RESOURCE RECOMBINATIONS IN THE FIRM: KNOWLEDGE STRUCTURES AND THE POTENTIAL FOR SCHUMPETERIAN INNOVATION

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Abstract

Schumpeterian innovation rests on the ability to imagine and realize novel combinations of firm resources and capabilities. Firms are envisioned as owning stocks of varied resources that are clustered in distinct competencies. Although the resource-based view literature has exposed the importance of these capabilities to firm performance, their treatment is largely in the singular and their interaction and recombination requires exploration. Building on the resource-based view of the firm (RBV), the notion of creative resource recombination is explored and a theory of innovation based on resource recombinations is advanced.

I. INTRODUCTION

In much of the RBV literature, resources are discussed in the plural but the implications of that plurality are seldom explored. Two contributions are often credited with laying the foundations for the school; those of Rumelt (1984) and Wernerfelt (1984). Rumelt argues that the competitive position of the firm is ultimately defined by the bundle of unique resources it contains, clearly a pluralistic picture of a firm's composition. Yet, in developing the central theme of the work, the implications of inimitability and the importance of isolating mechanisms, the firm is treated, in a sense, as owning a single indivisible resource. Wernerfelt emphasizes that diversified firms should be seen as portfolios of resources rather than simply as portfolio of products, as his resource-product matrix makes clear. Moreover, firms are encouraged to consider the contingencies between resources and product-markets, making sure the necessary resources are well aligned with the product-market in question and that new resources are developed as required by emerging markets. Yet, once again, while the conception of resources in the firm is clearly plural, the relationship between these resources (as opposed to their relationships with product-market areas) is not explored. Indeed, in Wernerfelt's mathematical model, he explores a single resource case.

In most of the work that followed, the term 'resources' could just as well be replaced with 'resource', singular. In fact, as Wernerfelt noted in his ten-year review of the RBV (Wernerfelt 1995), the focus has been on better understanding resources, particularly what constitutes a resource, what makes them of strategic value, and even how resources might have negative value (e.g. Dierickx and Cool 1989; Barney 1991; Leonard-Barton 1992; Montgomery 1995). While contributions to this stream have dealt with the properties of resources in the plural, none of the arguments the authors make would be altered significantly were they to have considered a firm possessing only a single resource. Moreover, there has been relatively little attention to how

resources beget further resources (Leonard-Barton 1992). Possibly the only authors since Wernerfelt who have begun to consider the interaction of a firm's multiple resources are Hamel and Prahalad (1994). While Hamel & Prahalad have given us some compelling examples of resource recombination (for example Canon), one of the major stumbling blocks for the RBV has been that despite the strength (not to mention elegance and apparent simplicity) of these firms' accomplishments *ex post*, outcomes seem difficult to predict *ex ante*. Some firm's can easily envision novel uses for resources and go about recombining them while others stumble. What are the general forces at play in enabling one and limiting the other? To this end, in this paper we concern ourselves with furthering the development of a general theory of resource recombinations in the firm.

Our interest in resource recombinations stems partly from the potential for entrepreneurial rents. Barney (1986) has argued that the market for strategic factor inputs will ensure that the cost of investment exactly matches their expected returns, making it impossible to earn above normal rents. Exceptions to this general rule occur either because of luck (i.e., the exploitation of chance events, for example coal mine owners benefited from the oil crises of the 1970's) or because of information asymmetries in the marketplace. We argue that novel recombinations offer firms the potential to generate abnormal rents through *the discovery of new ways to combine and exploit their existing resources*. Even as the market for factor inputs contain information asymmetries, so firms can contain "internal information asymmetries" that constrain the exchange and redeployment of resources. Understanding the nature of these constraints is the focus of the next section of this paper. Staying with Barney's exceptions to normal rents, we also suggest that there are ways firms can help manufacture 'luck,' that is increase the probabilities of successful resource recombinations. In the last section of the paper we take up strategies for enabling resource recombinations.

Where do we begin to examine novel recombinations? The appeal of examining resource recombinations within firms stems from the work of Schumpeter (Schumpeter 1934; Schumpeter 1942). Schumpeter emphasized that entrepreneurship was the key motive force in the capitalist process, generating the innovations that would alter the rules (via "creative destruction") by which an industry, or even economy, would operate (Schumpeter 1942). For our purposes, the nature of his "entrepreneurship" and innovations has at least two important characteristics. First, the entrepreneurial role often consisted of recognizing the value in the component parts of diverse systems and discerning that these parts could be recombined in a novel fashion. As Schumpeter wrote:

> the defining characteristic [regarding the 'entrepreneurial function'] is simply the doing of new things or the doing of things that are already being done in a new way. (1991 p.412)

Schumpeter emphasized that innovation, as a process, was often a matter of reconfiguring what exists. In our framework, therefore, we focus on innovation that involves the recombination of underlying resources.

Second, in his later work (cf. Swedberg 1991 p.173) Schumpeter emphasized that the entrepreneur did not have to be a single individual but rather that the 'entrepreneurial function' was a social and co-operative process: "Every social environment has its own way of filling the entrepreneurial function" (Schumpeter 1951 p. 255, as cited in Swedberg, 1991). The entrepreneurial role of the firm is clearly of great importance today (Guth and Ginsberg 1990). Doz and Lehmann (1986) suggest that the gaps between firms' capabilities are narrowing to the point where 'out-innovating' competitors is the only way to survive. We will therefore focus on how firms (as opposed to individuals and strictly cognitive processes) can generate novel resource recombinations. We also observe that strategy research has been undergoing a shift in emphasis from Ricardian (scarcity-based) rents to Schumpeterian (innovation-based) rents in recent years (e.g., D'Aveni 1994; Teece and Pisano 1994; Winter 1995). For our purposes, we hold that such a shift requires a more thorough understanding of how resources can be recombined in firms. Moreover, the RBV remains decidedly mute on the Schumpeterian rent creation process. As Montgomery notes, "The Schumpeterian view of competition.. ..has taken a distant back seat in the resource-based view of the firm" (1995 p.263). Although the Schumpeterian view has been used to describe industry competitive dynamics (see D'Aveni 1994) it requires considerable development within the firm (see Nelson and Winter 1982).

A useful precursor to our work comes from Henderson and Clark (Henderson and Clark 1990). Henderson and Clark defined architectural innovation as the linking of existing *components* in new ways. We extend the notion of architectural innovation from dealing only with physical components to dealing with resources in general. We pay particular attention to the knowledge-based resources of the firm (Kogut and Zander 1992). We suggest that because of the more abstract nature of these types of resources, combining them is likely to be more difficult to achieve than when dealing with physical components. Moreover, innovation is more than just of a technical nature and captured only in new product development. Innovation, more broadly, can occur in a wide variety of areas, including the underlying business processes, market image and strategic positioning of the firm, all of which may be impacted by how the underlying resources of a firm are combined and configured. We therefore adapt Henderson and Clark's original framework for defining innovation of this sort in the firm (see Figure 1).

Figure 1 about here

In this paper we advance a view of innovation in firms based on a theory of resource recombinations. In the next section below, we first base our thinking in a model of knowledge structures within firms. We hold that to understand how resources can be recombined within the

firm requires some conceptualization of how resources and knowledge are organized. In the third section we then consider the implications for resource recombinations, focusing particularly on how such structures can enable or inhibit the recombination of resources. On a cautionary note, we should make it clear that we are not proposing a theory that will identify which recombinations will succeed and which will fail. Our goal is much more modest; to identify processes and contextual factors that we believe provide a more fertile seeding ground for innovation of this sort.

II. RESOURCES AND KNOWLEDGE IN THE FIRM

A Taxonomy of Resources and Knowledge Structures

According to the Concise Oxford dictionary, a resource is simply "a means of supplying what is needed, a stock that can be drawn on". Resources, in other words, are defined largely by the outcomes that they contribute to rather than their inherent nature. This has clearly been the pattern of usage in the RBV. For example, Wernerfelt (1984 p.172) notes that "by a resource is meant anything that could be thought of as strength or weakness of a given firm." Even more explicitly, Barney (1991) observes that resources are "all assets" that a firm controls *in order to* improve its efficiency and effectiveness. Resources, however, can also be distinguished from one another by their nature. Taxonomies of this sort are no doubt problematic since it becomes difficult to stake-out categories objectively. Nevertheless, we hold that such an effort is crucial to gaining insights into resource recombinations.

We conceive of resources as consisting of two basic types: (1) **Input resources** and (2) **Knowledge-based resources** (see Figure 2).

Figure 2 about here

Input Resources

Input resources are predominantly tangible in nature. They include four basic parts: People, Plant & Equipment (e.g., all machinery and office equipment), Property Rights (e.g., rights to mineral deposits), and Capital (e.g., monetary items)[1]. We can, for the most part, 'touch' all these elements and they all, to various degrees, are required in the transformation processes

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1 We can include under capital less tangible things like firm reputation and brand image without undermining the usefulness of the model. Elements like reputation and image are distinct, however, from knowledge-based resources in that they are typically an outcome, over time, of the interaction of various other resources. They are also externally held (in the minds of consumers) and their generation is a process not entirely endogenous to the firm. Yet, once accumulated, they do operate as a basic input for the firm and can be included under capital.

of firms: these are the most basic building blocks of a firm, and therefore we call them input resources.

