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DYNAMIC CAPABILITIES: WHAT ARE THEY?

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This paper focuses on dynamic capabilities and, more generally, the resource-based view of the firm. We argue that dynamic capabilities are a set of specific and identifiable processes such as product development, strategic decision making, and alliancing. They are neither vague nor tautological. Although dynamic capabilities are idiosyncratic in their details and path dependent in their emergence, they have significant commonalities across firms (popularly termed 'best practice'). This suggests that they are more homogeneous, fungible, equifinal, and substitutable than is usually assumed. In moderately dynamic markets, dynamic capabilities resemble the traditional conception of routines. They are detailed, analytic, stable processes with predictable outcomes. In contrast, in high-velocity markets, they are simple, highly experiential and fragile processes with unpredictable outcomes. Finally, well-known learning mechanisms guide the evolution of dynamic capabilities. In moderately dynamic markets, the evolutionary emphasis is on variation. In high-velocity markets, it is on selection. At the level of RBV, we conclude that traditional RBV misidentifies the locus of long-term competitive advantage in dynamic markets, overemphasizes the strategic logic of leverage, and reaches a boundary condition in high-velocity markets. Copyright © 2000 John Wiley & Sons, Ltd.

The resource-based view of the firm (RBV) is an influential theoretical framework for understanding how competitive advantage within firms is achieved and how that advantage might be sustained over time (Barney, 1991; Nelson, 1991; Penrose, 1959; Peteraf, 1993; Prahalad and Hamel, 1990; Schumpeter, 1934; Teece, Pisano, and Shuen, 1997; Wernerfelt, 1984). This perspective focuses on the internal organization of firms, and so is a complement to the traditional emphasis of strategy on industry structure and strategic positioning within that structure as the determinants of competitive advantage (Henderson and Cockburn, 1994; Porter, 1979). In particular, RBV assumes that firms can be conceptualized as bundles of resources, that those resources are heterogeneously distributed across firms, and that resource differences persist over time (Amit and Schoemaker, 1993; Mahoney and Pandian, 1992; Penrose, 1959; Wernerfelt, 1984). Based on these assumptions, researchers have theorized that when firms have resources that are valuable, rare, inimitable, and nonsubstitutable (i.e., so-called VRIN attributes), they can achieve sustainable competitive advantage by implementing fresh value-creating strategies that cannot be easily duplicated by competing firms (Barney, 1991; Conner and Prahalad, 1996; Nelson, 1991; Peteraf, 1993; Wernerfelt, 1984, 1995). Finally, when these resources and their related activity systems have complementarities, their potential to create sustained competitive advan-

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tage is enhanced (Collis and Montgomery, 1995, 1998; Milgrom, Qian, and Roberts, 1991; Milgrom and Roberts, 1990; Porter, 1996).

Recently, scholars have extended RBV to dynamic markets (Teece *et al.*, 1997). The rationale is that RBV has not adequately explained how and why certain firms have competitive advantage in situations of rapid and unpredictable change. In these markets, where the competitive landscape is shifting, the dynamic capabilities by which firm managers 'integrate, build, and reconfigure internal and external competencies to address rapidly changing environments' (Teece *et al.*, 1997: 516) become the source of sustained competitive advantage. The manipulation of knowledge resources, in particular, is especially critical in such markets (Grant, 1996; Kogut, 1996).

Despite the significance of RBV, the perspective has not gone unchallenged. It has been called conceptually vague and tautological, with inattention to the mechanisms by which resources actually contribute to competitive advantage (e.g., Mosakowski and McKelvey, 1997; Priem and Butler, 2000; Williamson, 1999). It has also been criticized for lack of empirical grounding (e.g., Williamson, 1999; Priem and Butler, 2000). And, particularly relevant here, sustained competitive advantage has been seen as unlikely in dynamic markets (e.g., D'Aveni, 1994).

The purpose of this paper is to extend our understanding of dynamic capabilities and in so doing enhance RBV. Since dynamic capabilities are processes embedded in firms, we assume an organizational and empirical lens, rather than an economic and formal modeling one (Barney, 1991; Peteraf, 1993). We examine the nature of dynamic capabilities, how those capabilities are influenced by market dynamism, and their evolution over time.

We have several observations. First, dynamic capabilities consist of specific strategic and organizational processes like product development, alliancing, and strategic decision making that create value for firms within dynamic markets by manipulating resources into new value-creating strategies. Dynamic capabilities are neither vague nor tautologically defined abstractions. Second, these capabilities, which often have extensive empirical research streams associated with them, exhibit commonalities across effective firms or what can be termed 'best practice.' Therefore, dynamic capabilities have greater equifinality, homogeneity, and substitutability across firms than traditional RBV thinking implies. Third, effective patterns of dynamic capabilities vary with market dynamism. When markets are moderately dynamic such that change occurs in the context of stable industry structure, dynamic capabilities resemble the traditional conception of routines (e.g., Cyert and March, 1963; Nelson and Winter, 1982). That is, they are complicated, detailed, analytic processes that rely extensively on existing knowledge and linear execution to produce predictable outcomes. In contrast, in high-velocity markets where industry structure is blurring, dynamic capabilities take on a different character. They are simple, experiential, unstable processes that rely on quickly created new knowledge and iterative execution to produce adaptive, but unpredictable outcomes. Finally, well-known learning mechanisms guide the evolution of dynamic capabilities and underlie path dependence.

Overall, our work attempts to contribute to RBV by explicating the nature of dynamic capabilities in a way that is realistic, empirically valid, and non-tautological. Our work also attempts to clarify RBV's logic of dynamic capabilities, resources, and competitive advantage. We argue that, since the functionality of dynamic capabilities can be duplicated across firms, their value for competitive advantage lies in the resource configurations that they create, not in the capabilities themselves. Dynamic capabilities are necessary, but not sufficient, conditions for competitive advantage. We also argue that dynamic capabilities can be used to enhance existing resource configurations in the pursuit of long-term competitive advantage (RBV's logic of leverage). They are, however, also very frequently used to build new resource configurations in the pursuit of temporary advantages (logic of opportunity). Most significant, we suggest a boundary condition. RBV breaks down in high-velocity markets, where the strategic challenge is maintaining competitive advantage when the duration of that advantage is inherently unpredictable, where time is an essential aspect of strategy, and the dynamic capabilities that drive competitive advantage are themselves unstable processes that are challenging to sustain.

