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Prospering in Dynamically-competitive Environments: Organizational Capability as Knowledge Integration

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Abstract

Unstable market conditions caused by innovation and increasing intensity and diversity of competition have resulted in *organizational capabilities* rather than *served markets* becoming the primary basis upon which firms establish their long-term strategies. If the strategically most important resource of the firm is *knowledge*, and if knowledge resides in specialized form among individual organizational members, then the essence of organizational capability is the integration of individuals' specialized knowledge.

This paper develops a knowledge-based theory of organizational capability, and draws upon research into competitive dynamics, the resource-based view of the firm, organizational capabilities, and organizational learning. Central to the theory is analysis of the mechanisms through which knowledge is integrated within firms in order to create capability. The theory is used to explore firms' potential for establishing competitive advantage in dynamic market settings, including the role of firm networks under conditions of unstable linkages between knowledge inputs and product outputs. The analysis points to the difficulties in creating the "dynamic" and "flexible-response capabilities" which have been deemed critical to success in hypercompetitive markets.

(*Knowledge*; *Organizational Capability*; *Competitive Advantage*)

Introduction

The growing intensity and dynamism of competition across product markets has had profound implications for the evolution of strategic management thought during the 1980s and 1990s. Increasing turbulence of the external business environment has focused attention upon *resources* and *organizational capabilities* as the principal source of sustainable competitive advantage and the foundation for strategy formulation. As the markets for resources have become subject to the same dynamically-competitive conditions that have afflicted product markets, so *knowledge* has emerged as the most strategically-significant resource of the firm. This paper seeks to extend our understanding of the determinants of competitive advantage in dynamically-competitive market environments by analyzing the role of knowledge in organizational capability. Building upon four major theoretical streams: competition as a dynamic process, the resource-based view of the firm, organizational capabilities and competences, and organizational knowledge and learning, this paper establishes the rudiments of a knowledge-based theory of the firm. At the heart of this theory is the idea that the primary role of the firm, and the essence of organizational capability, is the *integration of knowledge*. The paper explores how knowledge is integrated to form organizational capability, and goes on to identify characteristics of capabilities which are associated with creating and sustaining competitive advantage in dynamically-competitive markets, including the achievement of *flexible integration* across multiple knowledge bases. Finally, I consider the relative merits of internal versus external knowledge integration and the benefits of firm networks in coping with hypercompetitive market conditions.

Background

The displacement of static theories of competition associated with neoclassical microeconomics and the "structure-conduct-performance" school of industrial economics by the more dynamic approaches associated with the Austrian school of economics, especially with Schumpeter's concept of competition as a process of "creative destruction" (Schumpeter 1934), has had profound implications for strategic management thought (Jacobsen 1992). During the early part of the 1980s, strategy analysis was focused upon the quest for monopoly rent through industry and segment selection and the manipulation of market structure to create market power (Porter 1980). However, if market structure is in a state of flux, and if monopoly rents quickly succumb to new sources of competition, approaches to

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strategy based upon choices of product markets and positioning within them are unlikely to yield profit advantages that are more than temporary. The impact of the resource-based view of the firm on strategic management thinking can be attributed to two factors. First, given the lack of evidence that monopoly power is an important source of profit (Rumelt 1991), Ricardian rents (returns to resources over and above their opportunity costs) appear to be the primary source of interfirm profitability differences. Second, if external markets are in a state of flux, then the internal resources and capabilities of a firm would appear to be a more stable basis for strategy formulation than the external customer focus that has traditionally associated with the marketing-orientation to strategy (Levitt 1960).

This emphasis on the "supply-side" rather than the "demand side" of strategy has been closely associated with recent work on organizational capabilities. Prahalad and Hamel (1990) argue that sustainable competitive advantage is dependent upon building and exploiting "core competences"—those capabilities which are fundamental to a firm's competitive advantage and which can be deployed across multiple product markets. Porter's recent work emphasizes the need for firms and countries to broaden and upgrade their internal advantages in order to sustain and extend competitive advantages (Porter 1991, 1992).

While extreme forms of dynamic competition (termed "hypercompetition" by D'Aveni 1994) are characteristic of product markets, dynamically competitive conditions also are present in the markets for resources. Indeed, competitive conditions in product markets are driven, in part, by the conditions of competition in the markets for resources (Barney 1986). Thus, the speed with which positions of competitive advantage in product markets are undermined depends upon the ability of challengers to acquire the resources needed to initiate a competitive offensive. Sustainability of competitive advantage therefore requires resources which are *idiosyncratic* (and therefore scarce), and not easily *transferable* or *replicable* (Grant 1991). These criteria point to knowledge (tacit knowledge in particular) as the most strategically-important resource which firms possess (Quinn 1992). Thus, this paper's focus upon knowledge and its integration is justified by two assumptions about the success in dynamically-competitive market environments:

First, under dynamic competition, superior profitability is likely to be associated with resource and capability-based advantages than with positioning advantages resulting from market and segment selection and competitive positions based upon some form of "generic strategy";

Second, such resource and capability-based advantages are likely to derive from superior access to and integration of specialized knowledge.

