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A MODEL OF KNOWLEDGE MANAGEMENT AND THE N-FORM CORPORATION

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A model of knowledge management is developed. It builds on the interplay between articulated and tacit knowledge at four different levels: the individual, the small group, the organization, and the interorganizational domain. The model is applied on differences between Western and Japanese patterns of knowledge management. These are related to organizational characteristics, such as employment systems, career patterns, and organization structure. Effective knowledge management is argued to require departures from the logic of hierarchical organization and the M-form structure. The alternative N-form is characterized and suggested as more appropriate. It entails combination of knowledge rather than its division, which is the basic principle in the M-form. Other attributes of the N-form are: temporary constellations of people, the importance of personnel at 'lower levels', lateral communication, a catalytic and architectural role for top management, strategies aimed at focusing and economies of depth, and heterarchical structures.

In recent discussions of needed foci for the analysis of corporate strategy and theories of the firm, two types of calls for a shift of emphasis are increasingly heard. First, the *internal organization and management of firms* are emphasized. Rumelt, Schendel and Teece (1991: 22) stress '—organizational capabilities, rather than product-market positions or tactics, as the enduring source of advantage.' Nelson and Winter (1982: 135) posed the challenge of developing the subject of 'organizational genetics,' indicating that 'the real work remains to be done.' Almost a decade later, Nelson (1991) insists even more strongly that differences between individual firms constitute a core problem, and that analyses have to consider firm strategies, structures and core capabilities in greater depth. The emerging ideas are claimed to serve as a basis 'not only as a guide to management, but also as a basis for a

serious theory of the firm in economics' (1991: 72). The resource based approach to strategy (Wernerfelt, 1984) similarly stresses internal capabilities, as does analyses in terms of core competences (Prahalad and Hamel, 1990).

Second, notions of change, dynamism and innovation become more prominent. The firm-specific capabilities that really make a difference are 'dynamic capabilities.' (For a review of work in this vein, see Teece, Pisano and Shuen, 1990). The Summer 1992 Special Issue of the *Strategic Management Journal* is devoted to 'Strategy Process: Managing Corporate Self-Renewal,' in which most papers deal with the dialectic of stability and change, identifying obstacles for renewal and their organizational implications. Relatedly, notions of knowledge and knowledge management are introduced into the strategy and economics discourse, sometimes clothed in the garb of 'organizational learning.' The special issue of *Organization Science* (February 1991) contains several examples. Dougherty (1992),

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Kogut and Zander (1992), and Nonaka (1987) constitute other recent efforts.

The often eloquent calls to arms notwithstanding, in my view there is much silence on what more precisely should be meant by knowledge and its management, or by dynamic capabilities. (Exceptions have been and will be referred to.) One reason is, I believe, that some dominant theoretical paradigms are inherently ill-suited to the particular task. For example, transaction cost approaches are hampered by taking transactions as given (rather than something to be created), adopting an atomistic view of the basic unit of analysis (rather than considering systemic aspects of transaction or action packages, cf. Winter, 1991: 191), not paying much attention to historical heritage and consequent inertia and path dependency, and by not considering what happens inside the firm in great detail. 'Hierarchy' denotes all forms of internal organization, and distinctions usually refer only to crude structural categories (M-form, U-form, etc).

Evolutionary theories do address questions of change, but often the focus is on selection mechanisms too crude to allow for internal adaptation in firms. 'Population ecology' approaches to organizational issues mostly see adaptation as less important than inertia, and renewal therefore as a 'Darwinian' process of selection of appropriate, inertial forms of organization. Nelson and Winter (1982) are refreshingly (and in my view appropriately) open about their theory being 'unabashedly Lamarckian' (1982: 11). Still, their analysis focuses on the inertia and permanence of 'routines,' and they admit that their discussion of routines as 'targets' and 'components' is only a preliminary effort to 'dynamize' the analysis. Later discussions from scholars in business strategy and organization theory take the analysis further by studying the 'intraorganizational ecology' (Burgelman, 1991) of selection and adaptation in greater detail. However, the starting point in the tacit nature of knowledge and skills adopted by Nelson and Winter (1982) is largely absent in the more 'micro-ecological' contributions.

The large literature on the management of technology and R&D, and on product development more specifically, of course provides many valuable insights concerning the nature of knowledge and its management. (See Tushman and

Moore, 1988, and Van de Ven, Angle and Poole, 1989, for state-of-the-art selections and summaries.) However, if theories from economics and inspired by biological analogies are too crude to capture the intricacies of internal organization and how it relates to knowledge management, the literature on product development is too specific and theoretically eclectic to generate more comprehensive models, that constitute alternatives or at least complements to the dominant overarching theories of the firm.

This paper is an effort to contribute to the development of such models in the grey zone between economics, organization theory and strategic management. The specific framework proposed builds on Hedlund and Nonaka (1993) and on earlier work on knowledge creation (Nonaka, 1987), exploitation and experimentation strategies (Hedlund and Rolander, 1987, 1990), and heterarchical structures (Hedlund, 1986, 1993). First, a typology of knowledge types and of knowledge transfer and transformation processes is presented. The usefulness of the model is tested by trying to explain some apparent peculiarities of Japanese¹ industrial strengths and weaknesses. Organizational requirements for effective knowledge management are posited, partly based on the analysis of differences between Japanese and other approaches. The paper concludes by proposing the *N-form corporation* as a likely and desirable development. More ambitious knowledge management is argued to require departures from the logic of hierarchical organization in general, and the M-form in particular. The N-form logic is one of multiplication and combination rather than of division. It also implies role assignments differing from those inherent in the M-form, at all levels of the firm.

A MODEL OF KNOWLEDGE TYPES, AND TRANSFER AND TRANSFORMATION PROCESSES

The model builds on two primary distinctions, often made but rarely put together and, as far as I know, not previously analyzed systematically

¹ 'Japanese' and 'Western' of course hide significant differences between firms and environments. Still, as a first approximation it is useful to contrast a Western archetype with the Japanese one, also obviously simplified.

