

**Knowledge-Based Theories of the Firm in Strategic Management:
A Review and Extension***

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Knowledge has received increased attention as the basis to explain differences in firm performance. Yet, the knowledge-based view of the firm in strategic management is still a contested and unmapped terrain with no unified clear-cut theories. This paper critiques existing contributions to knowledge-based views and highlights tensions in the field. We introduce an integrated knowledge-based view of the firm that encompasses and extends previous contributions and acts as a foundation for a future research agenda.

The overall purpose of strategic management theory and research is to explain how and why there are differences in firms' performance. Strategy scholars, thus, have a collective interest in understanding the fundamental nature of the firm, and not surprisingly, theorizing about the firm's origin, structure, boundaries, and performance has assumed an increasingly important role in our field (e.g., Barney, 1999; Poppo & Zenger, 1998; Rumelt, Schendel, & Teece, 1991; Rumelt, 1997). The increasing sensitivity to theory is a natural step in the evolution of strategic management scholarship, from relying on case-by-case, inductively driven inquiry to a more coherent body of both theoretical understanding and empirical insights (Rumelt, et al, 1991). Recently, the field has produced significant unconventional theorizing and research breaking with one of the fundamental assumptions of orthodox economics, that the firm can be best be understood as a simple production functionⁱ. Contributions have gone in various directions. Some examples include a behavioral theory of the firm emphasizing information processing, organization structure and resource allocation processes (Cyert & March, 1963; Cyert & Williams, 1993), an attention-based view of the firm by which decision makers' focus on issues and decisions matter for performance outcomes (Ocasio, 1997), a transaction-cost based view of the firm with direct implications for strategy (Williamson, 1999), a resource-based view of the firm where performance differences are explained by the characteristics of firm assets and competencies (Wernerfelt, 1984; Barney, 1991), and lately, a knowledge-based view of the firm (KBV) (Kogut & Zander, 1992; Nonaka, 1994; Spender & Grant, 1996; von Krogh, Roos, & Slocum, 1994).

Of all these developments, the knowledge-based view of the firm has some features that are particularly appealing. First, it draws on and/or encompasses many of the insights developed in the behaviorally oriented firm theories, like the interplay between action, cognition, and a

shared identity of organizational members (Kogut & Zander, 1996), as well as the resource-based view on the nature of competence and assets that enable sustainable competitive advantage (Barney, 1996; see also Mahoney, 1995; Christensen, 1995). In a mature form, it could also offer a complementary view to the transaction-cost economics explanation of firm boundaries (Poppo & Zenger, 1998). Second, it adds knowledge at the group and the firm levels of analysis to what had been a construct only at the individual level of analysis. By so doing, it puts particular emphasis on the interactions among individuals and groups for knowledge sharing and creation (like the development of routines), and ultimately the implications of such interactions for competitive advantage (Grant, 1996; see also Szulanski, 1996). Third, it reflects an emergent understanding among managers and academics, that the new economy gives rise to firms that have knowledge as their most precious asset, and that these firms may behave very differently from their old-economy cousins that base their business on a balanced portfolio of material and immaterial assets. The knowledge-based view of the firm provides novel analytical tools and approaches for understanding such new economy firms (Teece, 1996; see also Evans and Wurster, 1999). Fourth, a knowledge-based view of the firm connects well to a parallel stream of knowledge management in practice. Over the last 5-7 years, managers have become increasingly aware of the importance of managing the information resources and the knowledge of their employees, and various techniques and instruments have been developed to this end (Tiwana, 1999). A knowledge-based theory of the firm might explain this movement, as well as the possible implications of knowledge management for firm performance (Burton-Jones, 1999).

Yet, the knowledge-based theory of the firm in strategic management is still a contested and unmapped terrain. In fact, as of this writing, no unified, clear-cut theory existsⁱⁱ. There are many partial contributions each building on its own set of assumptions be it methodological

individualism or social-psychological identity theory: the concepts and their relationships vary considerably, and no unified predictions can be made. We believe it is time to take stock of the knowledge-based views in strategic management, in order to provide a foundation for its further development into a coherent theory. In this paper, we shall *first* track the history of the debate on knowledge and the firm, and proceed to review the current contributions to the knowledge-based theories of the firm in strategic management, compare and contrast these, and highlight emerging tensions in the field. We have chosen our source literature by four criteria. Generativity: the contributions have demonstrated an ability to generate further theory building (e.g., Kogut & Zander, 1992) or debate about the nature of the firm (e.g., Tsoukas, 1996), evidenced by citations. Parsimony: the contributions selected have made “knowledge” the central construct to the theorizing about the firm (e.g., Grant, 1996). Multi-disciplinary: recognizing that strategic management is inherently multi-disciplinary (Rumelt et al, 1991), the review and extension includes contributions that shared the assumptions of either or both sociology (social psychology) and economics (e.g., Grant & Baden-Fuller, 2000; Spender, 1996). Sensitivity to basic construct: part of the progress in the knowledge-based theory of the firm can be attributed to a cluster of contributions studying the fundamental nature of knowledge in organizations (e.g., Nonaka, 1994; von Krogh et al, 1994).

Second, we shall provide an integrated model or knowledge-based view of the firm that encompasses and extends previous contributions, and that will be used to formulate a research agenda. *Third*, we shall discuss the implications of this model for further empirical research and theory development. The paper contributes to the strategic management field first and foremost by showing emerging tensions, and by reconciling these in an integrated model. Academics should be interested in this effort as an attempt to map, compare and contrast existing

contributions. Moreover, the paper contributes to making the knowledge-based theory of the firm an accepted branch of the strategic management field by showing the strong progress achieved over a short time span. Practitioners, on the other hand, will obtain an overview of the theory building attempts so far, and normative implications for building a “knowledge-advantage” based on the integrated model.

KNOWLEDGE-BASED VIEW AS A THEORY OF THE FIRM

In this section, we review the antecedents of the current knowledge-based views of the firm, identify the criteria for a theory of the firm and examine current literature to determine to what extent these criteria have been met.

Antecedents and requisites of a KBV

Knowledge-based views have often positioned themselves as complements or reactions to the transaction cost economics of Coase (1937), which in grosso modo explain the existence of firms in terms of optimizing the costs of transactions, though each major theorist has a slightly different spin on the specific nature of the mechanism. Coase (1937) suggested that firms exist because they are more effective than markets in using price mechanisms to discover relevant information and to negotiate contracts. Furthermore, he argued that firms have lower costs because some authority (the entrepreneur) can more efficiently direct resources and control the terms of trade. Alchian and Demsetz (1972) disagreed with Coase’s conception of the entrepreneur and inherent authority relationships, and instead suggested that firms exist because they provide monitoring facilities, which prevent “shirking” or the non fulfillment of contractual conditions. Williamson (1975) explained that firms are more effective than markets because they control opportunism associated with the specificity of assets, and have lower costs that result from “haggling” associated with the negotiation of contracts. Despite significant inroads

in the area of why firms exist, scholars from a more knowledge-based view have critiqued traditional transaction cost economics for its weakness in explaining heterogeneous firm performance (Liebeskind 1996) and how knowledge is treated (Holmstrom & Roberts, 1998). Contemporary KBV scholars such as Liebeskind (1996) and Grant (1996) have used transaction cost economics in order to explain a firm's knowledge activities. We suggest that the KBV can be viewed as both a complement and a response to these two weaknesses of transaction cost economics.

KBV theorists have also drawn directly from the resource-based theory of the firm, which argues that firms exist because they have unique, often historically dependent, abilities to accumulate specific resources that lead to differential levels of firm performance (e.g., Reed & DeFillippi, 1990). Penrose (1959), the starting point for resource-based view, conceptualized the firm as an entity endowed with a broad set of resources which are rendered into resource-based services that lead to a strategic advantage. Wernerfelt (1984) built upon Penrose's work by introducing resource specificity and context, suggesting that strategic action requires a specific set of physical, financial, human or organizational resources, and thus a firm's competitive advantage is determined by its ability to obtain and defend resources. While Wernerfelt did consider knowledge as a resource required to obtain and transform other resources, Barney (1991) included knowledge as a separate resource on equal footing with other resources. He argued that for firms to gain a competitive advantage they require the capability to transform resources. Capabilities and resources have three distinct features which make them difficult to imitate, according to Barney: they are historically determined, socially embedded in the organization, and tacit (Barney, 1991). Foss and Eriksen (1995) suggest that two features distinguish resources from capabilities: tradeability and the extent they are tied to individual

agents. Resources are always tradeable and often tied to the individual. While capabilities are not tradeable and do not necessarily belong to sole individuals. Although the resource-based view recognizes the importance and role of knowledge in firms achieving a competitive advantage, knowledge-based theorists argue that the RBV does not go far enough. Specifically, the RBV treats knowledge as a generic resource, rather than having special properties, and subsequently, does not make any distinction between different types of knowledge-based capabilities. In addition, the RBV does not precisely specify the distinctions between resources and capabilities, whether they are inherently internal to the firm or can be outsourced, and if resources by themselves enable capabilities or capabilities create resources.