The literature on organizational knowledge and learning has explored the role of organizations in the acquisition, processing, storage, and application of knowledge (Argyris and Schon 1978, Levitt and March 1988, *Organization Science* 1991, Starbuck 1992). The primary emphasis of this literature is on the acquisition of information by organizations. Nonaka (1994) proposes a theory of knowledge creation built around dynamic interaction between two dimensions of knowledge transfer: transformations from tacit to explicit knowledge and vice-versa; and transfers between individual, group, organizational, and interorganizational levels. However, as Spender (1992) recognizes, firms are engaged not only in knowledge creation but also in knowledge application. The distinction between these two processes is crystallized in Demsetz's (1991) observation that efficiency in the acquisition of knowledge requires that individuals specialize in specific areas of knowledge, while the application of knowledge to produce goods and services requires the bringing together of many areas of specialized knowledge.

Much of the research into the management issues concerning the integration of different types of specialized knowledge has been within the context of new product development (Nonaka 1990, Clark and Fujimoto 1991, Wheelwright and Clark 1992). While some innovations are the result of the application of new knowledge, others result from reconfiguring existing knowledge to create "architectural innovations" (Henderson and Clark 1990, Henderson and Cockburn 1995). This ability of the firm to "generate new combinations of existing knowledge" and "to exploit its knowledge of the unexplored potential of the technology" is what Kogut and Zander (1992, p. 391) describe as "combinative capabilities".

The theory of organizational capability which follows represents an extension and synthesis of these contributions, based upon the idea that the essence of organizational capability is the integration of individuals' specialized knowledge.

The Model: Organizational Capability as Knowledge Integration

My model of organizational capability rests upon basic assumptions regarding the characteristics of knowledge

and its deployment. From these assumptions I develop propositions concerning the nature of organizational capability, the linkage of capability to organizational structure, and the determinants of competitive advantage.

Assumptions

The focus of this paper is upon a single resource: knowledge. This emphasis is justified by the assumptions that, first, knowledge accounts for the greater part of value added,[1] second, barriers to the transfer and replication of knowledge endow it with strategic importance. I define knowledge broadly to include both "explicit" knowledge which can be written down, and "tacit" knowledge which cannot. The emphasis is on tacit knowledge since, in the form of "know-how", skills, and "practical knowledge" of organizational members, tacit knowledge is closely associated with production tasks, and raises the more interesting and complex issues regarding its transfer both within and between organizations.

The key managerial issues arising from the characteristics of knowledge stem from the observation that tacit knowledge is acquired by and stored within individuals. Due to the cognitive limits of the human brain, knowledge is acquired in a highly specialized form: an increase in depth of knowledge implies reduction in breadth. Advances in knowledge tend to be associated with increased specialization. However, production—the creation of value through transforming input into output—requires a wide array of knowledge, usually through combining the specialized knowledge of a number of individuals.

Integrating Knowledge to Form Organizational Capability

These assumptions provide the basis for a knowledge-based view of the firm. If knowledge is a critical input into all production processes, if efficiency requires that it is created and stored by individuals in specialized form, and if production requires the application of many types of specialized knowledge, then the primary role of the firm is the integration of knowledge. But why are institutions called "firms" needed for the integration of knowledge? It is because the alternatives are too inefficient. An individual's ability to integrate knowledge is constrained by cognitive limits: it is not feasible for each individual to try to learn the knowledge possessed by other specialists. Integration across markets is difficult: in the case of explicit knowledge it is difficult to appropriate the value of the knowledge through market contracts; in the case of tacit knowledge, transfer is both difficult and necessitates transaction-specific investment. This view of the firm as an institution for knowledge integration establishes a view of the firm based upon close integration between organizational members implying stability, propinquity and social relationships, but it does not readily yield precision definition of the firm and its boundaries. For this reason, Demsetz (1991) refers to "firm-like organizations".