	INDIVIDUAL	GROUP	ORGANIZATION	INTERORGANIZATIONAL DOMAIN
ARTICULATED KNOWLEDGE/ INFORMATION Cognitive Skills Embodied	Knowing calculus	Quality circle's documented analysis of its performance	Organization chart	Suppliers' patents and documented practices
TACIT KNOWLEDGE/ INFORMATION Cognitive Skills Embodied	Cross-cultural negotiation skills	Team coordination in complex work	Corporate culture	Customers' attitudes to products and expectations

Figure 1. A model of knowledge categories and transformation processes: Types of knowledge. Adapted from Hedlund and Nonaka, 1993.

in conjunction. First, we distinguish between *tacit* and *articulated* knowledge.² Tacit knowledge (TK) is defined as in Polanyi (1962), indicating knowledge which is nonverbalized or even non-verbalizable, intuitive, unarticulated. Articulated knowledge (AK) is specified either verbally or in writing, computer programs, patents, drawings or the like.

Second, we distinguish between four different levels of carriers, or agents, of knowledge: the *individual*, the small *group*, the *organization*, and the *interorganizational domain* (important customers, suppliers, competitors, etc). AK and TK exist at all levels. Figure 1 provides examples of the eight types of knowledge so defined. The notion that knowledge resides not only at the individual level is of course not new. Cyert and March (1963) and Nelson and Winter (1982) explicitly talk about organizational routines. Pavitt (1980) stresses the firm's knowledge and capabilities, and as in Nelson and Winter, the tacit nature of the firm's skills is given prominence. From a different angle, Itami (1987) stresses 'invisible assets,' similarly combining the ideas of organizational capabilities and tacitness.

Without pretensions of a full review, some other recent examples of analyses of organizational knowledge and related matters are: Stubbart (1989) and other students of managerial and organizational cognition, Porac, Thomas and Baden-Fuller (1988) on 'cognitive groups/oligopo-

lies,' Wolfe (1991) on mind as a social category, March (1991) on the balance between exploitation and exploration and between individual and organizational learning, Seely-Brown and Duguid (1991) on the 'communal context of learning,' Stiglitz (1987) on 'localized knowledge,' Kogut and Zander (1992).

The basic structure of our model is an effort to synthesize and clarify insights in these and other contributions. We differ from Nelson and Winter (1982) in that we focus on the *interaction* between, for example, individual and organizational knowledge, rather than only using the former as an analogy of the latter. Posing the group as an intermediate level allows a more fine-grained look at what goes on within the organization. The prominence of small groups, often temporary, in innovation and product development indicates that this is the level at which much of knowledge transfer and learning take place. The level superordinate to the organization, the interorganizational domain of units interacting with the focal one, is also critical to knowledge development, as evidenced by von Hippel (1976) with regard to customers and by many recent analysts with regard to suppliers. Analyses of national systems of innovation (Freeman, 1982; Nelson, 1993) also show that the texture of social ecology matters a great deal.

The model distinguishes between three forms—or, perhaps better—aspects of knowledge: *cognitive knowledge* in the form of mental constructs and precepts, *skills*, and knowledge *embodied* in

² I will use 'knowledge' and 'information' interchangeably although they should be distinguished in a fuller treatment.

products, well-defined services or artifacts. To include skills is consistent with Polanyi (1962), whose discussion is mostly about individual skills. In my view, adopters and adapters of Polanyi's ideas have perhaps been too enamoured by the focus on skills. (Competences, capabilities, resources—conceived broadly (too broadly?) as also encompassing propensities for certain action—are examples in later vocabulary.) Cognitive knowledge is *also* important, particularly since its development and management is likely to differ substantially from that of skills. For example, cognitive knowledge is usually easier to articulate and transfer and not as sensitive to problems of team embeddedness (Winter, 1987; Zander, 1991).

Introducing embodiment in products as a category of knowledge is more problematical. Starbuck (1984) would rather see products as one of many forms of embodiment of knowledge. (Others being, for example, in individuals, in computer programs, in production equipment, etc.) Our wide definition of knowledge is influenced by the fact that transfer of knowledge between but also within organizations to such a large extent takes place through product flows. An advantage is that the three forms correspond to three recognized primary modes of corporate expansion: through increased sales (embodied in products), by licensing (selling cognitive blueprints or recipes), or by capacity-increasing investment (transferring a whole set of skills). The parallelism is most apparent in the context of multinational corporations (MNCs). A large literature discusses the relative merits of exports, licensing, and foreign direct investment (FDI). The three modes imply our three categories of knowledge.

Further distinctions between types of knowledge can fruitfully be made, but more important for the purposes of this paper is to 'dynamize' the model by introducing processes of *transfer* and *transformation* of knowledge. Much of the literature referred to earlier speaks primarily in terms of *storage* of information, and only secondarily about its transfer, whereas its transformation is left outside most analyses. For example, Nelson and Winter (1982: 134) talk about coordinating information being '... stored in the routine functioning of the organization and 'remembered by doing'. Their first concern is storage, and the second transfer, developing

models of imitation and emphasizing the differential abilities of social mechanisms (markets, firms) to 'actively *transmit* information' (1982: 403, my emphasis). Kogut and Zander (1992), as many others, rely on the concept of the organization as a 'repository of knowledge.' Their prime concern is the analysis of imitation and replication of knowledge, i.e., its transfer rather than its transformation.

Our model allows explicit distinctions between storage, transfer and transformation. I will discuss three basic sets of concepts (see Figure 2):

- Articulation* and *internalization*, the interaction of which is termed *reflection*. (The processes are illustrated through vertical arrows in Figure 2).
- Extension* and *appropriation*, together constituting *dialogue*. (Horizontal arrows in Figure 2.)
- Assimilation* and *dissemination*, referring to knowledge imports from and exports to the environment.

Articulation refers to tacit knowledge being made explicit, articulated. This can take place at all four levels in the model. Articulation is essential in facilitating transfer of information, but also for its expansion and improvement, since it allows open scrutiny and critical testing. In international technology transfer, it is a crucial element both in the case of licensing and of FDI. Ledin (1990) contains an account of Ericsson's concerted and successful campaigns to articulate and transfer telecommunications know-how. This process of articulation is crucial in the growth of the firm. Without such articulation, it is difficult to involve new employees and to divide up and specialize work. The current, and justified, fascination with the tacit component of knowledge in much of the literature must not cloud the fact that organizations to a large extent are 'articulation machines,' built around codified practices and deriving some of their competitive advantages from clever, unique articulation. In fact, much of industrialization seems to have entailed exactly the progressive articulation of craftsmanlike skills, difficult but not impossible to codify. (And, possible to appropriate within the firm in spite of being codified. The empirical results from Zander (1991) show that codifiability does not necessarily lead to quicker competitor imitation.)