Knowledge-based Resources

In order for these resources to be used together productively and create value, a further ingredient is needed: knowledge. Generally, the function of knowledge in our model is as a transformer and organizer of the input resources. That is, knowledge-based resources operate on the input resources providing both *specialized understanding* of the separate inputs as well as *co-ordinative understanding* of how the various input resources fit together to provide value to the firm. Beyond this general functionality of knowledge, however, it is useful to further categorize the structure of knowledge in a firm. There have been many categorizations of knowledge in the extant literature on organizations and strategy (e.g., Itami 1987; Winter 1987; Gupta and Govindarajan 1991; Kogut and Zander 1992; Leonard-Barton 1992). Since we find that there is a fair amount of consistency in these categorizations (and since we do not wish to reinvent them) we will build upon them. In particular, we find several common classifications and characterizations to be useful for our purposes.

First, we propose a taxonomy that distinguishes three forms of knowledge: i) **information,** and ii) **know-how** and iii) **understanding** (cf. Bohn 1991; Kogut and Zander 1992). Information refers to the data, facts, or symbols that can be exchanged between parties, that is for which there are standard syntactical rules for exchange and interpretation. In essence, this form of knowledge is declarative: it tells us what something is. Know-how, on the other hand, refers to the accumulated knowledge of how to do something, that is it is processual in nature. It essentially adds meaning to information, linking items in a cause effect relationship. Know-how includes knowledge of causal relationships, skills, routines and habits, standard operating procedures, organizational norms and values, and heedful interactions between individuals. Understanding denotes the comprehension or at least a theory of the underlying mechanisms for observed causal relationships. It is the generalization and abstraction that arises from experience of many specific instances of cause-effect relationships and includes managerial logics, mental models or maps and schemata. For our purposes (see figure 2), information paths (represented by arrows) serves to feed data between input resources and these knowledge-based resources as well as between knowledge-based resources.

Second, knowledge can be also be distinguished according to its **tacitness.** Tacitness is now a familiar category for knowledge as applied in organization and management theory (see Itami 1987) and generally describes the extent to which knowledge is or is not codifiable. For example, the dexterity with which an operatic tenor combines timing, body language and positioning on stage, and the various aspects of sound generation such as pitch and timbre in delivering an aria is largely a tacit (or non-codifiable) skill. At the other extreme, procedures for

shutting down a nuclear power plant are (one hopes) highly explicit. We also allow for the fact that while some knowledge may be inherently tacit, it is also possible that knowledge which is not inherently tacit may be, perhaps through choice, held in tacit form, such as through some form of routinization. Routines, which form around recurring activities, could, to some degree, be documented, although in many instances they are likely to remain in tacit form.

Third, knowledge can be distinguished according to its **dispersion**. It can be tightly held in the minds of individuals, such as in the case of the tenor. It can also be widely dispersed, residing in the collective organizational mind, for example in patterns of heedful interactions (Weick and Roberts 1993). As we shall see, the dispersion, or concentration, of knowledge will influence its transferability—concentrated knowledge may be moved much more easily than diffuse knowledge, even when the knowledge is explicit. Examples of the various classes of knowledge are illustrated in Figure 3. (For simplicity, know-how and understanding are grouped together in the figure.)

Figure 3 about here

Finally, we note that the context in which knowledge is developed is also important, largely because knowledge is often context specific. For example, the tight co-ordination of an aircraft carrier flight-deck crew, as Weick and Roberts (1993) describe, is a valuable resource to the US navy. However, in the case of the flight-deck crew, this type of 'group mind' is of little use outside of the relatively narrow context for which it was developed. A flight deck crew would be far less effective a resource at New York's JFK airport even if they were given the same broad set of tasks, still less at a sleepy rural airstrip in the south of England. Though the underlying tasks in all of these contexts may have considerable overlap, the differences in technology, physical layout, time pressures, task interaction effects and social atmosphere may all serve to reduce the usefulness of the carrier crew's "collective mind" when deployed in a different context. As Nelson emphasizes (1982, p 87):

> We have noted that all skills are context dependent in various ways, but the effectiveness of planning and implementation skills is particularly dependent upon detailed feature of the social context."

This is not to suggest that resources could not have multiple uses (cf. Wernerfelt 1984; Prahalad 1990). Input resources, in particular (e.g., machines and buildings), could be shared across different knowledge areas and can exhibit modularity (cf. Sanchez and Mahoney 1994). In particular, using knowledge-based resources across a wide variety of products maximizes the return on the investment in the creation of new knowledge. However, we point out that because of the advantages of specialization (i.e., making the knowledge more context specific) resources may be heavily customized to one particular use increasing the context specificity. A process of continuous refinement and honing of knowledge in a particular application may reduce the

potential for recouping that additional investment in other areas. For higher-level knowledge-based resources and more highly dispersed knowledge (e.g., group level routines) it is even less likely that these will overlap because these higher-level resources exhibit greater complexity vis-à-vis their integration of the underlying elements. Because an increase in complexity leads to greater idiosyncrasy, and hence specificity, higher level and dispersed knowledge will be less transferable across areas.

In summary, we conceive of knowledge-based resources as acting upon and transforming input resources to provide value for the firm. These knowledge resources may be distinguished according to their basic form (information, know-how, understanding), their degree of tacitness, their dispersion (concentrated or dispersed) and their context specificity. What remains is to consider how these elements are actually organized in the firm.

Competencies: Knowledge Structures and Institutions

It may seem curious that the word "competence" or "capability" has not entered the discussion yet, particularly strange given its popularity in the strategy literature. We have so far refrained from using these words for several reasons. First, although the field has converged on a relatively stable definition of capabilities and competencies, there is a still some ambiguity. Second, and more importantly, competencies/capabilities can best be articulated once a general description of resource and knowledge structures has been laid-down. We will therefore articulate competencies/capabilities with close reference to the above definitions and categories, showing them to be the key components of what we mean by a firm's competencies. In general, we will argue that competencies are *organized clusters of input and knowledge-based resources that exhibit institutional qualities within the firm*. The implications of this characterization for resource recombinations is the focus of the subsequent section of this paper.

The RBV literature has defined competencies and capabilities in many ways. The table below presents some examples.

Table 1: Some Examples of Definitions of Capabilities and Competencies

Reference	Definition
(Hamel and Prahalad 1994)	Competencies... • "current skills" of the firm • "accumulation of intellectual capital" • firm as portfolio of competencies
(Prahalad 1990)	Core Competencies... • those that offer competitive advantage
(Teece and Pisano 1994)	Capability

	• skills, resources, and functional competencies • ability to adapt the above
(Leonard-Barton 1992)	Core Capability • knowledge set (skills, technical systems, managerial systems, values and norms) • distinguish firm from others
(Barney and Zajac 1994)	Competencies • "the strategically relevant behavioral and social phenomena inside a firm"

Although the differences are not large, several observations can be made. First, competencies and capabilities are often used interchangeably and without particular distinction. Second, it is apparent that in some cases capabilities/competencies can take on a more specific definition (i.e., a focus on skills) while in others they are highly inclusive (i.e., all strategically relevant behavior and social phenomena). Although we favor the more inclusive definition, the underlying elements of competencies are often left without further organization and synthesis (exception is Leonard-Barton 1992). Finally, we can further distinguish between competencies which can sustain above normal economic profits, namely those which are rare, inimitable, and valuable to customers (Barney 1991) from those that are simply the entry ticket to the game, or "enabling competencies" (Teece and Pisano 1994).

One of the first difficulties that any theory dealing with competencies and resources must address is that of basic definition. How should competence be (generically) defined such that it can be identified by scholars and managers for the purposes of deciding on different permutations and combinations of underlying resources? For our purposes we propose the following. We will reserve the term capabilities for simply the ability to achieve or complete some task. Thus, we reserve the label capabilities for the smallest, relatively indivisible unit comprising of a set of resources that lead to the realization of a specific task (e.g., operation of a series of machines on an assembly line). This may still involve the clustering of underlying knowledge-based resources and raw inputs, and therefore resource recombination issues may also apply, however we reserve this label for those clusters of resources that are relatively nonessential to decompose further at the level of analysis of the whole firm. Given our purpose is to understand how underlying firm resources can be disentangled and recombined, our focus will be more on what we will call competencies. Below we will, first of all, provide a basic definition of competencies, focusing particularly on their i) hierarchical composition, ii) delineation in the firm (i.e., distinguishing

multiple competencies), and iii) institutional nature. The following section will then consider in more detail the implications for resource recombinations.

i.) The structure of competencies.

Competence, defined in the Concise Oxford dictionary as "ability (to do; for a task)", implies the presence of knowledge, both know-how and information, and the input resources on which the knowledge may act. Generally, organized clusters of various know-hows act on the basic input resources in the firm. The input resources are the basic raw materials needed for some transformation or maintenance process within the firm; the knowledge-based resources are the mechanisms that organize, co-ordinate, and add value to these input resources and release any potential value they may inherently embody. Thus, at a basic level, competencies are collections of the three levels of knowledge; information, which is relatively easy to codify, know-how, which often has a much greater tacit component, and understanding, which like know-how may also be highly tacit. Since competencies will comprise at least information and know-how if not also understanding, they will inevitably be based on knowledge which has a significant tacit component and which consequently will never be easily codifiable. So, in general, by competencies we will mean the more inclusive grouping of underlying resources in the firm.