The second stream of literature drawn upon by many KBV theorists is organizational theory. This stream offers insights into different types of behavior, inherent limitations of individuals, and the development of firms knowledge-based activities and routines. The point of departure for much of the organizational theory literature and its contribution to the KBV is the assumption that individuals are limited by their bounded rationality (March & Simon, 1958). Williamson (1975) further developed and articulated March and Simon's concept of bounded rationality by arguing that individuals are restricted (bounded rationally) on two dimensions: (1) neurophysiological limits and (2) language limits. The first dimension of bounded rationality, neurophysiological limits, describes individuals as limited to the amount of information that they can receive, store, retrieve, and process without committing errors. Secondly, individuals have language limits due to their inability to articulate all of their knowledge or feelings, and this results in the formation of tacit knowledge (Conner & Prahalad, 1996). This distinction between tacit and explicit knowledge is the reason often cited for distinguishing knowledge from other resources (see for example, Kogut & Zander 1992, 1996). As a consequence of these two

limitations, not all of the firm's knowledge can be found in any one person's head and, therefore, it is distributed across its members. Moreover, as Cyert and March (1963) argued in their seminal work, firms develop routines that act as repositories for knowledge and in this sense the firm becomes knowledgeable. Although organizational theory provides several contributions to the development of a KBV, the issue of the relationship between knowledge and firm performance is largely unaccounted for by this stream.

Using, therefore, transaction cost economics as a springboard, the knowledge-based view of the firm draws on two additional largely independent streams of research: resource-based theory and organization theory. Each stream of literature contributed to the KBV in terms of the role and conception of knowledge in firms. To determine the extent the KBV contributions actually form a theory of the firm, we argue that they must meet five tests. Firstly, any theory of the firm, not just a KBV, has to explain the existence of firms. This was pointed out and elucidated by Coase (1937), and remains as one of his seminal contributions to the theory of the firm literature. The second characteristic of a KBV, also pointed out by Coase (1937) and elaborated on in a KBV context by Grant (1996), is the relationship between knowledge and a firm's boundaries or the scope of the firm. Third, a KBV must articulate the relationship between knowledge and the firm's structures (Grant, 1996). For example, building on the concept of bounded rationality and tacit knowledge, Grant suggested that there are two types of structures in firms that assist in integrating knowledge: designed (purposeful) or emergent (non-purposeful). Fourth, as highlighted by our review of resource-based view and organizational theory, knowledge has an impact on behavior, either, in the case of resource-based theory, on some type of social behavior (Barney, 1991), or in the case of organization theory, the exchange of knowledge between the individual and the organization as well as the development of firm

routines (Cyert & March, 1963). While Holmstrom and Tirole (1989) consider the role of behavior from a theory of the firm perspective. Thus, a KBV has to elucidate the link between knowledge and behavior. Finally, for a theory of the firm to be strategic (to explain why certain firms obtain and maintain a competitive advantage over others), it must explain the relationship between knowledge and performance. This characteristic is a requisite by definition for any strategic theory of the firm.

In sum, we suggest that a strategic knowledge-based theory has five defining requirements: (1) why the firm exists, (2) effects of knowledge on the boundaries of the firm, (3) effects of knowledge on a firm's structure, (4) effects of knowledge on the behavior of the firm, and (5) effects of knowledge on the firm's performance.

A review of the knowledge-based view literature

Against these criteria, we propose to examine current knowledge-based theories of the firm in order to lay out a map and eventually point a way forward in this field. As a starting point, we also considered the respective theoretical perspective taken by the author as well as the concept of knowledge utilized.

Theoretical perspective. The KBV theories of the firm that we examined have emerged from different disciplines (broadly, economics, sociology and philosophy), and, as such, it is a mixed compote of ontological and epistemological underpinnings. Moreover, few KBVs are consistent, and even fewer are complete. Subsequently, in order to develop a theory, a minimum degree of congruence in underlying assumptions is required in order to be consistent and additive. Our view of knowledge transcends the epistemological differences between the views. In attempting to be integrative across these varied views, we are taking the strategic management multidisciplinary perspective.

Concept of knowledge. One of the critical weaknesses of existing knowledge-based theories is the definitional ambiguity when it comes to the main construct, knowledge. First, there is disagreement about the level of analysis at which knowledge is a valid concept. Grant (1996), for example, postulates that knowledge exclusively resides in individuals. However, March and Simon (1958) as well as Levitt and March (1988) contend that organizations accumulate knowledge beyond that which is embodied in individuals through organizational learning. We argue that, in a strategic knowledge-based theory of the firm, knowledge should be included as a multi-level concept. Second, while all scholars seem to agree that there are two types of knowledge -- explicit and tacit – and, they have also developed their own typologies in conjunction with their specific theories (e.g., internal vs. external knowledge, know-how vs. know-what). What is often lacking is an underlying definition of knowledge that allows future scholars to generate operationalizable models of the firm and its performance. We develop a definition of knowledge in the context of an integrated knowledge-based view of the firm in the following section.

Firm existence. Despite this definition ambiguity, nearly every one of the scholars who have contributed in this domain offer some theory about how knowledge relates to the existence of firms. Some expand on the rationale offered by transaction cost economics, explaining in numerous variations that contracts help assure that you have reserves of capabilities when you need them (Loasby, 1998; Williamson, 1999), that firm knowledge can be substituted for employee bounded rationality through firm contracts (Conner & Prahalad, 1996), that firms are better able to manage motivation than markets (Osterloh & Frey, 2000), that employment contracts function specifically to protect knowledge inside the firm (Liebeskind, 1996) or that, because tacit knowledge has infinitely high measurement costs, it will not be transacted between

firms (Hallwood, 1997). Contracts are also made less incomplete by higher order principles only possible in a firm setting (Foss, 1996).

Others argue that firms exist because they create special environments where certain knowledge tasks can only take place. Firms exist to create absorptive capacity (Cohen & Levinthal, 1990) or to provide the conditions for individuals to integrate their specialist knowledge (Grant, 1996; Grant & Baden-Fuller, 2000). Firms outperform markets in their ability to organize the combination of knowledge (Kogut & Zander, 1992), often by lowering the cost of communication and coordination through the development of identity (Kogut & Zander, 1996). Many focus on the knowledge creation task in particular, positing that because organizations have more dense social capitalⁱⁱⁱ, they have an advantage over markets in creating and sharing intellectual capital (Nahapiet & Ghoshal, 1998), that organizations amplify new knowledge created by individuals (Nonaka, 1994), that firms are enduring alliances between independent knowledge creating individuals (Spender, 1996), and that firms protect the highly fragile knowledge creation process (von Krogh et al, 1994).

While there are many answers to the question of firm existence in the knowledge-based view of the firm, there is little consistency. For example, the knowledge protection imperative (Liebeskind, 1996) contradicts directly that of knowledge sharing (Grant, 1996) or knowledge combination (Kogut & Zander, 1992). Many of these scholars recognize that these kinds of conflicts have not yet been resolved and have called for theory with more coherent epistemological underpinnings (Minkler, 1993; Spender, 1996; Spender, 1998; von Krogh et al, 1994; Williamson, 1999) to make progress in defining a coherent knowledge-based theory to explain why firms exist.

Firm boundaries. The current theories have less to say about explaining firm

boundaries or scope of operation. Many do not address boundaries at all. Others assume the presence of firm boundaries in order to discuss internal and external technologies (Cohen & Levinthal, 1990) or communities of interaction (Nonaka, 1994) but do not explain when and why these boundaries exist. Again, those with a transaction cost economics bent claim that boundaries depend on the bureaucratic costs associated with the decision to take a transaction out of the market and organize it internally (Osterloh & Frey, 2000; Williamson, 1999) and are determined by increasing moral hazard and capability differences such as the inability to communicate or higher information costs (Foss, 1996; Liebeskind, 1996). From the individual perspective, individuals choose between firms and market contracting depending on where their individual knowledge has the highest value (Conner & Prahalad, 1996). Though, others would claim that boundaries are not determined by transaction costs alone, but by the replicability and imitability of tacit knowledge (Teece, 1998) or by the need to maximize the conversion rate of knowledge creation (Nonaka et al, 1999). Still others see boundary setting as a management tool for precipitating interpretive flexibility and defining the difference between data and knowledge/meaning (Spender, 1996, 1998).