Internalization is when articulated knowledge

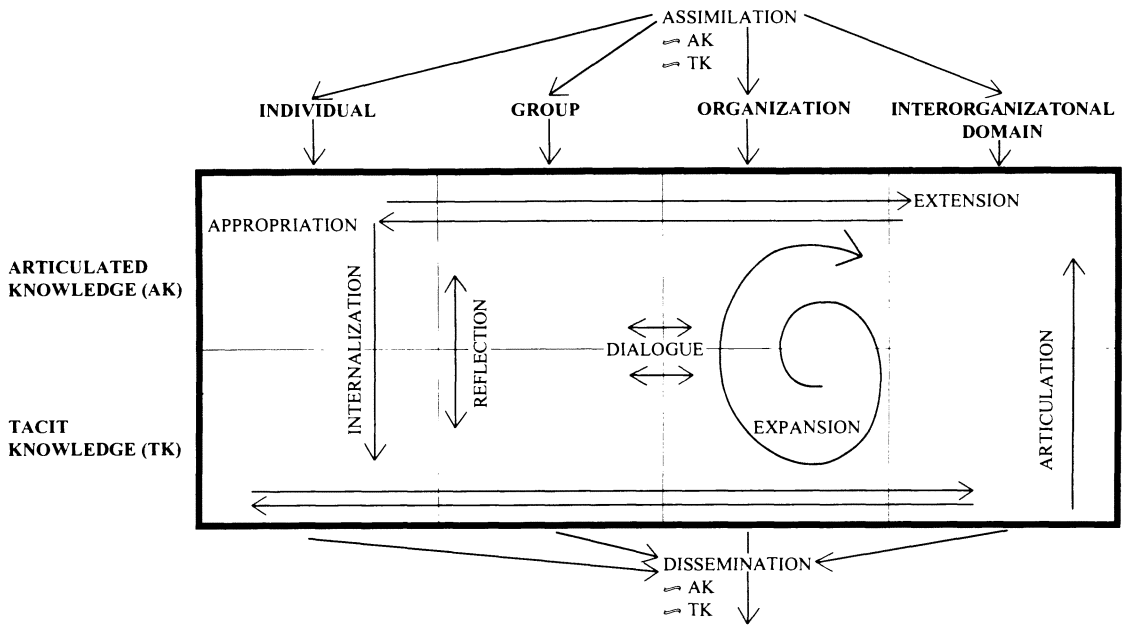


Figure 2. A model of knowledge categories and transformation processes: Types of transfer and transformation. Adapted from Hedlund and Nonaka, 1993

becomes tacit. It is important in that internalization economizes on limited cognitive, perceptual and coordinative resources. The whole literature on and building on bounded rationality (Simon, 1955) shows how individual and organizational routines are paramount in understanding how human systems assemble and use information. It also provides many examples of the negative sides of internalization in withdrawing knowledge into the unreflective unconscious and packaging it in conservative and conserving ways.

The interplay of tacit and articulated knowledge is termed *reflection*. Genuine knowledge creation (see Nonaka, 1987) usually requires such interplay. Writing a scientific paper is a good example of such a process; moving between hunches and expositions, loose analogies and structural similarities, unreflective impressions from chance encounters with reality and systematic search for evidence, etc.

Extension is transfer of knowledge (possibly resulting in its transformation) from lower to higher agency levels in the model, in articulated or tacit form. An example of the former would be when a company sends drawings of its planned future products to its subcontractors. The latter, tacit mode of transfer is usually entailed in the teaching of complex, practical skills, as when an

experienced management consultant coaches a group of younger colleagues through working together with them on a project. *Appropriation* is the reverse process, as when the organization teaches new employees about its products (mostly the articulate route) or indoctrinates them into the corporate culture (mostly through tacit transfer). *Dialogue* is the interaction of extension and appropriation. It also includes dialogue at a given agency level, for example within a working group. Dialogue takes place also at the tacit level. Craftsmanlike skills as well as corporate cultures probably develop and transfer largely through tacit communication.

The quantity and quality of dialogue and reflection are hypothesized to be important determinants of the type and effectiveness of knowledge management. It is significant that pedagogical practices usually involve the two basic processes in our model: dialogue between teachers and students in the classroom, and reflection in solitude in the library or at home. Great teachers have always known to inspire dialogue, and also to draw tacit knowledge out of the student. (Plato's dialogues (sic!) are prime examples, where Socrates always insists that the student really already knows the answer. The master's job (which Socrates compares to a

midwife's) is to pull it from the depths of muddled tacitness, or forgetfulness, to clear articulation.)

Assimilation and *dissemination* are conceptually straight-forward concepts covering the input and output, respectively, of knowledge (in cognitive, product or skill form).³ Also here, there are both articulated and tacit components. For example, complex packages of tacit knowledge are assimilated through selective recruiting of key individuals. Or, clearly articulated bits of information are accessed through data links to patent banks. Dissemination similarly can involve articulated as well as tacit elements. If knowledge is easily codifiable, selling patents is a feasible strategy, provided the 'appropriability régime' is benign (cf. Teece, 1977 and later work). Large doses of tacitness means that 'internalization' makes more sense, for example by investing in own manufacturing capability. (Teece interprets these matters in terms of transaction cost. I believe the original insight into the importance of the type of knowledge being transferred is somewhat lost and left unexplored in the reliance on assumptions of opportunism in most transaction cost literature.)

Hedlund and Nonaka (1993) argue for the descriptive incisiveness of the model in capturing essential differences between the Japanese and Western archetypical systems of knowledge management. Tacitness and tacit transfer of knowledge seem to be more important in large Japanese corporations, at the individual as well as at the group and organizational levels. The group and interorganizational levels, furthermore, appear to be most critical in the Japanese model, whereas the individual and organizational ones take precedence in the Western one.

Here, I will concentrate on the explanatory and potential predictive value of the model, also focusing on the Japanese case. This is not because of a taste for exoticism, but since the undeniable differences between large firms from Japan and the West pose a most serious challenge to all theories of the firm. Any model which can make sense of these differences is a stronger candidate for a more general theory than those limited by

behavioral and other assumptions peculiar to one or the other nation, tribe, etc. I will briefly discuss: the incrementalism of Japanese innovation strategies versus the 'large step' innovation in the West; the Japanese strength in fields relying on prespecified critical components or patents; the propensity to export products rather than sell know-how; the strength in fields requiring much intra- and interorganizational coordination; the weakness in large systems design; and, the special Japanese style of diversification.