This hierarchical architecture of competencies can be further defined (see Figure 4). For example, Canon describes its competencies as fine optics, precision mechanics, electronics and fine chemicals. Each of these competencies encompasses a wide range of basic inputs, information, know-how, and understandings. However, as illustrated in Figure 4, "fine optics" could be further subdivided into more basic capabilities, such as lens design, grinding and polishing processes, high performance coatings and thin film deposition. As noted previously, each capability could be identified with some underlying skill set or routine, which are, eventually, organizations of basic input resources. While each capability is potentially an independent element, they are typically clustered together into the groups in which they are most commonly deployed. A competence might thus be thought of as comprising a hierarchy of knowledge resources, the lower level 'capabilities' being components in higher order knowledge systems, or 'competencies'. Some competencies can be quite wide, involving a number of capabilities and underlying resources, while others may be quite narrow and involve relatively few.

Figure 4 about here

ii.) Delineating competencies.

Important to our purposes is the observation that firms are composed of competencies in the plural: several competencies are typically present in any firm. Moreover, the actual espousal of these competencies is probably more likely today as scholars and consultants encourage

managers to identify their core competencies. In fact, how well a firm consciously articulates its competencies could have adverse consequences for its ability to recombine resources (see under "competencies as institutions"). However, competencies need not be explicitly identified by the firm in order to exist and have influence. It is likely that these "resource clusters" exist whether or not a firm collectively acknowledges their existence—they are likely to evolve naturally. This does not mean that, to some extent, that which exactly marks-out a cluster of underlying resources as a competence will not be firm-specific and potentially idiosyncratic, more a matter of local perception than of general principle. However, there may be some grounds to support a more general means of delineation. The issue presently, therefore, is how competence boundaries may "naturally" fall, and what bearing this might have on the potential for resource recombinations.

One way in which competencies may come to be distinguished could be along the lines of those areas or groups in the firm which contain a knowledge base with a relatively high degree of overlap (both in terms of similarity of content and frequency of interaction). Such overlap in knowledge bases enables the essence of an idea to be exchanged with relative ease—only 'marginal changes' in shared knowledge need occur when ideas and information are exchanged. The more the two sets of knowledge bases differ between source and recipient, the more background information must be passed with the idea itself in order for it to be properly understood. For example, the use of a common (often unique) technical language improves the efficacy of information exchange, first by allowing exchanges to take place more quickly and second by avoiding the necessity for ideas to be translated into a higher level language for exchange (Cohen and Levinthal 1990; Kogut and Zander 1992; White 1992). Over time, frequent interactions will promote even more sources of shared communication, such as the development of lingo, particular body language and symbols, thus further improving the ease of exchange. Indeed, this process also suggests the construction and solidification of reality through the imparting of common *meaning* to repeated exchanges and patterns of action (Berger and Luckmann 1967). This has important cognitive implications, since the "externalized" actions and routines that are part of this process (see Zucker 1977) create schemata by which actors are guided in subsequent interactions. These schemata may create powerful sources of inertia in conducting the tasks within a competency regime, indirectly limiting the potential for novel recombinations.

iii.) Competencies as institutions

Finally, an important feature of competencies is their potential to exhibit institutional qualities (cf. Leonard-Barton 1992). This feature of competencies emphasizes less their complex structural integration per se, as presented above, than the fact that competencies tend to have histories. Competencies seldom form overnight, rather they accumulate various underlying resources and behaviors through a gradual, "interweaving" process. In particular, not only do the

underlying elements of a competence each have a history of development (i.e., the various input resources and individual skills), but these elements exhibit a *joint* developmental history. This feature of competencies tends to "institutionalize" them. The process is partly evidenced in the process of delineation described above, for example through the construction of common meaning within a competence regime. However, we refer here to a slightly different aspect of institutionalization, namely that competencies tend to develop a life of their own, a taken-for-granted quality that imparts to them *value* beyond their technical usefulness (Selznick 1957). Such structures tend to be identified by individuals as distinct, "living" entities, with certain anthropomorphic qualities—in turn, individuals tend to identify themselves with particular capabilities or competencies. This may make certain competency regimes within a firm less susceptible to alteration, both to the extent that they are seen as value-laden entities and thus worthy of preservation and to the extent that personal identities are wrapped-up within them. As Scott (1987) points out, institutionalization of this sort tends to promote stability of the structure being institutionalized, an artifact that will have implications for novel resources recombinations within firms. Moreover, and as noted above, to the extent that competency regimes are espoused and openly identified within the firm, these effects may become accentuated, that is there their institutional qualities will become deeper and more defined, and therefore greater constraints on resource recombinations may be likely.

Finally, a basic definition of competencies should say something about the imputation of value. Although attention is often directed to core competencies, i.e. those which sustain above normal rents, it should be noted that this is often a relatively small subset of competencies in any firm. Other, "enabling," competencies are required and there may be very good reasons for internalizing them within the firm's boundaries, even when the firm does not consider it to be a one of its inimitable competencies (cf., Teece and Pisano 1994). Thus, we retain a more inclusive definition which covers both core and enabling competencies.

In summary, we have described knowledge as information, know-how and understanding, as being partly tacit part explicit, partly held in the heads and hands of individuals and in their individual routines and habits. It is found in organizational routines, embedded in social processes, in heedful interactions between individuals and in the norms and values of the organization. Importantly, this knowledge is grouped into relatively homogeneous competence areas delineated by a shared meaning and language. In general, we define competencies as *organized* collections of a firm's basic input resources, information, and various know-hows. Based upon this model of knowledge in the firm, it remains for us to explore the consequences for novel resource recombinations. In particular, we will focus on how this structure of knowledge in the firm impedes or enables novel resources recombinations.

III. RESOURCE RECOMBINATIONS

Defining Recombinations

Our analysis now turns to connecting the nature of knowledge within firms to the issue of resource recombinations. At this point we have set-out what we mean by resources and how they are embedded and clustered in competencies. We should at this point clarify exactly what we mean when we talk of *resource recombinations*. There are three general forms of recombinations that we envisage, varying according to the degree of "creative destruction" that may need to occur in order for novelty to be created. These are: competence exploitation, within competence recombinations, and across competence recombinations. (See Table 2)

Table 2: Basic Forms of Resource Recombinations

	Resource Recombination Form		
	1. Competence Exploitation	2. Within Competence Recombinations	3. Between Competence Recombinations
Magnitude of Displacement	Low	Moderate	High
Potential Novelty	Moderate	Moderate	High
Likelihood of Recombinations	Moderate	High	Low

Competence Exploitation:

First, we make the distinction between the recombination of two or more competencies and value creation based on the exploitation of one particular competence. The latter is seen as a means of exploiting an existing core competence, for example when a single core competence is leveraged into alternative product-market areas, as described by Penrose (1959 p130):

> "..the competitive advantage in the new field can often be traced to the fact that the firm has developed productive services in its existing productive activities which are especially valuable in the new activity."

Kogut and Zander's notion of combinative capabilities also emphasizes such maximization of the alternative uses of existing core competencies; their "combinative capabilities" serve to match a firm competence to a technological opportunity, not competence with competence (1992). Such exploitation can certainly yield new rents. It may also involve some degree of recombination, to the extent that the existing competence must be adapted in order to be useful in its alternative deployment. Nevertheless, we believe that this leveraging process is

qualitatively different from, say, the recombination of the underlying resources within two distinct competencies. The former seems less dramatic in its transformation requirements on existing competence areas: the idea is to keep intact, as much as possible, the underlying skills and capabilities in applying them to another end. The latter is likely to involve more resources, and greater displacement of resources, and is nearer to what we believe Schumpeter intended in his notions of innovation through creative destruction of existing processes. Nevertheless, novelty, and new rents, can be expected, and at least moderate amounts of resources recombinations are likely.

Within Competence Recombinations:

A second type of resource recombination may occur *within* a competency area. Resources and capabilities may be recombined within the homogenous mass of input and knowledge-based resources that make-up some competency area. Such recombinations can equally be sources of new rents, for example, when new efficiencies are realized from the reconfiguration of a shop floor assembly line. Moreover, as Kogut and Zander point out, such recombinations are more likely than ones between competencies since the search for combinations of knowledge is highly constrained by the existing research heuristics and organizational structure (1992 p392), as well as by the higher absorptive capacity of the existing knowledge base (Cohen and Levinthal 1990) which facilities combinations in "proximate" technologies. The economic constraints that drive towards lowering the cost of information exchange will also constrain innovative search to a highly localized domain. *Ceteris paribus*, this limits the likely outcome of such activity to incremental innovation. While this also counts as a form of resource recombination and may produce novelty and new rent potential, the magnitude of resource displacement will be *relatively* lower than where two or more competencies are involved.

Between Competence Recombinations:

While we acknowledge the rent generating potential and difficulty of accomplishing the latter two forms of innovation, we wish to distinguish these from more radical forms of knowledge recombination, those that may take place between competency regimes. Our theory speaks more to the recombinations that take place *between competence areas, through the interaction or exchange of the underlying (input and knowledge-based) resources*. In other words, these recombinations occur when quasi-independent competency areas yield resources that fuse to produce some novel, potentially rent-creating entity. If the 'efficiency barriers' that may block such exchange and recombinations can be surmounted, the recombination of knowledge from one competency area with that of another offers the firm the possibility of breaking free of the constraints of local search, and the possibility of re-deploying resources in completely unforeseen (and rent generating) ways.