DYNAMIC CAPABILITIES

Resources are at the heart of the resource-based view (RBV). They are those specific physical

(e.g., specialized equipment, geographic location), human (e.g., expertise in chemistry), and organizational (e.g., superior sales force) assets that can be used to implement value-creating strategies (Barney, 1986; Wernerfelt, 1984, 1995). They include the local abilities or 'competencies' that are fundamental to the competitive advantage of a firm such as skills in molecular biology for biotech firms or in advertising for consumer products firms. As such, resources form the basis of unique value-creating strategies and their related activity systems that address specific markets and customers in distinctive ways, and so lead to competitive advantage (e.g., configurations, Collis and Montgomery, 1995, 1998; Porter, 1996; core competencies, Prahalad and Hamel, 1990; lean production, Womack, Jones, and Roos, 1991).

Dynamic capabilities are the antecedent organizational and strategic routines by which managers alter their resource base—acquire and shed resources, integrate them together, and recombine them—to generate new value-creating strategies (Grant, 1996; Pisano, 1994). As such, they are the drivers behind the creation, evolution, and recombination of other resources into new sources of competitive advantage (Henderson and Cockburn, 1994; Teece *et al.*, 1997). Similar to Teece and colleagues (1997), we define dynamic capabilities as:

> The firm's processes that use resources—specifically the processes to integrate, reconfigure, gain and release resources—to match and even create market change. Dynamic capabilities thus are the organizational and strategic routines by which firms achieve new resource configurations as markets emerge, collide, split, evolve, and die.

This definition of dynamic capabilities is similar to the definitions given by other authors. For example, Kogut and Zander (1992) use the term 'combinative capabilities' to describe organizational processes by which firms synthesize and acquire knowledge resources, and generate new applications from those resources. Henderson and Cockburn (1994) similarly use the term 'architectural competence' while Amit and Schoemaker (1993) use 'capabilities.'

Dynamic capabilities as identifiable, specific processes

Dynamic capabilities are often described in vague terms such as 'routines to learn routines' that have been criticized as being tautological, endlessly recursive, and nonoperational (e.g., Mosakowski and McKelvey, 1997; Priem and Butler, 2000; Williamson, 1999). Yet, dynamic capabilities actually consist of identifiable and specific routines that often have been the subject of extensive empirical research in their own right outside of RBV.

Some dynamic capabilities integrate resources. For example, product development routines by which managers combine their varied skills and functional backgrounds to create revenue-producing products and services (e.g., Clark and Fujimoto, 1991; Dougherty, 1992; Helfat and Raubitschek, 2000) are such a dynamic capability. Toyota has, for example, used its superior product development skills to achieve competitive advantage in the automotive industry (Clark and Fujimoto, 1991). Similarly, strategic decision making is a dynamic capability in which managers pool their various business, functional, and personal expertise to make the choices that shape the major strategic moves of the firm (e.g., Eisenhardt, 1989; Fredrickson, 1984; Judge and Miller, 1991).

Other dynamic capabilities focus on reconfiguration of resources within firms. Transfer processes including routines for replication and brokering (e.g., Hansen, 1999; Hargadon and Sutton, 1997; Szulanski, 1996) are used by managers to copy, transfer, and recombine resources, especially knowledge-based ones, within the firm. For example, at the premier product design firm, IDEO, managers routinely create new products by knowledge brokering from a variety of previous design projects in many industries and from many clients (Hargadon and Sutton, 1997). Resource allocation routines are used to distribute scarce resources such as capital and manufacturing assets from central points within the hierarchy (e.g., Burgelman, 1994). At a more strategic level, coevolving involves the routines by which managers reconnect webs of collaborations among various parts of the firm to generate new and synergistic resource combinations among businesses (e.g., Eisenhardt and Galunic, 2000). Disney, for example, has historically excelled at coevolving to create shifting synergies that drive superior performance (Wetlaufer, 2000). Patching is a strategic process that centers on routines to realign the match-up of businesses (i.e., add,

combine, and split) and their related resources to changing market opportunities (Eisenhardt and Brown, 1999). Dell's constant segmentation of operating businesses to match shifting customer demands is an example of a superior patching process (Magretta, 1998).

Still other dynamic capabilities are related to the gain and release of resources. These include knowledge creation routines whereby managers and others build new thinking within the firm, a particularly crucial dynamic capability in industries like pharmaceuticals, optical disks, and oil where cutting-edge knowledge is essential for effective strategy and performance (e.g., Helfat, 1997; Henderson and Cockburn, 1994; Rosenkopf and Nerkar, 1999). They also include alliance and acquisition routines that bring new resources into the firm from external sources (e.g., Capron, Dussauge, and Mitchell, 1998; Gulati, 1999; Lane and Lubatkin, 1998; Powell, Koput, and Smith-Doerr, 1996; Ranft and Zeithaml, 1998; Zollo and Singh, 1998). Cisco Systems has, for example, a very effective acquisition process by which managers have assembled a changing array of products and engineering know-how that drive superior performance. Similarly, biotech firms with strong alliancing processes for accessing outside knowledge achieve superior performance (Powell *et al.*, 1996). Finally, although often neglected, exit routines that jettison resource combinations that no longer provide competitive advantage are also critical dynamic capabilities as markets undergo change (Sull, 1999a, 1999b).

The identification of particular processes as dynamic capabilities has several implications. For one, it opens up RBV thinking to a large, substantive body of empirical research that has often been neglected within the paradigm. This research on capabilities such as product development and alliance formation sheds light not only on these specific processes, but also on the generalized nature of dynamic capabilities. So, contrary to the criticism that dynamic capabilities lack empirical grounding (Williamson, 1999), dynamic capabilities as specific processes often have extensive empirical research bases and management applicability.

