has a direct negative impact (5 per cent level) on the transfer of knowledge to other MNC units. However, the interaction effect of internal knowledge and external knowledge has a strong positive (1 per cent level) relationship with the level of knowledge transfer. These results point to the conclusion that while internal knowledge have a direct and positive effect on knowledge transfer, the effect external knowledge is more indirect going through

the interaction with internal knowledge, which might prove that external knowledge must be transformed from periphery to core knowledge before the knowledge transfer takes place.

The number of subsidiary employees turn out to be insignificant, while acquisitions do transfer more knowledge than green-fields to other MNC units (formation is significant). Recall that UK was used as a base case for the six country dummies, therefore the country dummies shows that subsidiaries from Denmark, Norway and Sweden are transferring significantly less knowledge to other MNC units than do the foreign owned subsidiaries hosted in UK (and Finland, Germany, and Austria). This might be explained by the small size of the Scandinavian markets and the location in the periphery of Europe.

V. Concluding Comments

In this paper, we have addressed the issue of knowledge transfer between MNC units in a novel way. Whereas most of the literature have paid rather little attention to the organizational aspects of development and transfer of knowledge. The development, characteristics and transfer of knowledge are seldom consistently taken to be endogenous to organizational processes and arrangements. In the literature, it is rather the other way around. Organizational arrangements are seen as rational responses to the requirements implied by different characteristics of knowledge. Most fundamentally, there is no coherent view of what it means to say that the MNC is a knowledge-based entity.

In this paper we have argued that adopting Lyles and Schwenk's (1992) notion of an organizational knowledge structure might be a good way to conceptualize the MNC as a knowledge-based entity. This notion allows us an understanding of the processes of knowledge development and knowledge transfer in MNCs, and the organizational mechanism that influence these processes.

We largely found support for the main argument of the paper that MNC management through choices regarding organizational control, motivation and context can influence the development, characteristics and transfer of knowledge. It was shown that organizational choice variables as the level of subsidiary autonomy (own decision-making), level of intra-MNC-trade, and interdependence among the subsidiary and other MNC units all have a bearing on the development of different sources of subsidiary knowledge.

Furthermore, internally sourced knowledge has a direct positive effect, while externally sourced knowledge has a direct negative effect on subsidiary knowledge transfer. However, the indirect effect of externally sourced knowledge going through the interaction (and transformation) with internally sourced knowledge also has a positive effect on subsidiary knowledge transfer. This indicate that the extent that management chooses a specific way of sourcing knowledge, it also implicitly chooses the characteristics of the sourced knowledge and the ease with which it can

be transferred inside the MNC. This is because knowledge from different knowledge sources has different characteristics and is thus transferred at different cost.

However, there are various problems with our approach that need to be briefly commented upon. First of all, the measures that proxy organizational means and context (Interdependence, Intra-MNC Trade, Autonomy) admittedly do so only rather imperfectly, and we would have preferred to have much more direct measures. For example, it is somewhat unclear what kind of organizational means or context the measure, Intra-MNC Trade exactly represents. However, these are unavoidable limitations of the dataset.

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Table 1 *Sample size and subsidiary employees in the different countries*

COUNTRY	SAMPLE SIZE	SUBSIDIARY EMPLOYEES (mean)
Austria	313	318
Denmark	308	284
Finland	238	200
Germany	254	1.574
Norway	262	130
Sweden	530	244
UK	202	3.787
Total	2.107	742

Table 2 *The average score on a seven-point scale of the level of competence.*

COUNTRY	Research	Development	Production	Marketing /sales	Logistics/distribution	Purchasing
Austria	3.1	4.4	5.8	6.1	5.7	5.2
Denmark	4.8	5.2	6.0	5.9	5.7	5.3
Finland	4.3	4.9	5.9	5.9	5.5	5.3
Germany	4.6	5.3	6.3	6.2	5.9	5.7
Norway	4.2	4.9	5.6	5.7	5.3	5.2
Sweden	4.7	5.3	5.9	5.9	5.5	5.2
UK	4.9	5.3	6.1	6.1	5.9	5.5
Total	4.4	5.1	6.0	6.0	5.6	5.3

Table 3: *The three-stage least squares estimation
of a simultaneous equation model.*

	Equations		
	INTERNAL KNOWLEDGE	EXTERNAL KNOWLEDGE	TRANSFER OF KNOWLEDGE
Intercept	2.38 (0.06)***	3.71 (0.08)***	1.29 (1.43)
Interdependence	0.10 (0.02)***		
Intra-MNC trade	0.08 (0.01)***		
Autonomy		0.09 (0.04)**	
Internal knowledge			0.99 (0.24)***
External knowledge			-1.33 (0.56)**
Internal knowledge*			0.28
External knowledge			(0.01)***
Employees			0.00002 (0.00002)
Formation			0.26 (0.06)***
Country dummies:			
- Austria			0.32 (0.24)
- Denmark			-0.39 (0.13)***
- Finland			0.10 (0.18)
- Germany			0.20 (0.26)
- Norway			-0.50 (0.11)***
- Sweden			-0.49 (0.11)***
F-value	90.61***	2.30**	73.40***
R-square			0.44
N	2056	2056	2056

***, ** and * = significant at 1, 5 and 10 per cent, respectively.

Figure 1: *The hypothesized model*