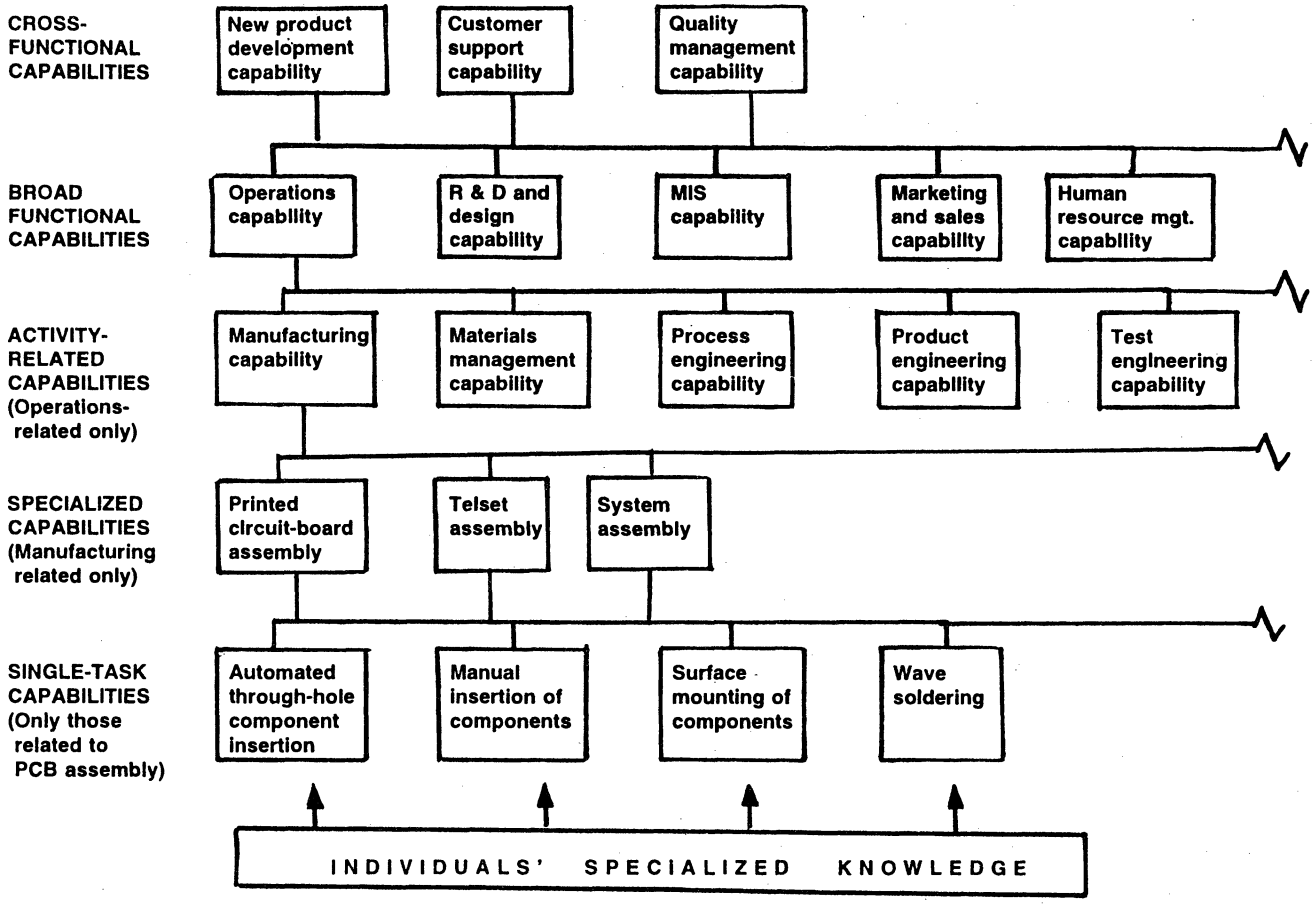
Integration of specialist knowledge to perform a discrete productive task is the essence of *organizational capability*, defined as a firm's ability to perform repeatedly a productive task which relates either directly or indirectly to a firm's capacity for creating value through effecting the transformation of inputs into outputs. Most organizational capabilities require integrating the specialist knowledge bases of a number of individuals. A hospital's capability in cardiovascular surgery is dependent upon integrating the specialist knowledge of surgeons, anaesthetist, radiologist, operating-room nurses, and several types of technicians. L.L. Bean's order processing capability, Rubbermaid's new product development capability and McDonald's Restaurants' capability in preparing and serving hamburgers are all examples of organizational capabilities requiring the integration of specialized knowledge across quite large numbers of employees.

The Architecture of Capabilities

The integration of knowledge into organizational capabilities may be viewed as a hierarchy. This hierarchy is not one of authority and control, as in the traditional concept of an administrative hierarchy, but is a hierarchy of integration. At the base of the hierarchy is the specialized knowledge held by individual organizational members. At the first level of integration are capabilities which deal with specialized tasks. Moving up the hierarchy of capabilities, the span of specialized knowledge being integrated broadens: task-specific capabilities are integrated into broader functional capabilities—marketing, manufacturing, R & D, and financial. At higher levels of integration are capabilities which require wide-ranging cross-functional integration —new product development involves especially wide-ranging integration (Clark and Fujimoto 1991). Figure 1 illustrates this concept of hierarchy of capabilities by providing a vertical segment of the hierarchically-arranged organizational capabilities of a manufacturer of private-branch telephone exchanges (PBXs).

The wider the span of knowledge being integrated, the more complex are the problems of creating and

Figure 1 Organizational Capabilities of a PBX Producer: A Partial Vertical Segment



managing organizational capability. The "quick response capability" which Richardson (1996) identifies among apparel suppliers Benetton, The Gap, and Giordano is an important competitive advantage primarily because it is difficult to achieve—it involves integrating across multiple vertical stages. The difficulties experienced by the Bell operating companies in transferring the new capabilities developed in their overseas businesses back to their domestic operations can be attributed to the fact that many of these new capabilities (e.g. wireless communication, fiber-optics, marketing within competitive markets, and managing joint ventures) require integration across broad-spans of knowledge and expertise (Smith 1996).

Although higher-level capabilities involve the integration of lower-level capabilities, such integration can only be achieved through integrating individual knowledge. This is precisely why higher level capabilities are so difficult to perform. New product development requires the integration of an extremely broad basis of knowledge, but communication constraints imply that the number of individuals who can be directly involved in the process is small.[2] Cross-functional product development teams are not so difficult to set up, the challenge (as confirmed by Imai et al. 1985 and Clark and Fujimoto 1991) is for the team to access the breadth and depth of functional knowledge pertinent to the product, and integrate that knowledge.

In most companies, hierarchies of capabilities do not correspond closely with their authority-based hierarchies as depicted by organization charts. In particular, some top management capabilities such as capital budgeting, strategic planning, and government lobbying may involve a limited scope of knowledge integration, and hence are closer to the base than to the apex of the capability structure. At the same time, if knowledge is to be integrated effectively by the firm, the architecture of capabilities must have some correspondence with the firm's structure of authority, communication, and decision making, whether formal or informal. For example, Clark and Fujimoto find that, within automobiles, superior capabilities in new product development

require product managers with substantial influence and decision making authority—what they term "heavyweight product managers". The need for organizational capabilities to be supported by firm structure poses difficulties for the creation of new capabilities. In the case of the Bell telephone companies, new capabilities were created outside the formal structure through "garbage can" processes (Smith 1996).