More significant, the identification of specific routines in terms of their relationship to altering the resource base addresses the tautology which arises when the value of dynamic capabilities is defined in terms of their effects on performance (e.g., Priem and Butler, 2000; Williamson, 1999). That is, when the VRIN resources that drive competitive advantage are identified by observing superior performance and then attributing that performance to whatever unique resources the firm appears to possess, the theory becomes tautological. In contrast, by defining dynamic capabilities in terms of their functional relationship to resource manipulation, their value is defined independent of firm performance. This enables empirical falsification.

Commonalities in key features, idiosyncrasy in details

Dynamic capabilities are often characterized as unique and idiosyncratic processes that emerge from path-dependent histories of individual firms (Teece *et al.*, 1997). Yet, while dynamic capabilities are certainly idiosyncratic in their details, the equally striking observation is that specific dynamic capabilities also exhibit common features that are associated with effective processes across firms. These commonalities arise because there are more and less effective ways of dealing with the specific organizational, interpersonal, and technical challenges that must be addressed by a given capability. In other words, just as there are better and worse ways to hit a golf ball or ski a mogul field, there are more and less effective ways to execute particular dynamic capabilities such as alliancing, strategic decision making, and knowledge brokering. In popular parlance, there is 'best practice.'

Take, for example, the product development process, an important dynamic capability that has been extensively researched (see Brown and Eisenhardt, 1995, for a review). Effective product development routines typically involve the participation of cross-functional teams that bring together different sources of expertise. These sources of expertise are essential for superior products because each addresses a unique aspect of product quality or related production. For example, Imai, Ikujiro, and Takeuchi (1985) studied seven product development efforts in five Japanese companies operating in several industries. The products included the Fuji-Xerox FX-3500 copier, the City box-car by Honda, and the Canon Sureshot camera. Performance was measured in terms of the speed and flexibility of development. The findings indicated that cross-

functional teams were essential for superior performance. The use of these teams enhanced the range of information that was available, and eased the coordination and overlap of manufacturing, marketing, and design tasks during the course of the process.

Effective product development processes also involve routines that ensure that concrete and joint experiences among team members, such as working together to fix specific problems or participating in brainstorming sessions occur. Such experiences enhance innovation by breaking down the thought worlds that arise because people with different expertise not only know different things, but know those things differently. Concrete experiences with others on the development team create a common experience base and language that facilitates communication among functionally distinct people. Dougherty (1992), for example, studied 18 product development projects in five well-established U.S. firms including Kodak and Campbell Soup. She found that common customer visits and feedback were essential for an effective product development process. Simply having liaisons between groups was not enough to ensure effective communication.

Effective product development processes also have extensive external communication that is often facilitated by strong or 'heavyweight' team leaders. For example, Ancona and Caldwell (1992) found that successful product development processes were characterized by extensive communication links outside of the group, particularly when those links were used by project team leaders to buffer the group from outside influences and to garner resources. Clark and Fujimoto (1991) similarly found that heavyweight leaders who engaged in significant external communication and vision setting led more productive product development projects.

Commonalities that are related to more effective routines exist for other dynamic capabilities as well. For example, successful acquisition processes are characterized by preacquisition routines that assess cultural similarity and consistency of vision (e.g., Larrson and Finkelstein, 1999) and postacquisition routines that pay particular attention to the speed of integration (Graebner, 2000) and the strategic redeployment of assets across the two firms (Capron *et al.*, 1998; Graebner, 1999, 2000). Similarly, effective routines for coevolving in order to capture synergies among resources located in different parts of the organization typically have common features. These include routines to ensure that business heads develop social bonds with one another, and surprisingly that the business heads are rewarded for individual, not collective success (Christensen, 1997; Eisenhardt and Galunic, 2000).

The existence of common features among effective dynamic capabilities does not, however, imply that any particular dynamic capability is exactly alike across firms. Take, for example, knowledge creation processes, a crucial dynamic capability especially within high-technology firms. A common feature across successful knowledge creation processes is explicit linkage between the focal firm and knowledge sources outside the firm. In the pioneering research of Allen and colleagues (e.g., Allen, 1977; Allen, Piepmeier, and Cooney, 1971; Katz and Tushman, 1981), these linkages were a small number of 'gatekeepers' within the firm. These individuals maintained active communication with scientists at other firms, government laboratories, and universities. Similarly, Henderson and Cockburn (1994) found that external linkages were crucial to effective knowledge creation processes in their extensive study of the pharmaceutical industry. These linkages, however, took the form of propublication incentives by which scientists were rewarded for maintaining external links to the wider scientific community through the use of publication in scientific journals as a promotion criterion. Similarly, Powell *et al.* (1996) found that knowledge creation processes that included external linkages in the form of significant alliance relationships led to superior R&D performance within biotech firms. So, while external linkages are necessary for effective knowledge creation, those linkages can take varied forms including informal personal relationships, relationships driven by promotion criterion, and formal alliances.

Commonalities across firms for effective specific dynamic capabilities have several implications. First, they imply equifinality. That is, managers of firms that develop an effective dynamic capability such as patching, knowledge creation, or alliancing processes very probably begin the development of that capability from different starting points, and take unique paths. Yet, since they end up with capabilities that are similar in terms of key attributes, there are multiple paths (equifinality) to the same dynamic capabilities.

A recent study by Cockburn, Henderson, and Stern (2000) illustrates this phenomenon. These authors studied the emergence of propublication incentives (as noted above, a common feature of effective knowledge creation processes in the pharmaceutical industry). They found that managers began at different starting points and traveled different paths before adoption of these incentives. By happenstance, managers at some firms were already rewarding scientists for their publications at the start of the study. Some adopted the practice sooner than others because cutting-edge research was more relevant in their particular areas of therapeutic emphasis, or because they were located near major research universities where firms were more influenced by the norms of academic institutions. Still others adopted the practice when senior leadership changed. Firms began with different initial conditions and propensities for adoption, and followed different adoption paths. But eventually managers at most firms adopted propublication incentives for their scientists.

Second, commonalities in key features of effective dynamic capabilities imply that these routines are more substitutable and fungible across different contexts than current theory suggests. In the case of substitutability, as our example of knowledge creation processes suggests, effective dynamic capabilities can differ in form and details as long as the important commonalities are present. In the case of fungibility, commonalities imply the efficacy of particular dynamic capabilities across a range of industries.