INCREMENTALISM VS. LARGE-STEP INNOVATION

The Western system specializes in radical innovation, and large firms are the instruments more of exploiting such innovations than of generating them. At least, the large firm appears to have a *comparative* (in relation to smaller firms) disadvantage in the creation of novelty, particularly regarding the productivity of R&D, measured for example in terms of output per dollar spent on R&D. The review by Scherer (1984: 222–237) provides empirical evidence. Explanations of the difference usually center on problems of bureaucracy in the large complex organization. However, this does not explain why in Japan exactly the large firms contribute crucially to innovation. (See Taylor and Yamamura, 1990, and Caldwell-Harris, 1985, for empirical support both for the prevalence of incrementalism and for the seemingly less constraining effects of size.)

Not disputing the general effects of bureaucracy, I suggest that one reason for the innovation problems of the large, Western firm is the inflexibility of tightly specified and articulated systems of knowledge. This makes it difficult to be 'inconsistent,' to engage in projects not perceived to fit what the company is all about. In the extreme, the entire organization becomes a plan, where nothing can be changed without disturbing everything else. The root cause of these inflexibilities is in the design of the firm as essentially an instrument (cf. the etymology—organization = tool - and Morgan, 1986) to exploit given resources and knowledge (or administer transactions) efficiently. The fluid markets for human resources at all levels force articulation

³ Note that input from and output to immediately related organizations are considered as appropriation and extension, respectively. We want to distinguish between the 'dense' transactional environment and the contextual, diffuse one.

and formalization, constraining units and individuals to stick to current notions of strategies, products, communication routes, etc. It also inhibits the transfer of tacit knowledge, which requires greater intimacy and permanence than the combination of fluidity and formalism allow. The strength of the system is in the allowance of radical novelty through the importation of highly specialized human resources, and through links to strong universities and scientific knowledge bases. Also the possibility to utilize, and expertise in handling, mergers and acquisitions allow quantum jumps in the reservoir of capabilities.

The Japanese corporation and overall system is the mirror image of the Western one; namely, a myriad of small improvements and rapid incremental development of knowledge. The major factor is the permanence of staff and interorganizational relations, and the intensive dialogue following from this. Dore (1987, Ch. 7) provides theoretical as well as empirical support both for the posited differences and the explanation suggested. Reliance on tacit rather than articulate, explicit structuring of knowledge⁴ leads to developments which would seem 'inconsistent' to a more 'rational' mind. Intensive dialogue and reflection at the group level is not inhibited by segmenting knowledge into functions, professional specializations, or hardware categories. Therefore, to exaggerate, the Japanese firm combines anything with anything else, as long as there is a market for the combination. This leads to frequent, small 'mutations' in offerings to the market. (Cf. Maruyama, 1978, on the differences between Japan and the West in terms of constraints through highly articulated, hierarchical classification systems. See also Baba and Imai, 1991, concerning Japanese company networks' competence in technology combinations.)

The crucial distinctions in analyzing incrementalism versus saltationism may have to do with organizational matters directly, rather than with knowledge categories in terms of the model, although of course the two are connected. Some of the argument above furthermore is really about different *types of articulated knowledge*,

rather than about tacit vs. articulated knowledge. The Japanese bias is to work with induction, lists, and eclectic combination. The Western one is for deduction, hierarchical classification, and division. The former is more likely to lead to many small steps, the latter to single large reconceptualizations or inventions. (See Hedlund and Zander, 1993.)

ASSIMILATION THROUGH PRE-EXISTING COMPONENTS, DISSEMINATION THROUGH PRODUCTS, AND TACIT THROUGHPUT

It is curious how Japanese strength resides in areas which build on clearly defined, crucial components, such as a transistor, an integrated circuit, automobile components, etc. In order to make sense of this, I first want to argue that the Japanese corporation is *biased in favor of articulated assimilation*. A patent or, even better, a tangible product is knowledge in a highly articulated form. The reason for this bias lies in the idiosyncracies of the internal company 'codes' (cf. Arrow, 1974) following from internalized labor markets and refusal to recruit senior and specialized personnel externally. Tacit knowledge probably comes packaged most efficiently in the form of individuals. (Or, on a larger scale, through the integration of whole organizations through acquisitions.) The Japanese willingness to buy technology in the form of patent rights or licenses is well documented, as is the resistance to acquisitions and recruitment at senior levels. (For technology trade, see Keizai Koho Center 1993: 25. For acquisitions and recruitment, see Abegglen and Stalk, 1985, and Dore, 1987, particularly pp. 33 and 141.)

Thus, and almost paradoxically, the internal tacitness and closure require external articulation. It is difficult for a Japanese firm to learn the tacit skills of their Western competitors, for example in the field of running an international organization. Bartlett and Ghosal (1989) contains many examples of the difficulties in Japanese firms of moving to more advanced, 'transnational' structures, where tacit elements encoded in corporate cultures have to be assimilated across borders. Imports or imitation of products is another matter. It is interesting to note that the colossal assimilation of knowledge since

⁴ Hedlund and Nonaka (1993) pursue the logic only hinted at here. Tacit syntax is argued to be less constraining and allows more experimentation than articulated syntax.

the Meiji restoration has been a project of people in firms (and government) learning the Western tricks themselves, not one of having knowledge walk in by recruiting top scientists or buying expertise packaged in companies. In the process of tapping the world for knowledge, bits are sometimes picked up and used in ways and contexts quite surprising to the 'exporters,' since the purchase of the part does not necessarily imply buying in to the tacitly assumed totality. The use of the transistor in consumer products is one example.

The logic of dissemination is a similar one. The Japanese exhibit a bias for exports in product form, and against, particularly, export of skills. Japanese MNCs typically resort to skill transfer through FDI only when forced to do so. The big expansion of outward FDI from the mid-1980s was motivated to a large extent by political pressure and trade barriers. The idiosyncrasy, tacitness and high involvement aspects of internal codes, I would argue, make adoption by external agents difficult. (Unless they are 'quasi-integrated,' as actors in the local interorganizational domain.) Better to sell products or, if that is not possible, licenses. *If* skills have to be transferred, the preference is for tightly controlled FDI (rather than, for example, management contracts and consulting services), where the tacit elements can be protected and transferred through sending along Japanese personnel and, as best one can, replicating the Japanese management systems in the alien environment. It is interesting that the concept of 'transplant' factories was used only when Japanese FDI became a significant reality in the Western countries. The word connotes a full-scale transfer of an identical copy from the Japanese to a foreign environment. There is little evocation of the adaptation to local circumstances that characterizes much of Western FDI.