Mechanisms for Integrating Knowledge

How is knowledge integrated by firms to create organizational capability? Explicit knowledge involves few problems of integration because of its inherent communicability. Advances in information technology have greatly facilitated the integration of explicit knowledge through increasing the ease with which explicit knowledge can be codified, communicated, assimilated, stored, and retrieved (Rockart and Short 1989). However, the most interesting and complex issues concern the integration of tacit knowledge. The literature points to two primary integration mechanisms:

(*i*) *Direction.* Demsetz (1991, p. 172) identifies direction as the principal means by which knowledge can be communicated at low cost between "specialists and the large number of other persons who either are nonspecialists or who are specialists in other fields." To optimize the operation of a McDonald's restaurant, it is more efficient for McDonald's to create an operating manual which covers almost every aspect of the restaurant's management than to educate every McDonald's manager in cooking, nutrition, hygiene, engineering, marketing, production management, human resource management, psychology, accounting and finance, and the other specialist areas of knowledge embodied in standard operating rules.

The more complex an activity, the greater the number of locations in which that activity must be replicated, and the more stringent the performance specifications for the outcome of that activity, the greater is the reliance on knowledge integration through direction. British Airways operates aircraft maintenance facilities in 67 locations distributed across the globe. Service and repair at these facilities is guided by a host of highly formalized procedures and directives based upon the standards established by the major regulatory authorities (the Federal Aviation Authority, the British Civil Aeronautics Board, and others), guidance and technical information provided by aircraft manufacturers, and the company's own policies and procedures. These directives, policies, and procedures embody the technical knowledge of a large number of specialists.

(*ii*) *Organizational Routines.* Direction involves codifying tacit knowledge into explicit rules and instructions. But since a characteristic of tacit knowledge is that "we can know more than we can tell" (Polanyi 1966), converting tacit knowledge into explicit knowledge in the form of rules, directives, formulae, expert systems, and the like inevitably involves substantial knowledge loss.

An organizational routine provides a mechanism for coordination which is not dependent upon the need for communication of knowledge in explicit form. March and Simon (1958, p. 142) "regard a set of activities as routinized to the extent that choice has been simplified by the development of a fixed response to a defined stimuli." Such patterns of stimulus and response may lead to highly complex and variable patterns of seemingly-automatic behavior. Within our knowledge-based view, the essence of an organizational routine is that individuals develop sequential patterns of interaction which permit the integration of their specialized knowledge without the need for communicating that knowledge.

Observation of any work team, whether it is a surgical team in a hospital operating room or a team of mechanics at a grand prix motor race, reveals closely-coordinated working arrangements where each team member applies his or her specialist knowledge, but where the patterns of interaction appear automatic. This coordination relies heavily upon informal procedures in the form of commonly-understood roles and interactions established through training and constant repetition, supported by a series of explicit and implicit signals (see Pentland and Rueter 1994, for a careful analysis). The advantage of routine over direction is in economizing on communication and a greater capacity to vary responses to a broad range of circumstances.

Competitive Advantage in Dynamically-competitive Environments

Creating and Sustaining Advantage

Under conditions of dynamic competition, the potential of organizational capabilities to earn rents for the firm through establishing sustainable competitive advantage depends upon their capacity for both creating and sustaining advantage. Competitive advantage is determined by a combination of supply-side and demand-side factors. On the demand side, a firm's productive activities must correspond to a market need. On the supply side, the firm must have the capabilities

not only to serve that market need, but to serve it more effectively or efficiently than other firms. For simplicity's sake, let us abstract from demand-side considerations and focus exclusively upon the supply side: the ability to create unique advantages and to protect these advantages against imitation.

The first observation is that the critical source of competitive advantage is knowledge integration rather than knowledge itself. Specialized knowledge cannot, on its own, provide a basis for sustainable advantage, first, because specialized knowledge resides in individuals, and individuals are transferable between firms; second, because the rents generated by specialized knowledge are more likely to be appropriated by individuals than by the firm. Of course, some knowledge (patents, copyrights, trade secrets) is proprietary to the firm, and is appropriable. However, empirical evidence suggests that the value of proprietary knowledge depreciates quickly through obsolescence and imitation (Levin et al. 1987). Hence, even in technology-intensive industries, the key to sustainable advantage is not proprietary knowledge itself, but the technological capabilities which permit the generation of new knowledge.

If knowledge integration is the basis for competitive advantage under dynamic market conditions, what are the characteristics of knowledge integration associated with the creation and sustenance of such an advantage? I identify three characteristics of knowledge integration pertinent to the competitive advantage and the rents associated with such advantage:

(i) The *efficiency of integration*—the extent to which the capability accesses and utilizes the specialist knowledge held by individual organizational members;

(ii) by the *scope of integration*—the breadth of specialized knowledge the organizational capability draws upon;

(iii) the *flexibility of integration*—the extent to which a capability can access additional knowledge and reconfigure existing knowledge.

My goal is to explore the performance requirements of systems of knowledge integration conducive to attaining competitive advantage. Given the uniqueness of each firm's stock of specialized knowledge and the idiosyncracy of each firm's institutional heritage, it is impossible to specify the organizational arrangements conducive to the formation of organizational capability through knowledge integration. Critical to the analysis of this paper is an equifinality view (Van de Ven and Drazin 1985) that, recognizing uniqueness of knowledge bases and institutional conditions, firms can achieve equally effective, yet highly differentiated approaches to knowledge integration. The key contribution of our analysis is in recognizing the common requirements of these different approaches.

