

Exploration and Exploitation Within and Across Organizations

DOVEV LAVIE¹

*Faculty of Industrial Engineering and Management,
Technion—Israel Institute of Technology*

URIEL STETTNER

*Faculty of Management, Recanati Graduate School of Business Administration,
Tel Aviv University*

MICHAEL L. TUSHMAN

Harvard Business School, Harvard University

Abstract

Jim March's framework of exploration and exploitation has drawn substantial interest from scholars studying phenomena such as organizational learning, knowledge management, innovation, organizational design, and strategic alliances. This framework has become an essential lens for interpreting various behaviors and outcomes within and across organizations. Despite its straightforwardness, this framework has generated debates concerning the definition of exploration and exploitation, and their measurement, antecedents, and

¹Corresponding author. Email: dlavie@ie.technion.ac.il

consequences. We critically review the growing literature on exploration and exploitation, discuss various perspectives, raise conceptual and empirical concerns, underscore challenges for further development of this literature, and provide directions for future research.

Introduction

In his seminal work on exploration and exploitation in organizational learning, March (1991) acknowledged the fundamental distinction between two gestalts of organizational behavior. Whereas exploration engages individuals and organizations in search, experimentation, and variation, exploitation enhances productivity and efficiency through choice, execution, and variance reduction. Both types of activities are essential for organizational learning and prosperity but entail inherent contradictions that need to be managed (Tushman & O'Reilly, 1996). Initially, scholars focused on a narrow aspect of this framework to underscore the merits of new knowledge development versus refinement of existing knowledge (Levinthal & March, 1993). More recently, however, this framework has been applied quite broadly to portray a wide range of phenomena that encompass various manifestations of specialization and experience, on the one hand, and diversity and experimentation, on the other.

As the scope of application of the exploration–exploitation framework has been extended, debates concerning fundamental assumptions and questions associated with this framework have emerged (Gupta, Smith, & Shalley, 2006; Raisch, Birkinshaw, Probst, & Tushman, 2009). Should scholars adopt the narrow knowledge-based application or the broad interpretation of this framework? Can exploration and exploitation coexist in organizations? Are they complementary or contradictory endeavors? Should they be viewed as opposing ends of a continuum of behaviors or as discrete choices? Should organizations specialize in either exploration or exploitation, or seek a balance between these tendencies? Will such balance enhance or undermine organizational performance? How can organizations facilitate exploration and exploitation? Under what conditions can they benefit from these activities?

We first discuss the origin and evolution of the notions of exploration and exploitation before examining their environmental, organizational, and managerial antecedents. We then consider the trade-offs and tensions involved in balancing these activities. We identify different modes of balance that involve either contextual ambidexterity, or some form of organizational, temporal, or domain separation. We then explore the consequences of exploration and exploitation. We conclude by highlighting gaps in the literature and suggesting directions for advancing research on exploration and exploitation. In developing our arguments, we follow Figure 1, which directs attention to the context, conduct, and performance implications associated with exploration and exploitation. We pay special attention to contrasting modes for coping with the paradoxical requirements ascribed to exploration and exploitation.

PERFORMANCE

CONDUCT

CONTEXT

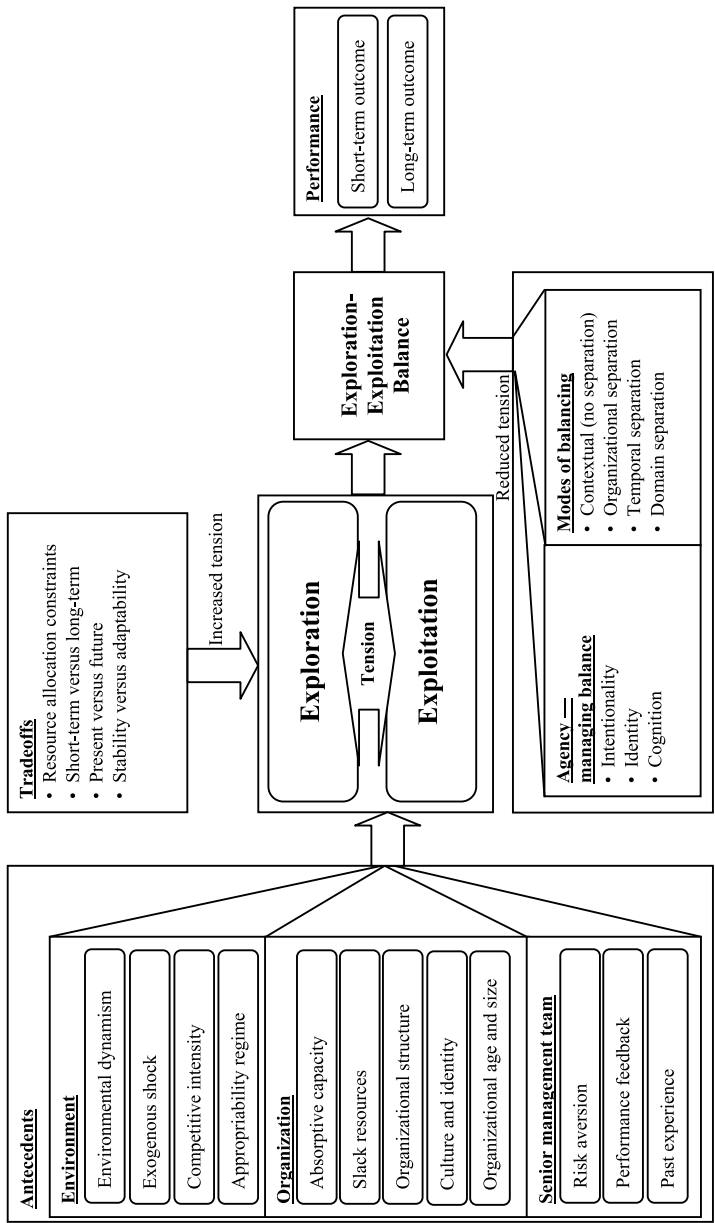


Figure 1 A Framework of Exploration-Exploitation.

