CODIFICATION AND TACITNESS AS KNOWLEDGE MANAGEMENT STRATEGIES: AN EMPIRICAL EXPLORATION☆†

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Abstract

This paper develops four categories of knowledge management strategies used by multinational corporations (MNCs). Codification strategies involve the transformation of tacit knowledge into explicit knowledge in order to facilitate flows of organizational knowledge. Tacitness strategies keep organizational knowledge tacit in order to prevent flows of knowledge to competitors. Focused knowledge management strategies regulate knowledge flows by controlling the degree to which knowledge is encoded in forms which match the information intensity and ambiguity of their knowledge. Unfocused knowledge management strategies attempt to regulate knowledge flows by controlling the overall level of codification of knowledge without special consideration of the capabilities of specific forms of codification. Empirical analyses of the effects of these strategies on subunit performance in a sample of U.S. and Danish subsidiaries suggest that the focused strategies are superior to the other strategies. Our results also indicate that different kinds of organizational knowledge require matching forms of codification in order to increase performance. The results give rise to a nested contingency model of knowledge management.

Introduction: Competitive Advantage Through Knowledge Management

The management of knowledge is increasingly considered a main source of competitive advantage for corporations (Winter, 1987; Prahalad and Hamel, 1990; Hedlund and Nonaka, 1993, Roth, 1996; Prusak, 1996, Spender and Grant, 1996, Grant, 1996). It is argued that companies enjoy a competitive advantage if they know how to expand, disseminate and exploit organizational knowledge internally (Szulanski, 1996; Bierly and Chakrabarti, 1996), if they know how to protect their knowledge from expropriation and imitation by competitors (Liebeskind, 1996), if they know how to effectively share with, transfer to, and receive knowledge from business partners (Mowery, Oxley and Silverman, 1996; Appleyard, 1996), and if they are able to effectively source knowledge from distant locations (Almeida, 1996).

Although research in this field is still expanding, it appears that first attempts are being made to identify strategies which help organizations to better manage their knowledge. Some researchers have emphasized organizational learning as a source of competitive advantage (Stata, 1989; Spender, 1994; Rahim, 1995; Inkpen, 1995; Bierly and Chakrabarti, 1996). Others have explored strategic implications of learning barriers (Levinthal and March, 1993; Nordhaug, 1994; Szulanski, 1996). Again others have emphasized knowledge creation (e.g. Nonaka and Takeuchi, 1995), and still others have emphasized replication and transfer of knowledge (e.g. Zander and Kogut, 1995).

In this paper we explore knowledge management strategies which are used to derive competitive advantage from the control and coordination of organizational knowledge flows. Knowledge flows are strategically important to organizations for several reasons. First, knowledge flows transmit localized know-how which is generated in one sub-unit to other locations in the organization. Second, knowledge flows facilitate the coordination of work flows linking multiple sub-units. Third, knowledge flows can enable organizations to capitalize on business opportunities requiring the collaboration of several sub-units. Knowledge flows are also crucial to the orchestrated execution of unified strategic responses to moves by competitors, customers, and suppliers. Finally, knowledge flows enable the recognition and exploitation of economies of scale and scope.

The management of knowledge flows is especially important for multinational companies (MNCs) because they operate in geographically and culturally diverse environments. Differences between local markets require adaptation of products and operations to local conditions. Host country governments make incompatible demands on different parts of the company. Multipoint

competition requires development of MNC-wide unified responses. Increasing global competition requires the exploitation of economies of scale on a global scale. To manage such contingencies, MNCs can derive great competitive advantage by managing knowledge flows between their subunits.

An important means to effective management of knowledge flows is the codification of organizational knowledge. When organizations codify their knowledge they package it into formats which facilitate knowledge transfer. Codification can be accomplished in a number of ways such as encoding of organizational knowledge in formulas, codes, expert systems, "spec sheets", or budget information; expressing knowledge in natural language formats, such as reports, memos, or policies; embedding knowledge in physical objects, such as prototypes or technologies, or even depositing it in employees who visit or rotate between different subunits.

Codification can greatly facilitate flows of organizational knowledge between subsidiaries and thereby help to identify new opportunities or emerging threats across markets and geographical regions. However, codification is no panacea. Codification has costs and benefits for organizations, and MNCs in particular. Codification can facilitate involuntary transfer of strategic know-how to competitors (e.g. leakage of data bases, formulas, specifications, blue prints, etc to competitors) and thereby hurt a MNC or its local operations in given markets. Codification involves considerable cost of creating and maintaining repositories of organizational knowledge (e.g. creating expert systems, updating web-pages). From that perspective, organizations might abstain from codification and choose to keep their knowledge tacit.

A priori, it is not clear if the costs or the benefits of codification prevail, and under which conditions they do so. It appears that knowledge management in MNCs involves difficult choices because the costs and benefits of codification most likely depend on the kind of knowledge to be codified, the forms of codification used, and on the strategic context of the MNC. Some knowledge is easier to codify in certain forms than others, some forms of codification facilitate flows of some knowledge more than flows of other knowledge, and some forms of codification might be more or less effective inhibitors of undesired knowledge transfers to competitors.

In this paper we attempt to understand (theoretically and empirically) the performance implications of organizational knowledge codification in MNCs. We explore if subunits of MNCs experience higher performance when they codify their knowledge, or when they abstain from codifying their

knowledge, and if the performance implications of codification depend on specific matches between codification forms and types of knowledge.

Since much of our theorizing is based on the effect of codification on knowledge flows, we start with a discussion of forms of codification, types of organizational knowledge, and knowledge flows in MNCs. Then we derive two basic hypotheses from lines of thought related to strategic management and knowledge based theories of the firm. Inspired by ideas related to contingency theories we derive additionally two hypotheses which emphasize the importance of particular combinations of codification forms and types of organizational knowledge. We test the hypotheses with empirical data from a sample of subsidiaries located in the U.S. and Denmark. The results give strong support for one set of hypotheses and motivate us to develop a nested contingency model of knowledge management.

Knowledge, Codification, and Knowledge Flows

We start with the assumption that knowledge in organizations evolves through a complex interaction of numerous knowledge flows which elaborate, support, and contradict prior knowledge. Organizational knowledge evolution can be represented as a form of a path model, in which organizational subunits combine their own experiences with knowledge inputs from other subunits. **Figure 1** shows knowledge flows between several subunits of a multinational corporation (MNC). Knowledge flows are represented by arrows on which packets of knowledge travel. Each subunit combines its own experiences (indicated with ε_i in the figure) with knowledge received from other units. The knowledge held by a subunit is elaborated, contradicted, or supported by knowledge arriving from other subunits.

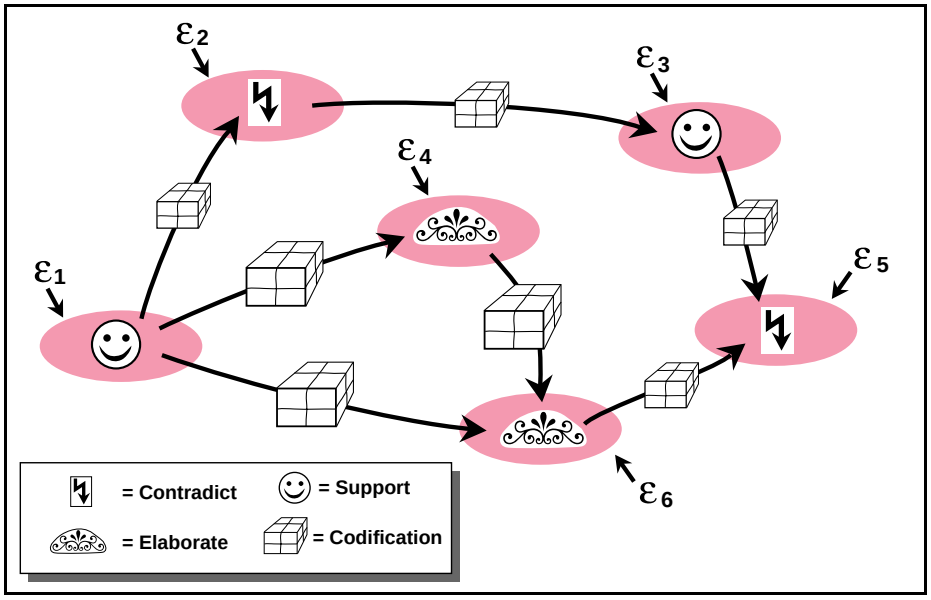

Figure 1 Knowledge in organizations evolves through a complex interaction of knowledge flows which elaborate, support, and contradict existing knowledge.

Within this scenario, it is likely that overall (corporate-wide) organizational knowledge is more accurate, up-to-date, and consistent the more knowledge flows between subunits. This holds for a number of reasons. First, contradicting knowledge flows help to correct faulty knowledge. Second, elaborating knowledge flows create new knowledge. And third, supporting flows increase a firm's certainty about the correctness of its knowledge. Moreover, the more knowledge is exchanged between subunits the more likely that new business opportunities will be identified and that economies of scale of scope can be exploited.