The Efficiency of Integration

Competitive advantage depends upon how productive firms are in utilizing the knowledge stored within individual organizational members, which is dependent upon the ability of the firm to access and harness the specialized knowledge of its members. Three factors are important in determining the efficiency with which a firm integrates the specialized knowledge available within it:

(a) *The Level of Common Knowledge.* Both direction and routine require communication between individuals. Demsetz (1991) identifies the prerequisite for communication between different specialists as the presence of *common knowledge* between them. If specialized knowledge must be reduced to common knowledge in order to communicate it, there is inevitably substantial information loss. The size of this loss depends upon the level and sophistication of common knowledge. A basic prerequisite is a common language. Direction is almost entirely ability upon detailed articulation of instructions. Routines typically rely upon a much more limited set of cues and responses which serve not so much as to communicate knowledge, but to permit a sequencing of individual's application of knowledge inputs. For both integration mechanisms, efficiency of communication depends upon commonality of vocabulary, conceptual knowledge, and experience between individual specialists. Shared behavioral norms form a central part of the common knowledge which facilitates communication and understanding (Garfinkel 1967, Zucker 1987). Generally speaking, the wider the scope of knowledge being integrated (and, hence, the greater the diversity of the individuals involved), the lower is the level of common knowledge, and the more inefficient the communication and integration of knowledge. Thus, the effectiveness of social networks among biotechnologists as mechanisms for communicating and integrating knowledge reflected their high level of common knowledge arising from their comparatively narrow spread of knowledge and commonality of behavioral norms (Liebeskind et al. 1996). Organizational culture may be regarded as a form of common knowledge, one of the functions of which is to facilitate knowledge integration within the company.

(b) *Frequency and Variability of Task Performance.* The efficiency with which organizational routines

integrate the specialized knowledge of team members depends upon the sophistication of the system of signalling and responsiveness which develops between team members as a result of repetition and improvement. The efficiency of an organizational routine derives from the fact that:

> While each organization member must know his job, there is no need for anyone to know anyone else's job. Neither is there a need for anyone to be able to articulate or conceptualize the procedures employed by the organization as a whole (Nelson and Winter 1982, p. 105).

The critical requirement is the "ability to receive and interpret a stream of incoming messages from other members and from the environment" (ibid, p. 100). Integrative efficiency depends upon the effectiveness of this communication in eliciting appropriate responses from each organization member. This is a function of the frequency with which the particular pattern of coordinated activity is performed. The greater the variation in the routine which is required in response to variation in environmental circumstances, the lower is integrating efficiency likely to be. The ineffectiveness of the response by the National Guard to the Los Angeles riots of 1992 and the Russian Army to the Chechnya rebellion of 1994/95 reflects, in part, the infrequence with which these organizations were required to suppress insurrection.

(c) *Structure*. Efficiency of knowledge integration requires economizing upon the amount of communication needed to effect integration. Organization structures need to be designed with a view to organizing activities such as to reduce the extent and intensity of communication needed to achieve knowledge integration. Bureaucracy is a structure which (under certain circumstances) maximizes the efficiency of knowledge integration in an organization where direction is the predominant integrating mechanism. A key feature of organizational innovations such as Henry Ford's moving assembly line, the kanban system for just-in-time scheduling, multidivisional structure (or "M-form") is their promotion of efficiency through achieving higher levels of coordination with lower levels of communication.

The principle of *modularity* is fundamental to the structuring of organizations to achieve communication efficiencies. Simon's observation that:

> ...division of labor means factoring the total system of decisions that need to be made into relatively independent subsystems, each one of which can be designed with only minimal concern for its interactions with the others (Simon 1973, p. 270),

and Williamson's "principle of hierarchical decomposition" (Williamson 1981, p. 1550), may be viewed as organizational conditions for optimizing the efficiency of knowledge integration.

Modularity is especially important in organizing highly complex capabilities which involve broad-scope knowledge integration. Clark and Fujimoto (1991) show how the hugely complex task of developing a new model of automobile is facilitated by means of organizing the task:

- into sequential phases (concept development, vehicle design and layout, component design, prototype building, process engineering);
- by function (marketing, product engineering, test engineering, process engineering);
- by product segment (body, chassis, engine, transmission, electrics and electronics).

The problem of many conventional approaches to modularity is that they rest heavily upon time-sequencing. Under conditions of hypercompetition such sequencing is simply too time consuming. The organizational challenge is creating modularity which permits either overlapping phases or full simultaneity.

The Scope of Integration

Increases in the span of knowledge which are integrated within an organizational capability increases the potential for both establishing and sustaining competitive advantages through two sources:

(i) Different types of specialized knowledge are *complements* rather than *substitutes* in production. Up to the point of diminishing relevance, the marginal revenue product of a unit of specialist knowledge increases with the addition of different types of knowledge.

(ii) The greater the scope of knowledge being integrated within a capability, the greater the difficulty faced by competitors in replicating that capability due to increases in "*causal ambiguity*" (Lippman and Rumelt 1982) and time-based diseconomies of replication (Dierickx and Cool 1989). The complexities associated with broad-scope integration are further increased when different types of knowledge require different patterns of integration. Toyota's lean production system combines cost efficiency, quality, flexibility, and innovation. These different performance dimensions involve different types of integration. While cost effi-

ciency may be best served through organization around "sequential interdependence", flexibility is likely to require more complex patterns of "reciprocal interdependence" (Thompson 1967, p. 40). Similar complexities of integration are likely among suppliers of fashion apparel which combine low costs with fashion-based differentiation and quick response capability (Richardson 1996).