Examples of resource recombinations come from many different streams of strategy and organizations literature and are not confined to the resource-based view. For example, the combination of competencies in musical instruments and consumer electronics that led to the rise of Japanese firms in electronic keyboards was described by Porter (1990). Within the domain of domestic appliances competencies in heating and in electric motors came together to create a completely new product, the home bread maker (Nonaka and Takeuchi 1995). A vivid empirical study of how a firm recombines novel areas of knowledge to create new value comes from Hargadon and Sutton (Hargadon and Sutton 1996). In there study of a product design firm, they show how this organization "brokers" knowledge via its central network position between several industries. The firm's network position between knowledge domains, along with its specific internal routines for organizing incoming knowledge, creates new knowledge through the "inventive combination" of existing ideas (1996:233). They recall one instance of a novel recombination where a project team was assembled for the purpose of designing ski-goggles, where some of the team had in-depth knowledge of foam, some knew clear plastics, some knew manufacturing, and some knew skiing. Although their product design firm specifically targeted "inventive combinations," and in a sense are not like many firms, many firms do aspire to be more innovative in this way. This is evidenced by the popularity in the management literature of such firms as 3M, who have a distinct reputation for recombining resources for the purpose of creating new knowledge. Moreover, most firms will have some story to tell of how they created novelty through resource recombinations.

The point is that examples of this form of resource recombinations may abound. Moreover (as to their specification) recombinations may come in endless shapes and sizes. Our purpose is not so much to explicate this process. Indeed, philosophers of science have eschewed the study of how exactly creative insights are realized, as Popper definitively notes (Popper 1934:31):

> The act of conceiving or inventing a theory [or any novel insight], seems to me neither to call for logical analysis nor to be susceptible of it.

Avoiding such ambitious questions, for the most part, has continued to the present (cf. Bechtel 1988). Although our objectives are also more modest, nor do we go to the other extreme and consider only how new value can be appropriated once it has been created. Value appropriation focuses on how value can be achieved by ensuring that the competence on which a rent stream depends is protected either through property rights, such as patents and copyright, and/or by building on resources that are intrinsically inimitable (Rumelt 1984). Our approach is more in line with designs that focus on how new value is created in the firm (see also Moran and Ghoshal 1996). We will not, however, deal with how resource recombinations can be the source of new value per se, that is to distinguish more from less valuable recombinations. Our focus is more on the prior issue of what may impede or promote resource recombinations in the first place. In

particular, we take a probabilistic view on novel resource recombinations: based upon the construction of knowledge within the firm, what forces exist that will make novel recombinations *more or less likely to occur*? The focus is on the general issue of the detection and creation of novelty through the recombination of resources (currently "constrained" within the knowledge structure of the firm). This seems to us the essential element of Schumpeterian rent creation.

Constraints to Resource Recombination

Figure 5 presents a model predicting resource recombination likelihood based upon our framework of knowledge structures and competencies in the firm. This model focuses particularly on constraints to resource recombinations, mainly because we see these as the more "natural" outcomes of the way in which resources and knowledge are organized within firms. We also focus on how our description of knowledge structures and competencies within the firm impact two important mediating mechanisms in determining recombination likelihoods: *exchange costs* and *detection hindrances* (of novel uses for resources). On the whole, we hold that exchange costs and detection probabilities are two basic underlying mechanisms explaining a failure to recombine resources. The subsequent section will examine what management should do to try and overcome these impediments to recombinations, often involving proactive managerial involvement and perhaps unorthodox organizational designs.

Figure 5 about here

Tacit Knowledge

We have described two types of tacit knowledge, that which is inherently tacit, such as that embodied in an individual's skills, and that which is held in tacit form, typically as routines, as a means of increasing efficiency and reliability of processes. In either form, the general impediment tacit knowledge creates to resource recombinations is that tacit knowledge is both more difficult to transfer and more difficult to detect than explicit knowledge. It will therefore be more difficult to interact with knowledge bases in other competence areas, decreasing the likelihood of resource recombinations.

Inherently tacit knowledge

Knowledge or skills which are inherently tacit will be difficult and costly, if not impossible, to explicitly document. Documentation would tend to lose much of the rich detail inherent in the source. The effectiveness of this method of transfer will therefore decline quite rapidly the higher is the inherently tacit component. This should focus attention on other means of transferring knowledge in the firm, such as moving the people possessing the skill or knowledge and allowing the transfer to take place 'osmotically'. From the point of view of effectiveness of knowledge transfer, tacit to tacit transfer, or socialization, will be preferred. Knowledge transferred through socialization will have a greater chance of preserving much more

of its rich detail. However, socialization is costly, involving the prolonged, if not permanent, interaction of individuals with the store of tacit knowledge with those to whom it must be transferred. In many situations, this will decrease the likelihood of any knowledge exchange occurring.

Furthermore, tacit knowledge may simply be difficult to detect. Because it is not prone to easy articulation and documentation, it is more difficult for someone to identify this potential resource and capture how it may be used in novel ways or new contexts. This will be particularly true across competence areas, where people are less likely to spend appreciable time interacting with one another, and thus less likely to have the time and experience to be able to detect the novel use of some (highly tacit) resource. In general, we propose

Proposition 1(a) The likelihood of Schumpeterian resource recombinations will be diminished the more inherently tacit the knowledge base, both due to lower detection probability and higher costs of exchange.

Tacit knowledge embodied in routines

Attempts to increase efficiency and garner resources through greater reliability and consequent legitimacy are both aided by increasing task routinization (Meyer and Rowan 1977). Moreover, this form of knowledge, which an organization has chosen to hold in tacit form (routines) for reasons of efficiency, may be transferred by making it explicit for the purposes of the transfer. For such knowledge, which is not inherently tacit, externalization does not lead to a large drop in richness. An explicit transfer mechanism is then potentially efficient, since the knowledge, once externalized, may be widely distributed at relatively low cost.

However, we would argue that there are increasing costs, and decreasing efficiencies, to the transfer of such knowledge the farther the routine is transferred, such as if a routine is transferred between competence regimes. As noted earlier, routines capture instances of cause-effect relationships which may thus be made widely available. However, routines also restrict the scope of tacit knowledge development and retention by increasing specialization and context specificity. Because re-deployment of the sort we are concerned with necessarily requires that knowledge be used in new contexts, greater context specificity reduces its utility for recombination (largely because the underlying understanding is less likely to be transferred). Here we differ somewhat from Levitt and March (1988) who suggest that routines make the lessons of history widely available to those who have not had the experience from which the learning was derived, thus allowing the benefits of that learning without reproducing the mistakes which were a part of the original learning process. We suggest that a routine is only of immediate use in a context that is broadly similar to that in which the routine was developed. What is lost through routinization is the understanding, the deeper logic, that would allow it to

be adapted to a new setting without extensive experimentation to generate learning needed to make the routine applicable to the new context. Although recombination based on knowledge transferred via routines is possible, it is not without exchange costs, and which are greater the further afield is the targeted home for the transferred routine. This would be particularly debilitating for Schumpeterian innovation. Finally, we add that despite the loosening of the assumption of inherent tacitness, this form of knowledge may still be quite difficult to detect since it is held in tacit form: detection probabilities should be as diminished as in the previous case.

Proposition 1(b) The likelihood of Schumpeterian resource recombinations will be diminished the more otherwise codifiable knowledge is held in tacit form (routines), both due to lower detection probability and higher costs of exchange.

Dispersion of Knowledge— "lumpiness"

As noted, tacit knowledge can be transferred by immersing individuals who want to acquire that particular skill in a context where the are exposed to it and/or have to undertake the skill-laden operation themselves, as in the home-baking case described by Nonaka and Takeuchi (1995). However, when knowledge is embedded in higher levels or systems of interactions (e.g., Weick and Roberts 1993), moving that knowledge cannot simply be achieved by inserting an individual into the team and transplanting them 'replete with new wisdom' into the new setting where the learned knowledge is to be applied. The transplanted individual will bring with them too small a part of the total system of heedful interactions to be of use in the new setting: In other words, knowledge that is widely dispersed is also likely to be "lumpy". Moving this type of systems-embedded knowledge may require the wholesale uprooting of the system and its transplanting in the new context.

Here, many difficulties present themselves. Firstly, this may not be realistic: current operating commitments and priorities may preclude the removal of the team with whom the knowledge resides. Second, because such knowledge is often highly context specific, it may well not be reproducible in the new setting for the purposes of merging with other knowledge in the recombination process. This 'lumpiness' of knowledge therefore represents an obstacle in recombination processes. Specifically, exchange costs may be prohibitively high the more widely knowledge is dispersed since it may only come in discrete, "lump-sum" bundles.

Proposition 2 The likelihood of Schumpeterian resource recombinations will be diminished the more widely dispersed the knowledge, largely because of higher costs of exchange.

Figure 6 captures propositions 1 and 2 by depicting the effect on resource recombination likelihood of two focal characteristics of knowledge in the firm. In general, the more tacit and the more dispersed the knowledge, the lower the likelihood of resource recombinations.

Figure 6 about here

Delineation & Institutionalization of Competencies

Earlier we described two dynamic qualities of competencies— the fact that they are likely to undergo a process of delineation and institutionalization within the firm. Both of these will increase the costs and reduce the probability of the exchange of knowledge, thus lowering the probability of recombinations.