A second main assumption of this article is that organizational knowledge does not flow easily by itself. Rather, organizational knowledge needs to be codified, i.e. packaged into formats which allow its transmission to other subunits. Our conception of codification is influenced by the work of the philosopher Michael Polanyi (1958) which has recently found a lot of attention in the strategic management literature (e.g. Nonaka and Takeuchi, 1995; Nelson and Winter, 1982; Spender, 1993; Kogut, 1991). In his work on private knowledge, Polanyi distinguishes between "tacit" and "explicit" knowledge. Explicit knowledge consists of knowledge which can be expressed in symbols, and which can be communicated through these symbols to other people. Tacit knowledge consists of knowledge which is difficult to express and to communicate to other people by means of symbols (Nelson and Winter, 1982; Spender, 1993; Hill and Ende, 1994). Tacit knowledge is a personal form of knowledge which a person gains only from direct experience in a given domain. This knowledge is held in pre-verbal form which prevents the holder of that knowledge from providing a useful verbal explanation to another person (examples in this literature include bicycling and swimming which require extensive demonstration and practice to learn). Tacit knowledge in general is more difficult to transmit than codified knowledge; it travels particularly poorly between organizations (Kogut and Zander, 1993). Efficient transmission of tacit knowledge requires its codification into explicit forms.

A third assumption of this article is that all tacit knowledge can potentially be translated into explicit knowledge, provided sufficient resources are devoted to it. The costs of doing so vary highly over different kinds of knowledge and can occasionally be considerable (e.g. developing expert systems for medical diagnosis). Partial codification is one approach frequently taken when the costs of making tacit knowledge explicit are severe. It appears, though, that the costs of codification are shrinking. Today, firms have access to an expanding array of increasingly powerful techniques which can be used to codify knowledge, i.e. transform tacit knowledge into explicit knowledge. Firms can create expert systems, data bases, flow charts, and reports on any part of their operations. They can stimulate intra unit communication, create cross-functional

teams, develop specialized languages and technical lingo, install training programs, expand organizational documentation, and, if everything else fails, they can hire consulting firms to extract and elucidate hidden capabilities and obstacles. Thus, the level of codification (and the level of tacitness) of organizational knowledge is not exogenous to organizations. Rather, it increasingly is a decision variable for organizations.

In this study we treat codification as a multidimensional construct. We focus on three different forms of codification. They can be aligned along a continuum of abstractness. Numbers and codes are the most abstract form of codification which would include knowledge encoded in mathematical formulae, computer programs, part numbers, bar codes and the like. Words and text is a less abstract form and refers to knowledge encoded in natural language (e.g., policy statements, memos, reports, etc.). Finally, we examine knowledge stored in people and objects. This is the least abstract category. It captures knowledge stored in prototypes, product samples, and knowledge stored in employees' minds.

Although organizational knowledge has many dimensions, for the purpose of this study we chose to focus on the three domains of organizational knowledge: 1. Knowledge about technologies (e.g., knowledge about information systems, engineering, or R&D); 2. Knowledge regarding sales and marketing (e.g., knowledge about markets, advertisement, or sales delivery); 3. Knowledge regarding strategies (e.g. knowledge regarding competitors, suppliers, or government agencies).

A Codification Strategy

One could argue that firms are codification machines which derive most of their competitive advantage from codifying tacit knowledge (see also Hedlund, 1994: 76). Earlier versions of this argument claimed that organizations develop bureaucratic rule systems to encode and manage their knowledge. Max Weber, the founding father of bureaucracy theory, argued that bureaucracies provided powerful advantages over other, pre-modern forms of organization because they embodied so much more expertise.

Today, companies can derive competitive advantage from pursuing multiple and non-bureaucratic forms of codification such as intranets, shared databases, expert systems, e-mail, and rapid prototyping technologies. The main benefit deriving from such forms of codification is the facilitation of flows of organizational knowledge. Modern forms of codification provide fast and reliable access to organizational knowledge across geographical, social, and organizational

boundaries. They facilitate the transfer of knowledge into and out of organizational knowledge repositories, and they tend to be more efficient and appropriate than earlier forms of codification.

Codification strategists exploit the benefits of codification. The current business environment, especially in the international sphere, demands increasing exchange of knowledge between geographically dispersed organizational subunits. A strategic response to this challenge is to encode large portions of organizational knowledge in multiple forms of codification. MNCs pursuing such a codification strategy are better able to quickly identify and exploit new business opportunities, to coordinate value chains spanning multiple subunits located in different countries, to exploit economies of scale and scope, and to effectively coordinate unified responses to challenges stemming from multipoint competition and pressures for global integration (Prahalad and Doz, 1987). MNCs which do not invest in codification of their knowledge impede knowledge flows and thereby forego the benefits of exploiting knowledge which is generated in single locations across the entire organization.

An additional benefit of codification is the facilitation of organizational learning on the level of organizational routines. Organizations learn by encoding "inferences from history into routines that guide behavior" (Levitt and March, 1988: 320). By updating and refining their routines, organizations can infuse their routines with optimized knowledge about current challenges. Codification also helps to retain organizational knowledge in the presence of personnel turnover (Simon, 1991). Overall, these arguments suggests that codification results in enhanced performance, and that firms which abstain from codifying their knowledge experience depressed performance. Thus, one should expect a positive relation between codification and performance.

Hypothesis 1: Subunits with high levels of codification of knowledge experience stronger performance than subunits with low levels of codification.

Two qualifications of this hypothesis are in order. First, some knowledge is more important for organizational performance than other knowledge. Thus, the strength of codification effects might vary depending on the kind of knowledge at hand. Some types of knowledge (e.g. knowledge regarding technical issues or strategic issues) require a higher level of coordination and might benefit more from codification than others. We treat this as an empirical issue here, and in our statistical models will allow parameters to vary across knowledge domains.

Second, some forms of codification might be more efficient facilitators of knowledge flows than others. For example, one might speculate that the codification of organizational knowledge into expert systems or relational databases advances the speed (and precision) of knowledge transfers to a higher degree than codification of knowledge into prototypes or corporate training materials. Thus, the strength of codification effects might vary depending on the form of codification used. We again treat this as an empirical issue and will allow parameters in our regression models to vary across forms of codification.

A Tacitness Strategy

Unfortunately, codification may not only have beneficial effects. It is well known, for example, that intense knowledge flows can lead to information overload (Horton, 1989; Stuller, 1996). Large directories of unread or unprocessed e-mail seem to be the rule these days. Internet junk mail is another case in point. In addition, codifying organizational knowledge entails considerable costs, for example, when expert systems are produced, or organizational knowledge is encoded in new procedures or processes. Most of these costs are impossible to recover when the underlying knowledge changes or becomes obsolete. Even the cost of updating codified knowledge seems to be considerable. For example, many procedure manuals tend to be out of date, information systems maintenance generates huge costs for organizations (and consequently is frequently neglected), and training materials (especially those related to cutting-edge technologies) fall obsolete at a remarkable rate (another case in point are the staggering proportion of internet hyperlinks turned invalid and not fixed).

In the presence of such costs companies might decide to abstain from codifying their knowledge and instead keep their knowledge tacit. Doing so can bring about a number of advantages. One is related to the knowledge-generating features of tacitness. Keeping knowledge tacit means also keeping it in a state of fluid gestation. Tacit knowledge (unlike codified knowledge which tends to be exterior and “objective”) depends on sense-making of participants. Tacit knowledge stimulates creativity, “creative chaos”, and innovative forms of response and coordination. Improvisation in string quartets is a case in point (e.g. Murnighan and Conlon, 1991). Nonaka and Takeuchi (1995) have emphasized the role of tacit knowledge for organizational knowledge creation. According to these authors, organizations create knowledge through social processes (which they call “knowledge conversion”) in which individuals share tacit knowledge and through that can produce new perspectives.

An even more important point has been raised recently in the strategic management literature. Authors such as Winter and Kogut and Zander (Kogut and Zander, 1993; Zander and Kogut, 1995) have argued that "involuntary transfer" (Winter, 1987: 173) of strategically important knowledge to competitors can create significant disincentives to codification in firms. The resulting dilemma for firms is that codified knowledge which is easily transferred and replicated within the organization may also be easy for competitors to imitate (Zander and Kogut, 1995: 78).

From this perspective it seems likely that some firms may opt to avoid codification to prevent involuntary transfer of organizational knowledge to competitors. Firms undertaking such a tacitness strategy are likely to experience some difficulties, however. A main difficulty ensues when key personnel depart. If they are the only carriers of a given kind of knowledge, their departure implies a loss of valuable organizational knowledge. Yet, in practice, tacitness strategists can protect against this risk by cross-specialization and team building. A second difficulty of the tacitness strategy stems from the resulting immobility of organizational knowledge. Solutions to tricky problems found in one part of the company spread very slowly (if at all) to other parts, putting strong limits on the company wide exploitation of local innovations. This problem is less serious, however, when knowledge sharing is less important for a company, e.g., when pressures for local responsiveness are high, or when the lines of functional and geographic differentiation of a company coincide.

Assuming that tacitness strategists are capable of appropriately managing such difficulties, one might expect that tacitness can generate significant benefits for MNCs and result in enhanced organizational performance. From this follows the next hypothesis.

Hypothesis 2: Subunits with high levels of tacitness of knowledge experience stronger performance than subunits with low levels of tacitness.

