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Entrepreneurship and Dynamic Capabilities: A Review, Model and Research Agenda*

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ABSTRACT The emergent literature on dynamic capabilities and their role in value creation is riddled with inconsistencies, overlapping definitions, and outright contradictions. Yet, the theoretical and practical importance of developing and applying dynamic capabilities to sustain a firm's competitive advantage in complex and volatile external environments has catapulted this issue to the forefront of the research agendas of many scholars. In this paper, we offer a definition of dynamic capabilities, separating them from substantive capabilities as well as from their antecedents and consequences. We also present a set of propositions that outline (1) how substantive capabilities and dynamic capabilities are related to one another, (2) how this relationship is moderated by organizational knowledge and skills, (3) how organizational age affects the speed of utilization of dynamic capabilities and the learning mode used in organizational change, and (4) how organizational knowledge and market dynamism affect the likely value of dynamic capabilities. Our discussion and model help to delineate key differences in the dynamic capabilities that new ventures and established companies have, revealing a key source of strategic heterogeneity between these firms.

INTRODUCTION

Entrepreneurial companies create, define, discover, and exploit opportunities – frequently well ahead of their rivals (Hamel and Prahalad, 1994; Miller, 1983; Sathe, 2003). While debate persists about the correlates of the processes associated with opportunity creation, discovery and successful exploitation (Davidsson, 2004), most scholars readily acknowledge the importance of these processes in generating value for firms and their owners. Yet, to date, research has not provided a compelling explanation for the ability of some new and established companies to continuously create, define, discover and exploit entrepreneurial opportunities.

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We propose that one source of these differences lies in these firms' developing and applying different dynamic capabilities, which we define as *the abilities to reconfigure a firm's resources and routines in the manner envisioned and deemed appropriate by its principal decision-maker(s)*. Indeed, the creation and subsequent use of dynamic capabilities correspond to the entrepreneur, the entrepreneurial team, or the firm's senior management's *perception* of opportunities to productively change existing routines or resource configurations, their *willingness* to undertake such change, and their *ability* to implement these changes (Katona, 1951; Penrose, 1959). This ability is largely determined by the motivation, skills and experiences of the firm's key managers (Penrose, 1959). We further propose that, although dynamic capabilities may enable firms to pursue opportunities in new and potentially effective ways, they do not guarantee organizational success or survival. Consequently, we will explain why it is important to distinguish conceptually between dynamic capabilities and their possible outcomes. Finally, we will address theoretically how the processes of creating and sustaining such capabilities may differ in new versus established firms, which often battle for technological and market leadership especially in nascent and emerging industries.

This article seeks to bring clarity to the notion of dynamic capabilities and their potential and realized relationships to the performance of new ventures and established companies. This article addresses three research questions: (a) What are dynamic capabilities and how do they differ from substantive capabilities? (b) How do dynamic capabilities come into existence, and what is the role of the firm's entrepreneurial and learning processes in creating and sustaining these capabilities? and (c) How do new ventures and established companies vary in their dynamic capabilities and what are the consequences of these differences?

This article makes three contributions to the literature. First, we review the literature and surface important (but subtle) inconsistencies and ambiguities in the extant literature and suggest remedies that can direct future studies. Second, we advance the understanding of dynamic capabilities in new vs. established firms. The dynamic capabilities literature has given scant attention to younger firms as they create, discover, and exploit opportunities. However, recently researchers have begun to probe the birth and evolution of new ventures' dynamic capabilities (e.g. Arthurs and Busenitz, 2005; Zahra and Filatotchev, 2004). We believe that a systematic comparison of these different contexts provides new insights into the creation and exploitation of dynamic capabilities. Third, we deepen the discussion by advancing a set of propositions (largely based on a learning theory lens) regarding the relationships between substantive and dynamic capabilities, the effects of age and learning styles on capabilities, and the contingencies that affect the value of dynamic capabilities.

The paper is organized as follows. First, we review the literature to show how dynamic capabilities have been portrayed in the literature. We then examine ambiguities in the literature and how they might be resolved. Next, focusing on

differences in new vs. established firms, we develop propositions on the relationships among substantive capabilities, dynamic capabilities, learning modes, and performance. Finally, we conclude with a discussion of our propositions.

The literature on dynamic capabilities has addressed the fundamental question of how companies develop the skills and competencies that allow them to compete and gain an enduring competitive advantage. To appreciate the contributions of this literature, it is important to separate studies based on *organizational type* (new ventures vs. established corporations). The literature suggests that these firms need different types of capabilities. To further gain insights into the contributions of the literature, it is essential to separate studies based on their *intellectual foci*. Some studies have focused on the nature of dynamic capabilities; others have addressed the antecedents vs. outcomes of these capabilities. Still other studies have explored the various processes and activities needed to develop and exploit dynamic capabilities for competitive advantage. As would be expected, some studies had multiple intellectual foci and examined more than one area by covering; for example, the process of dynamic capabilities as well as the outcomes of these capabilities.

Even though our review of the literature is not exhaustive, it serves to show that most research and theory building has focused on established companies thus ignoring new ventures and SMEs. We find this gap in the literature to be puzzling given that SMEs and new ventures need unique and dynamic capabilities that allow them to survive, achieve legitimacy, and reap the benefit of their innovation (Sapienza et al., 2006). The skills and competencies that these firms have must to be upgraded and new dynamic capabilities are built to ensure successful adaptation for growth.

Reviewing the studies in Table I, we note also that prior researchers have studied established companies in diverse industries, allowing for a richer test of the key propositions of the dynamic capability view. The literature shows that established companies benefit from having dynamic capabilities in crafting new business and corporate strategies (Bowman and Ambrosini, 2003); entering new market arenas (King and Tucci, 2002); completing successful mergers; learning new skills (Bowman and Ambrosini 2003; Zollo and Winter, 2002); overcoming inertia (King and Tucci, 2002; Repenning and Sterman, 2002); leveraging their other resources (Bowman and Ambrosini, 2003); introducing innovative programmes that stimulate strategic change (Repenning and Sterman, 2002); and successfully commercializing new technologies generated within their R&D units (Marsh and Stock, 2003). These activities increase organizational agility and market responsiveness (Zahra and George, 2002b). The literature also suggests that dynamic capabilities also encourage and facilitate internationalization (Griffith and Harvey, 2001) and learning in international markets. More broadly, prior research suggests that dynamic capabilities are also important for the creation and evolution of new ventures (Newbert, 2005) and successful entry and survival, especially in international markets (Sapienza et al., 2006).

Table I. Overview of past research on dynamic capabilities

Variable	*New ventures*	*Established companies*
Nature	George et al. (2004)	Eisenhardt and Martin (2000); Geiger and Kliesch (2005); Winter (2003)
Antecedents	Arthurs and Busenitz (2005)	Blyler and Coff (2003); Korr and Mahoney (2005); Verona and Ravasi (2003); Wheeler (2002); Zollo and Winter (2002)
Process	George et al. (2004)	George (2005); Lampel and Shamsie (2003); Lazonick and Prencipe (2005); Mosey (2005); Salvato (2003); Zollo and Winter (2002)
Outcomes	Arthurs and Busenitz (2005); Newbert (2005); Sapienza et al. (2006)	Blyler and Coff (2003); Bowman and Ambrosini (2003); Eisenhardt and Martin (2000); George (2005); Lazonick and Prencipe (2005); Lenox and King (2004); Verona and Ravasi (2003); Zahra and George (2002b)

Our review of the literature highlights the dearth of studies that examined SMEs and new ventures has limited the context in which dynamic capabilities are studied. The few studies reported about these companies to date (Table I) tend to be case study based, focused on a given activity such as internationalization (George et al., 2004). The literature does not tell much about the antecedents of new firms' dynamic capabilities. Moreover, our review of the literature and the studies summarized in Table I, suggests that prior researchers have not given much attention to the process by which these capabilities develop, emerge or evolve especially in younger firms that have limited resources, knowledge bases and expertise in building and integrating diverse capabilities.

DYNAMIC CAPABILITIES: WHAT ARE THEY, AND WHY ARE THEY IMPORTANT?

The emergent discussion of dynamic capabilities in the literature is grounded in the evolutionary theory of the firm (Nelson and Winter, 1982). The theory traces its intellectual heritage to Alchian (1950) and March and Simon (1958, 1993) who have suggested that because managers make decisions under uncertainty and are boundedly rational, they 'satisfice' rather than optimize in searching for and selecting solutions to problems. The implication is that managers (both in young and established firms) do not, and probably should not, create 'once-and-for-all' solutions or routines for their operations but continually reconfigure or

revise the capabilities they have developed. When the environment is dynamic or unpredictable, firms are especially challenged to revise their routines (March, 1991). The new routines form the foundation of firms' knowledge bases. However, along with these new capabilities, the firm also develops the capacity to change routines and integrate them into their operations. This description introduces three elements that have come to be confounded in the literature: (1) the ability to solve a problem (a substantive capability); (2) the presence of rapidly changing problems (an environmental characteristic); and (3) the ability to change the way the firm solves its problems (a higher-order *dynamic* capability to alter capabilities).

We refer, as have some other theoreticians (e.g. Winter, 2003), to the set of abilities and resources that go into solving a problem or achieving an outcome as a substantive (or 'ordinary') capability. We distinguish substantive capability from the *dynamic ability to change or reconfigure existing substantive capabilities*, which we term as the firm's dynamic capabilities. Thus, the qualifier 'dynamic' distinguishes one type of ability (e.g. the substantive ability to develop new products) from another type of ability (e.g. the ability to *reform* the way the firm develops new products). A new routine for product development is a new substantive capability but the ability to *change* such capabilities is a dynamic capability.[1] Just as a firm has many substantive capabilities of varying strengths, it has many dynamic capabilities of varying strengths. For example, the firm may have a strong dynamic capability to change its product development routine while at the same time have but a weak ability to reconfigure its accounting systems.