Delineation and Exchange Costs

As we noted, often within a competency regime a unique language and common system of meaning evolve to facilitate intra-group communications (Cohen and Levinthal 1990; Kogut and Zander 1992; White 1992). The effect is to create a potentially tight schemata by which actions are conducted and interpreted: Knowledge within the competence regime will tend to deepen while that of neighboring competencies will become shallower. Such schemata become a means of delineating and maintaining boundaries between a competence area and other parts of the organization. This may be an impediment to cross-competency exchange, in effect decreasing the amount of intercompetence absorptive capacity (e.g., Cohen and Levinthal 1990). For example, a common language itself represents a store of tacit knowledge since it often contains words with highly specific associations and meanings which are seldom (if ever) documented. Exchange of know-how between individuals or groups that do not share the same technical language requires that much of the tacit component of that knowledge be made explicit so that the language used in the exchange has a shared meaning for both parties, a time consuming, and therefore costly, process.

Moreover, the delineation process will build momentum around a competence regime, conditioning the future trajectories that a particular resource set within the firm may take. Penrose noted as much when she wrote (emphasis added, Penrose 1959 p113):

> "[A firm's] opportunities are largely determined by its existing resources. Its entrepreneurial and managerial personnel work within the framework provided by these resources and their *interests and abilities are conditioned by them*"

Although Penrose intended this as an explanation of why entire firms chose to grow and diversify in the directions that they do, we note that the same mechanisms can operate within the firm to explain why delineated resource bundles, once set on different and distinct trajectories (implicit in the delineation process), may fail to adequately interact, reducing the probabilities of resource recombinations.

Overall, the delineation process has implications for resource recombinations mostly through the inherent cost of exchanges across competence regimes (cf., North 1990). It is likely that certain exchanges within the firm will have lower transaction costs associated with them

than others owing to the construction of meaning and delineation of competencies within the firm. In general, competence regimes will encircle those entities within the firm with relatively low transaction costs between them. This may facilitate efficiencies in doing the work of the firm within a competency regime, but it should also make less likely the realization of particularly novel resource recombinations: to the extent that the transaction costs of exchanges between competencies are markedly higher than those within competencies, any resource recombinations may be "naturally" undermined across competence areas. In other words, search will be local and the likelihood of Schumpeterian innovation diminished (cf. Cyert and March 1963).

Proposition 3(a) The likelihood of Schumpeterian resource recombinations will be diminished the more delineated the competency area (i.e., distinct and separate schemata), largely because of the higher costs of exchange with other competency areas.

Institutionalization and Detection Probability

Closely related to issues of delineation are issues of institutionalization of a competence regime. As noted earlier, as competencies become imbued with meaning and acquire a taken-for-granted quality, they may also become valued in themselves, particularly as a means of signaling group and individual identity (Selznick 1957). Such institutionalization processes surrounding the development of competencies also emphasize another basic mechanism, in addition to exchange costs, by which resource recombinations may be hindered: they may simply go undetected. Individuals may become so "embedded" within a competency regime, both through recurring involvement and close identification, that they fail to detect alternative uses for, or combinations of, firm resources. By "embedded" we mean not only issues of time management (not having enough time to discover and explore alternatives—clearly an important factor given that the organization of resources in the firm may be very complex), but also an inability to adequately value the organization of resources residing outside of one's competence regime (i.e., rather like a "not-invented-here" syndrome operating within the firm). Other psychological/motivational traits that would support a failure to detect such novelty include hubris (e.g., an overestimation of the value of one's competence regime) and general defensive behavior (e.g., perceiving competencies outside of ones immediate association as threats) (Argyris and Schon 1978; Rumelt 1995). In any case, individuals will experience diminished motivations in looking for novelty.

We also add that low detection probabilities can evolve because of cognitive (as opposed to just motivational) biases. Although individuals could be encouraged to keep abreast of knowledge produced in other competence domains, the knowledge structures and schemata of the recipient will filter the inflow of information. As knowledge structures become stronger over time

and thus more prominent there will be an increasing tendency to perceive data congruent with one's own structure and unconsciously ignore information that might not fit (cf. Vallone, Ross et al. 1985). This 'distorted perception' reduces the identification and retention of knowledge that might seed a significant change to existing knowledge structures (Neisser 1976; Dutton and Jackson 1987). The probability of a 'frame-breaking' innovation through the recombination of two distinct sets of organizational knowledge is reduced. On the whole:

Proposition 3(b) The likelihood of Schumpeterian resource recombinations will be diminished the more institutionalized the competency area, largely because of the lower probabilities of detecting novel uses for existing resources across the firm.

Finally, we noted earlier that many firms are making a habit of pin-pointing their competencies at the present time. This should accentuate institutionalization processes. Sharp delineation will deepen the gulf between competencies, making interaction and transfer of knowledge more difficult. By overtly classifying a particular skill as a part of competence set X it is implicitly separated from possibly related skills in competence set Y. In general, the greater the degree to which competencies are clearly defined, the more rigid and entrenched they become. Firms which have leapt onto the core competence developing band-wagon and have tried to incorporate competence development explicitly into the strategic planning of the firm, have sometimes found themselves with core rigidities (Leonard-Barton 1992). The act of articulation thus reinforces the natural tendency towards institutionalization, and with it the aforementioned rigidities.

Incentives

We add one further component to our model of recombination likelihood: incentives. We include here both monetary incentives (salary-level, bonus) and social incentives (recognition, status). Although incentives have not been worked directly into our model of knowledge structures and competencies, they are clearly important to consider as they are closely related with competence boundaries. In particular, we argue that incentives often tend to be aligned with objectives being pursued *within* rather than across divisions between competency areas. Furthermore, incentive systems will significantly influence the probability of recombination. Much in the same way that, for example, SBU-aligned incentives impeded global co-ordination (Prahalad and Doz 1987), incentives that are aligned with competencies will reduce interaction between competencies. It is relatively rare for sub-units in organizations to reward people for helping other parts of the organization. Incentives are usually structured hierarchically, typically mapping the formal structure of the firm. For example, a country sales manager will measure his regional managers on the performance of their respective regions, branch managers

will be rewarded for their part of the region's sales achievement, individual marketing managers for the aggregate performance of those in their team. A salesperson is unlikely to get recognition for helping a colleague in the next marketing unit, let alone in another branch or worse still in another region. Any knowledge that salesperson accumulates, even though it might be valuable to people in other parts of the firm, will not be transferred unless incentives are in place to encourage him/her to do so. This is another aspect of finding an appropriate balance between cross competence exploration for novel resource combinations and within competence exploitation where improvement comes from building on the body of knowledge within the competence area. Of course, incentives can be altered to attempt a redress of this imbalance (see next section). However, we maintain incentives act as a constraint to resource recombinations since we believe this will, without intervention, tend to be the default or natural condition in most organizations.

Proposition 4 The likelihood of Schumpeterian resource recombinations will be diminished the more incentives are focused within a competency area. This should work to both lower the probabilities of detecting novel uses for existing resources across the firm and making exchange costs high.

We end this section by pointing out a double jeopardy that firms who seek novel resource recombinations face. The characteristic of "tacitness" of knowledge suggests that we can not transfer (very easily) what we do not know about and or cannot fully articulate and codify. On the other hand, "delineation and institutionalization" processes suggest that once we know the competency exists (and may even have labeled it) we may be no more likely to see novel resource recombinations. This suggests that, under normal conditions and without carefully crafted managerial interventions, the proverbial cards are stacked high against a firm experiencing innovation through novel resource recombinations.

Managerial implications: Enabling Resource Recombinations

Although the constraints above were presented as testable propositions (i.e., with expectations of variance across firms) we suspect that in many cases the "natural" tendency will be against radical resource recombinations. For this reason, we now offer some ways in which these constraints may be overcome and the sort of novel resource recombinations we envision enabled. However, we point out one caveat. Most of the constraints that we have suggested work to promote, to some extent, efficiencies within the firm (i.e., value appropriation within a competency area). We therefore recognize that suggestions that promote more exploration may

come with a cost for exploitation (cf. March 1991). Given the desire by many firms to become more innovative, however, it seems this is a cost worth considering.

The view of innovation through novel resource recombination being presented here is fundamentally stochastic. The normative implications therefore center around ways of improving the *odds* of producing valuable new combinations of resources. There are, of course, many ways this could be achieved, and our suggestions are not meant to be exhaustive. However, we derive our recombinations from an examination of the preceding constraints and the structure of knowledge in the firm. First, we hold that a prerequisite for Schumpeterian innovation involves *shaping the structure of knowledge* in the firm in order to increase the likelihood of recombination. This will involve taking into account and/or altering the form in which knowledge is held (Tacitness dimension), the locations in which it is held (Dispersion dimension), and the boundaries between competence areas (Delineation and Institutionalization dimension). Second, we also argue that Schumpeterian innovation requires *shaping the context for knowledge creation* in the firm (cf. Ghoshal and Bartlett 1994). This will involve changing the processes associated with discovery in the firm, including attitudes, values, and incentive structures.

Shaping the Structure of Knowledge in the Firm

In general, in order to promote the recombination of resources which will lead to Schumperterian innovation, elements from two or more competence areas must be somehow interacted or structurally brought closer together. Somehow a bridge or tunnel must be built between them in order to enable the potential for novelty to be recognized and for exchanges to occur. The issue we know take-up is, given what we assume about how knowledge is held in the firm, what should these bridges or tunnels look like?