Of course, it is likely that this relationship varies across organizational knowledge domains. E.g., some organizational knowledge is more sensitive than others. Some organizational knowledge benefits more from "creative chaos" than others, etc. Second, tacitness can take on various forms, such as minimal usage of numerical codes, or minimal usage of written communication, etc. In that sense, tacitness is multi-dimensional. It is conceivable that some forms of tacitness have more beneficial effects than others, e.g. refraining from codified bureaucratic procedure is likely to have more beneficial effects than refraining from building prototypes. Thus, we will allow parameters to vary accordingly.

Focused and Unfocused Knowledge Management Strategies

Although knowledge management is increasingly regarded as relevant for the welfare of MNCs (e.g., Ghoshal and Bartlett, 1988; Boettcher, and Welge, 1994; Gupta, and Govindarajan, 1991; Egelhoff, Liam, and McCormick, 1996; Badaracco, 1991), it is not clear how many MNCs formulate an explicit knowledge management strategy. This is particularly likely in MNCs which are not aware of the existence and strategic importance of knowledge management. In contrast, when a company is aware of the importance and techniques of knowledge management, it might take a differentiated approach and attempt to identify for each of its knowledge areas those codification forms which provide most leverage for the control of knowledge flows.

One can distinguish focused and unfocused knowledge management strategists. Focused knowledge management strategists specialize on specific forms of codification for each type of knowledge. For example, to codify its marketing knowledge, a firm (or its subunits) might decide to focus mainly on text-based forms of codification. At the same time, to codify its technology related knowledge the firm might focus on a combination of formulas and prototypes. In contrast, unfocused knowledge management strategists lack such a planned approach to knowledge management. They lack the decisiveness and the conceptual apparatus to discriminate between different forms of codification. Frequently, the degree to which they codify any kind of knowledge in any specific form is not the result of a deliberate decision but rather is the by-product of other decisions, e.g., the usage of written rules and policies to reduce interpersonal tensions (e.g., Gouldner, 1964), or compliance with tax codes in the host country.

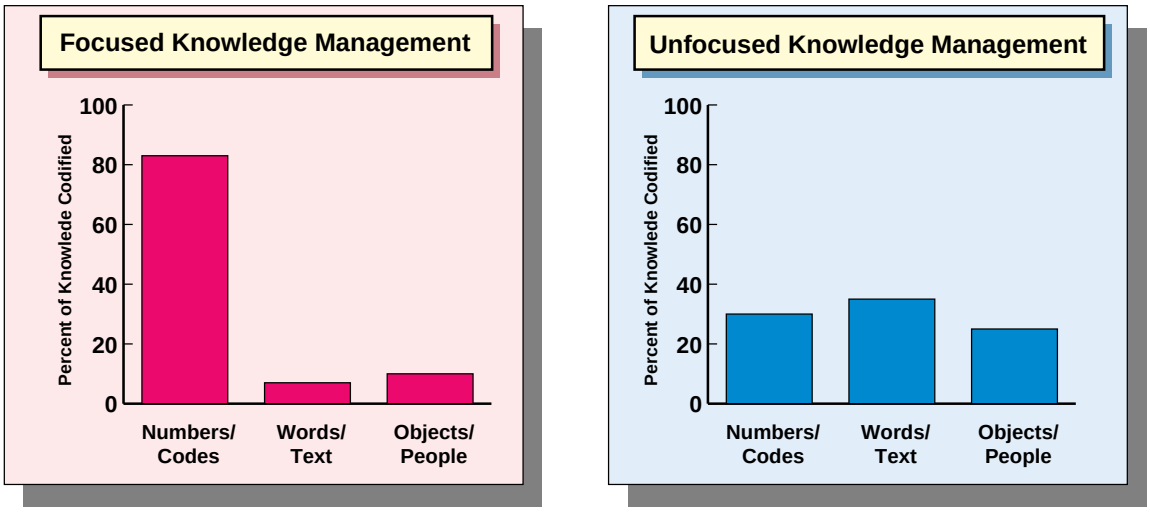

Figure 2 Focused codification strategists specialize on one codification form (or a small number of forms). Unfocused codification strategists do not specialize.

Figure 2 shows the difference between these two strategies in empirical terms, for one kind of organizational knowledge (e.g., marketing knowledge). The focused strategy is displayed in the left panel of **Figure 2**. Most of the knowledge is codified in numbers of codes. The unfocused strategy is displayed in the right panel. Knowledge is codified in multiple forms, and no clear preference is given to any form.

Table **1**: Knowledge Management Strategies

	Unfocused Strategy	**Focused Strategy**
Codification Strategy	Increase the absolute level of codification across all dimensions of codification and organizational knowledge.	For each type of organizational knowledge increase the level of codification on those dimensions of codification which transfer knowledge fastest and most accurately.
Tacitness Strategy	Decrease the absolute level of codification across all dimensions of codification and organizational knowledge.	For each type of organizational knowledge decrease the level of codification on those dimensions of codification which pose greatest risks of involuntary transfer of knowledge.

Combining focused and unfocused strategies with codification and tacitness strategies, we arrive at four knowledge management strategies (see Table **1**). For unfocused knowledge management strategists the primary strategic choice is between codifying knowledge and keeping it tacit. This simply amounts to adjusting the absolute level of codification. More specifically, unfocused codification strategists pursue encoding of knowledge across established forms without regard for the specific capabilities of different forms of codification. Unfocused tacitness strategists avoid codification of knowledge in any forms.

For focused knowledge management strategists the primary strategic choice is different. Assuming that some codification forms facilitate flows of some knowledge more than other flows, focused knowledge management strategists select those forms which permit knowledge flow intensities most appropriate to the demands of their strategic environment. They select the appropriate kind of codification form for each of their different kinds of knowledge and avoid the inappropriate ones. Thus, focused strategists increase the level of codification in one form relative to other forms. More precisely, focused codification strategists pursue (for each kind of knowledge) a high level of codification on one dimension of codification, and a low level on others. Focused tacitness strategists avoid those forms of codification which would incur the risk of involuntary transfers of

knowledge to competitors and instead pursue codification in other (less hazardous) forms which permit sufficient knowledge transfers within the corporation.

A focused approach to knowledge management provides a number of advantages. It is efficient because it requires less diversity of skills to codify, distribute, access, and decode knowledge in an area. It allows exploitation of economies of scale because codification tools can be developed and re-used for all of the parts of the knowledge area. It allows firms (e.g., through trial and error) to develop a fine-tuned approach to the management of knowledge flows because some forms of codification facilitate flows of some knowledge better than flows of other knowledge. Finally, it allows exploitation of economies of learning because it facilitates the development and refinement of skills to codify and decode the knowledge in that particular form.

Unfocused knowledge management strategists forego all these benefits. Moreover, because of their lack of focus, their codification is partially redundant; some of their knowledge is codified in multiple ways, e.g., when knowledge regarding customers is kept in written files as well as electronic databases. Such redundancy is not only inefficient. It also is likely to produce inconsistencies between the different versions of the same data. Thus, overall we expect that focused knowledge management strategists experience higher performance than unfocused strategists.

Hypothesis 3: Subunits with a focused approach to knowledge management have higher performance than subunits with an unfocused approach.

To operationalize focused and unfocused approaches, we compute a measure of codification dispersion for each knowledge area. The codification dispersion is essentially the variance of codification (across codification forms) for each knowledge area. It represents the degree to which a subunit takes a focused approach to knowledge management for a given area of its knowledge. Assuming that firms have a choice between L forms of codification for each knowledge area, the measure of codification dispersion for a specific knowledge area k is defined as:

$$Codif.Disp_k = \frac{1}{L-1} \sum_{i=1}^{L} (CodForm_{i,k} - Avg_k)^2 \quad \textbf{(1)}$$

where $CodForm_{i,k}$ gives the extent to which knowledge in area k is codified in codification form i, and Avg_k is the average level of codification in the knowledge area:

$$Avg_k = \frac{1}{L} \sum_{i=1}^{L} CodForm_{i,k} \quad \textbf{(2)}$$

The main empirical prediction derived from Hypothesis 3 is that large codification dispersion in organizational knowledge areas are positively associated with subunit performance. Since performance implications of focused codification approaches might vary across knowledge areas, we allow parameters to vary accordingly.

Hypothesis 3 implicitly assumes that all forms of codification are of equal importance for a firm's codification focus. According to Hypothesis 3, any codification focus for any kind of knowledge is assumed to be beneficial. Yet, one could well imagine that some forms of codification are more efficient facilitators for flows of some knowledge than for others. For example, encoding ambiguous strategic knowledge into rigid formulas or codes would probably not facilitate the proper transmission of that knowledge between organizational subunits.

Such matches between content and form have been explored in the context of media theory (Daft and Lengel, 1984; Daft and Lengel, 1986; Daft and Huber, 1987). Daft and Lengel (1984) proposed that organizations match type of task and media used. They argued that information intensive tasks (i.e., tasks at the bottom of the organizational hierarchy), tasks in the technical core, and tasks associated with integration (i.e., tasks associated with routine cross-unit relations) rely on lean media because they enable high volume transfers. Ambiguous tasks such as tasks at the top of the organization, tasks further from the technical core, and non-routine cross-unit coordination tasks rely on rich media.

This suggests that a matched codification focus has stronger performance implications than a codification focus which does not match form of codification to the kind of knowledge codified.

Hypothesis 4: Subunits with a matched codification focus have higher performance than subunits with an unmatched codification focus.