Support for the contention that Japanese internal company codes are indeed very specific to the company, contain important tacit elements, and require and entail a high degree of employee commitment and active participation can be found in the popular literature on Japanese management as well as in academic writing. For the latter, see for example Kagono *et al.* (1985), Dore (1987), Aoki (1990), and Fruin (1992). Putting the pieces together, we get a picture of the Japanese model as one of importing articulated knowledge, transforming it through largely tacit

processes, and again exporting something articulate. Or, schematically:

$$AK \rightarrow TK \rightarrow AK$$

The Western typical case, analogously, exhibits a (relative) bias to import complex packages of both tacit and articulated input,⁵ transform it in a machine-like fashion through articulated means (clear organization and division of labor, replaceable parts and people, etc.) and export in forms less restricted than in the Japanese case. Again, schematically:

$$AK + TK \rightarrow AK \rightarrow AK + TK$$

The middle category stands for what goes on in the firm and its immediate environment. By implication, the boundaries of the Japanese corporation are set largely through the demands for communication of tacit knowledge. For the Western firm, other considerations are more important. At least, this is so for the large, bureaucratic corporation, divided into parts where interunit dependencies are minimized. The difference with the Japanese case may be larger for some theoretical views of the firm than in reality. Some Western economists and organization theorists go to great length to formulate theories of the firm in terms of opportunism, moral hazard, incentive compatibility, and monitoring. Work in the transaction cost tradition following Coase (1937) and Williamson (1975), agency theory (for example Jensen and Meckling, 1976), and property rights (for example Alchian and Demsetz, 1972) all share the preoccupation with opportunism obstructing the achievement of efficiency in given, specified tasks or transactions.⁶ Aoki (1990) stresses the shortcomings of such models for understanding the Japanese firm, arguing that aspects of information processing and decision making need to be given a greater place in the analysis.

The ideal Japanese 'industry', in our analysis, would be one with *readily existing and articulated input (components and technologies), entailing a through-put process with strong tacit elements,*

⁵ There is no reason to suspect an inferiority in assimilating articulated elements in the West, other than because of 'too logical' and 'not invented here' syndromes.

⁶ However, in many cases also properties of information processing and bounded rationality figure prominently. Also, of course, evolutionary economists take the notion of tacit routines as central.

requiring much intra- and interorganizational dialogue, and allowing the exports of articulated output (products or patents). The prediction seems to fit the real world well. However, stricter tests of the hypotheses require much new empirical research. Many of the concepts proposed, furthermore, imply the development of measures hardly to be found in official statistics. Therefore, the empirical support claimed above has to be regarded as only tentative and illustrative.

An implication of the argument is success in relatively 'mature' technological fields, in the sense that inputs have 'materialized' into components, formulae, etc. Conversely, we arrive at a hypothesis of difficulties in fields where still much interpretation and prototyping remains to be done, and where different elements are not easily combinable. The electronics, computer, and mechanical engineering industries are characterized by rich possibilities of combination of elements. 'New products' are mostly 'simply' combinations of only marginally adapted components. The key to competitive advantage is in the speedy exploitation of opportunities for recombination, which in its turn requires flexible coordination and synchronized execution. Fields such as chemistry and biology differ in this regard, since they require more of new fundamental search, research and synthesis for each new product. The possible future decoding of the genetic language at the molecular level *may* make biology and biochemistry more like electronics, providing more scope for purposive combinatorial experiments.

WEAKNESS IN LARGE SYSTEMS DESIGN

Another interesting fact, and somewhat of an anomaly in other explanations of Japanese strengths, is the difficulties in integration of very large systems. For example, in telecommunications the Japanese suppliers have, so far, not made much progress in the West. According to the Western competitors, an important reason is weakness in complex systems design. In computers, software production is also lagging. In spite of a gigantic local market, leadership in autos and engine technology, and significant efforts, Japan has not yet given birth to a

significant passenger aircraft industry. This weakness in complex systems management is hard to explain in traditional frameworks of analysis. A 'Porterian' view would probably identify the existence of well developed 'diamonds' in all these fields (Porter, 1990). Likewise, those arguing that the Japanese take existing things, improve them and put them in new systems would rather assume that, for example, telecommunications systems design should be a strength of Japan. And, the defenders of strong customer orientation as a key determinant of Japanese success would say that these fields are exactly those where an ear close to the market and final customer is particularly crucial.

In our interpretation, a reason for the weakness in this area is instead that the reliance on internal dialogue, largely at the tacit level, is less effective when very complex tasks have to be coordinated. Articulation, systematization, written information, impersonal control become necessary, although not sufficient. The Japanese model of throughput is simply too time-consuming in these fields.

JAPANESE DIVERSIFICATION

Japanese industrial firms are generally smaller and less diversified than their Western counterparts (See Imai, 1980; Caves and Uekusa, 1976.) This in itself testifies to the requirements of close-knit, intensive communication with large doses of tacitness. Furthermore—although precise information, to my knowledge, does not exist on these matters—Japanese diversification seems to follow a logic of knowledge and competence development rather than of financial synergies or managerial expansionism. Empirical indications can be found in Taylor and Yamamura (1990: 38 ff.) and in examples provided by Prahalad and Hamel (1990). There seems to be a curious mixture of staying close to the knitting and trying anything. Japanese steel makers' ventures into electronics appear to be an example of the latter.⁷ Less spectacular, but still daring,

⁷ Many analysts attribute such moves to an urge to uphold an image of hi-tech and modernism, luring young talent into the firm. In this interpretation 'diversification' is one of the many indices of a strong commitment in Japan to continuous investment in upgrading human resources.

examples show that Japanese firms are willing to stray rather far from home. We do *not* observe Western-style conglomerate diversification, where the *objective* is to move into areas away from the core business. Thus, Japanese diversification is 'related,' but 'relation' is defined generously, and can only be understood in a company-specific, experimental framework, where the limits are set by the potential synergies given by intensive dialogue and combinatorial possibilities. (Cf. the notion of 'corporate coherence' in Dosi, Teece and Winter, 1990.) The *necessity* of finding new arenas for the exercise of basic company competences following from internalized labor markets is emphasized by Dore (1987, Ch. 7). Also Fruin (1992: 44 ff.) emphasizes the 'economies of learning' inherent in the organizational characteristics of the large, Japanese firm (low personnel turnover, in-company training, and egalitarian rewards coupled with opportunities for individual participation and meaningful contribution). Thus, there are both pressures to develop new, related products *and* the conditions to do it. It is interesting that the prevalence of vertical integration in many large Japanese corporations (see Taylor and Yamamura, 1990) can be understood as a consequence of such internal competence development. 'Diversification' in these firms is the unintended consequence of organic extension of internal skills, rather than the deliberate creation of semiautonomous units.