Tacitness: Building Closeness and Enduring Structures

Bringing together pools of knowledge from two or more competence areas requires integrating or boundary spanning mechanisms that link one set of knowledge to the others. These integrating mechanisms, however, may differ depending on the nature of the knowledge involved. As has been described earlier, externalization and documentation may be a viable option for transferring knowledge that is not inherently tacit. However, where highly tacit knowledge is involved, there may be no alternative to constructing *closer* and *enduring* interactions. Closeness recognizes that tacit knowledge only travels after considerable experience and exchange ("osmosis") between competence areas. Where areas have drifted apart, "resocialization" efforts may need to be conducted, where social and technical interaction is promoted. This was, for example, a key component in the integration efforts carried out by SmithKline and Beecham following their merger (Hyde and Haspeslagh 1994). Corporate management did not themselves provide an integration logic. Rather, they relied upon disparate

parts of both organizations, interacting through committees and task forces, to come-up with novel ways to organize corporate resources. Seemingly, corporate level management could not really begin to articulate and recombine for themselves all the deeper knowledge contained lower down in the newly merged organization.

Interactions should also be enduring or frequent. To continue with the bridge/tunnel metaphor, bridges may be temporary pontoons constructed with a particular project in mind. Cross-functional teams working on a new car might be an example of such a temporary bridging of the tacit knowledge gap. However, we believe that unless such structures become a more permanent way of life, the probability of generating radical innovation vis-à-vis tacit knowledge is greatly reduced. This is because, in general, it will take more time for deeper tacit knowledge to be exchanged. Exchange in this case may be possible only after actors have, to some extent, internalized each others ways and thinking: this will tend to take more time for the deeper insights. We prefer the tunnel metaphor in this case. First it is more permanent; it cannot be easily dismantled for use elsewhere. Second, it suggests transfer at a deeper level, that is a more tacit, and therefore richer, exchange of knowledge. Ongoing staff rotation between specific competence areas might be one "tunnel-like" suggestion.

Dispersion: Holding knowledge in the right place

As noted, problems arise when knowledge is widely dispersed, leading to a 'lumpiness' of knowledge. Here the constraints of maintaining current operations may prevent a large enough 'piece' of the system from being moved. We see no easy answer in dealing with the exchange costs of this situation. However, where the possibility exists, the current system might be expanded until it reaches a sufficient size that it may be split into two and one moved to a new competence area along with its dispersed or 'interaction-embedded' knowledge. A potential problem with this approach is that such a group may not be sustainable at twice its original size while still preserving the interactions and thus the knowledge embedded in the system.

Although dispersed knowledge can be a costly component in a recombination, there may be a "second best-way" of making such knowledge available. This simply recognizes that some actors (individuals or teams) are more "generalists" than "specialists". Moreover, generalists will have the better purview for replicating enough system-embedded knowledge from their setting to another to make a resource recombination possible. In this case, the entire system would not have to be transferred, rather one or a few generalists. The key managerial decision regarding the structure of knowledge in this case relates to the breadth of individual or team knowledge held in the firm. If human learning, retention and cognitive capabilities are not unlimited, individuals will continually be making trade-off decisions as to whether to increase the breadth and comprehensiveness of their knowledge or to deepen their understanding of a particular 'specialist' area of knowledge. Increasing eclecticism should facilitate identification of more

systems-level knowledge (however imperfect) making it more likely that recombinations, which require such dispersed knowledge, are possible. On the other hand, such increases in breadth of knowledge must come at the expense of the development of highly specialized knowledge, which may prove difficult for firms trying to stay at the cutting edge of research. A mix of both might be appropriate with some more people specializing deeply in their competence while others in the same area concentrate on acquiring a more general but broad understanding of other competencies. These people would fulfill a role analogous to that described by Lawrence and Lorsch (1967) of integrators between the different competencies.

Delineation and Institutionalization: Thinning boundaries

Delineation and institutionalization of capabilities and competencies in the firm is a natural and even necessary process. Simply put, bundles of firm resources are more likely to contribute to a firm's wealth when they are coherently organized, allowing everything from the creation of platforms for future innovation trajectories (Kim and Kogut 1996) to greater employee motivation through the creation of common identity. A firm's market image can also be bolstered through its association with a strong core competency. However, as we argued, such processes can also debilitate Schumpeterian rent creation. In turn, we suggest that firm's should consider a) tempering the competence identification process (while being careful not to destroy it) and b) attempt various exchange mechanisms for keeping diverging groups from become excessively isolated.

Tempering competence identification in essence means weakening the boundaries that divide various parts of a firm. This may come about through a continuous policy of avoiding strong demarcation of roles and domains. For example, Japanese firms have much less clear demarcation of where competencies reside. The boundaries of where knowledge of a particular area start and finish are typically much fuzzier (Doz and Lehmann 1986). This may be an indication of a higher degree of shared knowledge and which makes the separation between competencies much less clearly definable, both in terms of differences in language and in terms of knowledge bases and structures. With a greater degree of overlap between knowledge sets, critical insights are more likely to arise.

Strong boundaries may also be weakened through the occasional "redrawing" of boundaries and domains. For example, in large, diversified firms, divisional domains of responsibility may occasionally be transferred between related divisions (Galunic and Eisenhardt 1996). This practice was found to occur when the most appropriate (divisional) resources were in no longer in contact with product-market areas relative to the resource sets available in other divisions. It also created, however, a sense of collective responsibility for the broader corporate charter of this firm, keeping divisions that much more aware of what opportunities were available in other parts of the firm and conscious of altering their resource set accordingly.

Finally, another mechanism for fostering looser boundaries are systems and fora for knowledge sharing and exchange. We noted some exchange mechanisms under tacitness above, aimed more at specific bridge-making between areas. Here we consider more collective undertakings that provide a more general forum for exchange. Take for example Sony's annual science fair. This fair gathers people from various corners of the company in order to participate in the presentation of new ideas and projects. In essence, the fair allows different groups to keep abreast of leading edge research in other parts of the company, and thus helping alleviate at least some of the problems associated with boundary delineation. Of course, one problem with such a scheme is that in may cases the amount of knowledge that can be transferred in such a short time and using explicit, codified exchanges, *may* be inadequate even to sow the seeds of innovation. The strength here would seem to be in the number of different people who are exposed to ideas in different parts of the organization. As Mintzberg suggests(1995), arriving at a decision is an iterative process punctuated by insights and revelations, thus by increasing the range of different competencies of which people are aware, the range of options considered when charting a course for further development is greatly increased, reducing the probability that a promising new avenue for recombination is missed.

In short, managers should carefully consider how boundaries are being constructed within the firm and what steps they might take to provide some guidance and control to this process. Where those boundaries are drawn, while partly a function of objective differences between competencies, rests also on managerial judgment. From the managers perspective, too broad a definition of a competence area may create hindrances to efficiencies. Too narrow a definition, without sufficient bridging and exchange mechanisms, could lead to a loss of recombination potentials.

Shaping the Context for Knowledge Creation in the Firm

Above we have focused for the most part on mechanisms that attempt to directly link pockets of knowledge in the firm, creating structures that should induce recombinations. This is of course only one part of what it may take to encourage novel recombinations, albeit it falls naturally from our model of the organization of knowledge in the firm. Nevertheless, other factors should also be considered. We roughly put these under the umbrella of managing the behavioral context in the firm, or the "smell of the place" (Ghoshal and Bartlett 1994). Many factors could be included under such an umbrella and would go beyond the scope of this paper. Instead, we focus on two which we feel are particularly salient for our purposes: the management of "ambition" and the management of political resources.

Managing "Ambition"

Taking for granted that some degree of individual ambition is a psychological factor and outside the immediate control of management, management should nonetheless endeavor to

control the extent of ambition or stretch in the system (cf. Ghoshal and Bartlett 1994; Hamel and Prahalad 1994). Stretch has been generally defined as striving for more, rather than less, in fulfilling ones duties in the firm. However, stretch also connotes a feeling of being overburdened with things to do, which is not the concept we are after. Clearly, the notion of a sense of urgency or drive to accomplish more for the firm is important, and we retain this notion of stretch. However, we believe that in order to direct that energy to new innovations, as opposed to greater efficiencies in existing ways of doing things, firms need to also create some "slack" in the system (cf. March 1991). This may simply mean more "free" time, where employees are encouraged to build their stores of knowledge (hopefully allowing more time for intrafirm bridging activities, mentioned above) or simply more time to "think." Ironically, this may mean giving employees less things to do, or even loosening the expectations placed on actions likely to promote greater value appropriation. This may be a tough balancing act, given that attempts at stretching people tends to kill slack, largely because "stretch" could be mis-interpreted as simply requiring pre-existing managerial directives to become "more prominent" for the employee. One possible solution would be to focus much more on output controls in managing employees, and more general ones at that, rather than behavioral controls, such as the direct and frequent supervision of duties (Eisenhardt 1988). Specific incentives for the introduction of novelty, particularly rewarding ones that make use of wide ranging firm resources, should be considered. For example, Procter and Gamble have an incentive system that acknowledges and rewards those who, when in need of a new solution, manage to find an existing response to a similar situation and adapt it to their own needs. The system also actively discourages re-inventing the wheel and the 'not invented here' syndrome. While clearly serving as a means to promote the transfer of existing knowledge thus ensuring it is well exploited, it also helps in ways that might increase the likelihood of innovation. First, it is facilitated by the construction of a central database of knowledge within the company. Second, by exposing people looking though the data base to a menu of knowledge that exists elsewhere in the company, the probability of a change discovery of ideas that might lead to Schumperterian innovation is enhanced. Such mechanism should not only appropriately heighten motivations to innovate but also help ensure that resulting ambition is not quickly siphoned-off to well established paths of action in the firm.