These views of the firm boundary may be somewhat simplistic. A firm is generally portrayed as an entity within a boundary in which market forces do not predominate. Outside the firm's boundary there exists an infinite domain in which market forces dominate. Debates concerning the firm boundary generally concern themselves with which economic and social activities reside within the boundary and which do not. Here we concern ourselves only with boundaries separating the firm from the environment (those that should be explained by a theory of the firm) and do not consider other types of boundaries such as those between functions that could be critical in execution of knowledge processes (Carlile, 2000). In the next section, we

will build on existing thinking to introduce the concept of the “double boundary” of the firm and show that while some things (such as resources and knowledge) can reside both inside and outside the firm, capabilities can only be located inside the firm. And, for knowledge to pass from outside to inside the firm, it must cross two boundaries, those of integration and absorption.

Firm structure. To the extent that scholars of the knowledge-based view of the firm discuss organization structure, it is mainly in the debate about the value and role of hierarchy. Hierarchies can control moral hazard (Foss, 1996), provide a coordination mechanism for specialized or localized knowledge (Conner & Prahalad, 1996; Loasby, 1998), facilitate knowledge integration through compliance with directives (Grant & Baden-Fuller, 2000) and disaggregate knowledge in order to protect it (Liebeskind, 1996). Hierarchies also have an intertwined relationship with higher order principles that can integrate individual and social knowledge (Kogut & Zander, 1992) and can make contracts less incomplete (Foss, 1996). But, hierarchies also appear to have some negative features when it comes to knowledge tasks. Tacit knowledge may be better coordinated in team-based settings (Alchian & Demsetz, 1972; Grant, 1996) and “egalitarian” or flatter hierarchies may be more effective in the management of firms (Minkler, 1993; Spender 1998) in particular when managing dynamic capabilities (Teece, 1998). Nonaka proposes a resolution of this tension by suggesting that a dual structure of hierarchy (for socialization and internalization of knowledge) and heterarchy or project organization (for externalization and combination) is necessary (Nonaka, 1994; Nonaka, Nagata & Toyama, 1999).

Firm behavior. Firm behavior, the direct consequence of a firm exercising its capabilities, results in action that is observed externally as well as internally. Since different actions can be ascribed to different capabilities, the presence of a specific constellation of actions

can provide convincing evidence for the existence of specific capabilities inside the firm. Subsequently, the presence of a specific body of knowledge that is required to exercise a defined set of specific capabilities can be inferred. Most of the theories developed by these scholars have implications for behavior inside the firm. While the views expressed are highly diverse, they appear to cluster around the development and application of several knowledge-based capabilities (which we will explore further in the next section): knowledge protection (Hallwood, 1997; Liebeskind, 1996), replication (Osterloh & Frey, 2000), integration (Grant, 1996; Grant & Baden-Fuller, 2000), absorption (Cohen & Levinthal, 1990), and creation (Nonaka, 1994; Nonaka et al, 1999). In the next section, we return to these capabilities: knowledge creation (plus its relatively unexamined pair, knowledge destruction), integration, absorption, protection, and replication in much greater depth as we build up an integrated model of the firm.

Firm performance. From a strategic management perspective, making the link between knowledge and performance should be one of the critical aspects of any knowledge-based theory of the firm. Yet, this is precisely the area where current scholarship leaves open the most questions (Williamson, 1999). While resource and knowledge-based views of the firm have opened up the “black box” of the firm so that we can look inside at behaviors, they have left their own black box, that of the link between behavior and performance. Most theories either do not address performance at all or simply state that a certain knowledge capability (variously, absorptive capacity, innovation, combinative capabilities, knowledge transfer, and protective capabilities) will give a firm competitive advantage and thus lead to performance. Conner and Prahalad (1996) point out that any theory of firm performance requires that organizing an activity within the firm result in a competitive advantage, and some scholars have made more

explicit statements in this vein: firms often lose to competitors when they replicate knowledge (Kogut & Zander, 1992), differences in firm performance may represent differences in the ability to create and exploit social capital (Nahapiet & Ghoshal, 1998) or competitive advantage emanates from the ownership of knowledge assets (Teece, 1998). These theories, however, have not drawn a strong causal link between knowledge or behaviors and performance, and they have not proposed reasonable metrics for knowledge or for the capabilities that knowledge creates. The mechanisms remain obscure.

THE INTEGRATED KNOWLEDGE-BASED VIEW (IKBV) OF THE FIRM

This review shows that while the emerging field of strategic knowledge-based theories of the firm has made significant strides in understanding critical components important in the development of a KBV, individually the theories are incomplete and collectively are often contradictory. They do not address all of the requirements of a theory of the firm and do not elucidate the mechanisms of the link between knowledge and performance. To integrate and clarify many of the issues debated in the literature into a coherent picture, the authors propose an integrated knowledge-based view (IKBV) of the firm as shown in Figure 1. In this representation, knowledge and resources are viewed as distinct from each other and can exist inside as well as outside of the firm. Capabilities serve as the link between knowledge and firm performance and reside within the firm. While capabilities can be viewed as the operators; knowledge is the operand. In our model, the firm has two boundaries, which reflects the notion that a firm can bring knowledge and resources into a firm (integration) without absorbing them. We will explore this model in the discussion below.

Insert Figure 1 about here

Defining knowledge

Because knowledge is not directly observable or measurable, then, it becomes a construct whose existence and properties can only be inferred through firm capabilities that are manifested in observable action (Stehr, 1992). Most of the knowledge-based views do not clearly articulate this relationship between task or behavior and knowledge. In an attempt to fill this gap, we propose the following three-part working definition of knowledge that integrates across the views of several different fields and scholars: *knowledge* is information whose certainty is given by a specific context (Arrow 1962a, 1969), which creates space for a justified true belief (Nonaka, 1994; von Krogh, Ichijo & Nonaka, 2000) and gives a firm the capacity to act (Stehr 1992). Thus knowledge is only identifiable through the observation of action. This differentiates knowledge from resources, which can be identified without observable action. By defining capabilities as the capacity to act, we deduce that knowledge, in conjunction with resources, gives the firm its capabilities, and that the existence of capabilities is the prerequisite for potential action of any kind. Conversely, the observation of action by the firm demonstrates the existence of capabilities, and the existence of capabilities inherently identifies the presence of knowledge, even if knowledge itself cannot be directly observed.

The distinct treatment of knowledge and resources differentiates the knowledge-based view of the firm from the resource-based view of the firm, which regards resources in a broad sense that tends to include many concepts traditionally associated with knowledge (Barney, 1996). In the knowledge-based view, a resource is treated as a finite traditional stock, which must be replenished after it is depleted and which contributes to achieving competitive advantage (primarily by depriving other firms of that resource) (Wernerfelt, 1984). Knowledge, by contrast, can be replicated or transferred from a transmitting entity to a receiving entity without

loss to the transmitting entity, making a "knowledge position barrier" much harder to erect. The accumulation of knowledge in and of itself is not an inherent source of competitive advantage. Every firm must make an active effort at protecting its knowledge by selectively preventing it from being transferred to potential competitors outside the firm, but at the same time specifically transferring it to strategic partners and collaborators.

From Knowledge to Capabilities

While knowledge and resources are considered essential ingredients to firm survival, capabilities are its *raison d'être* -- they represent the firm's capacity to act. Therefore, the IKBV places capabilities exclusively inside the firm (outsourced activities are considered resources). As mentioned above, firm behavior, the direct consequence of a firm exercising its capabilities, results in action that is observed externally and internally. Since knowledge is not itself measurable, we only infer it through an organization's actions. Different actions can be ascribed to different capabilities. Thus a specific constellation of actions represents a specific set of capabilities inside the firm and implies the existence of specific knowledge that is required to exercise these capabilities.