To operationalize this hypothesis we assume that the level of information intensity decreases and that the level of ambiguity increases from knowledge regarding technologies to knowledge regarding marketing to strategic knowledge regarding competitors. At the same time we assume that codification forms differ along the lean-rich dimension with numbers and codes located on the

lean end, words and text in the middle, and people and objects located on the rich end. Then the matched codification hypothesis implies that codifying technical knowledge has the strongest performance effects when it is coded in the form of numbers/codes, codifying marketing knowledge has strongest performance effects when it is coded in words/text form, and codifying strategic knowledge has strongest performance effects when it is coded in people/objects form.

To test the matched codification hypothesis, we take the components of each codification dispersion (for each knowledge area) and include these as predictors in regression models of performance. Each of these components is a squared deviation of the level of knowledge codification in form *i* from the average level of codification Avg_k in a given knowledge area *k*:

$$DispersionComponent_{i,k} := (CodForm_{i,k} - Avg_k)^2 \quad \textbf{(3)}$$

We expect that the dispersion components corresponding to Hypothesis 4 (i.e. the matching combinations of knowledge area and codification form) have significant positive effects on performance, while the others do not.

Data and Methods

The data in this study were gathered from surveys administered to the leaders of Danish subsidiaries of U.S. firms and U.S. subsidiaries of Danish firms[1]. The population consisted of all such organizations that were on record with the Danish and US embassies respectively as of the summer of 1996 when the study was conducted. The total population included 570 subsidiaries, 238 of which were located in Denmark. The response rate of 17% resulted in 98 returned and completed questionnaires. Response rates did not differ substantially between the Danish and US portions of the sample.

Measuring characteristics of organizational knowledge across a heterogeneous set of organizational subunits by means of a mail survey necessarily has to rely on general categories. Identifying those categories is not easy. Knowledge is potentially of infinite dimension. Its tends to be codified in various ways and to varying degrees. For the purpose of this study we focus on three areas of organizational knowledge (knowledge regarding technologies, sales and marketing, and

[1] We considered using multiple respondents per subunit. This proved infeasible, though, because a large portion of subunits in our population are very small (e.g. sales offices consisting of one sales engineer plus a secretary).

strategy) and a small number of forms of codification (numbers/codes, words/text, and objects/people[2]). Both sets of categories were identified through informal interviews with a small sample of subsidiary heads before the beginning of the survey study.

To measure the extent to which different kinds of knowledge were codified in various codification forms we constructed a multi-item instrument which captured all combinations of knowledge domains and codification forms. Subsidiary heads were asked: "To what extent do you use these different forms of storing know-how and information? Please indicate the corresponding extent for each knowledge area." Responses were recorded on five point Likert-type scales. To facilitate comparisons, these measures were z-transformed before they were included in the analysis.

To test our hypotheses we estimate (OLS) parameters of regression models. The dependent variable is subunit performance. Because the unit of analysis of this study is the subunit, we had to rely on self-reports of the subunit heads. The unit performance item asked respondents to rate how well their unit was doing relative to their overall performance over the last 5 years. Responses were recorded on 9 point Likert-type scales. The average subunit performance score was 6.66. This measure was z-transformed before it was used in the statistical models.

The focal independent variables for the tests of Hypotheses 1 and 2 are levels of codification of the three areas of knowledge in the three forms of codification. For Hypothesis 3 the focal independent variables are the measures of codification dispersion for each knowledge area as defined in equation 1. For Hypothesis 4 the focal independent variables are the codification dispersion components as defined in equation 3 (to facilitate comparisons the deviances from the average level of codification were z-transformed before they were squared).

Several control variables were included as well. Cultural and economic differences between the U.S. and Denmark could cause differences in codification and reporting of subunit performance and result in spurious effects. Thus we included measures of host country and the top management team. Host country is a dummy variable indicating the location of the subsidiary (0=U.S., 1=DK). The top management team composition variable indicates the proportion of top managers that were born in the corresponding host country. Another potential source of spuriousness is

[2] We also collected data on a fourth form of codification, the usage of pictures and images such as organizational charts, blueprints, flow charts, etc. We excluded this form from our analyses mainly because it appeared to be a hybrid of the words/text and the objects/people categories. It was included as an omitted category in the dispersion component models to reduce multicollinearity problems of the dispersion components (because the deviations from the average level of codification are perfectly multicollinear).

organizational size because size tends to be positively related to codification (Blau, 1970) and potentially to performance. Thus we included the log of the number of employees of the parent corporation. The strategic context is another potential cause of spurious effects because subunits exposed to global integration pressures might codify extensively and perform better. Pressures for global integration (GI) and local responsiveness (LR) were measured via modified versions of instruments developed by Prahalad and Doz (1987). The GI scale included 7 items (alpha = 0.72) and the LR scale included 4 items (alpha = 0.63).

Because some industries might have higher levels of codification and also higher performance than others, we also included measures of the characteristics of the surrounding industry. Our measure of the level of innovation in the surrounding industry is based on an instrument which asked respondents to assess the intensity of innovation in each of the three knowledge areas of their sub-unit. The resulting index of innovation (i.e., the sum of the three items) is designed to capture the overall effect of innovation in these three areas. Our measure of uncertainty is based on an instrument which asks respondents to rate the degree to which performance in each of the three knowledge areas fluctuates unexpectedly over time. The resulting index is the sum of the three responses.

The degree to which companies derive competitive advantage from the selected areas of organizational knowledge might differ across the subunits in our sample. This can introduce a potential bias if companies which do not derive advantage from these areas do not codify knowledge in those areas, and companies for which these areas are important, do codify these areas. Thus a measure is added which controls for the average degree to which the subunits in the sample derive competitive advantage from these three areas of knowledge. Descriptive statistics of all variables are displayed in Table **2**.

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Results

A first set of parameters is presented in Table **3** (standard errors are in parentheses). The dependent variable in Table **3** is subunit performance. The main independent variables are the three codification variables, using numbers/ codes, using words/text, and using objects/people. Model 1 gives the effects of codifying technical knowledge. Model 2 gives the effects of codifying

marketing knowledge. Model 3 gives the effects of codifying strategic knowledge. Model 4 captures the sum of all codification variables.

---------- Please put Table **3** about here ----------

Of the parameters in Table **3**, only one is statistically significant (on the 0.1 level). It indicates that codifying strategic knowledge in numbers and codes is associated with reduced subunit performance. The absence of strong significant effects in Table **3** suggests that codification of organizational knowledge has almost no effect on subunit performance. Noteworthy effects of the control variables include a negative effect of domestically born top managers (quite in contrast to the usual assumption that hiring local top managers boosts performance), and a positive effect of the strategic importance of the focal knowledge areas of this study (suggesting that the three knowledge domains selected in this study are strategically important for the firms in the sample).

Overall, the results in Table **3** indicate that codifying organizational knowledge has neither a strong positive nor a strong negative effect on subunit performance. Thus, Hypotheses 1 and 2 are not supported by these results.

Tests of the performance implications of the focused/unfocused knowledge management strategies are presented in Table **4**. The focal independent variable is the dispersion of knowledge codification across codification forms. This variable is largest when knowledge in a given area is coded in one form and not at all in other forms, e.g. when all knowledge in an area is codified in words/text and not in any other form (i.e. a specialization of knowledge on a particular form of codification). The dispersion variable is zero when knowledge of an area is codified to equal extent in all three forms of codification. Model 1 gives the effect of codification dispersion in the technology area, Model 2 in the marketing area, Model 3 in the strategy area, and Model 4 shows the effect of a summary index of codification dispersion (summing up the dispersion measures for the three knowledge areas).

---------- Please put Table **4** about here ----------

Most of the codification dispersion parameters in Table **4** (except the parameter for codification dispersion in the marketing/sales area) are significant (on the 0.05 level). All effects of codification dispersion are positive. This suggests that subunits which take a focused approach to codification have higher performance than subunits which do not discriminate between

codification forms. Thus, Hypothesis 3 finds considerable support. Note that the effects of the control variables are quite similar to those in the preceding table.

Tests of the matched focus hypothesis (Hypothesis 4) are presented in Table **5**. The focal independent variables of these models are the dispersion components. A dispersion component gives the degree to which a given codification form is used above or below the average level of codification in an area (mathematically, they are squared deviances from the mean level of codification of the knowledge area of the subunit). A dispersion component is zero when the codification of knowledge in a given form is equal to the average level of codification in an area.

---------- Please put Table **5** about here ----------

Model 1 in Table **5** gives the effects of the dispersion components of knowledge regarding technologies. The parameter estimates indicate that the numbers/codes component has a strong ($P<0.05$) and positive effect on performance, that the words/text component has a positive but statistically weaker effect on performance ($P<0.15$), and that the objects/people component has no statistically significant effect.

The significant numbers/codes component suggests that for knowledge regarding technologies a codification focus on numbers and codes results in higher performance. In more concrete terms, it means that higher performance ensues in subunits which codify all their technology knowledge in numbers or codes (focused codification strategy). Because the dispersion components are squared deviations from average levels of codification, the result also means that higher performance ensues for subunits which avoid codifying their technology knowledge in numbers/codes (focused tacitness strategy).