The literature on the distinction between dynamic and substantive capabilities is in its infancy (Winter, 2003). Reviewing this literature, we find it riddled with inconsistencies, overlapping definitions, and contradictions (Salvato, 2003). Nonetheless, the theoretical and practical importance of dynamic capabilities to a firm's competitive advantage (especially in complex, volatile, and uncertain external environments) has catapulted this issue to the forefront of the research agendas of many scholars (Daniel and Wilson, 2003; Lampel and Shamsie, 2003; Lenox and King, 2004; Salvato, 2003; Teece et al., 1997; Zott, 2003).

Lack of agreement about whether a dynamic capability refers to substantive capabilities in volatile environments or to the organization's ability to alter existing substantive capabilities, regardless of the volatility of the environment, is perhaps the single largest source of confusion. This confusion is compounded when effectiveness is incorporated into definitions. Such definitions are implicitly tautological. For example, in his thoughtful analysis, Anand (2001) argues that a dynamic alliance capability is an organizational ability to choose good and reliable partners and to structure relationships with partners in a manner that improves performance.[2] Are we to infer that if performance is not superior, then the firm does not possess a dynamic alliance capability? Or, if it does perform well, does this mean it has such a capability? Further, if the environment is not very volatile, does that

Table II. Key definitions of dynamic capabilities

Author	*Definition*
Helfat (1997)	The subset of the competences/capabilities which allow the firm to create new products and processes and respond to changing market circumstances.
Teece et al. (1997)	The firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments.
Eisenhardt and Martin (2000)	The firm's processes that use resources – specifically the processes to integrate, reconfigure, gain and release resources – to match or even create market change. Dynamic capabilities thus are the organizational and strategic routines by which firms achieve new resources configurations as market emerge, collide, split, evolve and die.
Griffith and Harvey (2001)	A global dynamic capability is the creation of difficult-to-imitate combinations of resources, including effective coordination of inter-organizational relationships, on a global basis that can provide a firm a competitive advantage.
Lee et al. (2002)	A newer source of competitive advantage in conceptualizing how firms are able to cope with environmental changes.
Rindova and Taylor (2002)	Dynamic capabilities evolve at two levels: a micro-evolution through 'upgrading the management capabilities of the firm' and a macro-evolution associated with 'reconfiguring market competencies'.
Zahra and George (2002a)	Dynamic capabilities are essentially change-oriented capabilities that help firms redeploy and reconfigure their resource base to meet evolving customer demands and competitor strategies.
Zollo and Winter (2002)	A dynamic capability is a learned and stable pattern of collective activity through which the organization systematically generates and modifies its operating routines in pursuit of improved effectiveness.
Winter (2003)	Those that operate to extend, modify or create ordinary (substantive) capabilities.

mean that the firm's capabilities are not 'dynamic'? We encounter the same difficulties in interpreting many of the existing definitions of dynamic capabilities (see Table II).

While entrepreneurs and managers are the key agents of change, dynamic capabilities may also be embedded in organizational routines and may be employed to reconfigure the firm's resource base by shedding idle or decaying resources (Sirmon and Hitt, 2003), or recombining resources in innovative ways that develop virtually new substantive capabilities in existing or new market arenas (Kogut and Zander, 1992; Schumpeter, 1942; Sirmon et al., 2006). Dynamic capabilities *may* be most valuable when the external environment is changing rapidly or unpredictably (as several studies in Table II suggest), but a volatile or changing environment is not a necessary component of a dynamic capability. One of our key objectives is to stem the proliferation of confusing discussions regarding

substantive capabilities and dynamic capabilities. Table II presents, in chronological order, a sample of the most well-known definitions that have appeared in the literature to date.

As we review prior definitions (Table II), we find that they share the idea that dynamic capabilities ensure that a firm's substantive capabilities *change over time* (Rindova and Kotha, 2001). Some, however, refer to dynamic capabilities only as capabilities that respond to changes in the environment. Others require that dynamic capabilities are only those that provide a source of competitive advantage. From a theoretical point of view, the requirement that dynamic capabilities are only those that result in competitive advantage represents an unsatisfying tautology.[3] Although most definitions imply that dynamic capabilities are (or *can be*) valuable, some scholars correctly note that dynamic capabilities create value indirectly. Helfat and Peteraf (2003, p. 999), for instance, observe that, unlike new product development for example, dynamic capabilities 'do not involve production of a good or provision of a marketable service'. That is, the capacity to change routines is valuable to the extent that the resulting substantive capabilities are valuable. Yet, reviewing the literature and Table I reveals that even if the resulting substantive capabilities at a given point in time prove ineffective, the dynamic capabilities may yet prove valuable the next time the firm needs to alter the way it competes.

INCONSISTENCIES AND AMBIGUITIES IN THE EXTANT LITERATURE

Reviewing the literature reveals that researchers have tended to identify dynamic capabilities *post hoc*, inferring their existence from successful organizational outcomes such as profitability and growth, as prior definitions would suggest (Table II). This practice might reflect the difficulty of gaining access to managers and/or entrepreneurs as they build or upgrade these capabilities and the difficulty of distinguishing the creation of a new substantive capability from the transformation of an existing capability (i.e. the application of a dynamic capability to reconfigure the firm's resources or their uses). The result is that dynamic capabilities have been conceptualized and assessed in ways that make it difficult or even impossible to separate their existence from their effects.

Another source of the confusion in the literature is the tendency of some scholars to equate the presence of dynamic capabilities with environmental conditions. For example, in their seminal article, Teece et al. (1997) identify a dynamic capability as the firm's ability to address rapidly changing environments. Clearly, the use (and usefulness) of dynamic capabilities is greater in dynamic environments, but one should not confound external conditions with organizational capability. In dynamic environments, firms can gain but temporary advantages that evaporate with changes in environmental conditions. These firms have to continually recon-

figure their resources to protect their competitive lead (Sirmon and Hitt, 2003; Sirmon et al., 2006). Yet, judging whether a capability is 'dynamic' or not depending on the rate of change in a firm's external environment misses the true nature of the distinction between first and second order capabilities. Furthermore, the *need* for reconfiguration or the renewal of routines may emanate from changes in organizational conditions (e.g. change in resources) rather than in the external environment. For example, when a young firm undergoes rapid growth, it faces the challenge of how to reconfigure its internal processes in order to achieve effective functional specialization and to cultivate it through effective integration (Churchill and Lewis, 1983; Hambrick and Crozier, 1985; Penrose, 1959; Vohora et al., 2004). Moreover, if a firm's leaders come to believe that operating in a dramatically different way would improve performance (regardless of the level of environmental volatility), their ability to implement desired change would demonstrate a dynamic capability, whether or not they were correct in their belief. Indeed, misapprehension of the state of nature or misuse of the dynamic capabilities can undermine results.

We view dynamic capabilities as the abilities to reconfigure a firm's resources and routines in the manner envisioned and deemed appropriate by the firm's principal decision-maker(s).[4] Our definition parallels that of Winter (2003) who characterizes an 'ordinary' (substantive) capability as the organization's ability to produce a desired output (tangible or intangible), and a dynamic capability as the higher-order ability to manipulate their substantive capabilities. The distinctions we add are: (1) to tie the definition not necessarily to financial performance but to the ability to reconfigure as desired; and (2) to make explicit the role of decision-makers in enacting and directing such capabilities. The first distinction avoids some of the performance tautology noted in the literature and past definitions (presented in Table II). The latter distinction emphasizes the strategic choice perspective (Child, 1972, 1997) underlying our view and acknowledges the responsibility of managers for the actions of the firm (Ghoshal, 2005).

As we reflect on the literature and the definitions shown in Table II, we believe that several implicit myths about dynamic capabilities should be questioned and dispelled. Importantly, dynamic capabilities are not the sole province of established firms. The creation of dynamic capabilities and the transformation of substantive capabilities can commence very early in an organization's life, as we elaborate later. Further, dynamic capabilities develop in response to a variety of conditions, not just environmental dynamism, for example: (a) perceived external change that does not fully accord with objective facts; (b) learning about external conditions for the first time, and among other things; and (c) internal pressures towards change. In short, the possession of dynamic capabilities per se does not necessarily lead to superior organizational performance. Dynamic capabilities must be well-targeted and deployed in order to achieve strategic goals. Therefore, the *management* of these capabilities is critical in gaining organizational performance-related benefits.

Further, the building and use of dynamic capabilities are costly and can therefore lead either to losses or gains; some impact short-term performance, whereas others are likely to be important in the long run. Some dynamic capabilities play only a secondary role in enabling substantive capabilities to generate value. Dynamic capabilities emanate from a variety of situations, and they vary in timing and effects.

In summary, our definition emphasizes the dynamism of the capability itself, not the environment. This definition puts 'managerial choice' at the centre of the conversation (King and Tucci, 2002). Such choices give direction, substance, and variety to the firm's entrepreneurial activities (Miller, 1983; Sathe, 2003). Consequently, we further urge researchers to avoid the tautology of suggesting that successful outcomes necessarily signal the possession of dynamic capabilities or vice versa.

Having differentiated substantive from dynamic capabilities and offered a definition of dynamic capabilities, we now build on the literature to develop a set of propositions that further delineate the relationships among substantive capabilities, dynamic capabilities, integration skills, organizational age, learning modes, and organizational performance.

A THEORETICAL MODEL OF DYNAMIC CAPABILITIES AND THEIR CORRELATES

Thus far, we have not discussed how dynamic capabilities come into existence nor the factors affecting their nature and use. Table I shows that several authors have discussed specific qualities of dynamic capabilities (Zollo and Winter, 2002), the internal and external antecedents of their formation processes (Blyler and Coff, 2003; Korr and Mahoney, 2005; Verona and Ravasi, 2003; Wheeler 2002; Zollo and Winter, 2002) and the various managerial and entrepreneurial activities and processes associated with the evolution of these capabilities (George, 2005; King and Tucci, 2002; Salvato, 2003). These studies are informative in highlighting the contradictory forces that shape the emergence and subsequent evolution of dynamic capabilities. Yet, a model that integrates prior findings on the various activities associated with the evolution of these capabilities is lacking. Below we present such a model, hoping to bring clarity to this issue.