Our synthesis of the past knowledge-based theories of the firm generates six critical capabilities: creation, destruction, integration, absorption, replication and protection. The six capabilities are not completely independent of each other: they appear to possess a dyadic organization structure. Specifically, creation is associated with destruction; integration is intimately tied to absorption; and replication is linked to protection. This also points to the existence of a meta-capability for the firm to enable and constrain the individual capabilities. The authors contend that this meta-capability constitutes the essence of strategic management.

In Table 1, we show how researchers have covered the territory of the key elements of

the knowledge-based theory of the firm across the key capabilities. This analysis shows that while some capabilities have been discussed extensively (e.g., creation) others have barely been mentioned (e.g., destruction). In addition, no current knowledge-based theory of the firm has something to say about all of the six capabilities simultaneously, describing individual capabilities (possibly referring to them by a different name) and their effects on some, but not usually all, of the aspects of the theory of the firm: firm existence, boundaries, structure, behavior and performance. For each dyad, we first define the two capabilities and then show how they interact in a dyadic relationship.

Insert Table 1 about here

Creation and destruction

The *creation capability* is the capacity to combine knowledge with knowledge and knowledge with resources to produce output that exceeds the value of the sum of the inputs that are required to generate the output. Probably the strongest argument so far posited in the KBV is the firm's advantage in knowledge creation. Firms exist as alliances between knowledge creating entities (Spender 1996) or to protect the creative process (von Krogh et al, 1994). Loasby (1998) contends that firms outperform markets by building "reserves" of capabilities, which can be deployed to exploit new market opportunities. Nahapiet and Goshal (1998) claim that firms are conducive to higher levels of social capital than markets and are therefore better at creating and sharing intellectual capital. Kogut and Zander (1992) look at firms as a social community of voluntaristic action in which knowledge is learned, produced and commercially applied. Firms exist because they outperform markets in organizing the combination of knowledge. And, their boundaries are defined by the degree to which knowledge conversion takes place at a higher rate (Nonaka et al, 1999) or by the ability to resolve agency problems

among individual knowledge creators (Spender, 1996). Perhaps only in relation to creation capabilities do researchers make an explicit theoretical link to performance. The combination of knowledge and resources allows the firm to develop new knowledge, which gives it the capacity to produce better products and services. Thus, competitive advantage emanates from ownership of knowledge assets and the ability to combine them with other assets to create value (Teece, 1998).

The *destruction capability* constitutes the capacity to eliminate elements of knowledge or disassemble the interconnectedness of knowledge. Knowledge destruction differs from knowledge loss mechanisms such as organizational forgetting because it constitutes a volitional act. Elements of knowledge that are targets for destruction include routines, behavior patterns or beliefs, which can become inertial forces that interfere with the innovation process (Nelson & Winter, 1982). Leonard-Barton (1992) extends this argument stating that core capabilities can become core rigidities, and firms need to know when to eliminate certain knowledge and associated capabilities. No scholars, of course, have argued that firms exist solely based on superior knowledge destruction capabilities. Indeed, markets appear to be better at destruction (at least in the US, through easy bankruptcy laws) than firms are. But, others have shown that firm existence can be threatened by a failure to destroy old knowledge (Leonard Barton, 1992; Nelson & Winter, 1982). This link to performance has not been incorporated into existing KBV's. Furthermore, the relationship between knowledge destruction on one side and the firm boundary and firm structure on the other side remain largely unexplored. This relationship covers the consequences of merger and acquisition activity, where entities with intact routines and extensive tacit knowledge must change and possibly disaggregate to accommodate other entities within the firm. How knowledge is lost in the process, whether restructuring is

inevitable, and how it proceeds are all topics that have yet to be explained.

Scholars have surmised a link between the creative and destructive capabilities of the firm ever since Schumpeter (1942) proposed that "creative destruction" was an essential component of the innovation process. Replication and protection of knowledge, as we will discuss below, may sustain a firm in a static environment, but innovation is required for a firm to remain on a prolonged growth trajectory. And innovation mandates both the creation and the destruction of knowledge. For a firm to enhance its performance through innovation, it must be able to create by combining knowledge with knowledge and knowledge with resources, as well as change internal processes and structures, an activity that generally involves the destruction of knowledge. Under such circumstances, the firm needs to disrupt routines possibly by disassembling organizational structures. Removing or disassembling structures that inhibit creation involve the destruction of knowledge. Thus, if a firm willfully destroys existing structures, it enables the creation of knowledge by removing barriers that inhibit creation. Conversely, surges in creative activity may induce the destruction of existing knowledge by transferring new knowledge into existing structures. As people learn about more effective methods, they may voluntarily begin to practice these methods and abandon existing methods. In that case, knowledge creation drives knowledge destruction.

Integration, absorption and the double boundary of the firm

The *integration capability* is the capacity to secure a supply of knowledge and resources for the firm. Purchasing supplies is an example of integrating resources. Hiring people secures a supply of individual knowledge, be it tacit or explicit. Mergers and acquisitions integrate the knowledge and resources of whole firms. The main focus of research on integration has been on the boundary of the firm: for example, Williamson's (1999) demonstration that a firm may

decide to take a transaction out of the market to reduce bureaucratic cost. Demsetz (1991) argues that the vertical boundaries of the firm are determined by the extent to which knowledge is transferred effectively, while Conner and Prahalad (1996) take the view from the other side, showing that an individual chooses between firm organization and market contracting depending on where the individual knowledge has the highest value. Researchers have argued that firms outperform markets as coordination mechanisms, implying that a firm's integrative capabilities are linked to the firm performance (Grant, 1996; Grant & Baden-Fuller, 2000), but this link has only been made implicitly.

The *absorption capability*, the other half of the dyad, enables the use of knowledge and resources, and is intimately linked to integration. Moreover, bringing in some knowledge (by hiring individuals or making acquisitions) through integration is not enough; it must also be absorbed and made useful. Absorption of knowledge typically involves the externalization of tacit knowledge from employees and acquired entities, or the use of tacit knowledge within an enterprising context. The firm must also be willing and able to receive and use the knowledge, be it tacit or explicit in order for absorption to take place. The discussion about absorption of knowledge into a firm is most closely associated with Cohen and Levinthal (1990) who argue that firms exist because they can create absorptive capacity at an organizational level. A firm acquires absorptive capacity in a specific area by learning about related areas. R&D can enhance a firm's absorption capability by facilitating learning (Nonaka et al, 1999), lowering the cost of communication and coordination, providing a context of discourse and learning (Kogut & Zander, 1996), and generating innovation. Knowledge absorption is also linked to organization structure and behavior as well. The literature mentions that hierarchical relationships within firms serve to coordinate specialized knowledge resulting from division of labor (Loasby, 1998).

Hierarchies also facilitate knowledge absorption is facilitated through sequencing and compliance with directives (Grant & Baden-Fuller, 2000). While Cohen and Levinthal (1990) have proposed that the absorption of knowledge leads to improved performance.

Yet, the relationship between knowledge absorption and knowledge integration remains ill defined and unexplored. Adding knowledge to the firm without creating it inherently involves bringing knowledge or resources into the firm across the firm boundary. To do so, the firm must have capacity to procure the knowledge and resources from the outside. It must be able to integrate knowledge by hiring people that possess knowledge into the firm or by making acquisitions. Integration and absorption occur in tandem, because knowledge must be integrated before it can be absorbed. A firm can increase its acquisition rate either by increasing its rate of knowledge integration or by increasing its absorptive capacity (Cohen & Levinthal, 1990). This dual process of acquiring knowledge from outside the firm implies that the boundary of the firm has two layers. Knowledge that has not been integrated lies outside the firm's integration boundary; knowledge that has been both integrated and absorbed resides within the absorption boundary; and knowledge that has been integrated but not absorbed is located between the two boundaries.

Replication and protection

The *replication capability* represents the capacity to transfer knowledge from a transmitting entity (an individual, an organization or an industry) to a receiving entity with a minimal loss of information. While the literature makes no suggestions that the replication capability could serve as a justification for the existence of the firm, it does explore in depth the interaction between replication and the boundaries of the firm. Furthermore, the boundaries of the firm are also affected by the replicability and imitability of tacit knowledge, which can exist

to a higher degree inside the firm (Nonaka et al, 1999); by capability differences, such as the inability to communicate or higher information costs (Foss, 1996); or by the extent to which knowledge is transferred effectively (Demsetz, 1991). Organizational form has also been linked to the ability to transfer tacit knowledge (Osterloh & Frey, 2000), to control moral hazard and to take advantage of higher order principles (Foss, 1996). Finally, Osterloh and Frey (2000) contend that the transfer of knowledge, especially tacit knowledge, enhances a firm's performance and is essential to its competitive advantage.