The Flexibility of Integration

While integration across a wide scope of specialist knowledge is important in sustaining competitive advantage, hypercompetitive conditions ultimately result in all positions of competitive advantage being eroded by imitative or innovative competition. Hence, maintaining superior performance ultimately requires the continual renewal of competitive advantages through innovation and the development of new capabilities. Within the context of our model, there are two dimensions to such renewal: extending existing capabilities to encompass additional types of knowledge, and reconfiguring existing knowledge into new types of capability.

The ease with which existing capabilities can be extended to encompass new knowledge depends heavily upon the characteristics of knowledge with regard to communicability. If new knowledge is explicit, or if tacit knowledge can be articulated in explicit form, then integrating new knowledge does not pose major difficulties. In designing its 777 passenger plane, Boeing was able to greatly extend its knowledge of electronics and new materials through an advanced CAD system which provided a common language for specialists across widely different knowledge areas and different companies to communicate and integrate. By contrast, General Motors' upgrading of its manufacturing capability to encompass the knowledge embodied in Toyota's system of lean production was a slow and painful process because much of that knowledge was tacit and the routines for its integration were deeply embedded with Toyota's history and culture.

The reconfiguration of existing knowledge through new patterns of integration is more complex, but may be even more important in creating competitive advantage. Such knowledge reconfiguration is central to Abernathy and Clark's (1985) concept of "*architectural innovation*". Subsequent research by Henderson and Clark (1990) and Henderson and Cockburn (1995) identifies the critical role of "*architectural knowledge*" —the "integration of knowledge across disciplinary and organizational boundaries within the firm" (Henderson 1995, p. 3)—in driving such innovation. Her studies of pharmaceuticals and the semiconductor photolithographic alignment equipment industry provide strong support for the role of broad-scope knowledge integration in supporting superior performance.

Such architectural innovations are concerned not only with product and process innovations, but also with *strategic innovations* which reconfigure knowledge into new approaches to competing. Such "new-game strategies" (Buaron 1981) are not specific to technology-based industries. Baden-Fuller and Stopford (1994, Chapter 3) show that strategic innovation is fundamental to creating competitive advantage in mature business environments. In fashion clothing for example, Benetton and The Limited have created "quick-response capability" through innovative approaches to value-chain reconfiguration (Richardson 1996).

Most examples of firms' reconfiguring knowledge into architectural innovations (EMI's CT scanner, the Polaroid instant camera, the Apple Macintosh, Pilkington's float glass process, Lanier's "virtual reality") and strategic innovations (Nucor in steel, Benetton in apparel, Starbuck's in coffee houses) point to these innovations as isolated successes rather than evidence of flexible capabilities which have the capacity to continuously and repeatedly reconfigure knowledge in new patterns of interaction. Given the difficulties inherent in integrating tacit knowledge and dependence of such integration upon routines and communication patterns developed over time, establishing organizational arrangements needed to achieve the "flexible integration" proposed by Henderson (1995) and "meta-flexibility" proposed by Volberda (1996) represents a formidable challenge to management. Continuous innovation in dynamically-competitive environments (e.g., Rubbermaid in plastic housewares, 3M in adhesive and thin-film products, Sony in consumer electronics, Motorola in communication products) tends to be the result of the deployment and extension of a continuing core of capabilities rather than the constant creation of new capabilities. Achieving flexible integration, either through continually integrating new tacit knowledge or through constantly reconfiguring existing knowledge, is likely to impose substantial costs in terms of reducing the efficiency of knowledge integration. The implication is that radical, discontinuous change in industry environments (such as the micro revolution in computing and the possible displacement of internal combustion engines by electric motors in autos) is likely to be accompanied by the decline of established market leaders. The noteworthy feature of IBM's performance during the 1980s and 1990s is not

so much its decline during the 1990s, but its remarkable success in microcomputers during the 1980s.

Internal Versus External Integration: The Case for Networks

The need for flexibility in organizational capabilities poses complex issues with regard to firm boundaries and choices between internal and external knowledge integration. In common with other types of transactions, there are three basic alternatives for knowledge transfer and integration: internalization within the firm, market contracts, and relational contacts (which in multiple form create firm networks). Given uncertainties over appropriability and valuation, market contracts are typically inefficient means for transferring knowledge. In Demsetz's (1991) analysis, market transactions are only efficient in transferring knowledge when that knowledge is embodied within a product. Such transfer of product-embodied knowledge across markets is efficient when the effective utilization of the product by buyers is not dependent upon the buyers needing access to the knowledge embodied within the product. Thus, within the context of fashion apparel (Richardson 1996), Benetton does not need to integrate knowledge of the application of computer science to computer-aided design into its design capability, if it can purchase CAD software adequate to its needs. On the other hand, expertise in fashion design is tacit, and it cannot be embodied into expert-system software. Thus, Benetton cannot purchase fashion design knowledge packaged into software, neither can Benetton rely upon purchasing individual fashion designs from independent designers because of the need for garment design to integrate multiple knowledge bases: fashion design flair, Benetton's own market knowledge, and manufacturing expertise. The implication is that Benetton is likely to require internalization of at least some of fashion design capability. Similarly, in the case of the regional Bell companies' expansion into wireless communication. If knowledge concerning wireless switching and siting of cellular bases is not capable of embodiment within marketable products and services, then these companies will, ultimately, be required to extend their capabilities to embody such knowledge (Smith 1996).