Figure 1 presents a broad, stylized model of the various activities associated with the creation of dynamic capabilities and, in turn, their effect on a company's performance. The starting point in Figure 1 is the firm's entrepreneurial activities, defined as those activities that centre on the identification and exploitation of opportunities. Figure 1 depicts entrepreneurial activities as influencing the selection of resources and skills *and* promoting organizational learning processes to capture external knowledge as new situations arise. These choices combine to create new substantive capabilities and the organization's knowledge base. Orga-

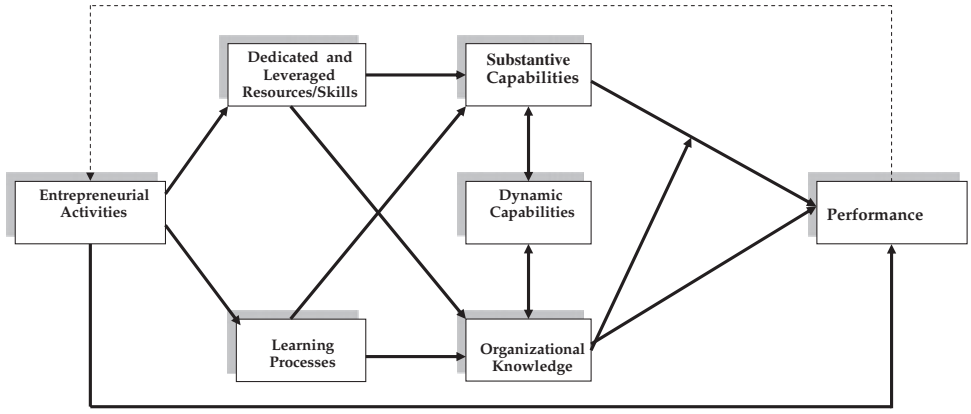

Figure 1. A stylized model of capability formation and performance

nizational knowledge is the set of all that is known or understood by the organization and its members, whereas the firm's substantive capabilities are the set of things that the firm can do. Clearly, the two affect one another in that what the firm can do (its skills) is shaped in part by what it knows, and what the firm knows is affected in part by what it does. Together, organizational knowledge and substantive capabilities determine which dynamic capabilities are necessary to adapt to emerging conditions. The bi-directional arrows to and from dynamic capabilities indicate that dynamic capabilities are affected by and transform substantive capabilities and the firm's knowledge base. Together, the substantive capabilities and firm's knowledge base directly and interactively affect the organization's performance. Finally, performance results affect future entrepreneurial choices.

Figure 1 implies that entrepreneurial processes shape the recombination of substantive capabilities and, over time, increase its 'strategic variety' which Miller (1993) views as the ability of the firm to conceive and implement varied, multiple, and innovative strategic responses to the challenges it faces in its environment. However, our central interest here is to elucidate how substantive and dynamic capabilities are related to one another, how these differ between young versus established firms, and how these differences and environmental conditions shape the likely effects of dynamic capabilities on performance of organizations. We now develop four sets of propositions which address our earlier research questions.

THE NATURE, DEVELOPMENT, AND EFFECTS OF DYNAMIC CAPABILITIES

The propositions we develop are based primarily on learning (e.g. Cohen and Levinthal, 1990) and behavioural theories (e.g. Cyert and March, 1963). One basic assumption that we make is that there are costs to developing and using dynamic

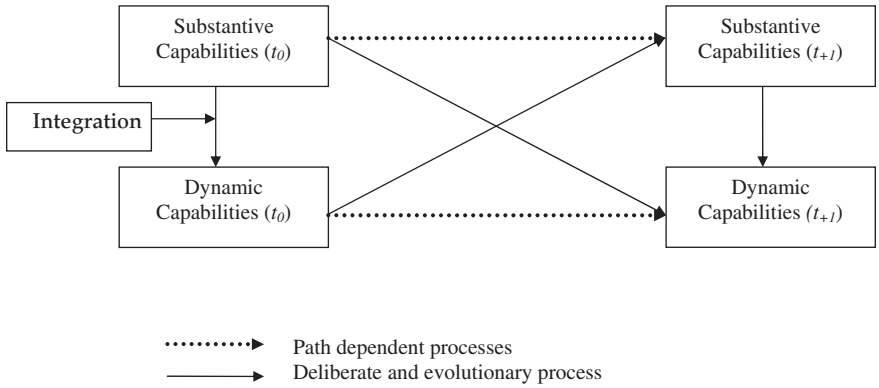

Figure 2. Evolutionary and Path Dependent Processes in Dynamic Capability Development

capabilities. These costs involve the consumption of organizational resources in devising new capabilities and in reconfiguring existing capabilities, not to mention the potential costs of wrongly estimating the need for change. Thus, although such capabilities are developed in order to realize strategic advantages, their development does not ensure organizational success.

Figure 1 implies that, in the earliest instance, substantive capabilities precede dynamic capabilities. Over time, however, the relationship between substantive and dynamic capabilities becomes complex and intricately interwoven. Our first set of propositions examines how the exercise of capabilities affects their strength and persistence.

Relationships between Substantive and Dynamic Capabilities

As we have indicated earlier, dynamic capabilities are affected by and operate on substantive capabilities. In Figure 2, we explicate in greater detail the complex relationship between the two. A path dependency develops over time as the configuration of, understanding of, and 'automatic' processes of substantive capabilities are embedded in what the firm does and how it does it.

Both learning and behavioural theories of organizational change recognize that decisions to change are dependent on the willingness to change, the awareness of the need to change, and the perceived capacity to change effectively (Katona, 1951; Penrose, 1959). Learning theory holds that organizational capacities evolve out of learning from repeated trials (Cohen and Levinthal, 1990; Zahra and George, 2002a). As firms exercise their capabilities in similar and dissimilar circumstances, they learn more about cause-effect relationships and how to achieve desired results. In short, the effects of intense, repeated exercise of routines is increased knowledge of cause-effect relationships and hence greater confidence in their use. Therefore, the exercise of routines is self-reinforcing in that it reduces

variability in the results (allowing managers to minimize risks by repeating these routines rather than trying new ones), minimizes the costs of repeating these actions, and increases managers' confidence in their future use of these routines. These ideas suggest that the more managers exercise substantive capabilities and dynamic capabilities, the more facile they become with these capabilities. Therefore:

> *Proposition 1*: Substantive capabilities and dynamic capabilities strengthen with use.

Our first proposition implies that the more firms exercise their capabilities, the more they gain command over the efficient exercise of these capabilities. The inverse is also implied: when firms do not exercise these capabilities, their *command* over these capabilities will atrophy. Nonetheless, learning theory suggests that are dangers inherent in exercising the same capabilities, especially substantive capabilities, without exploring for new ones.

The well-known notions of competency- and propinquity-traps (Ahuja and Lampert, 2001) acknowledge the self-reinforcing nature of substantive capabilities implied in our first proposition. However, the very command and efficiency gained through repetition has a downside: they provide disincentive to change. That is, great command of substantive capabilities may induce firms to repeatedly exercise those capabilities in exactly the same way with little significant effort to adjust them. The result will be ever-increasing command and ever-increasing tightly-coupled relationships among sub-routines. Therefore:

> *Proposition 2a*: The repeated use of substantive capabilities without change (i.e. without developing or exercising dynamic capabilities) renders substantive capabilities more difficult to change in the future.

At the other extreme, a firm could be continually tinkering with its substantive capabilities. One of our premises is that such tinkering is costly. Continual change consumes time and resources and disrupts the learning process by preventing the firm from being able to observe differences in the same processes under different conditions. All else equal, the cost of executing the firm's key substantive capabilities (e.g. new product development or distribution capabilities) will be minimized if the systems, resources, and processes in place are used uniformly across time. If new individuals are chosen to carry out functions, learning time will be required; if different systems or processes are to be put in place, the accommodation of the old with the new will also take time and consume resources.

Yet, if a firm is continually utilizing its dynamic capabilities, there may be gains in efficiency to be realized when major changes are suddenly determined to be necessary. According to Proposition 2a, firms that have made little use of their

dynamic capabilities will find altering their substantive capabilities difficult, costly, and minimally effective. The short-term costs of frequent exercise of dynamic capabilities must be weighed against the potentially large costs of leaving substantive capabilities unaltered. Therefore:

> *Proposition 2b*: The repeated application of dynamic capabilities to substantive capabilities increases the costs of substantive capability utilization but decreases the costs of future dynamic capability utilization.

A key direct value of the exercise of dynamic capabilities is that they keep substantive capabilities flexible, but at a short-term cost. Firms will typically develop a rhythm or habit in their application of dynamic capabilities, establishing a pattern that regulates their propensity to alter substantive capabilities. In the next section we consider the primary factors (beyond idiosyncratic preference) that influence the frequency of use.

Triggers for Developing/Using Dynamic Capabilities

The persistence of existing capabilities depends on the strength of the perceived need to change, the impetus for change, and the managerial capacity to integrate and recombine resources as desired (Penrose, 1959). Hamel and Prahalad (1994) have shown that allocating and dedicating resources are not in themselves sufficient to build capabilities or sustain a competitive advantage. Yet, fear of disrupting existing systems constrains firms from change. We propose here that a firm's facility with integration, its inability to keep up with competition, and the rate of change or volatility in the market environment provide for developing and/or utilizing its dynamic capabilities.