The *protection capability*, the flip side of replication, is defined as the capacity to control the replication process or alternatively, the ability to protect knowledge. Theoretical work on replication to date has often placed this capability as the primary justification for firm existence. Firms provide the physical, social and resource allocation to shape knowledge into competence and have the ability to protect intellectual rights (Teece, 1998). They outperform markets in the protection of knowledge because they provide unified ownership and employment contracts instead of market and futurity of reward (Liebeskind, 1996). Foss (1996) argues that firms exist as contracts and nourish higher order principles to control moral hazard and agency problems regarding knowledge protection. Mechanisms to protect knowledge may also determine the boundary of the firm by increasing the communication costs with the outside, and hierarchies serve to disaggregate knowledge for protection (Liebeskind, 1996). Firms establish formal mechanisms of knowledge protection (Liebeskind, 1996), such as patents, copyrights and trademarks, as well as informal mechanisms such as accumulating tacit knowledge (Kogut & Zander, 1992) or encoding private information in ways that raise measurement costs (Hallwood, 1997). Protective capabilities, such as privately held knowledge (Conner & Prahalad, 1996), give a firm competitive advantage, which subsequently influences the firm's performance in a

positive way (Liebeskind 1996).

The replication/protection dyad is derived from the historical notions of explicit and tacit dimensions of knowledge. Explicit knowledge is well encoded and can be acquired and transferred directly and very easily. It is not "sticky" (Von Hippel, 1994): it is ready to use and easy to replicate. Tacit knowledge, on the other hand, can neither be expressed nor encoded very easily. It is extremely difficult to articulate an instruction set that would describe these activities to the point where other people could repeat them (Polanyi, 1966). It is "sticky", difficult to replicate, and can be transferred in one of two ways: indirectly through a time-consuming socialization process (Nonaka, 1994) or via the sequence of externalization, direct transfer, and internalization. The latter mechanism, which has not been discussed in the literature to date, is suited for organizations that want to grow rapidly and develop new capabilities (build up momentum). These organizations convert the tacit knowledge that resides in its employees into explicit knowledge through an externalization process such as writing a book or developing a toolkit for users of technology (von Hippel 1994, 1999). Once externalized, large amounts of knowledge can be transferred directly, easily and at low cost. The explicit knowledge will be converted to tacit knowledge through internalization processes such as learning by doing (Arrow, 1962b), learning by using (Rosenberg, 1986), or other means of the developing routines (Nelson & Winter, 1982).

Replication and protection are countervailing capabilities that inhibit each other. Firms need to replicate their knowledge to mass produce and exploit economies of scale, yet easy replication of knowledge makes firms vulnerable to imitation (Kogut & Zander, 1992). The ability to replicate knowledge allows a firm to ramp up to production and take advantage of economies of scale. A firm's ability to replicate knowledge could prove to be a weakness because

knowledge, especially if it is in explicit form, could leak outside the firm where others could pick it up and imitate the firm's products and services. Kogut and Zander (1992) would therefore recommend against running a firm in the manner that externalizes knowledge. By contrast, if the firm's knowledge remains primarily tacit, the firm would have the capability of constraining knowledge transfer to another company. An employee that leaves the firm would either transfer the knowledge through a time consuming socialization process or take a long time externalizing the knowledge, giving the firm that originated the knowledge a strong learning curve advantage. The greater the knowledge replication rate, the less knowledge is protected. Conversely, the more a firm focuses on protection, the less it can replicate knowledge. Firms must therefore find a balance between replication and protection, by knowing what knowledge to replicate and what knowledge to protect, a topic that the literature has not yet adequately discussed.

Metrics for capabilities

In order for the knowledge-based view of the firm to create models that can be operationalized, observable metrics for these capabilities must be developed. Table 2 lists some possible metrics for each of the six knowledge capabilities. Ultimately, research should be able to show that changes in these input measures would effect various measures of performance such as gross revenue, gross profit, net profit, return on assets, return on investment or, as posited more recently, IPO value (DeCarolis and Deeds, 1999). For example, if research and development within a firm positively affects the firm's creation capability, then increasing the R&D budget should improve the firm's traditional performance metrics a few months or years after the increase in R&D spending was instituted. Conversely, an increase in the firm's budget for restructuring and reengineering should adversely affect the performance metrics of sections or divisions that are targeted for knowledge destruction, while improving the firm's global

performance metrics. If a firm's integration capability directly affects firm performance, then changes in a firm's purchasing and hiring patterns should result in an observable change in the firm's traditional performance metrics. Changes in the training budget, selective elements of the IT budget, R&D budget should influence a firm's capability to absorb knowledge, which should also affect the firm's global performance metrics.

Insert Table 2 about here

Firm-to-firm comparisons are less complicated when capability-specific measures can be identified. For example, the cost of copying information, the cost of franchising, the cost of training, and a firm's willingness to invest resources (as measured by person-hours and dollars) into these activities should affect the firm's replication capability. Therefore, a firm that invests heavily in copying and training should be able to transfer a process from R&D to manufacturing and ramp it up to volume production in much less time than one who does not. Similarly, the costs of establishing and enforcing patents and trademarks affect a firm's ability to protect itself from imitation. A firm that invests heavily in patent and trademark protection should therefore be able to hold a product monopoly much longer than one who does not.

Strategic management: the meta-capability

The discussion above illustrates the critical intra- and inter-relationships and tensions for each of the dyads. Figure 2 shows that the nature of the relationships between the capabilities within each dyad varies from dyad to dyad. Replication and protection are mutually inhibitory; creation and destruction are mutually excitatory; and integration enables absorption. Dealing with these tensions becomes the linchpin of a meta-capability that represents the essence of strategic management. Each firm must have the capacity to allocate resources in a manner that enables and constrains the exercise of these six capabilities, which give a firm some control in

gaining a strategic advantage over its competitors. Of course, the decisions behind resource allocations require knowledge, which the firm can replicate, protect, create, destroy, integrate and absorb. It also appears, as Figure 2 shows, that the meta-capability is exercised on two levels: within the dyad, and between dyads.

Insert Figure 2 about here

For example, the firm can choose to increase its research and development budget and its budget for restructuring, a decision that is appropriate in an early stage of a project. These actions represent a stimulation of both components of the creation/destruction dyad, which would most likely induce a surge of creative activity. During product development a firm may discover it needs complementary knowledge that resides outside the firm. It may then decide to hire new people (integration), increase its funding of training programs (absorption), decrease the budget for R&D and restructuring, but invest more in IT. At that point, the firm has exercised the meta-capability at a higher level, by increasing the importance of the integration/absorption dyad at the expense of the creation/destruction dyad. The firm may also decide to invest in patents and trademarks to protect its intellectual property while a product is under development. However, once the product is ready, the firm is likely to enhance its replication capabilities and diminish its protection capabilities, by increasing its training budget and spending less on patent protection, which are decisions solely affecting the two components of the replication/protection dyad. As a consequence, employees in manufacturing facilities internalize the firm's recently created and acquired knowledge by learning by using or learning by doing. The knowledge becomes tacit, which protects the firm from imitation. Consequently, formal protection mechanisms become less important.

This kind of meta-capability has not been explored in depth either theoretically or

empirically. Lei, Hitt and Bettis (1996) have postulated the existence of an organizational meta-learning capability that serves as the basis for building a firm's dynamic core competencies. They define a firm's core competencies as set of problem-defining and problem-solving insights that foster the development of idiosyncratic growth alternatives. Our concept expands this view by identifying specific capabilities, suggesting metrics by which they can be observed, and describing the relationship between them. Once researchers characterize the interdependencies between these capabilities, practicing managers can utilize the meta-capability that we postulate to gain competitive advantage.

RESEARCH AGENDA

The framework of the integrated knowledge-based theory of the firm that has been presented in this paper suggests several themes for future research.

Comprehensiveness. In our analysis, we show that different authors emphasize various sources of knowledge and capabilities. Their conclusions result from their choice of topic and the theories they apply. Theories have a tendency to focus on only a subset of knowledge capabilities, e.g., knowledge creation. We provide a framework that shows various tensions among these contributions, not only at the level of basic assumptions, but also at the level of empirical phenomena. Hence, future empirical research needs to focus on the balance between capabilities, how firms invest to build capabilities, and how capabilities individually and in concert have an impact on firm performance (e.g., relative impact of each capability).