Model 2 gives the effect of the dispersion components of codifying knowledge regarding sales and marketing. Only the words/text component is significant ($P<0.10$). It indicates that for knowledge regarding sales and marketing a codification focus on words and text results in elevated performance. Model 3 gives the effect of the dispersion components of codifying knowledge regarding strategies. Only the objects/people component is significant.

Overall, the results of Models 1 to 3 in Table **5** support the matched focus hypothesis (Hypothesis 4). The significant parameters pertain to the predicted combinations of organizational knowledge and codification form, i.e. encoding of technical knowledge in numbers/codes, of marketing

knowledge in words/text, and of strategy knowledge in objects/people. Above and below average codification of knowledge in these combinations is associated with higher performance. Average level codification of knowledge in these combinations results in lower performance.

To test if each of these significant combinations provides an independent contribution to performance we integrated them in a single model (Model 4 in Table 5). All three parameters are positive and all are statistically significant (the words/text dispersion component of codifying marketing knowledge is significant on the 0.05 level, and the other two are significant on the 0.1 level). This suggests that the matched dispersion components contribute independently to subunit performance, and thus provide additional support for the matched focus hypothesis (Hypothesis 4).

Discussion -- Towards a Nested Contingency Theory

The empirical analyses suggest that a focused approach to organizational knowledge management enhances performance, while unfocused approaches do not, i.e. the results do not support Hypotheses 1 and 2 but they support Hypotheses 3 and 4. In applied terms: Subunits which codify their knowledge without regard to specific forms of codification do not perform better or worse than subunits which keep their knowledge tacit. But subunits which make distinctions between different forms of codification by specializing on one form of codification and abstaining from others experience higher levels of performance.

This is especially true when subunits match codification forms to types of knowledge. The results suggest that some forms of codification work better for some kinds of knowledge than for others. The significant effects of the matched codification dispersion components and the absence of such effects for the unmatched components suggest that some forms of codification facilitate flows of some knowledge more than others. This result is congruent with Hypothesis 4. Subunits which match the form of codification to the information intensity and level of ambiguity of their knowledge have higher performance than subunits which do not pay attention to this match.

It might appear that focused knowledge management is an instance of contingency theory. Contingency theory traditionally emphasizes matches between different contingencies. In the context of this study this means that subunits of MNCs enjoy a performance advantage when they match codification forms to appropriate types of knowledge. Insofar, this paper supports lines of thought related to contingency theory and especially to media theory. Yet, the results suggest a picture which is more complex.

Our results support the idea that subunits of MNCs face a situation which one might characterize as “nested contingency”. On a first level, subunits of MNCs match strategic context and strategy. They face a specific strategic context which determines the costs and benefits of codifying each kind of knowledge. In some contexts and for some kinds of knowledge, the benefits of codification far outweigh the costs, in others, they don’t. If benefits exceed the costs (factually or perceived) then subunits might adopt a codification strategy for a given kind of knowledge. If costs exceed benefits, they might adopt a tacitness strategy for that kind of knowledge.

On a second level, subunits match forms of codification to each kind of knowledge in a way which is consistent with the adopted strategy. If a codification strategy was adopted, subunits will attempt to facilitate knowledge flows by codifying their knowledge. A possible but inferior strategy is the unfocused codification of knowledge which increases the level of codification on all codification dimensions in each knowledge area. Yet, this is less effective than focused codification. Focused codification of knowledge in an area codifies knowledge in a form which matches the “richness” of the codification form to the information intensity (and ambiguity) of the knowledge, and thereby facilitates knowledge flows more effectively (and efficiently) than an unfocused approach.

If a tacitness strategy was adopted, subunits will attempt to inhibit knowledge flows. One way to do so is the unfocused tacitness strategy. Subunits which pursue an unfocused tacitness strategy attempt to keep codification low on all possible dimensions of codification. Yet, this is less effective than a focused approach. A focused tacitness approach avoids those forms of codification which would facilitate potentially detrimental knowledge flows, i.e. focused tacitness strategists will avoid the matching forms and rather codify knowledge in forms which capture its information intensity and ambiguity only incompletely. Doing so will assure modest intra-organizational dissemination of knowledge, but slow down involuntary transfers to competitors to a tolerable level.

An interesting implication of the nested contingency model is a u-shaped relation between performance and the relative level of codification, as displayed in **Figure 3**. The figure is based on the parameter estimates for the effects of the dispersion components of the “match model” of Table **5** (only the sampling ranges are displayed). The mathematical reason for the u-shape of the graphs is a) that the parameter estimates are positive and b) that the dispersion components are squared deviations from the average level of codification in each knowledge area.

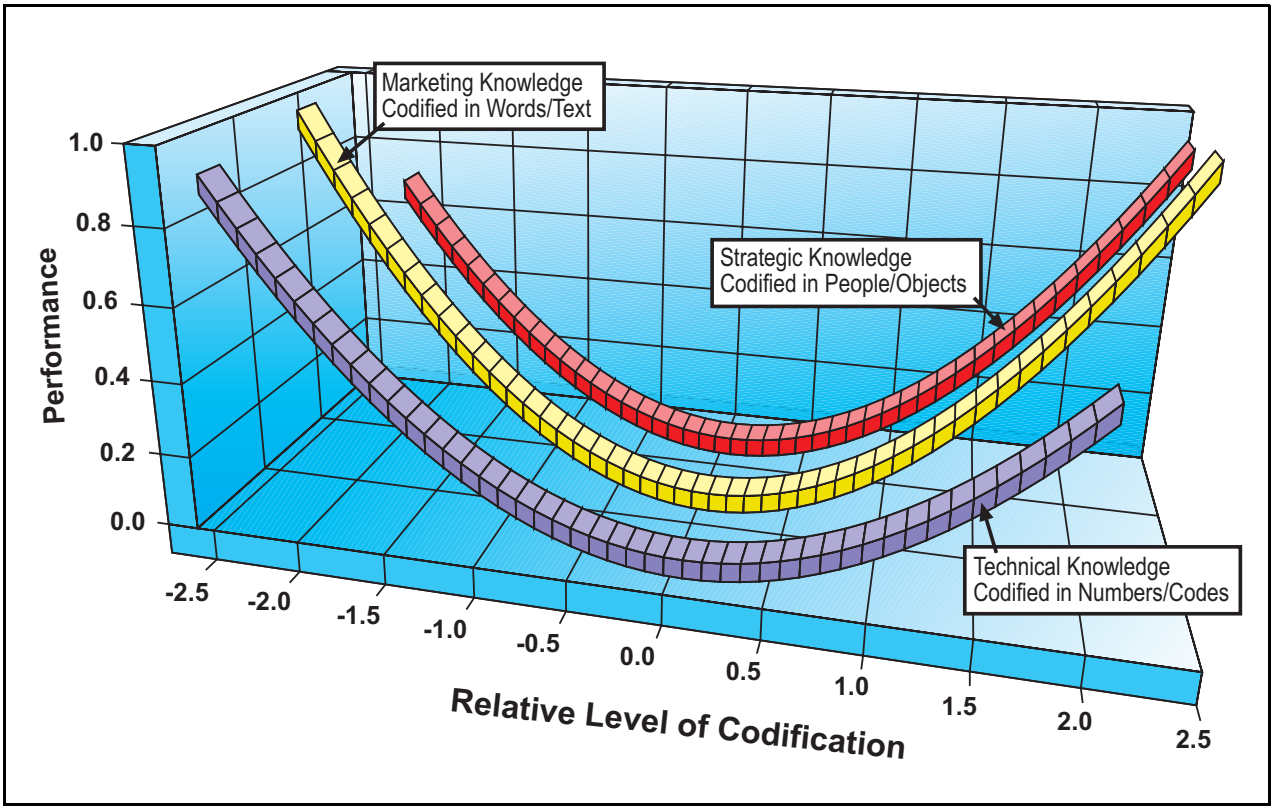

Figure 3 Performance is a u-shaped function of the relative level of codification of knowledge in matching forms of codification.

The substantive reason for the u-shape is that focused approaches to knowledge management (focused codification and focused tacitness strategies) yield higher performance than unfocused approaches. In **Figure 3**, focused codification strategists are located on the right side of the figure (high levels of relative codification). They codify knowledge in matching forms of codification and thereby facilitate flows of that knowledge. Focused tacitness strategies are located on the left side (low levels of relative codification). They avoid codification of knowledge in matching forms in order to impede knowledge flows. Unfocused codification and tacitness strategies are located in the middle (relative codification close to zero). They do not give special emphasis to any particular form of codification and experience lower performance.

The U-shapes in **Figure 3** are reminiscent of Porter's stuck-in-the-middle model (Porter, 1980: 41). In his model, firms which do not pursue any of his generic strategies are stuck in the middle (in terms of market share) and would experience lower performance than the firms which do pursue one of the generic strategies. In the context of this paper, the main practical implication of **Figure 3** is to avoid getting stuck in the middle between the focused codification and the focused tacitness strategies. In other words, companies should avoid an unfocused commitment to

codification. Instead, they should carefully pick specific forms of codification for specific kinds of knowledge in order to adjust the intensity of knowledge flows to levels compatible with the demands of their strategic environment.