The detailed explication of the relationship between substantive and dynamic capabilities depicted in Figure 2 indicates the role of integration. Noting a paucity of research on capability development, transformation and evolution, Burgelman (1991) illustrates the complexity of the process by which senior managers choose new capabilities. Burgelman's work shows that inevitable conflicts arise between autonomous (e.g. improvisation) and induced strategic behaviour (e.g. formally planned actions). These conflicts can be especially acute in new ventures because their 'search' processes (March, 1991) are not well developed, command is in the hands of a few people, and strategic objectives are still in flux. In established companies, conflicts also arise regarding priorities (what areas and capabilities to build) as well as how to obtain and assemble resources without incurring the wrath of existing powers. Coordination, selection and combination are important dimensions of the process of integration; these enable the firm to build its dynamic capability to reconfigure their substantive capability routines. Coordination involves formal and informal efforts to resolve disputes, disagreements, or conflicts

about the nature and scope of capabilities to be built and how to obtain needed resources (Zahra and Nielsen, 2002). Selection induces coherence through the identification of those capabilities worthy of further refinement and development. The combination of these different capabilities occurs once coordination and selection have occurred. In sum, the aim of integration in both new and established ventures is to increase efficiency. Several researchers (e.g. Eisenhardt and Martin, 2000; Iansiti and Clark, 1994; Teece et al., 1997) have highlighted the importance of integration in their discussion and definition of dynamic capabilities.

In new ventures and established companies alike, managers may identify multiple capabilities as potential candidates for development. Conflicts about the judicious use of resources often pressure entrepreneurs and managers to make difficult choices about the capabilities that could be further developed. These choices are shaped by entrepreneurs' and managers' views of their competitive arena, projections about the industry's evolution, and beliefs about their ability to integrate the firm's capabilities. These increase 'variety' within the capability development process (Burgelman, 1991). Firms make use of this variety to map out strategic options and exploit their capabilities. But managers must decide how many (and which) of these capabilities they can afford to develop.

The ability to combine multiple capabilities in a coherent fashion can minimize redundancies, ensure congruence of strategic direction, and set the stage for effective deployment of resources (Penrose, 1959; Zahra and Nielsen, 2002). The possession of well-developed integration skills helps a firm overcome its fear of change. It also sets the expectation that exercising dynamic capabilities will result in positive outcomes for the firm, and thereby increases the propensity to enact reconfiguration processes. These observations lead to the following proposition:

Proposition 3: Integration skills increase the development and use of dynamic capabilities.

Implicit in Proposition 3 is that the more confidence a firm has in its integration skills, the more inclined it will be to develop dynamic capabilities. Yet, as we have asserted throughout this article, such skills will not necessarily ensure success. Behavioural theory holds that when firms succeed, they are apt to continue to utilize the resources, routines, and initiatives associated with this success (Cyert and March, 1963). Thus, when a firm matches or exceeds the results of key competitors, it will see its configuration and execution of its substantive capabilities as adequate or superior. Its confidence in its ability to respond to the market if necessary will be reinforced and the search for alternatives will be curtailed. It is likely that even when firms are being marginally outperformed by competitors, self-serving bias and hubris (Campbell and Sedikides, 1999, Kroll et al., 2000) will cause them to attribute lack of success to luck or factors outside their control. Yet, they will not necessarily be motivated to instigate change.

Still, as a firm's results begin to fall significantly behind referent others, the pressure to change will grow. Firms that fall well below aspirations, regardless of how good their integration skills may actually be, may begin to lose confidence in how they are operating and may begin to seek new ways to compete. McGrath (1995) has noted that, for firms in her study, change was spurred by failure via a three step process of *recognition* of the failure, *interpretation* of results as failure, and finally *adjustment of capabilities*. In short, behavioural logic and empirical observation suggest that the greater the success of current operations, the less the incentive to change. Success breeds a kind of complacency and comfort that render many firms, new and established, content to continue with the current modes of operation. Therefore:

Proposition 4: Lack of success with current substantive capabilities increases the development and use of dynamic capabilities.

The literature reveals that external factors may also trigger a firm's use of dynamic capabilities. Cyert and March (1963) observe that when the environment is volatile, organizations are likely to alter their goals, priorities ('attention rules'), and where and how they search for new knowledge and opportunities ('search rules'). Despite internal inertial forces for consistency, significant or constant change in environmental circumstances can make a firm aware of the inadequacy of current substantive capabilities. Operating in volatile environments where change is common and/or rapid, such as in high-technology industries, will cause firms to be aware of the need to repeatedly reconfigure substantive capabilities (whether by preconceived plans or spur-of-the-moment responses) in order to compete. Indeed, Moorman and Miner (1998b) found that firms in turbulent environments were more apt to improvise and experiment than those in more stable environments.

We would expect that, on average, development and use of dynamic capabilities will vary with the rate of change in the industry itself. Large disruptive events such as the introduction of a radically new technology (e.g. the emergence of digital cameras) or of drastic changes in market segments or preferences (e.g. the emergence of the dual income family) will also spur firms' efforts to develop and utilize dynamic capabilities to transform or reconfigure their substantive capabilities. Majumdar (2000) concluded in his study of the telecommunications industry over 16 years that, contrary to myths regarding the depth of inertia in larger firms, even larger more stable firms can and do transform in the face of huge structural changes. Therefore:

Proposition 5: Major or continual environmental change increases the development and use of dynamic capabilities.

We expect the foregoing propositions to be applicable to both young and established firms. The learning literature suggests, however, that younger and older

firms may indeed vary in how and what they learn, and consequently in how much and how rapidly they change. We develop in the next section propositions on the relationship between organizational age and modes of learning, and on the impact of the learning modes on speed and rate of change in capabilities.

Organizational Age, Learning Modes, and Rate of Change

An important insight from the literature is that circumstances outside the control of entrepreneurs and managers often require responses that are not within the firm's repertoire of routines (Christensen and Raynor, 2003; Miller, 1993; Moorman and Miner, 1998a, 1998b). A firm must often 'invent' solutions in order to survive. Both new and established firms engage in experimentation (Ahuja and Lampert, 2001), learning-by-doing (Minniti and Bygrave, 2001), trial-and-error learning (Eisenhardt and Tabrizi, 1995; Moorman and Miner, 1998a, 1998b), and improvisation (Moorman and Miner, 1998a, 1998b) to deal with changing demands. However, because learning is a path dependent process wherein what firms learn depends on what they already know (Cohen and Levinthal, 1990; Zahra and George, 2002a), how and what firms learn and how they change depends in part on the length of their history and the development stage of their organizational routines (Autio et al., 2000).

A vast literature on learning covers a wide spectrum of modes of learning from highly deliberate learning (Zollo and Winter, 2002) to unplanned learning (Moorman and Miner, 1998b). This literature is particularly helpful in investigating how the relatively well-explored arenas of improvisation, trial-and-error learning, and experimentation vary over the life span of organizations. Such an examination will help to reveal how and why dynamic capabilities operate differently in young versus established firms. We also consider imitation as a mode for developing dynamic capabilities, though we see this approach as less systematically related to firm age than the other modes.

Miner et al. (2001, p. 319) distinguish these three learning types as follows: Improvisation involves real-time, unplanned experience in which action informs design as it occurs. Trial-and-error learning involves the taking of actions, planned or unplanned, to inform *future* action. Experimentation is the deliberate and systematic use of varied conditions to learn cause-effect relationships. The majority of research on capability building and organizational learning has examined these processes in well-established companies (e.g. Bosch et al., 1999; Helfat, 1997). In order to provide some insight into what the literature reveals, we reviewed 19 studies that touched upon organizational learning and capability creation that appeared from 1992 to 2002 in the management, strategy and entrepreneurship journals.[5] Table III highlights the samples and conclusions of these studies. Most of the studies in Table III have focused on established firms in high technology

Table III. Review of representative studies on organizational learning and capability development

Authors (year)	*Type of study*	*Sample and method*	*Key issue(s) examined*	*Results or conclusions*
1. Van de Ven and Polley (1992)	Empirical	Single biomedical innovation over a five year period; in-depth case study with multiple sources and ongoing observation	Examined the process of trial and error learning in technological innovations by a joint venture created to commercialize products	– Observed greater escalation of commitment and other types of non-rational behaviour than implied in the learning literature – Suggested the following to increase adaptation ability: • separate planning from resource funding • limit 'impression management' opportunities • foster frank communication across departments and levels
2. Eisenhardt and Tabrizi (1995)	Empirical	36 Computer-related firms, (72 projects); case studies – multi-respondents per project	Examined effects of planning, CAD tools, teams, supplier involvement, reward, and time schedules on product development time	– Found planning and CAD tools *increase* the time to develop new products – Cross-functional teams, frequent iterations, leader power, and trial-and-error learning decrease development time
3. McGrath (1995)	Empirical	23 Financial services firms; over 200 interviews	Exploratory research to see how firms process and learn from poor outcomes in internal corporate venturing	– Noted three processes needed to learn from disappointments: • recognition of failure (*measurement*, *involvement*, *communication* of results) • interpretation of results into a business model that can be tested • action taken to change routines
4. Helfat (1997)	Empirical	26 largest energy firms over extended period of time; historical and secondary data	Examined if success of responses to changes in external conditions depends on existing stocks of complementary know-how and assets	– Firms with larger stocks of complementary technological knowledge and physical assets experienced greater increase in capabilities – Yet, such increased capabilities could not compensate for the large drop in real oil prices