Evolution. The knowledge-based theories of the firm as well as resource-based views have a tendency to look at the firm as an established entity, well endowed with resources, knowledge, and capability. However, the discussion of the meta-capability has shown that the stage of the life cycle may affect the manager's choice of capabilities. That is, depending on the

where the firm is in the evolutionary cycle different capabilities will emerge as more or less relevant. For example, in the pioneering phase, creation, integration, and absorption could be the most relevant. In the growth phase, integration and absorption might be the most relevant. As the firm matures, destruction and protection may be particularly critical, perhaps coupled with even more creation.

Contingencies. In addition, there have been few attempts at integration between contingency theory and KBV's. Future research could exploit this weakness by finding out what capabilities that best fit what type of environment. Given, for example, an increasingly complex environment, creation, absorption, and integration might be most relevant. Rate of change also matters. If the environment changes rapidly, the creation-destruction dyad might become more pronounced, whereas absorption and integration could exist more in the background. In this case, firms would also have, for example, a tendency to protect less of their knowledge and will be increasingly pushed to constantly innovate.

Empirical research: What we have proposed in the framework can be studied at the level of firms and industries. However, we have also shown possible organizational tensions or paradoxes that need to be reconciled. For example, how does the organization cope with a simultaneous allocation of resources to build creation and destruction capabilities? How do people come to terms with possible differences in incentive systems or power structures? How do firms resolve conflicts over resources? How are managers rewarded for fostering capability development? How do organizational norms, values, and attitudes co-evolve with capabilities? These questions will likely only be resolved with more qualitative field research (ethnographies, case studies, action research).

Meta-analysis in strategic management. We believe more meta-analysis, such as the

one we have attempted here, is needed for strategic management to advance as a coherent discipline. The analysis of streams of discourse can show interesting patterns that in turn can lead to new research questions and open up new debates. Meta-analysis also has an integrative function: to show people where each contribution falls in the ongoing debates, and to provide options for authors to reposition themselves in the research landscape. Our paper is but one type of meta-analysis focusing on the knowledge-based view of the firm.

CONCLUSION

The purpose of this paper is to track and review developments leading to a knowledge-based theory of the firm in strategic management and to provide an integrated model of the firm that encompasses and extends previous contributions. We found many partial contributions, but none that provides a coherent view of knowledge related to a firm's existence, boundaries, behavior, structure, and competitive advantage. As a consequence, it should not come as a surprise to scholars that a knowledge-based view of the firm still has some way to go in order to assume an established role as a useful theory within strategic management (Burton-Jones, 1999; Williamson, 1999). Our model, an integrated knowledge-based view of the firm, links knowledge, capabilities, and competitive advantage to address some of these shortcomings. We identified six types of capabilities (*creation, destruction, integration, absorption, replication* and *protection*) that are organized in pairs, and should be understood as having a joint impact on competitive advantage. Strategic management is, in this view, considered a meta-capability that allocates resources to the building of these capabilities.

Scholars have been aware of the above capabilities, but to date have not integrated them into a comprehensive model. Instead, the literature has described individual capabilities and their effect on some aspects of firm existence, boundaries, structure, behavior and performance.

To promote more empirical work on these capabilities, we have suggested some potential measures. We also tried to fill in where the literature has left significant gaps. For example, our survey found little work on how knowledge destruction has affected firm existence, boundaries, structure and performance. Yet the links between firm capabilities and these attributes may exist, giving future scholars enormous opportunities for study.

Because our attempt with this model is to integrate and make additional move towards empirical research, purely discipline-based readers might find a limited attention to and discussion of fundamental theoretical assumptions. By bringing together of contributions from sociology, economics, and social-psychology, the model development is driven by a certain pragmatism characteristic for strategic management. In doing so, our predefined criteria for the literature search potentially leaves several blind spots that could impact on the field's understanding of capabilities as well as the overall organization of these. Also, this paper aimed to develop a mid-range model rather than building a new theory or conducting empirical research. We argue that more empirical work in this area is a critical next step.

A knowledge-based theory of the firm should hold great promise in strategic management, but it has to rise beyond the somewhat naive idea of “knowledge as a source of sustainable competitive advantage”. Knowledge is also a double-edged sword: while the benefits are often immediate and easily recognizable, the costs related to rigidity, failure of appropriation, and change are more subtle, less transparent, and intimately tied to social processes. This, however, should embolden rather than discourage scholars in the field. Delving into the link between knowledge and capabilities and firm performance will keep us occupied for many years to come, and as empirical research gains ground using improved models, it has the potential to bring real a real value to the teaching and practice of management.

ENDNOTES

ⁱ Similar developments occur in contemporary economics. Many of the proponents here, some of which we will review in this paper, draw upon evolutionary economics in order to better explain the nature of the firm. See for example Nelson and Winter (1982), Winter (1991), and Nelson (1991). For a recent contribution see Dulbecco and Garrouste (2000).

ⁱⁱ This argument is very similar to that made by Oliver Williamson in his 1999 article in which he argues that no knowledge-based theories lend themselves to empirical verification or falsification. In fact, the knowledge-based theory of the firm seems more like a theoretical patchwork than a solid body of theoretical knowledge. In effect, empirical research is scant, and we should not expect a successful empirical project unless we are able to resolve some of the more fundamental theoretical controversies at the present time.

ⁱⁱⁱ Social capital is variously defined but one more comprehensive view posits it as “the sum of actual and potential resources embedded within, available through, and derived from the network of relationships” (Nahapiet and Ghoshal 1998: 244)

REFERENCES

- Alchian, A.A., & Demsetz, H. 1972. Production, information costs, and economic organization. *American Economic Association*. 62(5): 777-795.
- Arrow, K. 1962a Economic welfare and the allocation of resources for invention,. In NBER (ed.), *The Direction and Rate of Inventive Activity*. Princeton, NJ: Princeton University Press.
- Arrow, K. 1962b. The Economic Implications of Learning by Doing. *Review of Economic Studies* 29: 155-173.
- Arrow, K. 1969. Classificatory Notes on the Production and Transmission of Technological Knowledge. *American Economic Review Papers and Proceedings*,. 59: 29-35.
- Barney, J. 1991. Firm resources and sustained competitive advantage. *Journal of Management*. 17: 99-120.
- Barney, J.B. 1996. The resource-based theory of the firm. *Organization Science*. 7: (5) 469-469.
- Barney, J.B. 1999. How a firm's capabilities affect boundary decisions. *Sloan Management Review*. 40: (3) 137
- Burton-Jones, A. 1999 *Knowledge-Capitalism: Business, Work, and Learning in the New Economy*. New York: Oxford University Press.
- Carlile, P. 2000. A Pragmatic View of Knowledge and Boundaries:Boundary Objects in New Product Development. Cambridge, MA: *Unpublished manuscript*, August 2000.
- Chesbrough, H. & Teece, D. 1996. When is virtual virtuous, *Harvard Business Review* 74(1): 65-73

- Christensen, J.F. 1995. Asset profiles for technological innovation. *Research Policy*. 24: (5) 727-745.
- Coase, R.H. 1937 The nature of the firm. *Economica*. 4: 386-485.
- Cohen, W. & Levinthal, D. 1990. Absorptive Capacity: A New Perspective on Learning and Innovation. *Administrative Science Quarterly*. 35(1): 128-152.
- Conner, K. & Prahalad, C. 1996. A resource-based theory of the firm: Knowledge versus opportunism. *Organization Science*. 7 (5): 477-501.
- Cyert, R.M. & March, J. 1963. *A Behavioral Theory of the Firm*. London: Blackwell.
- Cyert, R.M. & Williams, J.R. 1993. Organizations, decision making, and strategy. *Strategic Management Journal* 14: 5-10.
- DeCarolis, D. M., & Deeds, D. L. 1999. The impact of stocks and flows of organizational knowledge on firm performance: An empirical investigation of the biotechnology industry. *Strategic Management Journal*, 20(10): 953-968.
- Demsetz, H.. 1991. The Theory of the Firm Revisited. In Williamson, O.E. & Winter, S.G. ed. *The nature of the firm: Origins, evolution, and development*. New York; Oxford: Oxford University Press.
- Dulbecco, P. & Garrouste, P. 2000. Production structure and knowledge: Towards an Austrian theory of the firm. *Revue Economique*. 51: (1) 75-101.
- Evans, P., & Wurster, J.S., 1999. *Blown to Bits: How the New Economics of Information Transforms Strategy*. Cambridge, Mass.: Harvard Business School Press.