One example of the power of creative application of a key capability in a seemingly totally unrelated area is Kao's 'diversification' into floppy disc manufacturing from a base in chemicals and household cosmetics and detergents. The central idea here was to utilize a competence in surface chemistry. Such ideas are standard fare in Western marketing textbooks, but mostly the common thread is seen as residing in the market rather than in the competence of the firm. ('We are not in the railway business, but in transportation ...') The difference may be in at least some Japanese companies' ability to actually exploit such opportunities. This, in turn, we would hypothesize has to do with the focus on organizational and group level processes aiming at knowledge creation, albeit incremental and 'merely' combinatorial, rather than just the exploitation of existing knowledge.

MANAGING KNOWLEDGE—FROM M-FORM TO N-FORM?

The analysis above has attempted to show that our model captures important differences between Western and Japanese approaches to knowledge management in large firms. I have also related these differences to organizational practices such as employment systems, rotation schemes, and the reliance on groups. Taking the analysis a step further, I will argue that effective knowledge management (again, in large firms) requires a view of the firm that differs significantly from that of theorists of the 'M-form (multidivisional form). The latter is understood in the senses given by Williamson (1991) and Chandler (1991), to take two recent statements. 'M-form' here also implies a logic of hierarchical organization, built on assumptions and hypotheses like those articulated, for example, by Simon (1962) and Galbraith (1973). As an alternative, I suggest the '*N-form*.' 'N' stands for 'new,' and 'novelty,' and comes after M. It is too bad for the mnemonics that 'multiplication' does not begin with 'N,' since of the four basic arithmetic operations multiplication best represents the creation oriented, recombining and experimenting corporation. Addition corresponds to simple volume growth and acquisition, division to the necessary splitting of the unrelated assemblage of units following, and subtraction to the equally necessary and mostly painful pruning of excesses.

The differences between the two firms are summarized in Table 1. Six main themes defining the N-form corporation will be briefly discussed below.

1. Putting things together, *combining* rather than *dividing* them.
2. *Temporary constellations* of people and units rather than *permanent structures*.
3. The importance of *personnel* at '*lower*' levels in interfunctional, interdivisional, and international dialogue, rather than handling coordination through '*managers*' and only at the top.
4. *Lateral* communication and dialogue rather than *vertical*.
5. Top management as *catalyst*, *architect* of communications (technical and human) infrastructure and *protector* of knowledge invest-

Table 1. N-form vs. M-form

	N-form	M-form
Technological interdependence	Combination	Division
People interdependence	Temporary constellations, given pool of people	Permanent structures, changing pool of people
Critical organizational level	Middle	Top
Communication network	Lateral	Vertical
Top management role	Catalyst, architect, protector	Monitor, allocator
Competitive scope	Focus, economies of depth, combinable parts	Diversification, economies of scale and scope, semi-independent parts
Basic organizational form	Heterarchy	Hierarchy

ment rather than *monitor* and *resource allocator*.

6. *Focusing* the corporation on fields with rich potential for combining knowledge elements rather than *diversifying* to create semi-independent parts.
7. *Heterarchy* as the basic structure rather than *hierarchy*.

The conclusions form an integrated set. If the aim is combination (1), a certain focus is necessary (6). It also requires experiments with varying constellations of actors (2). In order to achieve some consistency of effort, investments in communications and coaching and catalyzing top management are necessary (5). The global dispersion of knowledge allowing combination (1) also requires involvement by many individuals at different levels (3), and lateral communication between them (4).

Combination vs. division

Dialogue in particular, but also assimilation, are processes aiming at the combination of pieces of knowledge. As such, they do not comfortably fit the logic of the M-form corporation. It arose essentially to *divide* complexity into units as independent of each other as possible. Apologizing for the glibness of the analogy, it is perhaps not surprising that the large M-form Western corporation faces difficulties of renewal. Only the most primitive organisms reproduce by division, whereas more innovative genetics require combination. Dividing something given

does not produce much novelty, whereas combination might.

Insisting on combination has important organizational implications. Integrating mechanisms become more important than differentiating ones. We know that the combination of different functional sets of expertise is critical for effective product development. (See, for example, Clark and Fujimoto, 1991). There are also indications that the trend towards ever finer division into independent business areas or divisions (sic!) has gone too far in some corporations and may be turning. Ericsson has recently reorganized to allow for more integration in technology, and on the market, between its radio systems and digital telecommunications exchange divisions. The analysis by Prahalad and Hamel (1990) points in the same direction, stressing the complementarity of corporate assets rather than their exclusivity to one part of the organization.

Temporary constellations from given people pool vs. permanent structures with changing pool

Multifaceted dialogue requires shifting groupings of individuals. The permanent hierarchical structure assumed in M-form reasoning provides for dialogue only along prespecified channels. Also assimilation benefits from a capacity to mobilize human resources flexibly. The 'scanner' in the environment running into something potentially interesting must be able to link up and work with people and units outside the normal structure. The temporary project—multifunctional, multi-

national, multidivisional—becomes the natural mechanism, and the quality of project management and project/organization interface critical for success.

In order for this type of combination and recombination of people to function, one needs, almost paradoxically, permanence in the personnel pool. Otherwise, the necessary commonality of communicative codes (cf. Arrow, 1974) is not achieved, particularly as regards tacit communication. Kogut and Zander (1992) distinguish between the 'know-what' and 'know-how' of an organization. Effective dialogue in shifting constellations also requires *know-who*. This is also necessary for deeper *reflection*, the interplay of articulated and tacit knowledge. To draw on tacit reservoirs of expertise, a certain permanence of employment and relations is desirable. This is obvious at the individual level. Reflection at supra-individual levels demands physical proximity and intensive interaction. Group or organizational level reflection also require great *trust* between agents, since much uncertainty is involved in, for example, a process of articulating tacit knowledge. In order to develop the smoothness of perfected routines, practice and continuity are also required. Long-term tenure within firms, development of interunit networks through personnel transfer and rotation, reward schemes that encourage long-term collaboration and sharing of knowledge, and investment in internal training contribute to reflection within the large corporation.