Table III. *Continued*

Authors (year)	*Type of study*	*Sample and method*	*Key issue(s) examined*	*Results or conclusions*
5. Brown and Eisenhardt (1997)	Empirical	6 firms in computer industry (41 projects); case studies	Examined the ability of firms to change their competences continuously in response to high velocity environments	– Reject notion of punctuated equilibrium and event-based approaches in favour of time-paced responses. Learning and dynamic capability creation based on: • well-defined managerial responsibilities and project priorities • extensive communication • frequent low-cost experiments and iterations
6. Moorman and Miner (1998a)	Conceptual	n.a.	Consider how procedural and declarative organizational memory moderate the effects of improvisation on the novelty, speed, and coherence of organization action	– Argue that improvisation (convergence of planning and action) has no direct effects on organization action but is moderated thus: • presence of existing routines (procedural memory) will decrease novelty, increase speed and coherence • presence of prior related knowledge (declarative memory) will increase novelty and coherence, but decrease speed
7. Moorman and Miner (1998b)	Empirical	One electronics instruments firm; one food products firm (107 action events over nine months); survey data on selected events	Examined the effects environmental turbulence, improvisation, and organization memory on product and process efficiency/effectiveness	– Turbulence has a weak positive effect on use of improvisation – When turbulence is low, improvisation has negative effect on effectiveness; when turbulence is high, the effect is positive – Organization memory has a negative effect on improvisation – However, organization memory significantly improves positive effects of improvisation on all process and product outcomes
8. Zahra et al. (1999)	Conceptual	n.a.	Considers the skills that add unique value to a firm's products or services; especially interested in how knowledge integration moderates the effects of new knowledge on competence development	– Argues that learning enables the creation and extension of existing competencies via the application, integration, and deployment of acquisitive (learning from external sources) and experimental (internal learning) knowledge – Argues that value creation requires management to articulate, focus, share, and transfer knowledge – Argues that greater potential for distinctiveness and competitive advantage can be derived from experimental learning

9. Kazanjian and Rao (1999)	Empirical*	225 Computer-related companies; survey data in two waves	Examined factors influencing engineering capability institutionalization in firms highly dependent on this expertise	– Found managerial advocacy key positive factor – Found mixed results with regard to CEO background – Found institutionalization more likely with smaller TMTs – Found no effects of formalization or centralization
10. Bosch et al. (1999)	Empirical	Publishing firms; illustration of two cases	Focused on how organization form and combinative capabilities mediate effects of prior related knowledge on absorptive capacity	– Definitive conclusions hard to draw, but arguments regarding organization forms are: • Functional form is + for efficiency, – for flexibility, – for speed • Divisional form is – for efficiency, + for flexibility, + for speed • Matrix form is – for efficiency, + for flexibility, + for speed
11. Majumdar (2000)	Empirical	39 Telecommunication firms over 16 yrs; secondary data	Examined effects of structural changes in the environment on resource accumulation, configuration, and utilization capabilities of firms	Concludes that contrary to popular beliefs, larger more stable firms can indeed transform their capabilities in the face of overwhelming structural changes to the industry
12. Autio et al. (2000)	Empirical	59 Electronics firms; panel survey data over four year period, some validation from repeat surveys and secondary sources	Examined the effects of early inter-nationalization on the prospects of smaller firms' growth. Argued that such firms may possess learning advantages over older firms.	– Found that internationalization at an early age was associated with greater growth both domestically and internationally – Found product imitability to be positively rather than negatively associated with growth – Found knowledge intensity positively related to growth
13. Zahra et al. (2000)	Empirical*	321 High technology firms (from 12 different sectors); survey data with validation from second respondents and secondary data	Examined the effects of international diversity and mode of market entry on technological learning and performance of high technology firms	– Found that international diversity had positive effects on the breadth, depth, and speed of technological learning in new internationalizing high technology ventures – Found that knowledge integration significantly enhanced the positive effects of diversity on the breadth, depth, and speed of technological learning; found that modes of entry also significantly affected breadth, depth, and speed of learning – Found a positive relationship between international diversity and performance

Table III. *Continued*

Authors (year)	*Type of study*	*Sample and method*	*Key issue(s) examined*	*Results or conclusions*
14. Minniti and Bygrave (2001)	Conceptual*	n.a.	Considered how entrepreneurs accumulate and update their knowledge bases	– Argued learning occurs in unpredictable ways, based on ability of entrepreneur and random events that reinforce existing beliefs – Learning is path dependent and may be based on false feedback or information – Thus, entrepreneurs seek to maximize, but subjective assessments can be myopic, have elements of non-rational and suboptimal
15. Ahuja and Lampert (2001)	Empirical	97 Global chemical firms; secondary data, especially patent citations	Examined how large corporations create breakthrough inventions and how exploration of novel, emerging, and pioneering technology helps them overcome competency traps	– Found inverted-U shaped relationship of exploration of novel and emerging technologies with creation of breakthrough invention – Found positive relationship of exploration of pioneering technologies with creation of breakthrough invention – Concluded that continual activity and experimentation are needed for firms to renew and reconfigure capabilities
16. Katila and Ahuja (2002)	Empirical	124 Robotics firms; secondary data, especially patent citations	Examined the effects of search depth and search breadth on a firm's ability to create change in product introduction	– Found a positive relationship between search breadth and depth on new product introduction; but, beyond a certain level, additional depth begins to reduce new product introduction – Concluded that exploitation is a broader concept and more beneficial than previously believed

Note: * New firms study.

industries, and most have emphasized innovation, new product development, or new market entry activities to illustrate concepts.

As we reflect on prior studies we find that they are largely cross-sectional and because few focus specifically on young firms, they provide little direct empirical evidence on differences in learning processes for newly founded versus established firms. As two exceptions, Van de Ven and Polley (1992) and Autio et al. (2000), suggest that learning modes and practices do change over time. Observing a single firm over five years, Van de Ven and Polley (1992) noted a tendency for the firm to become more 'set' in its ways over time. Consistent with this view and based on panel data, Autio et al. (2000) argued that younger firms have some 'learning advantages' because their short history provides them with less to *un*learn. However, taken as a whole, the empirical evidence is suggestive rather than definitive. Therefore, Propositions 6a–d (below) regarding the links between organizational age and learning modes for dynamic capability development are based primarily on theory and logical inferences.

Although empirical data show that firms learn via all of the above-mentioned modes *throughout* their existence, reasons exist to expect that the younger the firm, the more likely it is to resort to improvisation. Young firms are notorious for having to 'fight fires' (Churchill and Lewis, 1983). They do not possess the slack resources that would allow time to plan actions or to experiment with different contingencies, even if planning might indeed pay off (Delmar and Shane, 2003). Furthermore, their limited experience dictates that, especially in the very earliest stages, they will be confronted with many situations they have never seen before. Without adequate time or resources to plan fully, and without a large repertoire of prior experience, they will often be forced to improvise to create or enact solutions. Over time, if they survive, the need to improvise will decline, even if it never disappears completely. Consistent with these arguments, Moorman and Miner (1998b) found organization memory to have a negative effect on the tendency to use improvisation. All else equal, as the venture builds its knowledge base, its need to improvise will decline. Therefore:

> *Proposition 6a*: Improvisation becomes a *decreasingly* likely choice for developing and using dynamic capabilities as firms age.

Trial-and-error learning (prepared actions aimed at least in part to inform future decisions) shares some properties with improvisation but also differs in critical ways (Miner et al., 2001). Like improvisation, it implies that the firm has a significant degree of discomfort with its level of knowledge of the critical causal relationships. However, unlike improvisation, it involves planning to utilize part of the firm's 'bag of tricks' to learn how it should proceed in the future. In order to engage in trial-and-error learning, then, the firm must build a stock of capabilities to draw upon, and it must be able to afford the time to pre-plan, execute,

and use the information for later significant decisions. Thus, it appears that trial-and-error-learning would increase in usage over the early stages of the ventures' life as it builds knowledge, routines, and slack resources. However, given the non-systematic nature of its utilization (Miner et al., 2001), we would expect the use of this mode of learning to level off or decrease over time as firms' processes and knowledge become more structured. In short, we see trial-and-error learning as an important mode for the early development of the firm, but we do not expect that it will continue to be used at the same rate later in the life of the venture. Therefore:

> *Proposition 6b*: Trial-and-error learning first becomes an *increasingly* and then a *decreasingly* likely choice for developing and using dynamic capabilities as firms age.

We have used the literature to argue that efforts to upgrade capabilities tend to be spontaneous and spur-of-the-moment for young firms, a condition which itself requires continual change in how new ventures respond to change. In contrast, established companies are likely to be more deliberate in their approach to thinking about, developing, and reconfiguring capabilities. In established firms, senior managers will typically have more resources to devote to systematically exploring the potential contributions of existing approaches to performance. Managers are apt to focus also on leveraging what their companies are already doing while stretching the uses of given capabilities into new fields (Hamel and Prahalad, 1994). Such tendencies match Miner et al.'s (2001, p. 319) observations of the characteristics of experimental learning. They note that in experimental learning, 'inputs are deliberately varied and contexts compared so outcomes can be attributed to inputs . . . Reflection is high because observing outcomes under varied conditions is the goal.'

For the resource and time reasons articulated in Propositions 6a and 6b, young firms will have little inclination or ability to 'experiment' in order to develop their capabilities. They will rarely have the luxury of planning ahead how they might convert substantive capabilities over time, much less the luxury of waiting for or comparing the results of multiple experiments. Consistent with Sarasvathy's (2001) work on effectuation (which posits that entrepreneurial search often proceeds from resources to goals rather than the reverse), young firms sink or swim with what they have; they tend to learn by doing. As time passes, however, these firms will become increasingly aware of exactly what they know and do not know and will be more able to design and execute experiments to revise capabilities. Furthermore, if indeed they do become increasingly bound to existing ways of doing things (Autio et al., 2000; Cohen and Levinthal, 1990; Majumdar, 2000), the more incremental and controlled means of gaining knowledge afforded by experimentation will become increasingly appealing. Thus, we propose:

Proposition 6c: Experimentation becomes an *increasingly* likely choice for developing and using dynamic capabilities as firms age.