- Foss, N.J. 1996. Knowledge-based approaches to the theory of the firm: Some critical comments. *Organization Science*. 7 (5): 470-476.
- Foss, N.J. 1996. More critical comments on knowledge-based theories of the firm, *Organization Science*. 7 (5): 519-523.
- Foss, N. J., & Eriksen, B. 1995. Competitive Advantage and Industry Capabilities. In C. A. Montgomery (Ed.), *Resource-based and evolutionary theories of the firm: Towards a synthesis*: 43-69. Dordrecht and Boston: Kluwer Academic.
- Grant, R.M. & Baden-Fuller, C. 2000. Knowledge and economic organization: an application to the analysis of interfirm collaboration. In von Krogh, G., Nonaka, I. & Nishigushi, T. eds. *Knowledge Creation: a new source of value*: 89-111. London: MacMillan.
- Grant, R. 1996. Toward a Knowledge Base Theory of the Firm. *Strategic Management Journal*. 17(Special Issue): 109-122.
- Hallwood, C. P. 1997. Competencies as private information: An efficient capital asset pricing theory of the firm. *J. Inst. Theor. Econ.-Z. Gesamte Staatswiss.* 153(3): 532-44.
- Holmstrom, B. & Roberts, J. 1998. The Boundaries of the Firm Revisited. *Journal of Economic Perspectives*. 12(4):73-94.
- Holmstrom, B., & Tirole, J. 1989. The theory of the firm. In Schmalensee, R. & Willig, R.D. (Eds). *Handbook of industrial organization*: volume 1: 61-133. Amsterdam: North Holland.
- Klein, B., Crawford, R.G., & Alchian, A.A. 1978. Vertical integration, appropriable rents, and the competitive contracting process. *Journal of Law and Economics*. 21: 297-326.

- Kogut, B. & Zander, U. 1992, Knowledge of the firm, combinative capabilities, and the replication of technology. *Organization Science*. 3 (3): 383-397.
- Kogut, B., & Zander, U. 1996. What firms do? Coordination, identity, and learning. *Organization Science*. 7 (5): 502-518.
- Lei, D., Hitt, M.A. and Bettis, R. 1996. Dynamic core competences through meta-learning and strategic context. *Journal of Management*. 22(4): 549-69.
- Leonard-Barton, D. 1992. Core Capabilities and Core Rigidities: A Paradox in Managing New Product Development. *Strategic Management Journal*, 13(Special Issue): 111.
- Levitt, B., & March, J. G. 1988. Organizational Learning. *Annual Review of Sociology*, 14: 319-340.
- Liebesskind, J.P. 1996. Knowledge, Strategy and Theories of the Firm. *Strategic Management Journal*. 17(Special Issue):93-107.
- Loasby, J. 1998 The organization of capabilities. *Economic Behavior and Organization*. 35: 139-160.
- Mahoney, J.T. 1995. The management of resources and the resource of management. *Journal of Business Research*. 33: (2) 91-101.
- March J., & Simon, H. 1958. *Organizations*. New York: Wiley
- Minkler, A. P. 1993. Knowledge and Internal Organization. *Journal of Economic Behavior and Organization*. 21(1):17-30.

- Rosenberg, N. 1982. *Inside the Black Box: Technology and economics*. New York: Cambridge University Press.
- Nahapiet, J. & Ghoshal, S. 1998. Social Capital, Intellectual Capital, and the Organizational Advantage. *Academy of Management Review*. 23(2): 242-266.
- Nelson, R.R, 1991. Why do firms differ and how does it matter ? *Strategic Management Journal*. 12:61-74.
- Nelson, R.R., & Winter, S. 1982. *An evolutionary theory of economic change*. Cambridge, MA: Harvard University Press.
- Nonaka, I. 1994. A dynamic theory of organizational knowledge creation. *Organization Science*. 5(1): 14-37.
- Nonaka, I., Nagata, A. & Toyama R. 1999. The Theory of Innovative Firm. *Unpublished manuscript*, July 1999.
- Ocasio, W. 1997 Towards an attention-based view of the firm. *Strategic Management Journal*. 18: 187-206, Sp. Iss.
- Osterloh, M. & Frey, B.S. 2000. Motivation, knowledge transfer, and organizational forms. *Organization Science*. 11(5): 538-50.
- Penrose, E.T. 1959. *The theory of the growth of the firm*. New York: John Wiley & Sons Inc.
- Polanyi, M. 1966. *The Tacit Dimension*. New York: Doubleday.

- Poppo, L., & Zenger, T. 1998. Testing alternative theories of the firm: Transaction cost, knowledge-based, and measurement explanations for make-or-buy decisions in information services. *Strategic Management Journal*. 19: (9) 853-877.
- Reed, R., & DeFillippi, R. J. 1990. Casual Ambiguity, Barriers To Imitation, And Sustainable Competitive Advantage. *The Academy of Management Review*, 15(1): 88.
- Rumelt, R. P. 1997. Towards a Strategic Theory of the Firm. In N. J. Foss (Ed.), *Resources, firms, and strategies: A reader in the resource-based perspective*: 131-145. Oxford and New York: Oxford Management Readers series. Oxford University Press.
- Rumelt, R.P., Schendel, D., & Teece, D.J. 1991. Strategic management and economics, *Strategic Management Journal* 12: 5-29, Sp. Iss.
- Schumpeter, J. 1942. *Capitalism, Socialism and Democracy*, 2nd ed.. London: George Allen & Unwin, Ltd.
- Spender, J.-C., & Grant, R. M. 1996. Knowledge and the firm: Overview. *Strategic Management Journal*, 17: 5-9.
- Spender, J. C. 1996. Making knowledge the basis of a dynamic theory of the firm. *Strategic Management Journal*.17: 45-62.
- Spender, J. C. 1998. Pluralist epistemology and the knowledge-based theory of the firm. *Organization*. 5(2): 233-56.
- Stehr, N. 1992. *Practical Knowledge*. Sage Publications, Inc.
- Szulanski G. 1996 Exploring internal stickiness: impediments to the transfer of best practice within the firm. *Strategic Management Journal*. 17:27-43

- Teece, D. J. 1996. Firm organization, industrial structure, and technological innovation. *Journal of Economic Behavior & Organization*, 31(2): 193-224
- Teece, D. J. 1998. Capturing value from knowledge assets: the new economy, markets for know-how, and intangible assets. *California Management Review*. 40:55-79
- Tiwana, A. 1999. *Knowledge-Management Toolkit*. Englewood-Cliffs, NJ: Prentice-Hall.
- Tsoukas H. 1996. The firm as a distributed knowledge system: A constructionist approach. *Strategic Management Journal* 17:11-25
- Von Hippel, E., 1994. Sticky Information and the Locus of Problem Solving: Implications for Innovation. *Management Science* 40(4): 429-439.
- Von Hippel, E. 1998. Economics of product development by users: the impact of sticky local information. *Management Science*. 44(5): 629-643.
- Von Hippel, E. 1999. Toolkits for User Innovation: The Design Side of Mass Customization. *MIT Sloan School of Management* Working paper # 4058, (February 1999).
- Von Krogh, G., Ichijo, K.& Nonaka, I. 2000. *Enabling knowledge creation : how to unlock the mystery of tacit knowledge and release the power of innovation*. Oxford ; New York: Oxford University Press.
- Von Krogh, G., Roos, J. & Slocum, K. 1994. An Essay on Corporate Epistemology. *Strategic Management Journal* 15: 53-71.
- Wernerfelt, B. 1984. A resource-based view of the firm. *Strategic Management Journal*. 5(2): 171-180.

Williamson, O.E. 1975. *Markets and hierarchies – analysis and antitrust implications*. New York: The Free Press.

Williamson, O. E. 1999. Strategy research: Governance and competence perspectives. *Strategic Management Journal*, 20(12): 1087-1108.

Winter, S. 1991. On Coase, competence, and the corporation. In: Williamson, O.E. & Winter, S.G. (Eds). *The nature of the firm - Origins, evolution, and development*. Oxford: Oxford University Press.