Relational contracts, either in individual strategic alliances or broader interfirm networks, are an intermediate solution justified by a number of intermediate situations. For example, explicit knowledge which is not embodied in specific products cannot be efficiently transferred through market contracts, but diffusion of its sources or uncertainty over its applicability to the firm's products may not justify the internalization of its producers within the firm. Networks, either of firms or of individuals, may be well-suited to the transfer and integration of such knowledge. Thus, in biotechnology, social networks of scientists provide a powerful vehicle for the transfer of scientific knowledge since such networks provide the reputational assets and the repeated-game characteristics necessary to avoid the inefficiencies associated with market exchanges (Liebeskind et al. 1996).

Interfirm collaboration through relational contracts is also likely to provide efficient mechanisms for knowledge integration where there is a lack of perfect correspondence between the knowledge base of the firm and its set of products. The scope of a firm may be defined in terms of its range of knowledge or its range of products. Where the boundaries of both knowledge and products correspond perfectly, not only are firm boundaries unambiguous, but knowledge resources are fully utilized. Where a perfect correspondence does not exist, or where uncertainty exists over the linkages between knowledge and products, then two consequences follow:

(a) ambiguity is created over the optimal boundaries of the firm;

(b) internal provision of the full range of specialized knowledge needed for a particular set of products must result in the inefficient exploitation of at least some of that specialist knowledge.

In such circumstances, interfirm collaboration can increase the efficiency with which specialized knowledge is utilized. A consequence of hypercompetition is uncertainty over links between knowledge inputs and product outputs. In biotechnology, new knowledge may have applications in "human health, crop production and protection, chemical feedstock production and processing, food processing, and waste management" (Liebeskind et al. 1996). As a result, "these sources of technological and competitive uncertainty make it extremely difficult to determine which scientific knowledge is potentially valuable and which is not" (ibid). While my analysis points to the superiority of intrafirm relationships in integrating knowledge, the importance of networks in sourcing biotechnological knowledge suggests that the inefficiencies of interorganizational relationships are outweighed by the flexibility advantages associated with a wider set of knowledge-product linkages.

A final consideration concerns the speed with which new capabilities can be built and extended. Even if relational contracts are imperfect vehicles for integrat-

ing knowledge, a critical concern is that they can permit knowledge to be transferred and integrated with a comparatively short time. If competitive advantage in dynamic market settings is critical dependent upon establishing first-mover advantage then the critical merit of firm networks is in providing speed of access to new knowledge. Such considerations proved to be critically important both in biotechnology (Liebeskind et al. 1996, and in telecommunications (Smith 1996). In fashion apparel where the need to access new knowledge was less apparent, firm networks did not provide any clear advantage over vertical integration (Richardson 1996).

Similar considerations explain the establishment of the Nordvest Forum regional learning network (Hanssen-Bauer and Snow 1996). Although such interorganizational contacts have limited potential for integrating knowledge across companies, such a network permits fuller utilization of knowledge by permitting firms to share knowledge that has application outside of each firm's product set. Second, it encourages investments in knowledge acquisition in the face of uncertainty over knowledge-product linkages.

Summary and Conclusion

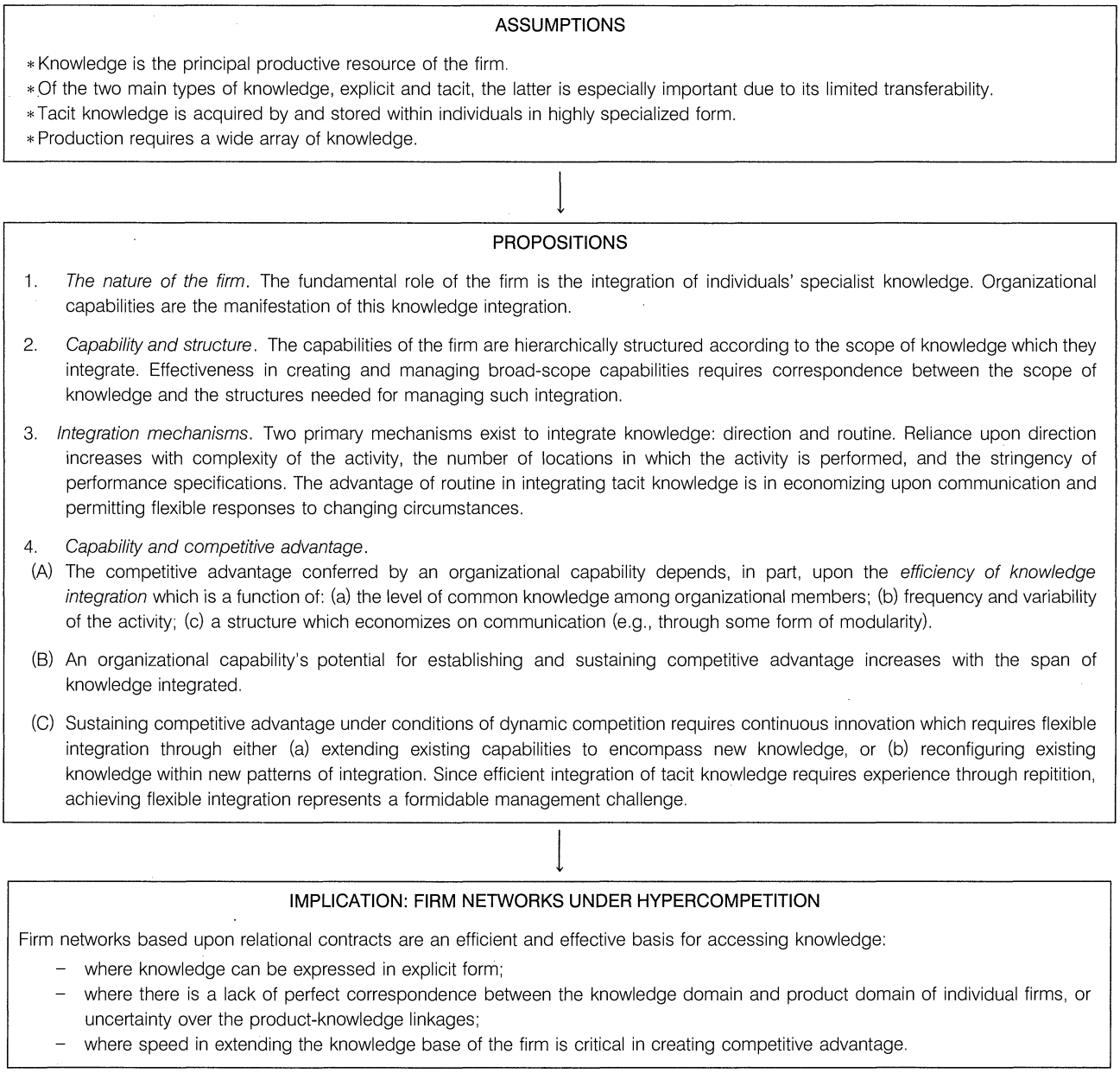
I have established that knowledge is the preeminent resource of the firm, and that organizational capability involves the integration of multiple knowledge bases. The resulting theory of organizational capability provides a more cogent description of firm competence and analyzes more precisely than hitherto the relationship of organizational capability to competitive advantage in markets where market leadership and power is continually undermined by competition and external change. I show that the processes through which firms integrate specialized knowledge are fundamental to their ability to create and sustain competitive advantage. Figure 2 summarizes this theory of organizational capability and its implications for competitive advantage in hypercompetitive environments.