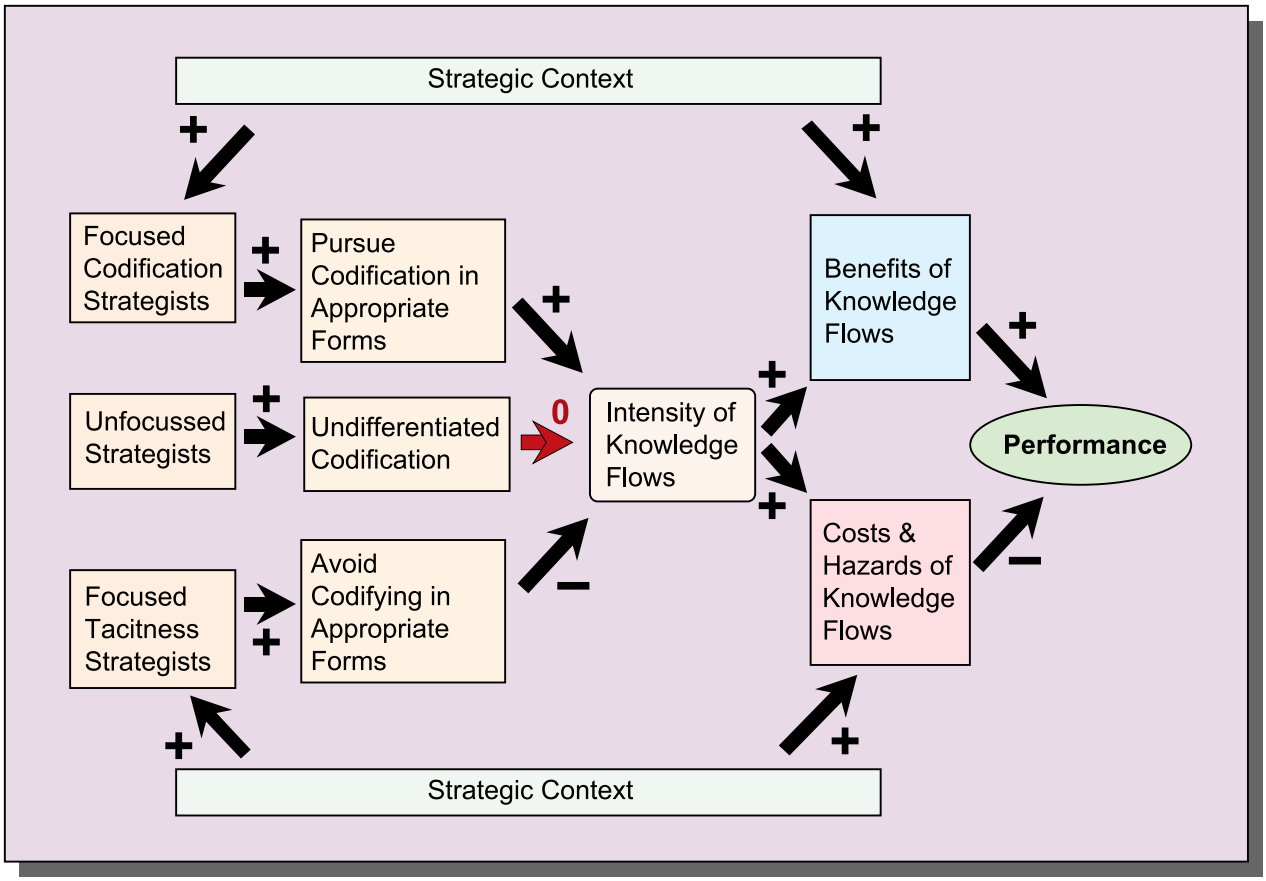

Figure 4 The causal structure of the nested contingency model.

The causal structure of the nested contingency model is displayed in **Figure 4**. The strategic context determines if flows of a given form of knowledge are beneficial or hazardous for a given firm. In response to the strategic context, the firm (or a given subunit) adopts a focused codification strategy, a focused tacitness strategy, or an unfocused strategy for that kind of knowledge. Focused codification strategists pursue codification in forms which match the information intensity and ambiguity of the knowledge, thereby increasing the intensity of beneficial knowledge flows, and hence increasing performance. Focused tacitness strategists avoid codification in such forms in order to reduce detrimental knowledge flows, thereby increasing performance. Unfocused strategists might pursue high or low levels of codification, but since they lack focus (on effective codification forms for the knowledge at hand), they are less effective at

controlling the intensity of knowledge flows, and thus they experience no (or a much smaller) performance advantage.

It is possible to imagine alternative interpretations of our results. One alternative interpretation emphasizes general management over knowledge management. It is conceivable that subunits do well because of superior management (unrelated to knowledge) and not because of superior knowledge management[3]. Superior management is likely to pay attention to knowledge management and thus might pursue focused knowledge management strategies, yet it is possible that enhanced performance results from superior management in other areas not related to knowledge management.

On the basis of our data it is not possible to entirely rule out this interpretation. Yet, even if enhanced performance is primarily due to superior general management, our results would mean that subunits which are well run and which perform well pay detailed attention to knowledge management -- confirming the view that knowledge management has at least some degree of significance for successful MNCs. Of course, the subunits of our study might adopt knowledge management for less than rational reasons, but we think that is not too likely at the current level of institutionalization of "knowledge management". It is unlikely that many managers in our sample are aware of knowledge management strategies which match codification forms to types of organizational knowledge in the specific and complex ways we found. Knowledge management is a very new managerial technique and in-depth insights of its implications (including the results of this study) are not (yet) widely disseminated. Still, we believe that future research on this issue might help to disentangle effects of superior general management from effects of knowledge management. Yet doing so would not be easy because it would require separate measures of both constructs.

[3] A related alternative interpretation emphasizes general managerial decisiveness. It is possible that decisive managers report higher performance levels and at the same time tend to take decisive stances towards codification. We tested this possibility with a combined index of reported decision speed and effectiveness. Including this variable in our models resulted in negligible changes of the codification effects. The decision speed index itself had no significant effect on subunit performance. Thus, decisiveness can be ruled out as a confounding factor.

Conclusion

Overall, this paper adds to a current stream of research which emphasizes the importance of intangible resources of organizations. We have explored management of a specific organizational resource: organizational knowledge. Our results indicate that proper management of organizational knowledge is associated with enhanced performance.

This paper explores knowledge management which regulates the mobility of organizational knowledge. It is frequently argued (e.g., Barney, 1986; Dierickx and Cool 1989; Barney, 1991) that immobile resources provide a source of competitive advantage for companies. Keeping organizational knowledge immobile is a very competitive strategy especially when the knowledge at hand helps to generate significant returns and when it is difficult to generate. Yet it is also well known (e.g., Egelhoff, 1991; Van De Ven, Delbecq and Koenig, 1976) that companies need to keep knowledge resources sufficiently mobile to facilitate coordination between subunits. In fact, the current craze about intranets and groupware indicates that companies have great needs to disseminate knowledge accurately and effortlessly.

Finding the appropriate level of mobility of organizational knowledge thus faces a trade-off between potentially beneficial intra-organizational knowledge flows and potentially detrimental inter-organizational knowledge flows to competitors. The research reported in this paper suggests that there is no simple general solution to this trade-off. Our results indicate that simply enhancing the mobility of knowledge by encoding it in multiple forms does not help performance. Nor does the opposite strategy, a reduction of the mobility of knowledge by keeping it tacit.

Yet we find that more complex knowledge management strategies do have performance implications. Performance is enhanced when subunits focus on specific forms of codification instead of encoding their knowledge in all available forms. Specializing on single forms of codification has a number of benefits, among them are consistency of data and economies of scale of using the same or similar codification forms.

The most important benefit of focused approaches to codification, however, stems from the differential ability of codification forms to facilitate knowledge flows. Some forms of codification are inadequate for some types of knowledge, whereas others are well matched to the information intensity and ambiguity of the knowledge at hand and thereby are able to greatly enhance its mobility. Our results suggest that knowledge flows are most facilitated when technical knowledge

is codified in numbers and codes, marketing and sales knowledge is codified in text and language based forms, and when strategic knowledge regarding competitors is encoded in objects and people. Encoding knowledge in these combinations (i.e., a "focused codification strategy") greatly facilitates knowledge flows and thereby can help to boost performance of companies which rely on strong knowledge flows. Conversely, avoiding codification in these combinations and instead codifying knowledge in forms which do not match its information intensity and ambiguity (i.e., pursuing a "focused tacitness strategy") permits some intra-organizational knowledge flows, yet cripples the knowledge to a degree which makes it difficult to use by competitors.

Apart from reconfirming the importance of knowledge resources for MNCs, this paper suggests that it might be worthwhile to integrate knowledge based views of the firm with contingency approaches (especially media theory). We believe that a "nested contingency model" is most appropriate for understanding the relationship between codification and performance. On a first level, subunits of MNCs (or firms in general) adopt a tacitness or codification strategy (potentially a different one for each of their different types of knowledge) consistent with their strategic context. On a second level, subunits match forms of codification to each kind of knowledge in a way which is consistent with the adopted knowledge management strategy.

Although we have explored some of the main mechanisms of the nested contingency model, several of its parts would benefit from further research. One area concerns the match between strategic context and knowledge management strategy. Which dimensions of the strategic context are most relevant for a firm's knowledge management strategy? What are the factors which render codification beneficial or dangerous? On first thought, a number of factors come to mind, such as intensity of rivalry, industry position, industry fragmentation, personnel turnover, corporate culture, organizational structure, etc. But more research is needed, especially how these factors affect the optimal level of codification for different types of organizational knowledge and for different forms of codification.