Besides experimentation, another important source of intentional change or variation in organizations is imitation (Aldrich, 1999). Although many new ventures may initiate or change routines based on imitation of others, an effective process of imitation is more complex and difficult than is readily apparent. Miner et al. (1999) note that firms use different bases of imitation (frequency of use, outcomes, and traits) and may find imitation as challenging as the creation of their own change processes because of lack of transparency and lack of commensurability across settings. Although incentives to emphasize imitation as a means of selecting and initiating change would appear to differ between young and mature firms, the net result may be that young and old are equally likely (or unlikely) to learn through imitation. Young firms may wish to use imitation as a means of acquiring new knowledge because of their relative inexperience and lack of knowledge. Older firms may observe newcomers succeeding where they have stumbled and wish to 'get in on' the new way of doing things; institutional pressures from external stakeholders may also push them to conform to the state of the art. Even without external pressure, managers in some older firms may simply deem that it is time to try something new, and, rather than 'reinventing the wheel' they may look to copy ideas from competitors.

Imitation holds some perils for firms of any age as well. Young firms' lack of experience may limit the extent to which they can choose the right candidates for imitation; it may also hamper their ability to execute imitated actions effectively, even if they choose the right ones. Older firms may simply perpetuate their own sedentary habits if they copy rather than create new processes. Yet, because of the unpredictable nature of transferring practices across organizational boundaries, imitation can actually be a reasonable source of innovation (Aldrich, 1999), intendedly or unintendedly, for both young and old firms. In summary, it appears that incentives to utilize and to eschew imitation exist for both younger and older firms. Therefore:

Proposition 6d: Imitation for developing and using dynamic capabilities is unrelated to firms' age.

Despite the popular idea that young firms are much more agile and 'fit' for change (such as the reconfiguring of routines) than are older firms, Aldrich (1999) notes that evidence in the sociological literature on whether organizational variation is associated with age is equivocal at best. Further, based on his review of 18 empirical studies, Baum (1996) concluded that the age-variation association was unclear and recommended that researchers focus their energy instead on understanding the underlying processes. We have proposed above that a firm's choice of processes

of change may be related to age: e.g. greater use of improvisation early on and greater experimentation later on. We now suggest that the amount and speed of change in capabilities may be related to the chosen processes as well.

By its very nature, experimentation implies a higher level of control than that present in improvisation and even trial-and-error learning. The deliberate and systematic choice of inputs for subtle variation and comparison used in experimentation allows for fine-grained understanding of the effects of incremental change. In contrast, improvisation requires that a firm 'invent' on the fly, that it proceed without a roadmap as to where it is going, and that it contend with whatever may come its way. Trial-and-error learning also requires that a firm voyage outside its familiar comfort zone (Miner et al., 2001). Both improvisation and trial-and-error learning thus involve some unplanned and online aspects not typical in experimentation. Given its reliance on detailed planning and evaluation, experimentation requires more time from initiation to integration of lessons learned then improvisation and trial-and-error learning. Consistent with this assertion, Eisenhardt and Tabrizi (1995) found that, in comparison to trial-and-error learning, planning tools increase time to develop responses.

Not only may the speed of change be greater with the less structured learning processes, but the *amount* of change may be greater as well. Using controlled experiments to drive change limits the firm to its sphere of knowledge (Cohen and Levinthal, 1990). The truly novel and unexpected is much more likely to emerge when the firm opens itself to learning from unstructured, external stimuli (Zahra and George, 2002a). Indeed, Aldrich (1999) notes that processes emanating out of the lack of knowledge may produce the greatest variations. Thus, taken together, the foregoing arguments suggest that the speed and amount of reconfiguration of a firm's capabilities will depend in part on the learning processes themselves. Given that 'planned' change processes require more time to develop and that they tend to remain in the vicinity of what is known, we propose:

> *Proposition 7*: The amount and speed of change in substantive capabilities is greater from trial-and-error and improvisation than experimentation processes.

Table IV presents an overview of the implications of the foregoing propositions. We consider Table IV suggestive rather than definitive because many of the ideas in this layout have not been tested, nor have we had space within the framework of this review to develop all of the underlying logic. It is worth noting that our focus on how organizational age affects the propensity to choose different learning styles highlights two important issues. First, the *tendency* to choose particular learning modes explains, on average, why younger firms are more likely to change more dramatically than older firms. Still, the fact that some do not choose in this fashion explains why the link between age and capacity to change is not clear-cut (Aldrich, 1999; Baum, 1996; Majumdar, 2000). This fact highlights why managers are an

Table IV. Dynamic capabilities in new ventures versus established companies

Dimension	*New ventures*	*Established companies*
Configuration and attributes of DC (number, scope, complexity, stability)	• Few • Focused • Simple then complex • Rapidly changing	• Many • Broad • Complex then simple • Resistant to change
Triggers/speed for the development and use of DC	• Increasing integration skills, recent execution failures, opportunities in previously unexplored areas, and major changes in demands from customers	• Presence of integration skills, recent *repeated* execution failures, and major changes in the competitive landscape whereby competitors have leapfrogged the firm's technology or features
	• Development, use likely follows vary rapidly upon event; changes sometimes dramatic	• Development, use occurs after a significant gap following changed circumstances; changes rarely dramatic
Primary method(s) for discovering or developing DC	• Trial-and-error • Improvisation • Imitation	• Learning from experience • Planned change, experimentation • Imitation
Capability upgrading	• Learning is based on action more than planning • A key goal is filling major gaps in the firm's existing capability portfolio to explore opportunities for organic growth	• Deliberate, with an emergent quality • The focus is on building dynamic capabilities that both leverage what the firm is already doing while stretching its competence basis

important aspect for understanding the evolution and development of dynamic capabilities: development, though path dependent, is not inevitable nor deterministic. Managers' perceptions, preferences, capacities, and errors significantly influence the path taken and its results.

One aspect of Table IV is worth a special mention here. We imply in the table, but do not develop in our arguments, that routines start as relatively simple processes, become more complex, and finally tend toward simplicity once again. The logic is that firms start with little knowledge or resources, add resources and knowledge as they grow so that the complexity of relations among components expands, and finally simplifies as they become more knowledgeable and efficient. Yet, this pattern may be disrupted under conditions of severe upheaval so that the performance of firms that cling to old, simplified patterns when change is necessary, may suffer. We now turn our attention to the issue of dynamic capabilities and performance.

Dynamic Capabilities and Organizational Performance

We began our review of the popular definitions of dynamic capabilities with the opinion that a good definition should not define the concept in terms of its results. In particular, we objected to defining dynamic capabilities as those capabilities that produced superior performance in dynamic environments. We are still left, however, with the question of whether dynamic capabilities are directly and significantly related to organizational performance. Indeed, a major reason for the ongoing interest in dynamic capabilities is their *potential* for influencing a firm's performance. We agree with Eisenhardt and Martin's (2000) view that having dynamic capabilities *per se* does not lead to superior firm performance. Such capabilities are necessary but not sufficient for conditions with a sustained advantage. If the substantive capabilities upon which they operate are mediocre and remain so after reconfiguration, no advantage will accrue. Yet, we would argue that given two firms with equivalent substantive capabilities, those firms with superior dynamic capabilities are more likely to meet emerging challenges in a timely fashion. The fact that different firms *could* arrive at the same point from different processes or angles does not diminish the potential advantage of possessing the ability to rapidly adjust, reconfigure, or change as desired.

We believe that the realization of the potential advantage accruing to dynamic capabilities depends on two factors: the need to change and the wisdom of the chosen changes. The less often a firm needs to change, the lower the opportunity to cover the costs of developing dynamic capabilities. Our premise that the development and use of dynamic capabilities involves costs has implications for the potential value of the dynamic capabilities. If a firm rarely has need to change substantive capabilities because its market or technological environment is stable, its performance may be harmed if it expends significant resources to develop change capabilities. On the other hand, if the environment is highly volatile, frequently and unpredictably necessitating changes in substantive capabilities, the potential value of dynamic capabilities can be quite high. In short, we hold that the potential value of dynamic capabilities is moderated by the dynamism of the external environment. Therefore:

> *Proposition 8*: The *potential* gain from dynamic capabilities (through substantive capabilities and organizational knowledge) is greater in dynamic environments.

Several studies have attempted to catalogue and document the various effects of dynamic capabilities. Several of these studies appear in Table I (see 'outcomes'), covering larger and well established companies. The literature summarized in Table II highlights key reasons why dynamic capabilities can improve a firm's performance. For example, Anand (2001) argues that a dynamic alliance capability enables the firm to choose good and reliable partners and structure their relationships effectively, and gain new knowledge that improves its performance. Teece

et al. (1997) note that dynamic capabilities renew a firm's competencies that improve performance, especially in dynamic markets. Rindova and Taylor (2002) believe that a dynamic management capability is essential for upgrading a firm's managerial skills to spot and exploit opportunities in evolving environments. Daniel and Wilson (2003) suggest that dynamic capabilities enhance the success of organizational transformational efforts. Lee et al. (2002) observe that a new source of competitive advantage lies in the ability to conceptualize how firms can cope with environmental changes by identifying and exploiting opportunities. These views reflect the general tenor of the literature on the value of dynamic capabilities to creating and sustaining competitive advantage.

Some researchers observe, however, that not all organizational learning or change is purposeful or useful (Huber, 1991). Eisenhardt and Martin (2000), for example, question whether dynamic capabilities are capable of providing a *sustainable* advantage for firms. We have ourselves asserted that dynamic capabilities are costly and that they may be used to achieve misguided aims. For us, then, the effect of dynamic capabilities on performance will depend on the quality of the organization's knowledge base. The use of dynamic capabilities when they need not be implemented or when based on incorrect cause-effect assumptions may harm rather than help performance outcomes. Yet, as the knowledge base of the firm increases, so should the positive outcomes of the learning and change processes. Consistent with this position is Moorman and Miner's (1998b) finding that even though organizational memory has a negative effect on the propensity to improvise, it significantly improves the positive effects of improvisation on processes and outcomes.

To summarize, currently there is some disagreement in the literature on the potential effect(s) of dynamic capabilities on organizational performance. Some researchers believe that dynamic capabilities *necessarily* enhance performance by increasing companies' agility and strategic flexibility. We have argued, instead, that the effects of dynamic capabilities on organizational performance work through substantive capabilities ('what the firm can do') and depend on the quality of the organization's knowledge base ('what the firm knows'), as Figure 1 shows. Therefore:

Proposition 9a: The relationship between dynamic capabilities and performance is mediated by the (resulting) quality of substantive capabilities.