Third, commonalities imply that dynamic capabilities per se are not likely to be sources of sustained competitive advantage. The thinking is as follows. According to the logic of RBV, sustained competitive advantage occurs when capabilities are not only valuable and rare, but also inimitable, immobile, and nonsubstitutable. Dynamic capabilities are typically valuable. They may be rare or at least not possessed by all competitors equally, as is apparent in much of the empirical research. Sustainability, however, breaks down for the latter conditions. Equifinality renders inimitability and immobility irrelevant to sustained advantage. That is, firms can gain the same capabilities from many paths, and independent of other firms. So, whether they can imitate other firms or move resources is not particularly relevant because managers of firms can discover them on their own. Dynamic capabilities are substitutable because they need to have key features in common to be effective, but they can actually be different in terms of many details. This suggests that dynamic capabilities per se can be a source of competitive, but not sustainable, advantage.

Finally, commonalities suggest that the scale of 'idiosyncratic firm effects' in the empirical literature (Brush, Bromiley, and Hendrickx, 1999; McGahan and Porter, 1997; Roquebert, Phillips, and Westfall, 1996; Schmalensee, 1985; Wernerfelt and Montgomery, 1988) is probably overstated. Simply using dummy variables for firms leads to underspecified models that cannot capture key organizational attributes of dynamic capabilities as drivers of performance. Table 1 contrasts our view with previous ones.

Market dynamism: moderately dynamic to high-velocity markets

The pattern of effective dynamic capabilities depends upon market dynamism. In particular, dynamic capabilities vary in their reliance on existing knowledge. Moderately dynamic markets are ones in which change occurs frequently, but along roughly predictable and linear paths. They have relatively stable industry structures such that market boundaries are clear and the players (e.g., competitors, customers, complementers) are well known. In these markets, effective dynamic capabilities rely heavily on existing knowledge. Managers analyze situations in the context of their existing tacit knowledge and rules of thumb, and then plan and organize their activities in a relatively ordered fashion (Burns and Stalker, 1966). They can develop efficient processes that are predictable and relatively stable with linear steps, beginning with analysis and ending with implementation (Helfat, 1997).

For example, Pisano (1994) studied the development of new manufacturing processes in a sample of 23 process development projects in chemical- and biological-based pharmaceutical companies. In the moderately dynamic chemical industry where there is deep theoretical and practical knowledge, the routines for developing new manufacturing processes were more effective when they involved a structured and analytic process. Termed by the author 'learning before doing', managers relied on analyzing the situation

Table 1. Contrasting conceptions of dynamic capabilities

	Traditional view of dynamic capabilities	Reconceptualization of dynamic capabilities
Definition	Routines to learn routines	Specific organizational and strategic processes (e.g., product innovation, strategic decision making, alliancing) by which managers alter their resource base
Heterogeneity	Idiosyncratic (i.e., firm specific)	Commonalities (i.e., best practice) with some idiosyncratic details
Pattern	Detailed, analytic routines	Depending on market dynamism, ranging from detailed, analytic routines to simple, experiential, ones
Outcome	Predictable	Depending on market dynamism, predictable or unpredictable
Competitive Advantage	Sustained competitive advantage from VRIN dynamic capabilities	Competitive advantage from valuable, somewhat rare, equifinal, substitutable, and fungible dynamic capabilities
Evolution	Unique path	Unique path shaped by learning mechanisms such as practice, codification, mistakes, and pacing

to come up with an appropriate manufacturing process, and then implementing that process within the factory.

Similarly, Fredrickson (1984) examined strategic decision making in the paint industry, a slowly evolving industry. He found that more effective decision making processes were linear. These effective processes were characterized by a sequence of problem solving steps that began with comprehensive collection of data, followed by development of alternatives, extensive analysis of those alternatives, and choice.

In some situations, existing tacit knowledge is further codified into detailed routines that precisely specify steps and subdivide activities among different individuals. Such routines deepen the memory of firms for the routine (Argote, 1999) and enhance the predictability of the process (Nelson and Winter, 1982). A good example is Eisenhardt and Tabrizi's (1995) study of 72 product development projects in the computer industry. In the moderately dynamic mainframe sector, more effective product development processes were characterized by a linear progression through progress gates, from specification through prototype to design, test and finally manufacturing ramp-up. Tasks within the development process were distributed among suppliers and focal firms, which permitted the overlap of different process steps without requiring extensive communication during the process.

In contrast, when markets are very dynamic or what is termed 'high velocity' (e.g., Eisenhardt, 1989), change becomes nonlinear and less predictable. High-velocity markets are ones in which market boundaries are blurred, successful business models are unclear, and market players (i.e., buyers, suppliers, competitors, complementers) are ambiguous and shifting. The overall industry structure is unclear. Uncertainty cannot be modeled as probabilities because it is not possible to specify a priori the possible future states. In these markets, dynamic capabilities necessarily rely much less on existing knowledge and much more on rapidly creating situation-specific new knowledge. Existing knowledge can even be a disadvantage if managers overgeneralize from past situations (Argote, 1999).

Effective dynamic capabilities in high-velocity markets are simple, not complicated as they are in moderately dynamic markets. Simple routines keep managers focused on broadly important issues without locking them into specific behaviors or the use of past experience that may be inappropriate given the actions required in a particular situation. Often these routines consist of a few rules that specify boundary conditions on the actions of managers or indicate priorities, important in fast-moving markets where attention is in short supply.

Eisenhardt and Sull (2000) discussed the use of simple routines in high-velocity markets. They

described, for example, how Yahoo's very successful alliancing process is largely unstructured, consisting of a two-rule routine that sets the boundary conditions for managers wishing to forge alliances. The rules are: no exclusive alliance deals and the basic service provided by the deal (e.g., online greeting cards, party planning services, etc.) must be free. There is little else to the routine. These rules set the boundary conditions within which Yahoo managers have wide latitude for making a variety of alliancing deals.