Another key component of managing ambition is the management of risk. It is likely that employees observe as closely how a firm deals with failures as they do how it treats successes. In general, the downside of attempted recombinations should be minimized in order to promote more ideas to emerge. Of course, the downside is that it may encourage an overabundance of ideas, many of which may be inappropriate and time consuming to develop (for employees) and sort through (for management). Nevertheless, it is certainly true that one way to increase the likelihood of novel recombinations is to increase the number of trials. Trials can, to some extent, be directed, such as when senior management creates for the firm an overall sense of direction, call it a strategic context (Bower 1970) or strategic intent (Hamel 1989). However, such

directions, if overly orthodox and maintained too stringently, may also create barriers to truly novel resource recombinations, inducing change that is mostly in line with current directions (see Burgelman 1991). In general, we are skeptical that proactive, or overly directive behavior, is of much use to firms in search of the sort of innovations we have described-if firms knew such paths they would scarcely need to worry about managing the behavioral context.

Managing the availability of political resources

Finally, although the management of ambition in the firm can encourage the detection of novel uses for resources, it does not necessarily speak to problems of implementing those ideas once they have been developed. Political barriers may exist that make the movement of resources very difficult to in fact achieve. Political activity (i.e., protection of self-interests) will be particularly robust where competence boundaries have been firmly defined and associated with individual identities. In such situations, even if novel ideas could be conceived, they would die for lack of tools to implement them. One remedy, of course, is to weaken those boundaries, as noted above. This could go some way in lowering political behavior, largely because it should help reduce political attitudes. Nonetheless, this may still not be enough to counter political sentiment. There are many suggestions to be made for guiding change through politicized systems (see, Kanter, Stein et al. 1992), although once again outside our scope. However, we choose to emphasize the role of the senior executive (i.e., someone with wide-spanning fiat power) in this situation. This is largely because only someone with such a position has a sufficiently encompassing view of an organization and authority in order to ensure that the flows of knowledge are managed appropriately for the firm's needs. To the extent that suggestions are far-reaching in their content and implications for a firm's strategy, executives need to be involved. There may be no substitute for executive attention, support, and encouragement in such undertakings. Leaving such processes to autonomous strategic behavior (Burgelman 1991), which seemingly requires clandestine action on the part of employees, may also mean leaving transaction costs too high for such innovation to be attempted.

Concluding comments

We have argued that the RBV must be supplemented to encompass value creation rather than simply value appropriation. One means of realizing Schumperterian innovation is by combining a firms existing resources in novel ways. Productive resources require two elements - basic inputs and know-how. We equate competencies, the means of co-ordinating input resources such that value might be obtained from their deployment, to know-how. The different characteristics of knowledge, its tacitness and its location are discussed and their impact on recombination evaluated.

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Figure 1: A framework for defining innovation (adapted from Henderson & Clark, 1990)

		Firms resources and capabilities	
		Reinforced	Overturned
Ways in which Resources are combined	Unchanged	Incremental Resource Development	"Modular" Resource Substitution
	Changed	Simple Resource Recombination	Radical Resource Recombination

(Shaded area represents our general focus in this paper)