Proposition 9b: The effect of substantive capabilities (and, indirectly, dynamic capabilities) on performance is moderated by organizational knowledge such that low organizational knowledge increases losses and high organizational knowledge increases gains.

As the above discussion indicates, changes in the firm's entrepreneurial processes and resource allocation patterns can set the stage for developing new substantive

capabilities that open up new strategic options and require the parallel development of corresponding dynamic capabilities. Burgelman (1983) has noted that a firm's strategy guides such choices. Managers may also see the potential for a new strategic direction in the process of exercising new capability development; thus, capability development may also drive new strategy. Over time, some firms may develop dynamic capabilities that stimulate and foster an entrepreneurial orientation throughout their operations.

The ongoing cycle between strategy and capability development makes it possible for the firm to quickly exploit its discoveries in conceiving and implementing innovative strategic alternatives that give the firm a potential source of competitive advantage. The novelty of these strategies improves the firm's market standing. This cycle also reduces the time that elapses between the development of new strategies and their execution, enhancing the firm's agility and market responsiveness.

DISCUSSION

Dynamic capability is an important and complex concept that occupies a central place in the entrepreneurship and competitive strategy literatures. Recognizing this importance and complexity, we have defined the concept so as to avoid tautology and have developed a framework that explicates the relationships among substantive capabilities, dynamic capabilities, learning, and organizational performance. We have emphasized the role that managerial choice plays in these processes and have posited that the realized value of dynamic capabilities depends on environmental conditions and organizational knowledge. Our framework highlights the role of organizational learning in the evolution of capabilities. This view extends the ideas of Cyert and March (1963) who suggest that organizational learning is multifaceted and centres on adaptations of goals, existing attention rules (what is important), and existing search rules (where and how to look for new ideas and knowledge). We have also articulated key differences between new ventures and established companies in the nature and use of their dynamic capabilities. We now discuss some of the implications of our framework for managerial practice and theory.

Managerial Implications

Our definition of dynamic capabilities places entrepreneurs and managers at the centre of the process by which companies give birth to substantive capabilities and develop the dynamic capabilities to transform them over time. Our view is that, it is managers' (and entrepreneurs') visions and integration skills that make an important difference in directing the development of these capabilities. Thus, there is a need for managerial vision in thinking about the firm's competitive arena and the

trajectory of its future evolution. Luck, of course, can play a role in which firms survive and thrive, but our propositions collectively suggest that over time those firms that develop the substantive capabilities that address current challenges *and* the dynamic capabilities to redeploy or reconfigure those capabilities are the ones that will be most likely to succeed as things change. Ultimately, firms that survive for a long period of time are those that keep fresh both these first-order and second-order talents.

The literature also highlights a need for dynamic capability development in dynamic environments. The assumption that volatility and uncertainty of such environments exacerbates the salience of the ability to rapidly change direction has great validity. However, it is likely that firms in these environments are acutely aware of the value of such capacities. More insidious might be the circumstances of firms, especially mature firms, in stable environments that overlook the need to keep current through their capacity for renewal of stale routines. These capacities are kept fresh through improvisation, trial-and-error learning, and experimentation. Use of dynamic capabilities keeps substantive capabilities fresh and helps firms avoid some of the traps related to pure efficiency seeking repetition.

Dynamic capabilities evolve from attempts to deal directly with the challenges of keeping substantive capabilities vibrant and with the organizational learning that occurs through the acquisition of new internal and external knowledge. Moorman and Miner (1998a, 1998b) observe that the capacity to adjust routines on the fly can result from encountering a situation for which the organization is not prepared. New situations and new challenges provide opportunities for organizational learning, setting a foundation for creating dynamic capabilities. Although unanticipated circumstances may provide opportunities for learning, the greatest learning may occur if firms consciously experiment. Moorman and Miner (1998b) speculate that improvisation does not necessarily lead to learning, and McGrath (1995) cautions that unless firms carefully measure what they do, define roles, and explicitly communicate results, little may be gained by a mere 'bias for action'. Indeed, the notion that systematic planning may be detrimental for emerging ventures has recently been challenged (Delmar and Shane, 2003).

The challenge for new and established firms is to create – to a degree sufficient to meet the challenges of their environment – a systematic openness to upgrading and revising their substantive capabilities, through a variety of learning modes. Autio et al. (2000) posit that such openness (or lack thereof) becomes embedded in a firm's culture by its early choices. Sapienza et al. (2005) also found evidence that firms develop a degree to which they operate as a 'learning culture'; i.e. they have found that firms tend to expend high or low levels of learning effort in all the markets in which they operate as opposed to being highly active in one and reactive in another. For established companies that have developed a proactive approach, the trick is to continually renew the system itself in order to retain the dynamism of their capabilities. Companies that have not operated in this fashion face a more

daunting task: they have to break old habits, replace them with new ones, and then ensure that no reversion occurs. These firms have to learn how to develop and hone their dynamic capabilities.

Theoretical Implications and Future Research Directions

Our article underscores the usefulness of integrating learning theory (Cohen and Levinthal, 1990; Zahra and George, 2002a), the behavioural theory of the firm (March and Simon, 1958) and the dynamic capabilities literature (Nelson and Winter, 1982) to better understand how organizations adapt and create value (Mahoney, 2005). Our model (Figure 1) and our nine propositions provide new ways of seeing current literature and suggest several avenues for future research.

Our model. Figure 1 indicates that entrepreneurial activities directly affect organizational performance which in turn feeds back to new entrepreneurial activity choices. However, it also indicates a much more complex set of relationships among resources, learning processes, capability development, and organizational outcomes. The key feature of the model is that dynamic capabilities mediate the relationships between substantive capabilities and organizational knowledge, resulting in an indirect impact of dynamic capabilities on performance.

One implication of this model is that the nature and quality of both substantive capabilities and organizational knowledge stem from the resources and learning processes the venture puts in place early on. New ventures and established companies might have different types of advantages of their own when it comes to developing and harvesting dynamic capabilities. These differences are not well catalogued in the literature, and future research can enrich our understanding of these issues. Such understanding can help us form different prescriptions for new and established firms. For example, one of the most widely held assumptions is the malleability of new ventures' routines, making it easier for founders and entrepreneurs to develop radically new capabilities (Autio et al., 2000). Is it reasonable to assume that the routines of younger firms are relatively more malleable? What causes these routines to calcify in later stages? How may they be kept flexible? Do established companies have unique advantages in developing dynamic capabilities? What is their source? Can they leverage their greater resources to an advantage? How do older firms renew different routines and develop capabilities? These are a few of the questions we need to consider as we contemplate the differences between newer and established firms' dynamic capabilities.

Relationship between dynamic and substantive capabilities. Our propositions regarding the utilization of substantive and dynamic capabilities and their relationship to one another hold some interesting dilemmas or paradoxes for ventures, young and old. First, consistent with learning theory we propose that both types of capabilities

'strengthen' with use. Here, we imply two qualities: they become better controlled and more 'fit' for their purposes, but they also become more persistent or resistant to extermination. Furthermore, because of the path dependent nature of learning, this also implies that the earlier in the firm's formation such capabilities are developed, the more deeply embedded in the culture of the firm is the propensity to develop and use such capabilities (Autio et al., 2000).

A second implication is that dynamic capabilities are needed to keep substantive capabilities vibrant. On the one hand, substantive capabilities atrophy without use; on the other, they become so embedded in organizational memory if not altered that flexibility is harmed. It is the function of dynamic capabilities to keep strong, exercised substantive capabilities supple. Yet, we have not addressed here how a firm may keep its dynamic capabilities fresh. Theoretically, a kind of 'infinite spiral' of capabilities to renew capabilities could be conceived.[6] A fruitful avenue for future research would be to develop, explore and test ideas about how firms resolve this issue.

Another implication of the first set of propositions is that the positive effects (if any) of dynamic capabilities require time to appear because of the costs involved in developing and exercising them. Thus, if researchers are sampling and testing the effects of dynamic capabilities, it might be wise for them to expect that measurable positive outcomes will take some time to appear. The longer the time period sampled following the development of a dynamic capability, the more positive the observed relationship will likely be. Further, Proposition 8 suggests that the more volatile the environment during this period, the greater will be the likelihood of a large, positive effect. It is also possible that although frequent changes prevent optimizing current substantive capabilities, the frequent changes may occasionally result in early innovations (in 'crude' form) with substantial cost or quality advantage over competition.

Many other fruitful areas of investigation of the relationship between substantive and dynamic capabilities may be explored. For example, an interesting question is whether different substantive capabilities demand different skills in developing relevant dynamic capabilities. If so, how do these vary? Are some more difficult to develop than others? Is there an optimal sequence for developing these capabilities? Finally, an interesting question is whether there is a core dynamic capability skill that is common to all of the various dynamic capabilities the firm develops. If there is something common or at the core, is it truly a skill or is it more an attitude or orientation (Lumpkin and Dess, 1996; Sapienza et al., 2006)?

Triggers for dynamic capabilities. Assumptions central to the strategic choice framework (Bazerman, 2002; Child, 1972, 1997; Friend and Hickling, 2005; King and Tucci, 2002) are implicit in our model of the triggers for dynamic capability development and use. More specifically, we assume that entrepreneurs and other key organizational decision makers are boundedly rational and undertake choices

designed to maximize organizational goals. Fittingly, then, Proposition 3 posits that firms with greater integration skills are more inclined to leverage these skills as the positive feedback from their application encourages further use. Proposition 4 holds that failing with current applications spurs attempts to change, and Proposition 5 implies that when the environment changes rational decision makers will change what they are doing. What we do not take up is when decision makers may be inclined to deviate from these expectations.