Similarly, Burgelman's (1994, 1996) study of Intel's resource allocation process illustrates a simple routine, in this case one that specifies priorities. At a time of extreme volatility in which Asian manufacturers disrupted world markets with severe price cutting and accelerated technological improvements, Intel managers followed a simple production rule, 'margin-per-wafer-start' that determined the resource allocation for manufacturing capacity (Burgelman, 1996: 205). Accordingly, as margins for memory chips decreased and margins for microprocessors increased, Intel began producing proportionally more microprocessors. By following this simple prioritization, Intel managers flexibly allocated resources and ultimately morphed into a microprocessor company well before senior managers recognized the transition.

While dynamic capabilities are simple in high-velocity markets, they are not completely unstructured or 'organic' (e.g., Burns and Stalker, 1966; Lawrence and Lorsch, 1967). Indeed, if there were no structures, these processes would fly out of control and exhibit no coherence. Therefore, simple routines provide enough structure (i.e., semistructure) so that people can focus their attention amid a cacophony of information and possibilities, help provide sense making about the situation, and be confident enough to act in these highly uncertain situations where it is easy to become paralyzed by anxiety.

Brown and Eisenhardt's (1997) study of multiple product development processes is an illustration. The authors found that firms with highly structured processes such as extensive gating procedures produced new products quickly, but that those products often were not well adapted to market conditions. But, firms without some simple rules were equally ineffective. Developers at these firms had difficulty delivering products on time to hit market windows, and consistently reinvented technical solutions. In contrast, firms with the most successful product development processes relied on limited routines for priority setting, a business vision that bounded possible products, and adherence to deadlines, but little else in the way of routines.

In high-velocity markets, absence of detailed, formal routines is not indicative of extensive use of tacit knowledge or complex social routines that cannot be codified, although these may be present. Rather, dynamic capabilities strikingly involve the creation of new, situation-specific knowledge. This occurs by engaging in experiential actions to learn quickly and thereby compensating for limited, relevant existing knowledge by rapidly creating new knowledge about the current situation. So, dynamic capabilities often use prototyping and early testing to gain new knowledge quickly. Such actions create rapid learning through small losses and immediate feedback (Argote, 1999; Sitkin, 1992). Dynamic capabilities in these markets proceed in at iterative fashion. As managers adjust to new information and changing conditions, they engage in more recycling through steps such as developing alternatives and implementation that would be linear in less dynamic markets. Dynamic capabilities also rely more on real-time information, cross-functional relationships and intensive communication among those involved in the process and with the external market. Real-time information alerts people early on to the need to adjust their actions since problems and opportunities are spotted more quickly than when individuals were more distant from information. Real-time information also builds intuition about the marketplace such that managers can more quickly understand the changing situation and adapt to it (Eisenhardt, 1989). Finally, dynamic capabilities in these markets are characterized by parallel consideration and often partial implementation (e.g., prototyping) of multiple options. Such options provide fallback positions, which are useful since situations can change rapidly. They also give managers a sense of confidence to act quickly. The emotional inability to cope with uncertainty is a major factor that slows down managers in high-velocity markets (Eisenhardt, 1989).

Pisano's (1994) study of the process to develop new manufacturing procedures in chemical- and biological-based pharmaceutical firms mentioned

above, is consistent with this thinking. The author found that 'learning-by-doing' (as contrasted with 'learning-before-doing' described above) was advantageous in the more rapidly changing biotech industry. In this context, it was effective to engage in greater experimentation and prototyping with early testing of processes. Similarly, studies of strategic decision processes (e.g., Eisenhardt, 1989; Judge and Miller, 1991; Wally and Baum, 1994) found that experiential actions like creating multiple alternatives (in addition to actions such as using real-time information) was related to more effective strategic decision making processes in high-velocity markets. These findings contrasted significantly with the linear, analytic process that Fredrickson (1984) found in the less dynamic paint industry. Finally, Eisenhardt and Tabrizi (1995) found that more and earlier testing, and more prototypes were features of effective product development processes in the fast-paced work station and personal computing markets. These experiential processes contrasted with the detailed, linear processes that were effective in the less dynamic, mainframe sector. Taken together, these studies support the view that effective dynamic capabilities in high-velocity markets are experiential with extensive and frequent use of prototyping, real-time information, experimentation, and multiple alternatives.

While dynamic capabilities in high-velocity markets consist mostly of simple rules and real-time knowledge creation, they may have detailed routines to deal with aspects of the process where prior knowledge and/or codification are particularly useful. Very often, this more detailed scripting exists at the end of a process where such scripting helps to ensure fast, coordinated execution of complex details.

For example, Terwiesch, Chea, and Bohn (1999) examined the process of developing manufacturing processes in the disk drive industry. They found that, while most of the process involved prototyping a variety of manufacturing alternatives, once decided, implementation of the chosen approach occurred in a highly scripted fashion. Adler's (1999) study of developing manufacturing processes in the automotive industry had similar results for the importance of experimentation followed by highly rationalized implementation of the chosen option. Brown and Eisenhardt's (1998) study of multiple product development also indicated that most of the process was experiential except for a highly scripted roll-off routine to move developers from the end of one project to the beginning of the next.

The effects of market dynamism on dynamic capabilities have several implications. One is that sustainability of the capabilities themselves varies with the dynamism of the market. In moderately dynamic markets, dynamic capabilities resemble the traditional conception of routines (Cyert and March, 1963; Nelson and Winter, 1982; Zollo and Winter, 1999). That is, they are complicated, predictable, analytic processes that rely extensively on existing knowledge, linear execution and slow evolution over time. As managers continue to gain experience with these routines, they groove the processes more deeply such that they become easily sustained and even inertial. Codification of the routines through the technology or formal procedures enhances that sustainability (Argote, 1999). Therefore, the capabilities become robust.