Another set of questions stimulated by this paper concerns the relationship between codification and knowledge flows. We have argued in this paper that some forms of codification facilitate flows of some knowledge more than others. Direct tests of this idea would be highly desirable. Although prior work related to media theory provides a very good starting point for this line of inquiry, empirical research focusing on knowledge flows is largely absent. Knowledge can flow in many directions in organizations, e.g. upward, downward, horizontally, into and out of subunits, etc. We know surprisingly little about how codification facilitates these different kinds of

knowledge flows, and more specifically, how different kinds of codification interact with different types of knowledge in facilitating directed knowledge flows. We hope future research in this area will help to gain a deeper understanding of the evolution, distribution, and performance implications of organizational knowledge.

Tables

Table **2**: Descriptive Statistics of the Variables used in the Analyses.

Variable	N	Mean	Stddev	Min	Max
Subunit Performance	97	0.000	1.000	-2.384	1.200
Codification Measures					
Numbers/Codes Technology Kn.	89	0.000	1.000	-1.755	1.124
Words/Text Technology Kn.	91	0.000	1.000	-2.722	1.089
Objects/People Technology Kn.	89	0.000	1.000	-1.901	1.161
Numbers/Codes Sales&Marktng Kn.	90	0.000	1.000	-1.295	1.369
Words/Text Sales&Marktng Kn.	94	0.000	1.000	-2.993	1.144
Objects/People Sales&Marktng Kn.	90	0.000	1.000	-2.008	0.967
Numbers/Codes Strategic Kn.	91	0.000	1.000	-1.057	1.751
Words/Text Strategic Kn.	94	0.000	1.000	-2.504	1.103
Objects/People Strategic Kn.	91	0.000	1.000	-1.828	1.311
Codification Dispersion					
Codification Dispersion Technology Kn.	90	1.344	1.478	0.000	5.333
Codification Dispersion Sales&Marktng Kn.	92	1.721	1.707	0.000	5.333
Codification Dispersion Strategic Kn.	93	1.710	1.578	0.000	5.333
Sum Codification Dispersion Measures	89	4.712	3.905	0.000	16.000
Dispersion Components (i.e. Squared Deviances)					
Numbers/Codes Technology Kn.	89	0.989	1.345	0.001	6.732
Words/Text Technology Kn.	91	0.989	1.528	0.020	8.724
Objects/People Technology Kn.	89	0.989	1.530	0.001	8.142
Numbers/Codes Sales&Marktng Kn.	90	0.989	1.081	0.002	4.694
Words/Text Sales&Marktng Kn.	94	0.989	1.272	0.000	5.796
Objects/People Sales&Marktng Kn.	90	0.989	1.319	0.003	6.064
Numbers/Codes Strategic Kn.	91	0.989	1.299	0.000	6.897
Words/Text Strategic Kn.	94	0.989	1.136	0.000	4.475
Objects/People Strategic Kn.	91	0.989	1.236	0.007	5.627
Control Variables					
%Top Mngrs born in host cntry	92	60.239	42.881	0.000	100.000
Location of Unit (Denmark = 1)	97	0.361	0.483	0.000	1.000
Log Corporate Size	96	7.364	2.469	1.792	12.766
Competitive Advantage of Kn.Areas	95	11.253	2.073	4.000	15.000
Innovative Industry	97	0.000	2.337	-5.993	4.771
Local Responsiveness	97	0.000	2.750	-8.641	4.833
Global Integration	97	0.000	4.290	-11.774	8.952
Uncertainty Measure	97	0.000	2.006	-4.337	6.110

Table **3**: Linear Effects of Three Forms of Codification (and Control Variables) on Subunit Performance: Codification of Technical Knowledge (Model 1), Marketing Knowledge (Model 2), Strategic Knowledge (Model 3), and Aggregate Codification (Model 4).

	Model 1	**Model 2**	**Model 3**	**Model 4**
	Techn	Marktng	Strat	All Areas
Numbers/Codes	-0.138	-0.047	-0.213●	
	(0.110)	(0.105)	(0.107)	
Words/Text	-0.034	0.042	0.170	
	(0.115)	(0.104)	(0.119)	
Objects/People	-0.045	-0.003	-0.016	
	(0.119)	(0.112)	(0.109)	
Sum Codification				-0.013
				(0.026)
INTERCEPT	-1.963●●	-1.455●	-1.828●●	-1.511●●
	(0.755)	(0.740)	(0.731)	(0.736)
%Top Mngrs born	-0.006●●	-0.007●●●	-0.006●●	-0.007●●
in host cntry	(0.003)	(0.003)	(0.003)	(0.003)
Location of Unit	-0.218	-0.296	-0.254	-0.318
(Denmark=1)	(0.289)	(0.264)	(0.269)	(0.277)
Log Corp Size	-0.014	-0.011	-0.003	-0.011
	(0.050)	(0.047)	(0.048)	(0.047)
Competitive Advantage	0.222●●●	0.184●●●	0.203●●●	0.188●●●
(of knowledge areas)	(0.064)	(0.061)	(0.062)	(0.062)
Innovative Industry	0.011	0.034	0.000	0.038
	(0.054)	(0.054)	(0.055)	(0.053)
Local Responsivenss	-0.031	-0.040	-0.033	-0.044
	(0.042)	(0.039)	(0.041)	(0.040)
Global Integration	-0.043†	-0.034	-0.044†	-0.035
	(0.028)	(0.027)	(0.027)	(0.027)
Uncertainty	-0.035	-0.035	-0.010	-0.039
	(0.053)	(0.050)	(0.052)	(0.051)
R-squared	0.285	0.307	0.318	0.305
N	81	81	82	78

Note: ●●●=P<0.01 ●●=P<0.05 ●=P<0.10 †=P<0.15

Table **4**: Effects of Codification Dispersion on Subunit Performance: Codification Dispersion of Technical Knowledge (Model 1), Codification Dispersion of Marketing Knowledge (Model 2), Codification Dispersion of Strategic Knowledge (Model 3), and Aggregate Codification Dispersion (Model 4).

	Model 1	**Model 2**	**Model 3**	**Model 4**
	Techn	Marktng	Strat	SumDispers
Dispersion of Codif.	0.146●●	0.082	0.145●●	0.060●●
in Knowledge Area	(0.068)	(0.062)	(0.064)	(0.026)
INTERCEPT	-2.220●●●	-2.064●●●	-2.320●●●	-2.285●●●
	(0.714)	(0.721)	(0.710)	(0.725)
%Top Mngrs born	-0.007●●	-0.007●●	-0.006●●	-0.006●●
in host cntry	(0.003)	(0.003)	(0.002)	(0.003)
Location of Unit	-0.331	-0.271	-0.240	-0.275
(Denmark=1)	(0.246)	(0.251)	(0.243)	(0.250)
Log Corp Size	0.005	0.002	-0.003	0.001
	(0.046)	(0.047)	(0.045)	(0.046)
Competitive Advantage	0.219●●●	0.210●●●	0.226●●●	0.216●●●
(of knowledge areas)	(0.060)	(0.061)	(0.059)	(0.060)
Innovative Industry	0.017	0.021	-0.008	0.012
	(0.051)	(0.052)	(0.051)	(0.051)
Local Responsivenss	-0.026	-0.015	-0.026	-0.019
	(0.038)	(0.039)	(0.037)	(0.038)
Global Integration	-0.041†	-0.039†	-0.046●	-0.043†
	(0.026)	(0.026)	(0.025)	(0.026)
Uncertainty	-0.005	-0.024	-0.002	-0.007
	(0.050)	(0.050)	(0.050)	(0.051)
R-squared	0.315	0.294	0.323	0.320
N	84	85	86	83

Note: ●●●=P<0.01 ●●=P<0.05 ●=P<0.10 †=P<0.15

Table **5**: Effects of Codification Dispersion Components on Subunit Performance: Squared Distance from Average Codification of Technical Knowledge (Model 1), Squared Distance from Average Codification of Marketing Knowledge (Model 2), Squared Distance from Average Codification of Strategic Knowledge (Model 3), and the Match Model (Model 4).