Two categories of deviance from these expectations may be worth exploring. One category is factors that cause suspension of rational economic decision making. This suspension could be the result of adopting, at least temporarily, goals other than the maximization of return. For example, decision makers may adopt, or be pressured to adopt, employment maximization as its central goal. This shift would certainly affect what would or would not trigger the development and use of dynamic capabilities. Alternatively, rational thinking itself may be disrupted without changing avowed goals. For example, phenomena such as threat rigidity response (Staw et al., 1981) may occur in the face of certain types of threats but not others.

Another category is the circumstances that lead managers to conclude that the development and use of dynamic capabilities may be harmful. For example, perhaps firms that are operating on the margins of existence would conclude that any change (in the short run) would spell termination of the business. Alternatively, implicit or explicit contracts may render change illegal or a violation of agreements. A third possibility is when managers judge drastic environmental change or disruption as temporary and there is a high likelihood of 'return' to former circumstances. Investigating what kinds of signals or circumstances would induce this type of judgment would be interesting in its own right. In short, there are many potential contingencies that scholars may deem best to define the boundaries or qualifications of our propositions regarding the triggers for dynamic capability development.

Organizational age and learning modes. One contribution of this article is our delineation of potential differences between new and established firms in the processes and attributes of dynamic capability creation (Table IV). Future researchers could expand upon our logic, empirically examine the suggested differences, and relate them to performance. It might also be insightful to attempt to link differences in learning processes not only to organizational age but to differences in competitive positions and growth trajectories.

Assumptions about older and younger firms should also be examined in greater depth in future research. As with our earlier propositions, we highlight here general tendencies rather than 'laws' regarding the relationships between age and learning mode choice. However, some have noted that new and established companies also differ in their resources, managerial processes, systems, their entrepreneurial inten-

sity, and their focus (e.g. Autio et al., 2000; Lumpkin and Dess, 1996). The implication of these differences would be not only that companies might make different choices regarding learning modes, but also that if they made the *same* choices, the consequences might differ.

In our quest for parsimony, we portrayed expected activities and phenomena in starkly different terms. However, some researchers claim that differences are overstated in the literature (e.g. Majumdar, 2000). Empirical documentation of these differences, as well as their sources and magnitude, are required to fully understand the links between organizational age, choice, and capability configuration. Research designs that include tracking new ventures over time should improve our understanding of these phenomena.

Researchers should also recognize that firms vary significantly in their origins, history and goals. Different founding conditions may cause ventures to evolve differently and, as a result, to develop different types of learning capabilities at different stages of their evolution (Vohora et al., 2004). These variables are likely to shape how these ventures reconfigure their resources and build different dynamic capabilities at different stages of their evolution. Penrose (1959), among others (Mahoney, 2005) also highlight the importance of differences in top teams in their firm-specific experiences as a key source of innovation, especially in transforming resources (notably managerial resources) to a key source of innovation that fosters organizational growth.

The literature (and our own elaboration of propositions) implies that studied experimentation, trial-and-error learning, and improvisation are useful. Even if this assumption is correct, it is too broad to be of much use in guiding managerial choices. What kinds of experimentation should be undertaken? By whom, and across which activities? When might such processes be more or less likely to lead to disruptive technologies or breakthrough process innovations?

Finally, our brief coverage of learning types suggest many additional areas to be studied. For example, is it important to balance across the types of learning modes in order to ensure learning or to prevent 'lopsided learning'? How do other types of learning (such as learning-before-doing) relate to organizational age, and are there interactive effects of modes of learning? For example, it could be that improvisation and experimentation are powerful in conjunction with one another because the former keeps the firm agile and the latter disciplined. It may be that imitation is more efficacious early or late in organizational development, even if it is no more or less common. Clearly, much remains to be explored in regards to learning modes and organizational development.

Dynamic capabilities and organizational performance. We have suggested that the creation of dynamic capabilities is not necessarily associated with higher performance. For one thing, an inevitable outcome of a high number attempts to change and improve is a high number of 'failed' experiments. For new ventures, too many of

these consecutive attempts could damage a new venture's credibility and even lead to its demise. Established companies also pay dearly for failed experiments, though these firms are buffered somewhat by their slack resources. Competitors also learn vicariously and through competitive intelligence from the actions of the innovating firm. Some of these capabilities might become a source of rigidity as the firm overuses them in their operations.

At the same time, errors themselves provide new, useful and important information that could facilitate the building of sustainable advantage. McGrath (1995) directly examines the impact of unsuccessful innovation and concludes that in order to create capabilities, companies must be able to live with these errors. Building dynamic capabilities allows firms to conceive of new resources and explore new uses for their resources. Firms that have this orientation are less likely to be caught in the various maturity, familiarity, and propinquity traps (Ahuja and Lampert, 2001) than those that never experiment for fear of failure. They also enable strategic renewal (Sathe, 2003; Zahra et al., 1999), enhance the strategic variety of the firm's decision-making process (Burgelman, 1991; Miller, 1993), and keep competition off-balance by leaving open many alternative paths. Proposition 8 states our position that dynamic environments afford the greatest number or size of opportunities for the realization of such advantages through the use of dynamic capabilities.

Figure 1 and Proposition 9 indicate that the impact of dynamic capabilities occurs through substantive capabilities and depends upon the quality of the knowledge upon which the choices are based. Given that managers are choosing in uncertain environments, errors in judgment are always possible and may lead to suboptimal performance (note 4). Our framework does not explicitly address how this information or knowledge may be best maintained to lead to the best judgments. Implicitly, however, our argumentation and framework suggest that, on average, the more active a firm is in developing and exercising its capabilities, the more likely these choices will be superior. A great deal of room is left here for future researchers to fill out our theoretical reasoning and to test these ideas.

A key question in the evolving dynamic capabilities literature is whether dynamic capabilities give a firm a sustainable competitive advantage. Eisenhardt and Martin (2000) advance that dynamic capabilities are not a source of sustainable strategic advantage because firms can reach the same resource configurations via different processes or paths. Thus, they point out, a degree of *equifinality* (i.e. same end result via multiple different paths) exists with regard to these capabilities. Their view is that similar dynamic capabilities exist across different firms and thus that 'idiosyncratic firm effects' are overstated in the literature. We agree with them in part, but in part we disagree. We agree that unbounded sustainable competitive advantage itself is likely a myth. The competitive landscape simply changes too much, too often, and too unpredictably for any capability to confer a permanently *sustainable* advantage. The emphasis is on the fact that multiple firms may arrive at

the same (or very similar) resource configurations via different means; hence, they conclude that the two are essentially equivalent. However, we hold that even if the same resource configuration or substantive capability (which they call 'best practices') is achieved, the differences in means to get there (dynamic capabilities) *do* matter. The reason they matter is that for two firms in exactly the same place (metaphorically), where they go next and how quickly they get there will differ if their dynamic capabilities are different. The relative validity of these two positions is open to further theorizing and testing.

Conclusion

A growing body of research highlights the importance of entrepreneurial activities for the conception, development, configuration and maintenance of dynamic capabilities in new ventures and established companies. Building on this emergent literature, we have proposed a model of the various links among these variables and how dynamic capabilities might influence a company's performance. We have offered in this article a definition intended to make clear separations of dynamic capabilities from substantive capabilities, environmental conditions, and performance outcomes. We have also introduced the role of the strategic decision maker into our definition.

Our model (Figure 1) highlights a firm's entrepreneurial process as the 'starting point' in conceptualizing the process by which both substantive and dynamic capabilities come into existence. This process itself is fertile territory for theoretical and empirical investigation. Here, we have focused on developing several testable propositions intended to advance the understanding of the relationships among variables central to dynamic capabilities inquiry, their antecedents, and their outcomes. We hope that other scholars will take up the challenge of further exploring and testing these ideas.

NOTES

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[1] This distinction identifies the primary difference between our definition and that of Eisenhardt and Martin (2000); they see, for example, product development capability as a dynamic capability because it results in new products for the firm, whereas as we see new product development as a substantive capability operating through a set of routines. For us, the ability to change product development routines would be a dynamic capability – a dynamic new product development capability if you will. The firm may have a strong substantive product development capability while having a weak or no corresponding dynamic capability to change. Without a substantive product development capability it cannot have a dynamic product development capability.

[2] Again, Anand's rendering would be what we would call a substantive capability; the ability to *reconfigure* how this partnering operates would be the dynamic alliance capability.
[3] A repeated theme of ours is that having dynamic capabilities is potentially very valuable, but creating value is not what determines whether the firm has a dynamic capability. Just as a sword is potentially valuable in combat, one may fall on it as well; whether you have a sword is not determined by whether you succeed. We believe it is very important to make the distinction between a dynamic capability (i.e. the ability to change existing substantive capabilities) and its effects (which may include a whole host of outcomes from increased costs, to organizational resistance, to sustainably superior performance).
[4] By principal decision-makers we mean all those empowered to conceive or implement changes to the core substantive capabilities of the firm. In small or new firms this set probably includes but a relatively small number of top managers; in larger firms this set includes not only 'top' managers but the set of middle managers key in strategy implementation and formation. There is still the following issue to note in our definition. Imagine two firms with identical substantive capabilities in the same environment. An objective environmental change occurs which requires a change of magnitude x to be optimally met. Firm A's managers perceive a need for a change of magnitude x/4 and succeed in accomplishing this. Firm B's managers correctly perceive a need for change of magnitude x, but only accomplish x/2. By our definition, Firm A's managers have greater dynamic capability for they can achieve closer to what they aim. Yet Firm B's managers have greater knowledge and hence achieve greater results. This aspect of our definition preserves its non-tautological quality. The explanation given here shows why knowledge moderates effects (see Figure 1) and is consistent with Proposition 9 developed later.
[5] We acknowledge that this is not a comprehensive review of all studies potentially related to this topic.
[6] We thank the editor and reviewers for suggesting this idea.

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