The M-form builds on the reverse principle of achieving robustness through a clear structure of specialized roles, where the individual parts can be changed through recruitment and interfirm mobility. Ideally, there should not be any necessity of moving competences or people between 'divisions'. If the logic is extended to apply within the divisions, in the many 'U-forms,' the limiting case is one where every individual is a semiindependent profit center, free from systemic interdependence with other individuals. In all fairness, this is not, as far as I know, a solution recommended by any proponent of the M-form. Still, there are two main problems. First, the appropriate organization of the corporation as a whole at the highest level is regarded to be the division into independent parts, excluding the possibility of building the firm on the basis of shared and synergetically linked competences.

Second, in the literature on the theory of the firm, there is great silence on how those units that do contain interdependences should be managed. In practice, we have indeed often seen 'a cascading M-form,' where managers at lower levels imitate the 'govern by division' principle of their superiors. (Organization theorists do, of course, discuss these matters in greater depth. See, for example, Galbraith, 1973.)

Middle vs. top levels

Insisting on intensive dialogue across all levels from the individual to the surrounding network of related organizations automatically implies a focus on less than the most senior personnel in the corporation. Such reemphasis is motivated also by the fact that knowledge is increasingly dispersed, due to rapid technological change, education, and global macroeconomic power shifts. Any good knowledge management system must elicit knowledge from many nodes, often distant from each other. The primary focus is on the middle levels, senior enough to be competent and trusted, but not so senior as to be out of touch, and perhaps energy. The arguments apply also to assimilation from the environment. It is interesting to note that Nonaka (1988), in arguing for a genuine knowledge creating company, emphasizes 'middle management.' I would agree, except that the middle may not be managing as much as exercising more specific competences. The M-form, in contrast, gives great importance to the top of the organization, and to general management capabilities rather than more specific ones.

Lateral vs. vertical communication

It is significant, I believe, that Galbraith (1973) stresses 'vertical information systems' as one of many organizational design devices. The M-form logic is a top-down, or bottom-up, one, rather than one of horizontal coordination. The N-form's reliance on the latter follows almost by definition from the focus on dialogue, temporary teams and middle-level initiative. To what has already been suggested, it may be worth noting that openness towards the environment (implied by the processes of assimilation, dissemination and interaction with the interorganizational domain) necessitates

much communication at similar 'hierarchical' or status levels.

Top management: Catalyst vs. monitor

The problem with the N-form as described so far is that it may look like a totally 'emergent' entity—a kaleidoscope of shifting coalitions, chaotic communication patterns, random combinations, and general information overload. The advantage of the M-form and hierarchical ordering in general is the sealing off of complexity in units within a 'nearly decomposable system' (Simon, 1962). Therefore, there is a need for integration, to give direction and consistency to the knowledge development activities. In the N-form, this is top management's primary role. However, it must be exercised in a rather indirect way, lest the effectiveness of the intensive and diffused processes at 'lower' levels is compromised.

A clear vision of broad long term developments regarding both final products and internal competences is perhaps the most important integrative tool. This means that top management must know the substance of the business, and not only its results in financial or other equally abstract terms. Another main task is to build the infrastructure for interpersonal as well as more technical communication. (Recruitment policies, rotation schemes, assigning project teams, nurturing a shared corporate 'language' and culture, investing in computer networks: these are some of the practical dimensions of action. For the last point, see Hagström, 1991). A third function is 'simply' to promote and guard the investment in new knowledge, since this does not automatically occur in the decentralized structure suggested.

The roles differ from those implied in the M-form. Less substantive knowledge of the individual parts is required in the M-form, with consequent dangers of superficiality. Division into subunits is motivated by a need to reduce complexity for coordinating top management. Its role becomes one of monitor and resource allocator from 'the corporate office,' and it is argued that these roles are served more efficiently than by a noninternalized capital market. As corporations have grown more diversified, this argument becomes more important and its validity essential for an assessment of the *raison d'être* of the M-form. I have emphasized quite different

roles for 'headquarters,' if that is an appropriate term.⁸ In fact, these roles are more akin to those served within the 'U-form,' but instilling direct cross-unit interaction is even more important.

Focusing vs. diversifying

In order to be able to have a dialogue aiming at combination of different pieces of knowledge, a shared focus is necessary. This applies also for assimilation and, less obviously, reflection. A very diversified firm cannot internalize, at the corporate level, processes into a tacit organizational reservoir of routines. Extreme diversity does not permit the progressive 'automatizing' of skills and cognitive knowledge packages. In practice, everything has to be explicitly recognized to be noticed and effectuated. Also the reverse process—of articulation from the tacit domain—is compromised, since 'recipes' (cf. Spender, 1989) will differ too much between contexts to be generalized and articulated.

Although some proponents of the M-form have been critical of the conglomerate, others are not. At least, the logic of the argument (monitoring, allocating) is consistent with widely diversified forms.⁹ Economies of scale and scope are emphasized (Chandler, 1990). My argument would recognize particularly arguments of scope, but emphasize the knowledge combination aspects of scope rather than monitoring economies, risk sharing, and financial synergies. In addition, I would suggest that *economies of depth* are heavily involved in knowledge transformation processes. 'Depth' refers to the experience and involvement in an area necessary to be able to generate new knowledge, and, increasingly importantly, to benefit from knowledge in related fields. Fertile combination requires intimate knowledge of both one's own and the other's capabilities. 'Depth' also refers to the virtues of experience in a specific company and industrial field. Sometimes, we notice efforts to integrate super-

⁸ 'Headquarters' implies that the head *and brain* (presumably not only the spatial location in up-right, nonsleeping condition is referred to) reside at this place. Dispersed knowledge suggests that the concept is inappropriate. Cf. the discussion of brain-of-the-firm vs. firm-as-brain (Hedlund, 1986; Morgan, 1986).

⁹ Cf. the argument that the M-form, although perhaps originally well-intentioned, spawned the 'monster of the conglomerate' in Shleifer and Vishny (1991).

ficially (or substantially, but without knowledge of more exactly how) related fields failing because of too shallow understanding of particularly the technological issues involved on the part of initiating top managers. Often these are presiding over very diversified firms. Semi-independent units harnessed in M-form are anathema to depth. Before turning to the last contrast between M- and N-form knowledge management—structuring in hierarchical and heterarchical form, respectively—I want to redress the balance of the discussion so far by briefly mentioning some of the weaknesses of the N-form and strengths of the M-form.