While making some progress in integrating prior research on organizational learning and organizational resources and capabilities, much remains to be done at both the empirical and the theoretical level, especially in relation to understanding the organizational processes through which knowledge is integrated. For example, while organizational routines are generally recognized as important mechanisms for coordination within firms, with a few notable exceptions (e.g. Pentland 1992, Pentland and Rueter 1994), detailed study of the operation of organizational routines is limited. Further progress is critically dependent upon closer observation of the processes through which tacit knowledge is transferred and integrated.

Despite its limited achievements so far, this analysis offers considerable potential—especially in building bridges between strategic management and organization theory and design. Conventional notions of organizational structure rest heavily upon concepts such as division of labor, unity of command, and grouping of similar tasks. The view of the firm as an integrator of knowledge provides a rather different perspective on the functions of organization structure. The analysis can also offer insight into many current developments in management practice. Cross-functional product development teams, TQM, and organizational change programs such as GE's "workout" can be viewed as attempts to change organizational structure and processes to achieve better integration across broad spectra of specialized knowledge. The trend towards "empowerment" takes account of the nature of knowledge acquisition and storage in firms:—if each employee possesses unique specialized knowledge and if each employee has access to only part of every other employee's knowledge base—then top-down decision making must be a highly inefficient means of knowledge integration. The task is to devise decision processes that permit integration of the specialized knowledge held throughout the organization—not just in the boardroom, but on the shop floor as well.

The paper offers little solace to managers grappling with the uncertainties and demands of hypercompetitive environments. While establishing that, under conditions of intense and dynamic competition, internal capabilities provide a more stable basis for strategy than market positioning, my analysis points to the difficulties inherent in achieving the dynamic capabilities which for many are the "solution" to the problem of sustaining competitive advantage under conditions of hypercompetition. Volberda (1996) identifies these dynamic capabilities with "the repertoire of flexibility-increasing capabilities that management possesses." But, if such capabilities depend upon integration across a broad span of largely-tacit knowledge, then a firm's strategic flexibility is limited by two factors: first, its repertoire of capabilities is unlikely to extend far beyond those currently deployed within existing business activities; second, the time horizon and uncertainty associated with creating new capabilities. The "flexible integration" and network relationships I propose as responses to this problem identify what is required, but offer little guidance as to the management actions needed to achieve flexibility in knowledge integration.

Figure 2 Summary: The Knowledge-based Theory of Organizational Capability



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Endnotes

[1]The part of national income attributable to knowledge may be calculated as wages and salaries over and above that which would be earned by unskilled manual labor, plus royalties and license fees. To this a major part of profit can be added, since profit is a return to the resources owned by the firm, a major part of which comprise or embody the knowledge of people. International differences in living standards and productivity are mainly due to differences in human capital. Denison's research into international differences in growth rates found that, in the case of Britain, advances in knowledge accounted for 46 percent increases in real national income per person employed between 1950 and 1960 (Denison 1968).

[2]A key distinction between an administrative hierarchy and the hierarchy of capabilities is that, in the administrative hierarchy, the span of control can remain constant throughout the hierarchy. In the

hierarchy of capabilities, the fact that each layer of capabilities cannot directly integrate the preceding layer of capabilities and must return to the base in terms of integrating individual's knowledge, means that the span of integration increases as one ascends the hierarchy.

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