In contrast, in high-velocity markets, dynamic capabilities take on a different character. They are simple (not complicated), experiential (not analytic), and iterative (not linear) processes. They rely on the creation of situation-specific knowledge that is applied in the context of simple boundary and priority-setting rules. But since these routines are simple, there is little structure for managers to grasp and so they become easy to forget (Argote, 1999). This tendency to forget is exacerbated by the high turnover and rapid growth that often accompanies firms in high-velocity markets. In more technical terms, these improvisational processes are dissipative, meaning that they require constant energy to stay on track (Prigogine and Stengers, 1984). They are in the continuously unstable state of slipping into either too much or too little structure that is sometimes termed the 'edge of chaos' (Kauffman, 1995). What is challenging to manage then is the optimal amount of structure (Eisenhardt and Bhatia, 2000). Therefore, dynamic capabilities themselves become difficult to sustain in high-velocity markets. In moderately dynamic markets, competitive advantage is destroyed from outside the firm. In high-velocity markets, the threat to competitive advantage comes not only from outside the firm, but also more insidiously from inside the firm through the potential collapse of dynamic capabilities.

The following quotes from several managers

in the computing industry capture this instability. As one manager described, 'We do everything on the fly … I've done some things at IBM and other companies where there is a very structured environment—these companies are failing and we're leading the way. I'm not comfortable with the lack of structure, but I hesitate to mess with what is working.' At the other extreme, another manager described, 'It is real easy for the division to just sort of put its head down in blinders and just go run forward and implement … We've got to force ourselves to step back' (Brown and Eisenhardt, 1997: 28).

A second implication is that causal ambiguity of dynamic capabilities varies with market dynamism. In moderately dynamic markets, dynamic capabilities are causally ambiguous because they are complicated and difficult to observe (Simonin, 1999). In contrast, in high-velocity markets, dynamic capabilities are causally ambiguous because they are simple. The extensive, experiential activity of effective dynamic capabilities in high-velocity markets obscures the fundamental commonalities that drive the effectiveness of the capability. So, it is difficult to isolate causality from the extensive, but unimportant idiosyncratic details. Sometimes even the managers themselves do not know why their dynamic capabilities are successful. For example, the CEO of a major biotech firm told one of the authors, 'We have the best research process in the industry, but we don't know why.' Further, many managers have a tendency to imitate more than is appropriate in the mistaken belief that more detailed processes are better. Indeed, the counterintuitive insight is that the complicated, highly adaptive moves required by high-velocity markets are driven by simple rules. Table 2 links characteristics of dynamic capabilities with market pace.

Evolution of dynamic capabilities

The literature characterizes dynamic capabilities as complicated routines that emerge from path-dependent processes (Nelson and Winter, 1982; Teece *et al.*, 1997; Zollo and Winter, 1999). However, while path dependence appropriately emphasizes the encoding of inferences from the unique histories of firms into distinctive routines, path dependence is more accurately described in terms of learning mechanisms that have been identified principally within the psychological literature (Argote, 1999). These learning mechanisms guide the evolution of dynamic capabilities.

For example, repeated practice is an important learning mechanism for the development of dynamic capabilities. Practice helps people to understand processes more fully and so develop more effective routines. The efficacy of such experience has been demonstrated in numerous empirical studies, including the vast literature on learning curves in manufacturing (Argote, 1999). Similarly, Zollo and Singh's (1998) research on bank acquisitions illustrates the role of repeated practice. The authors found that integration, relatedness and acquisition experience led to increased performance. Specifically, repeated practice with homogeneous acquisitions (i.e., those in the related markets) was positively associated with the accumulation of tacit and explicit knowledge about how to execute acquisitions and achieve superior acquisition performance.

While repeated practice per se can contribute to the evolution of dynamic capabilities, the codification of that experience into technology and formal procedures makes that experience easier to apply and accelerates the building of routines (Argote, 1999; Zander and Kogut, 1995). For example, Kale, Dyer and Singh (1999), in a cross-industry study of alliances, found that concentrating alliance experience in a dedicated alliance function was a more powerful predictor of alliance success than experience alone. They suggest that a dedicated alliance function provides an important formalization mechanism through which alliancing know-how (e.g., routines) can be articulated, codified, shared and internalized within the organization.

Mistakes also play a role in the evolution of dynamic capabilities. Small losses, more than either successes or major failures, contribute to effective learning (Sitkin, 1992). Success often fails to engage managers' attention sufficiently so that they learn from their experience. Major failures raise defenses that block learning. In contrast, small failures provide the greatest motivation to learn as such failures cause individuals to pay greater attention to the process, but do not create defensiveness that impedes learning.

The effects of mistakes were examined by Hayward (2000) in his study of 241 acquisitions in 120 U.S. firms in six market sectors. He found that a moderate number of small mistakes led to

Table 2. Dynamic capabilities and types of dynamic markets

	Moderately dynamic markets	High-velocity markets
Market definition	Stable industry structure, defined boundaries, clear business models, identifiable players, linear and predictable change	Ambiguous industry structure, blurred boundaries, fluid business models, ambiguous and shifting players, nonlinear and unpredictable change
Pattern	Detailed, analytic routines that rely extensively on existing knowledge	Simple, experiential routines that rely on newly created knowledge specific to the situation
Execution	Linear	Iterative
Stable	Yes	No
Outcomes	Predictable	Unpredictable
Key to effective evolution	Frequent, nearby variation	Carefully managed selection

superior acquisition skills. Similarly, Eisenhardt and Sull (2000) recounted how Yahoo managers developed one of their rules for alliancing, described above, from a mistake. Yahoo managers formed an exclusive relationship with a major credit card firm. Shortly, they recognized that this alliance restricted flexibility, especially with regard to retailers, and terminated it at great expense. The 'no exclusive deals' rule emerged from this mistake. Similarly, in a study of long-term development of capabilities, Kim (1998) noted the importance of crises, both contrived and real, for developing dynamic capabilities. In his investigation of the long-term building of Hyundai's organizational competencies in their automotive business, Kim (1998) found that the internal generation of a sense of failure (which he termed 'constructed crisis') was essential to the motivation of the internal learning environment. These crises created greater engagement in the situation, and so increased learning within Hyundai.

The evolution of dynamic capabilities is also affected by the pacing of experience. Experience that comes too fast can overwhelm managers, leading to an inability to transform experience into meaningful learning. Similarly, infrequent experience can lead to forgetting what was learned previously and so result in little knowledge accumulation as well (Argote, 1999). For example, in the study mentioned earlier, Hayward (1998) found that timing had an inverted 'U'-shaped relationship with acquisition performance. Too many acquisitions done too frequently impaired managers' ability to absorb the lessons of any particular acquisition. They needed time to consolidate their learning. Yet, when there were too few acquisitions spaced too far apart, managers did not have enough opportunities to hone their skill.