TABLE 1

Knowledge-based theories of the firm – by capability

Category	Effects of knowledge on firm existence	...on boundaries	...on structure	...on behavior	...on performance
Creation	Outperform markets in combining knowledge (Kogut & Zander 92) and protecting the creative process (Von Krogh, Roos, Slocum 94) Better at creating and sharing intellectual capital (Nahapiet & Goshal 98) and building reserves of capabilities (Loasby 98)	Knowledge creation internalized in firm if conversion rate higher than in market (Nonaka et al 99) Tacit knowledge can be higher inside firm boundaries (Nonaka et al 99) Firms resolve individual agency problems (Spender 96)	Redundant structures for knowledge creation (Spender 96) Higher order organizing principles integrate individual and social knowledge (Kogut & Zander 92) Dual structure of hierarchy and heterarchy assures knowledge creation and application (Nonaka et al 99)	R&D as a mechanism to facilitate learning and innovation (Cohen & Levinthal 90) Firms exchange and create intellectual capital through collective learning (Nahapiet & Goshal 98)	Knowledge creation leads to competitive advantage (Nonaka et al 99; Spender 96) Differences in firm performance due to ability to create/exploit social capital (Nahapiet & Goshal 98) Competitive advantage from ownership of knowledge assets and ability to combine with other assets (Teece 98)
Destruction				Core capabilities can become core rigidities. (Leonard-Barton 92)	Rigid routines lead to failure during discontinuities (Nelson & Winter, 82)
Integration	Coordination mechanisms (Grant 96, Grant & Baden-Fuller 00) Firms exist because tacit knowledge has infinitely high measurement costs and will not be transacted between firms (problems of efficient capital-asset pricing) (Hallwood 97)	Individual chooses between firm and market contracting based on highest value for knowledge (Conner and Prahalad 96) Boundaries depend on transaction costs (Williamson 99), effectiveness of knowledge transfer (Demsetz 91)	Hierarchy coordinates specialized knowledge resulting from division of labor (Loasby 98)	Firms seek to integrate individual knowledge which is often of a specialist character (Grant 96) Firms seek to integrate knowledge from partners through alliances (Grant & Baden-Fuller 00)	Integrative capabilities have impact on firm performance (Grant 96)

Category	Effects of knowledge on firm existence	...on boundaries	...on structure	...on behavior	...on performance
Absorption	Firms exist because they can create absorptive capacity at an organizational level (Cohen & Levinthal, 90; Nonaka et al 99) Firms lower cost of communication, coordination (Kogut & Zander 96)	Firms internalize knowledge creation if conversion rate is higher than in the market (Nonaka et al 99)	Hierarchical relationships in firms facilitate absorption by sequencing, compliance (Grant & Baden-Fuller 00) Higher order organizing principles integrate individual/social knowledge (Kogut & Zander 92)	R&D as mechanism to facilitate learning and generate innovation (Cohen & Levinthal 90)	Firm specific absorptive capacity can lead to innovation which leads to performance (Cohen & Levinthal 90)
Replication		Boundaries defined by inability to communicate or higher information costs (Foss 96) Boundaries determined by transaction costs <u>and</u> replicability of tacit knowledge (Teece 98); higher degree of tacit knowledge can exist inside a firm (Nonaka et al 99)	Type of organizational form linked with motivation and capabilities to generate and transfer tacit knowledge (Osterloh & Frey 00)	Intrinsic and extrinsic motivation matter in terms of transfer of tacit knowledge (Osterloh & Frey 00)	Knowledge generation and transfer are essential to a firm's competitive advantage. (Osterloh & Frey 00)
Protection	Firms are contracts, higher order principles to control moral hazard, agency problems (Foss 96), ability to protect intellectual rights (Teece 98) Employment contracts protect knowledge (Liebeskind 96)	Mechanisms to protection knowledge with outside increase communication costs (Liebeskind 96)	Hierarchies control moral hazard and lead to higher order principles (Foss 96) Hierarchies serve to disaggregate knowledge for protection (Liebeskind 96)	Firms establish mechanisms of knowledge protection (Liebeskind 96) Firms should see to encode private information in ways that raise measurement costs (Hallwood 97)	Privately held knowledge is a source of advantage (Conner & Prahalad 96) The protective capabilities create competitive advantage (Liebeskind 96)

TABLE 2

Definition of critical knowledge-based capabilities

Dyad	Capability	Description	Examples of metrics
Creation and destruction	Creation	Capacity to combine knowledge with knowledge or resources to produce output that exceeds the value of the sum of the inputs	R&D budget or R&D spending
	Destruction	Capacity to eliminate elements of knowledge or disassemble the interconnectedness of knowledge	Budgets for or spending on restructuring and reengineering
Integration and absorption	Integration	Capacity to secure a supply of knowledge and resources for the firm: hiring people (individual knowledge, tacit or explicit) or mergers and acquisitions (knowledge and resources of whole firms).	Purchasing records and salaries (labor costs)
	Absorption	Enables the use of knowledge and resources, and realizes their potential (typically involves the externalization of tacit knowledge from employees and acquired entities)	Training budget, selective elements of the IT budget, R&D budget
Replication and protection	Replication	Capacity to transfer knowledge from a transmitting entity -- an individual, an organization or an industry -- to a receiving entity without loss of information	Cost of copying information, cost of franchising, person-hours and resources invested in training
	Protection	Capacity to control the replication process including how many times knowledge can be replicated and whether it exits the firm	Legal costs, costs of establishing and enforcing patents, trademarks, etc.

FIGURE 1

The Integrated Knowledge-Based View of the Firm.

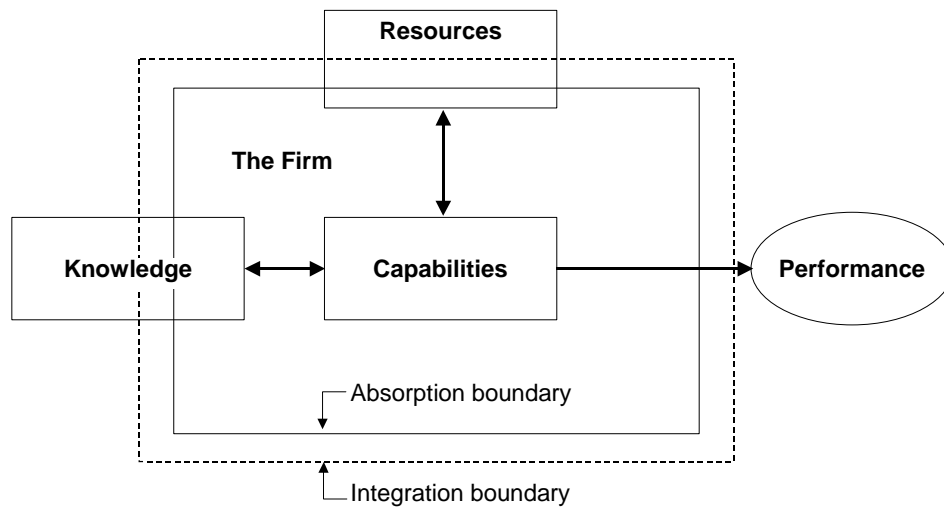
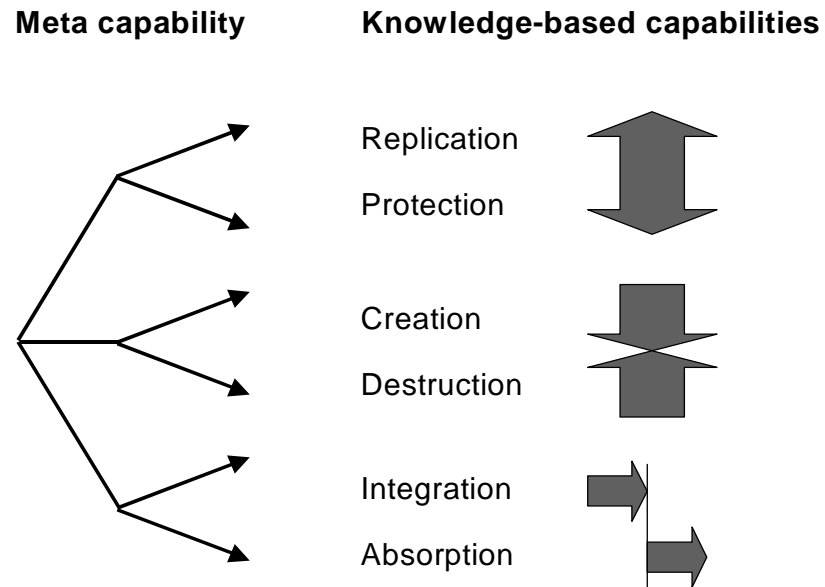


FIGURE 2
Organization of Capabilities



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