	Model 1	**Model 2**	**Model 3**	**Model 4**
	Techn	Marktng	Strat	Match Model
Numbers/Codes	0.161●●	-0.094	-0.047	T 0.130●
Disp. Component	(0.079)	(0.097)	(0.082)	(0.076)
Words/Text	0.115†	0.148●	0.047	M 0.169●●
Disp. Component	(0.072)	(0.078)	(0.088)	(0.079)
Objects/People	-0.023	0.092	0.172●	S 0.160●
Disp. Component	(0.068)	(0.087)	(0.089)	(0.082)
INTERCEPT	-2.245●●●	-1.778●●	-2.527●●●	-2.843●●●
	(0.736)	(0.730)	(0.786)	(0.763)
%Top Mngrs born	-0.006●●	-0.008●●●	-0.006●●	-0.007●●
in host cntry	(0.003)	(0.002)	(0.003)	(0.003)
Location of Unit	-0.378	-0.237	-0.344	-0.302
(Denmark=1)	(0.261)	(0.249)	(0.266)	(0.252)
Log Corp Size	0.011	-0.026	0.003	-0.003
	(0.048)	(0.047)	(0.048)	(0.046)
Competitive Advantage	0.212●●●	0.208●●●	0.250●●●	0.254●●●
(of knowledge areas)	(0.061)	(0.059)	(0.064)	(0.062)
Innovative Industry	0.027	0.034	0.007	-0.001
	(0.054)	(0.051)	(0.054)	(0.050)
Local Responsivenss	-0.036	-0.012	-0.022	-0.006
	(0.039)	(0.040)	(0.040)	(0.039)
Global Integration	-0.051●	-0.028	-0.047●	-0.043†
	(0.027)	(0.025)	(0.027)	(0.026)
Uncertainty	0.004	-0.033	-0.030	-0.027
	(0.052)	(0.049)	(0.053)	(0.050)
R-squared	0.336	0.361	0.310	0.389
N	81	81	81	80

Note: ●●●=P<0.01 ●●=P<0.05 ●=P<0.10 †=P<0.15

References

Almeida, Paul 1996
Knowledge Sourcing by Foreign Nationals: Patent Citation Analysis in the U.S. Semiconductor Industry in: Strategic Management Journal, Vol. 17 (Winter Special Issue), 1996: 155-165

Appleyard, Melissa M. 1996
How Does Knowledge Flow? Interfirm Patterns in the Semiconductor Industry in: Strategic Management Journal, Vol. 17 (Winter Special Issue), 1996: 137-154

Badaracco, Joseph L. 1991
The Knowledge Link: How Firms compete through Strategic Alliances Boston: Harvard Business School Press

Barney, J. 1986
Strategic factor markets: expectations, luck and business strategy. in: Management Science, 32(10): 1231-1241.

Barney, J.B. 1991
Firm resources and sustained competitive advantage. in: Journal of Management, 17(1): 99-120

Bierly, Paul; Chakrabarti, Alok 1996
Generic Knowledge Strategies in the U.S. Pharmaceutical Industry in: Strategic Management Journal, Vol. 17 (Winter Special Issue), 1996: 123-135

Blau, Peter M. 1970
A Formal Theory of Differentiation in Organizations. in: American Sociological Review 35: 201-218

Boettcher, Roland; Welge, Martin K. 1994
Strategic Information Diagnosis in the Global Organization in: Management International Review, Vol.34 1994: 7-24

Daft, Richard L.; Huber, George P. 1987
How Organizations Learn: A Communication Framework. in: Research in Organizational Behavior, Vol. 5, 1987:1-36

Daft, Richard L.; Lengel, Robert H. 1984
Information Richness: A New Approach to Managerial Behavior and Organizational Design in: Research in Organizational Behavior, vol. 6, 1984:191-233

Daft, Richard L.; Lengel, Robert H. 1986
Organizational Information Requirements, Media Richness and Structural Design in: Organizational Science, Vol. 32, No. 5, 1986:554-571

Dierickx, I. and Cool, K. 1989 1989
Asset stock accumulation and sustainability of competitive advantage. in: Management Science(35): 1504-1513

Egelhoff, William G. 1991
Information-processing theory and the multinational enterprise. in: Journal-of-International-Business-Studies, Fall, 1991, v22(n3). p341(28)

Egelhoff, William G., Liam, Gorman and McCormick, Stephen 1996
Organizational learning in MNCs: the flow of knowledge between Irish subsidiaries and other parts of the company. Unpublished manuscript presented at the 1996 Academy of Management Meetings

Ghoshal, Sumantra; Bartlett, Christopher A. 1988
Creation, Adoption, and Diffusion of Innovations by Subsidiaries of Multinational Corporations. in: Journal of International Business Studies, Fall 1988: 365-388

Gouldner, Alvin W. 1964
Patterns of Industrial Bureaucracy. New York: The Free Press

Grant, Robert M. 1996
Toward a Knowledge-Based Theory of the Firm in: Strategic Management Journal, Vol. 17 (Winter Special Issue), 1996: 109-122

Gupta, Anil K.; Govindarajan, Vijay 1991
Knowledge Flows and the Structure of Control Withing Multinational Corporations in: Academy of Management Review, Vol.16, No.4 1991: 768-792

Hedlund, Gunnar 1994
A Model of Knowledge Management and the N-Form Corporation in: Strategic Management Journal, Vol. 15, 1994: 73-90

Hedlund, Gunnar; Nonaka, Ikujiro 1993
Models of Knowledge Management in the West and Japan in: Lorange, P.; Chakravarthy, B.; Roos, J.; Van de Ven, A.; Implementing Strategic Processes, Change, Learning & Co-operation; Oxford: Basil Blackwell, Ltd, 1993

Hill, Lewis E.; Ende, Eleanor T. 1994
Towards a Personal Knowledge of Economic History: Reflections on Our Intellectual Heritage from the Polanyi Brothers in: American Journal of Economics and Sociology, Vol 53, No 1, January 1994: 17-26

Horton, Thomas R. 1989
Coping with Information Overload in: Management Review, Dec 1989, v78 (n12), p5(2)

Inkpen, Andrew C. 1995
The Management of Knowledge in International Joint Ventures in: 1995 Academy of Management Meetings, Vancouver

Kogut, Bruce 1991
Country Capabilities and the Permeability of Borders in: Strategic Management Journal, Vol. 12, 1991: 33-47

Kogut, Bruce; Zander Udo 1993
Knowledge of the Firm and the Evolutionary Theory of the Multinational Corporation in: Journal of International Business Studies, Vol.24 1993: 625-645

Levinthal, Daniel A.; March, James G. 1993
The Myopia of Learning in: Strategic Management Journal, Winter, 1993, V 14, p95-112

Levitt, Barbara; March, James G. 1988
Organizational Learning in: Annual Review of Sociology 14 (1988): 319-340

Liebeskind, Julia Porter 1996
Knowledge, Strategy, and the Theory of the Firm in: Strategic Management Journal, Vol. 17 (Winter Special Issue), 1996: 93-107

Murnighan, J. Keith and Conlon, Donald E. 1991
The Dynamics of Intense Work Groups: a Study of British String Quartets in: Administrative Science Quarterly, June 1991, v36(n2) p165(22)

Nelson, Richard R.; Winter, Sedney G. 1982
An Evolutionary Theory of Economic Change Cambridge: Belknap

Nonaka, Ikujiro; Takeuchi, Hirotaka 1995
The Knowledge Creating Company Oxford University Press, New York

Nordhaug, Odd 1994
Structural Learning Barriers in Organizations in: Scandinavian Journal of Educational Research, Vol. 38, Nos 3-4, 1994:299-313

Polanyi, Michael 1958
Personal Knowledge. Chicago: University of Chicago Press

Porter, Michael E. 1980
Competitive Strategy The Free Press: New York

Prahalad, K. C.; Doz, Yves L. 1987
The Multinational Mission The Free Press, New York

Prahalad,C.K.; Hamel,Gary 1990
The Core Competence of the Corporation in: Harvard Business Review, May-June 1990:79-91

Prusak, Laurence 1996
The Knowledge Advantage in: Strategy and Leadership, March/April 1996: 6-8

Rahim, M. Afzalur 1995
Issues In Organizational Learning in: The International Journal of Organizational Analysis, Vol 3, No 1

Roth, Aleda V. 1996
Achieving Strategic Agility Through Economies of Knowledge. in: Strategy and Leadership, March/April, 1996: 30-37

Simon, H.E. 1991
Bounded Rationality and Organizational Learning. in: Organization Science, Vol. 2, No. 1, February 1991: 125-134

Spender, J.-C. 1993
Competitive Advantage From Tacit Knowledge? Unpacking The Concept And Its Strategic Implications in: Academy of Management Best Papers Proceedings, 1993:17-41

Spender, J.-C. 1994
Organizational Knowledge, Collective Practice and Penrose Rents in: International Business Review, Vol. 3, No. 4, 1994:353-367

Spender, J.-C; Grant, Robert M. 1996
Knowledge and the Firm: Overview in: Strategic Management Journal, Vol. 17 (Winter Special Issue), 1996: 5-9

Stata, Ray 1989
Organizational Learning -- The Key to Management Innovation. in: Sloan Management Review, Vol. 30 No. 3, Spring 1989: 63-74

Stuller, Jay 1996
Overload (Coping with Information Glut) in: Across the Board, April 1996, V33(n4), p16(7)

Szulanski, Gabriel 1996
Exploring Internal Stickiness: Impediments to the Transfer of Best Practices Within the Firm in: Strategic Management Journal, Vol. 17 (Winter Special Issue), 1996: 27-43

Van De Ven, Andrew H.; Delbecq, Andre L.; Koenig, Richard Jr. 1976
Determinants Of Coordination Modes Within Organizations in: American Sociological Review, Vol. 41. April, 1976:322-338

Winter, Sidney G. 1987
Knowledge and Competence as Strategic Assets in: Teece, D.J.(ed.), The Competitive Challenge: Strategies for Industrial Innovation and Renewal. Ballinger: Cambridge, Mass.

Zander, Udo; Kogut, Bruce 1995
Knowledge and the Speed of the Transfer and Imitation of Organizational Capabilities: An Emprical Test in: Organization Science, Vol. 6, No. 1, Jan-Feb 1995: 76-92