While basic learning mechanisms such as those noted above underlie the evolution of dynamic capabilities, crucial aspects of that evolution also depend upon market dynamism. In moderately dynamic markets, experience in closely related, but different situations, is particularly effective in sharpening dynamic capabilities. Frequent, small variations help managers to deepen capabilities by elaborating them in current situations and extending them to related new ones. The result is efficient, robust routines that keep pace with changing markets and broaden opportunities for growth.

For example, Haleblian and Finkelstein (1999), in their study of 449 acquisitions, explored the relationships between acquisition experience and acquisition performance. Using the theoretical frame of learning theory, the authors found that managers with extensive experience were able to discern similarities and differences between current and previous acquisitions, and so apply their acquisition skills in a more discriminatory manner that was associated with superior performance. In contrast, managers with moderate experience had less nuanced acquisition capabilities. Similarly, Hayward (2000) found that moderate levels of prior acquisition similarity were positively related to the development of acquisition capability. Managers appeared to create superior skill when they both reinforced their existing knowledge and yet also extended their experience into new types of acquisitions.

In contrast, in high-velocity markets, the more crucial aspect of evolution is selection, not vari-

ation. Variation happens readily in such markets. In contrast, selection is difficult because it is challenging to figure out which experience should be generalized from the extensive situation-specific knowledge that occurs. Which of the many experiences should be incorporated into the ongoing routines for the capabilities and which should be forgotten? The temptation is to generalize too quickly, and so to churn capabilities too often on the basis of idiosyncratic events (Gersick, 1994; Sastry, 1999).

Finally, the order of implementation of dynamic capabilities is consequential. That is, dynamic capabilities are often combinations of simpler capabilities and related routines, some of which may be foundational to others and so must be learned first. Brown and Eisenhardt (1997) termed this property 'sequenced steps.' In their study of multiple product development processes in six firms in the computer industry, they observed that multiple product development required the combination of three simpler dynamic capabilities: single product development, probing the future and linking routines from one product development project to the next. Managers who built an effective dynamic capability to develop multiple products did so according to 'sequence steps' that had to be executed in the proper order. Single product development skills needed to come first to provide the platform for future products, then skills related to probing the future for new product opportunities, and finally time-pacing skills to create a product development rhythm connecting current products to future ones. Similarly, in his study of Hyundai, Kim (1998) found an appropriate sequencing of the learning of capabilities from the simpler and more predictable capabilities around manufacturing process creation to the more improvisational design ones in the development of design routines. Thus, effective implementation requires knowing both the ingredients (i.e., key commonalities of capabilities) and the recipe (i.e., order of implementation).

DISCUSSION

The purpose of this paper is to explore dynamic capabilities and more generally, RBV. In addressing this agenda, we focused on the nature of dynamic capabilities, the impact of market dynamism, and their evolution. Our observations link to several research areas.

Our work suggests reframing the concept of dynamic capabilities. Dynamic capabilities are not tautological, vague, and endlessly recursive as some have suggested (e.g., Priem and Butler, 2000; Williamson, 1999). Rather, they consist of many well-known processes such as alliancing, product development, and strategic decision making that have been studied extensively in their own right, apart from RBV. Their value for competitive advantage lies in their ability to alter the resource base: create, integrate, recombine, and release resources.

Dynamic capabilities also exhibit commonalities across firms that are associated with superior effectiveness. So while the specifics of any given dynamic capability may be idiosyncratic to a firm (e.g., exact composition of a cross-functional product development team) and path dependent in its emergence, 'best practice' exists for particular dynamic capabilities across firms. These commonalities imply that dynamic capabilities are equifinal such that firms can develop these capabilities from many starting points and along different paths. They are also more homogeneous, fungible, and substitutable than is usually assumed. Overall, these observations suggest a modified conception of dynamic capabilities.

Our work also suggests an expanded view of routines (Cyert and March, 1963; Nelson and Winter, 1982; Winter and Szulanski, 1999). We argue that, in moderately dynamic markets, routines in the form of dynamic capabilities are embedded in cumulative, existing knowledge. They involve analysis using existing knowledge and rules of thumb, followed by implementation. When this existing knowledge is codified, the resulting routines are often detailed and specific with predictable outcomes (Helfat, 1997; Nelson and Winter, 1982). Therefore, in moderately dynamic markets, dynamic capabilities exhibit the properties suggested in the traditional research where effective routines are efficient and robust processes (Cyert and March, 1963; Nelson and Winter, 1982).

In contrast, in high-velocity markets, dynamic capabilities rely extensively on new knowledge created for specific situations. Routines are purposefully simple to allow for emergent adaptation, although not completely unstructured. Since new knowledge must be rapidly gained in each new

situation, experiential activities such as prototyping, real-time information, multiple options, and experimenting that generate immediate knowledge quickly replace analysis. In order to adapt to changing information, routines are iterative and cognitively mindful, not linear and mindless. Although there may be pockets of detailed routines where existing knowledge is relevant, dynamic capabilities are strikingly simple. Therefore, in high-velocity markets, effective routines are adaptive to changing circumstances. The price of that adaptability is unstable processes with unpredictable outcomes. Overall, this points to a richer conception of routines that goes beyond the usual view of efficient and robust processes (Cyert and March, 1963; Nelson and Winter, 1982) to include these more fragile, 'semistructured' ones that are effective in high-velocity markets.

Our work also addresses the evolution of dynamic capabilities. We observe that, while the evolution of dynamic capabilities occurs along a unique path for any given firm, that path is shaped by well-known learning mechanisms. Repeated practice, for example, accelerates the formation of dynamic capabilities (Argote, 1999). Small losses (Sitkin, 1992), crises (Kim, 1998), and paced experience (Hayward, 2000) can motivate more rapid evolution. In moderately dynamic markets, small and frequent variations through related experience deepen capabilities (Haleblian and Finkelstein, 1999). In high-velocity markets where learning can be too rapid, selection of what to keep from experience is more crucial (Gersick, 1994). Finally, the order of implementation can be critical in dynamic capabilities that are composed of several distinct capabilities (Brown and Eisenhardt, 1997). Taken together, these insights open the 'black box' of path dependence to reveal that the evolution of dynamic capabilities is guided by well-known learning mechanisms.