WHERE THE N-FORM FAILS

I have concentrated on the virtues of the N-form, as defined in Table 1 above, for effective knowledge management. However, the discussion of the relative merits of Japanese and Western models suggests that different organizational models are required for different types of innovation and knowledge processing generally. (It should be emphasized that the M/N distinction is *not* the same as the Japan/West one, although many of the attributes of the N-form are found in the product development organization of large, Japanese firms, but by no means only there.) Therefore, we should expect the M-form to hold

advantages over the N-form in some distinct areas. Table 2 summarizes some hypotheses (cf. also Nonaka, 1989).

Most points in Table 2 are self-explanatory. It is important to note that perhaps the most apparent strength of the M-form is not included. Since the discussion is focused on knowledge transfer and transformation, the possible (but not obvious) superiority of the M-form in more operational and unchanging matters is not recognized. A case could be made for the comparative effectiveness of M-form for exploitation, and of N-form for exploration (cf. March, 1991; Hedlund and Rolander, 1987, 1990).

The various trade-offs between M- and N-form show that the choice between them depends on the nature of the field in which the company operates and that the optimum probably is some mixture of the two. However, it seems that for most fields of international competition, the N-form has much to offer. Therefore, it is of interest to compare the N-form's structural archetype, emerging from the first six characteristics in Table 1, with some recent notions in the analysis of the modern multinational corporation.

Heterarchy vs. hierarchy

Williamson (1975: 149) argues that the M-form obviously is not the final word in governance

Table 2. Where the M-form is superior

N-form weaknesses	M-form strengths
Fundamental, radical innovation not achieved by (re)combination and experimentation only	Radical innovation through specialization, abstract articulation, and investment outside present competences
Long time to acquire fundamental new knowledge because of restrictions on senior recruitment and acquisitions	Rapid infusion and diffusion of drastically new perspectives through people, acquisitions, and spin-offs
Difficulty in coordinating very large projects because of reliance on small groups	Large systems design capability through complex articulation and tightly controlled complexity
'Competence traps' through too constrained development path	Risk management through 'competence portfolio'
Bias for internal exploitation of ideas	Freedom to use most effective mode, internal or external
Difficult to change overall vision because of internal management promotion	Change of basic direction and culture through external recruitment of top management
Strategic vulnerability through strong focus and inter-relationships	Strategic robustness through quasi-independent parts

form, but that future ones (at least of a nonmarket, internalized, 'corporate') will be essentially hierarchical. It is not possible to discuss this contention in depth here. Suffice it to note that the six characteristics discussed above connote significant departures from what is ordinarily meant by hierarchy. The dispersal of knowledge and strategic action initiative to 'lower levels;' shifting bases of leadership and composition of teams; importance of internal, lateral communication and integration through shared culture; and, change or roles at all levels of the corporation: these all suggest that the basic structure of the N-form corporation is not a hierarchy. Instead, more 'network-like' conceptions of the firm seem appropriate. In the recent discussions of the modern MNC, there is a broad convergence of views among analysts such as Bartlett and Ghoshal (1989), Doz and Prahalad (1987), White and Poynter (1990), and Hedlund (1986, 1993). They all emphasize: geographical dispersion of strategic assets and leadership roles; upgrading of the role of 'foreign subsidiaries;' horizontal communication across borders; utilization of knowledge from several organizational bases; the impotence of solely formal methods of coordination; new roles for management at headquarters as well as other levels. It is significant that the arguments for the 'transnational' (Bartlett and Ghoshal) as well as the 'heterarchy' (Hedlund) rely to a large extent on an assumption that a significant role of the MNC is one of knowledge creation and transfer.

At least since the pioneering experiments on the optimal configuration of problem solving groups (Leavitt, 1951), organization theorists have claimed that the characteristics of the task, in terms of its knowledge requirements and knowledge distribution, should influence the design of the organization. The broad consensus has been that more 'organic' solutions have to be adapted when uncertainty is high, the environment unstable, and internal differentiation far-reaching (Burns and Stalker, 1961; Lawrence and Lorsch, 1967).¹⁰ This undermining of the

idea of hierarchical and formal control has generally not been appreciated among economists. Arrow (1974) sees hierarchy as indeed the natural response to complex information processing. All the relevant knowledge is brought to a central decision point, thereby economizing on communication costs. The design of the hierarchy reflects an optimal break-down of knowledge and consequent specialization. Thus, the organization's structure and its strategy are mirror images of its information base.

What happens in today's leading companies, in fast-moving technological fields at least, is that the dispersal and rapid change of knowledge make such a match problematical. The challenge is not to divide a given task in a way ensuring maximally efficient performance. Rather, it is to position the company so that *new* tasks can be initiated, often on the basis of a combination of separate knowledge pieces from different organizational units. Instead of bringing the *information to the given decision point*, it becomes a matter of bringing the *decision to the knowledge bases*. Thereby, the center of initiative and action continuously shifts with consequent changes of roles at all 'levels' of the firm.

The characteristics of a corporation evolving according to a logic of knowledge management, rather than to a logic of exploitation of given resources or advantages, depart sufficiently from the common understanding of hierarchical structure in general and the multidivisional structure in particular to deserve new conceptions and names. I have suggested *heterarchy* as an ideal type in contradistinction to hierarchy (Hedlund, 1986, 1993). Some basic points are that *several strategic apexes* emerge, that these *shift over time*, and that there are *several ordering principles* at work. Knowledge is structured in one way, the formal organization—which will always have to be simpler and clearer than the processes of work it undertakes—in another, and action initiatives in yet a third. The unification of these three aspects in one clear structure underlies the conception of hierarchy and the M-form. In the N-form, they interweave in a dynamic process, where the requirements posed by the two types of interaction in our model are central. The interplay of tacit and articulated knowledge and the dialogue at and between individual and organizational levels suggest a partly new perspective on the sources of dynamic competitiveness and the heterogeneity of firms.

¹⁰ However, recent work on the management of innovation suggests that the free-floating structure is not the whole truth. Strict discipline and formalization seem to characterize some 'high-tech' firms. The important point here is that this still does not connote a hierarchy in the classical sense, since the *tight structures are typically temporary* and disbanded after completing one task.

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