Figure 2: Basic Structure of Resources and Knowledge

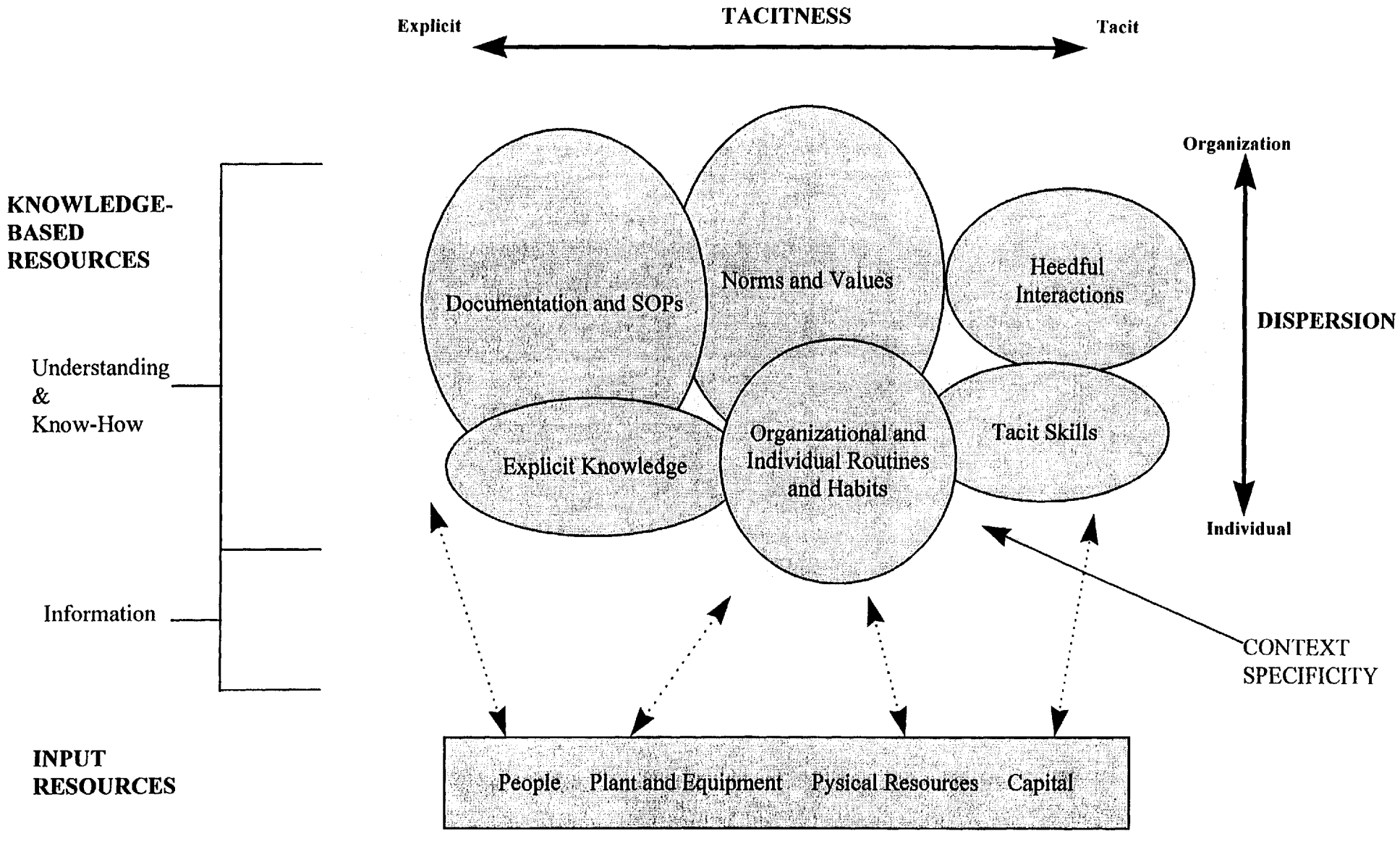

Figure 3: Taxonomy of Firm Knowledge

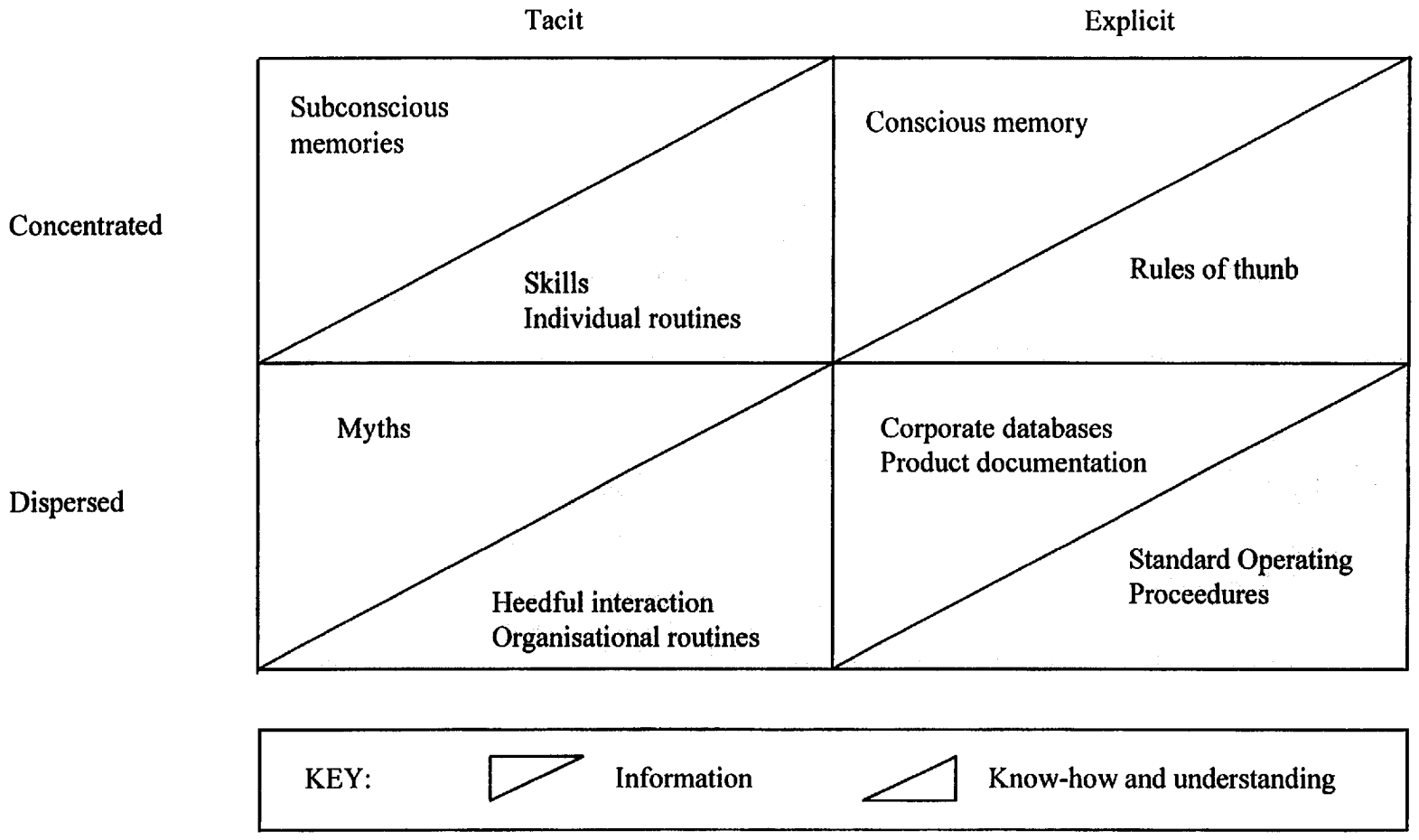

Figure 4: The Sub-Structure of Competencies—Example of Canon

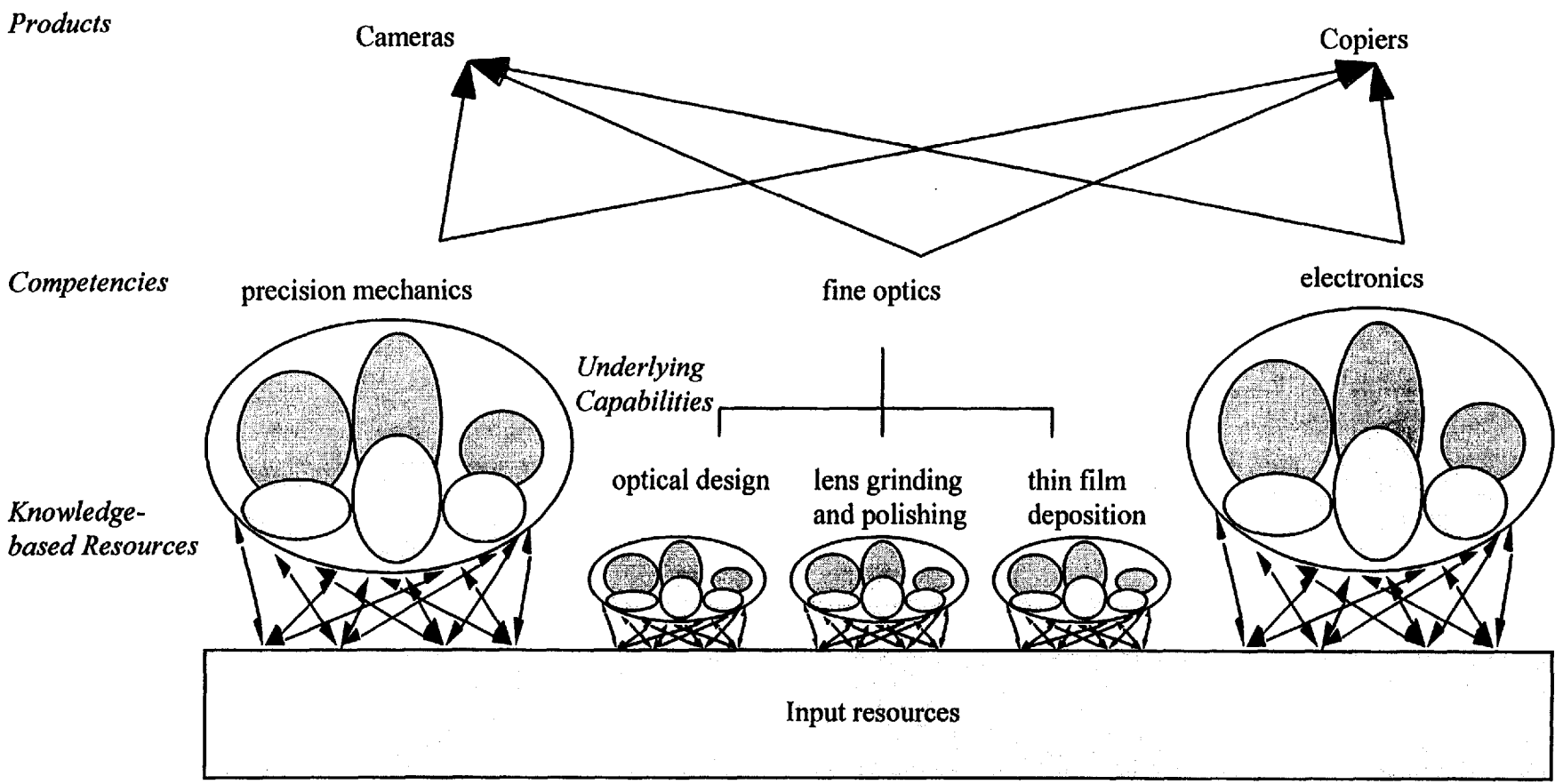

Figure 5: A Model of Resource Recombination Likelihood

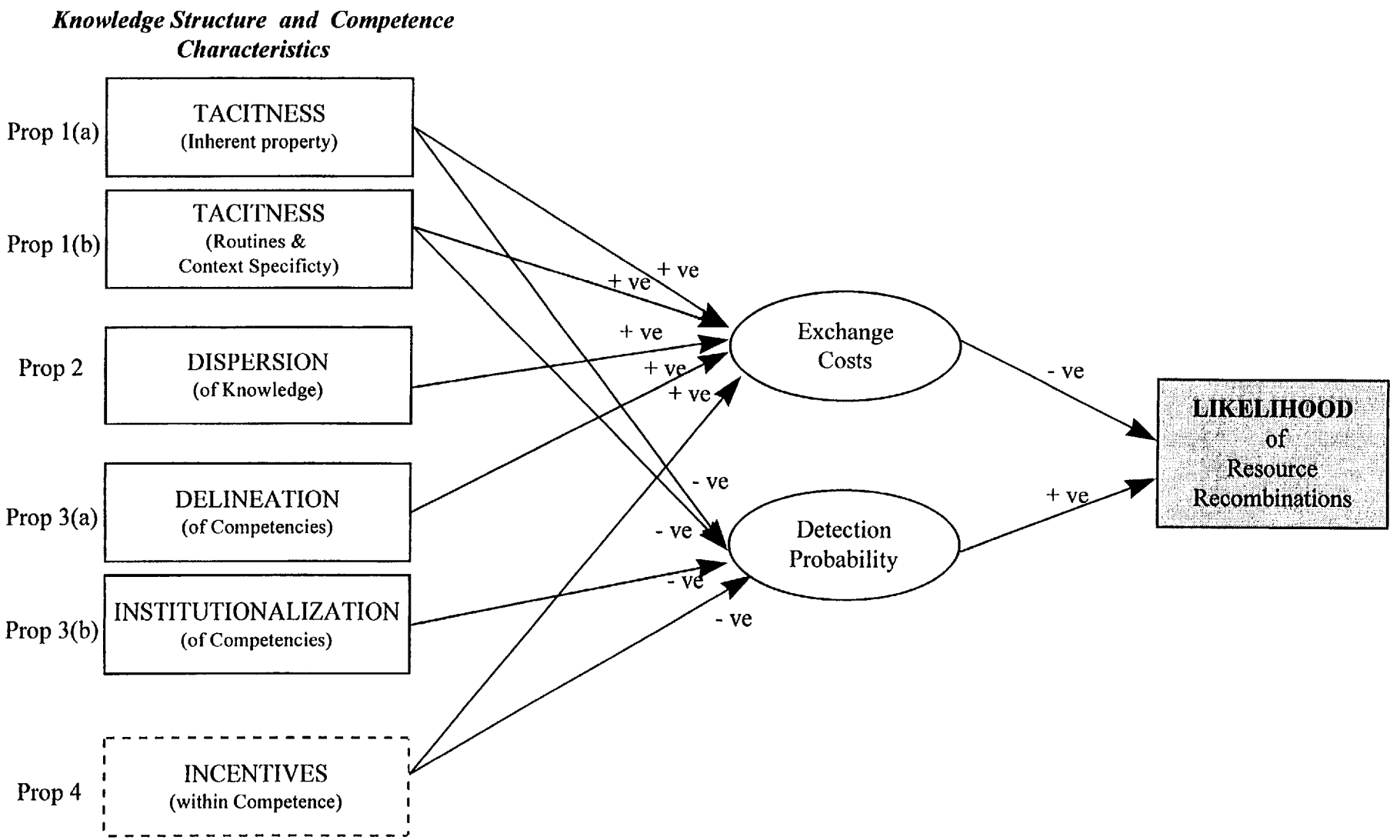

Figure 6: Bottleneck in Crossing Competence Boundaries