Towards a new perspective on the resource-based view

Most significant, our work addresses the logical links among dynamic capabilities, resources, and competitive advantage, a problematic area within RBV (Priem and Butler, 2000). We have three points. First, the argument that VRIN dynamic capabilities are themselves the source of long-term competitive advantage in dynamic markets misidentifies the source of that advantage. As noted earlier, effective dynamic capabilities have commonalites across firms in terms of key features (popularly termed, 'best practice'). Therefore, they violate the RBV assumption of persistent heterogeneity across firms. So, while firms with more effective dynamic capabilities such as superior product innovation and alliancing processes are likely to have competitive advantage over firms with less effective capabilities, dynamic capabilities are not themselves sources of long-term competitive advantage.

So where does the potential for long-term competitive advantage lie? It lies in using dynamic capabilities sooner, more astutely, or more fortuitously than the competition to create resource configurations that have that advantage. So, for example, the acquisition capability of GE Capital is well known, and competitors can readily copy it or independently develop it themselves. But what is far more difficult to duplicate is the resource base of already acquired companies and the related synergies among them that GE Capital has achieved and continues to build. This advantage is particularly enhanced when the related resource configurations are combinations of tightly woven, synergistic activities (Collis and Montgomery, 1995; Milgrom and Roberts, 1990; Porter, 1996; Prahalad and Hamel, 1990). Therefore, long-term competitive advantage lies in the resource configurations that managers build using dynamic capabilities, not in the capabilities themselves. Effective dynamic capabilities are necessary, but not sufficient, conditions for competitive advantage.

Second, RBV thinking overemphasizes the strategic logic of leverage. While certainly some resource configurations do lead to long-term competitive advantage and some situations such as those with significant scale economies or network effects favor the emergence of such advantages, long-term competitive advantage is infrequently achieved in dynamic markets. Rather, the reality is that competitive advantage is often short term. In these situations, it makes sense for managers to compete by creating a series of temporary advantages. Their strategic logic is opportunity (Lengnick-Hall and Wolff, 1999).

For example, D'Aveni (1994) described the Coke vs. Pepsi duopoly in which the competitors leapfrogged one another for decades with temporary advantages in new products, technical and

organizational innovations, and advertising. Neither firm could consistently gain the upper hand. Rather, each prospered by rapidly moving into new sources of advantage. Similarly, Roberts' (1999) study of the pharmaceutical industry indicated that persistent high performance was driven by temporary advantages in the form of new products. More successful firms appeared to possess a product development dynamic capability that led to a superior product flow, but one that only rarely led to long-term positional advantage. In both of these situations, creating a series of moves and counter-moves to outmaneuver the competition and build temporary advantage led to superior performance (D'Aveni, 1994).

Overall, dynamic capabilities are best conceptualized as tools that manipulate resource configurations. Sometimes it is effective to use these tools to enhance existing resource configurations and to strengthen current position using RBV's path-dependent strategic logic of leverage. Here, the goal is long-term competitive advantage. More frequently, in dynamic markets, it makes sense to use dynamic capabilities to build new resource configurations and move into fresh competitive positions using a path-breaking strategic logic of change (see also Karim and Mitchell, 2000). Here, the goal is a series of temporary competitive advantages. The broad point is that a blend of strategic logics makes sense in dynamic markets.

Finally, high-velocity markets are a boundary condition for RBV, a much needed addition to the theory (Lengnick-Hall and Wolff, 1999; Priem and Butler, 2000). In such markets, firm managers must cope not only with the external challenge of competition, but also with the internal challenge of potentially collapsing dynamic capabilities. As significant, RBV's path-dependent strategic logic of leverage not only lacks a logic of change that is crucial in dynamic markets, but also underplays the difficulty of predicting the length of current advantage and the sources of future advantage. Intel is a terrific example. Although the firm dominated its market for over a decade, its managers operated as if its competitive advantage could end at any time. Indeed, their slogan was 'only the paranoid survive.'

Similarly, RBV's assumption of the organization as a bundle of resources breaks down in high-velocity markets. In these situations, resources are added, recombined, and dropped with regularity (Galunic and Eisenhardt, 2000; Galunic and Rodan, 1998). Being tightly bundled is usually problematic. RBV's emphasis on long-term competitive advantage is often unrealistic in high-velocity markets. Short-term, unpredictable advantage is the norm. Growth is a more useful performance metric than profit. Finally, RBV misses the strategic role of time. Understanding the flow of strategy from leveraging the past to probing the future and the rhythm of when, where, and how often to change is central to strategy in high-velocity markets (Brown and Eisenhardt, 1998). Overall, while RBV centers on leveraging bundled resources to achieve long-term competitive advantage, strategy in high-velocity markets is about creating a series of unpredictable advantages through timing and loosely structured organization. The strategic logic is opportunity and the imperative is when, where, and how often to change.

CONCLUSION

This paper explores dynamic capabilities and, more broadly, RBV. Based on the sometimes neglected insights of organizational theory and empirical research, we conclude with what we hope is a more realistic, theoretically valid, and empirically accurate view. Dynamic capabilities include well-known organizational and strategic processes like alliancing and product development whose strategic value lies in their ability to manipulate resources into value-creating strategies. Although idiosyncratic, they exhibit commonalities or 'best practice' across firms. Their broad structural patterns vary with market dynamism, ranging from the robust, grooved routines in moderately dynamic markets to fragile semi-structured ones in high-velocity ones. They evolve via well-known learning mechanisms.

More broadly, we conclude that long-term competitive advantage lies in resource configurations, not dynamic capabilities. In moderately dynamic markets, RBV is enhanced by blending its usual path-dependent strategic logic of leverage with a path-breaking strategic logic of change. Finally, RBV encounters a boundary condition in high-velocity markets where the duration of competitive advantage is inherently unpredictable, time is central to strategy, and dynamic capabilities are themselves unstable. Here, the

strategic imperative is not leverage, but change.

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