The Notion of Exploration–Exploitation

The notion of exploration–exploitation has been studied in a wide variety of literatures such as organizational learning (e.g., Levinthal & March, 1993; March, 1991), organizational design (e.g., Tushman & O'Reilly, 1996), knowledge management (e.g., Brown & Duguid, 2001), and adaptation (e.g., Eisenhardt & Brown, 1997). These concepts have been employed in various contexts such as technology development and product innovation (e.g., Danneels, 2002; Greve, 2007; He & Wong, 2004; Tushman, Smith, Wood, Westerman, & O'Reilly, 2003), strategic alliances (e.g., Beckman, Haunschild, & Phillips, 2004; Koza & Lewin, 1998; Lavie & Rosenkopf, 2006; Rothaermel, 2001; Rothaermel & Deeds, 2004), and senior-management teams (e.g., Beckman, 2006; McGrath, 2001). Furthermore, the notions of exploration and exploitation have been investigated at various levels of analysis, generating research at the individual (e.g., Mom, Van den Bosch, & Volberda, 2007), group (e.g., Beckman, 2006; McGrath, 2001), organizational (e.g., Benner & Tushman, 2002; Greve, 2007; Harreld, O'Reilly, & Tushman, 2007; Jansen, Van Den Bosch, & Volberda, 2006), inter-organizational (e.g., Lavie & Rosenkopf, 2006; Lin, Yang, & Demirkan, 2007; Rothaermel, 2001; Vassolo, Anand, & Folta, 2004), and industry levels (e.g., Gilsing & Nooteboom, 2006). We focus on exploration and exploitation at the organizational and inter-organizational levels of analysis from the standpoint of the individual organization. Whereas individuals and groups within organizations also attend to pressures to explore and exploit (Smith & Tushman, 2005), we focus here on more macro levels of analysis.

Fundamental Assumptions and Definitions

March (1991) defined exploitation as “refinement, choice, production, efficiency, selection, implementation and execution,” contrasting it with exploitation, which involves “search, variation, risk-taking, experimentation, play, flexibility, discovery, and innovation” (p. 71). This definition is quite broad in scope and allows for various interpretations. In subsequent work, Levinthal and March (1993) restricted the scope of these activities to the knowledge domain, stating that exploration involves “a pursuit of new knowledge,” whereas exploitation involves “the use and development of things already known” (p. 105). Subsequently, scholars limited their attention to the distinction between knowledge development and utilization, relating the concepts of exploration and exploitation to the scale and scope of knowledge created or acquired relative to an organization’s existing knowledge base. More recently, however, scholars have applied this framework beyond the context of knowledge management, reverting to March’s original definition. Exploration has since been broadly associated with notions such as organizational diversity, diversification, and variation, whereas exploitation has been used to generally describe organizational focus, experience, and variance reduction.

We maintain, however, that there is little value in examining completely distinctive phenomena with the unifying lens of the exploration–exploitation framework. Phenomena such as product diversification, risk taking, internationalization, variation in organizational forms, and experimentation with new knowledge have all been viewed as manifestations of exploration. But how can one benefit from drawing analogies between such disparate phenomena? Attempts to generalize findings about the antecedents and consequences of exploration and exploitation in completely different contexts using distinctive interpretations lead to inconsistent findings and unwarranted generalization.

Some studies, for example, report that organizations that pursue either exploration or exploitation outperform those that combine these activities (Ebben & Johnson, 2005), whereas others report that pursuing both activities simultaneously enhances performance (He & Wong, 2004). Whereas Ebben and Johnson (2005) conceptualize exploration and exploitation with a single variable that ranges from organizational efficiency to flexibility, He and Wong (2004) consider the extent of product innovation using two independent measures of exploration and exploitation. These two studies conceptualize and measure exploration and exploitation in very different manners, yielding inconsistent findings that cannot be synthesized.

We contend that scholars who employ the exploration–exploitation framework should conceptually relate their constructs back to March's (1991) original definitions. Furthermore, we call for systematic definition of distinctive domains in which the exploration–exploitation phenomenon should be studied, recognizing that exploration–exploitation patterns may vary across these domains. For this defined set of domains, scholars should be able to draw consistent conclusions given that equivalent interpretations are possible per domain. Recent research has made some strides toward identifying such domains in the inter-organizational context (Lavie & Rosenkopf, 2006). Still, specifying these domains remains a task for future research.

But just how different is exploration from exploitation? Even when applying the narrow definition, scholars have debated whether refinement of existing knowledge should be considered exploration or exploitation (Gupta et al., 2006). Whereas some scholars acknowledge that exploitation may involve knowledge development (e.g., He & Wong, 2004), others refer to exploitation as the mere deployment of existing knowledge (e.g., Vermeulen & Barkema, 2001). Distinguishing exploration from exploitation becomes more challenging given the multidimensionality of knowledge, debates concerning the amount of learning that each activity entails, and the tendency to attribute either activity to distinctive value-chain functions (Li, Vanhaverbeke, & Schoenmakers, 2008).

Realizing that new knowledge development depends to an extent on an organization's current knowledge base (Cohen & Levinthal, 1990), scholars often find it challenging to distinguish between exploration and exploitation.

We suggest that in this context exploitation is associated with building on the organization's existing knowledge base. As long as the organization persists within an existing technological trajectory and leverages its existing skills and capabilities, its operations are geared toward exploitation. For example, the Swiss-watch manufacturers' transition from hand-wound watches to automatic watches is a form of exploitation, as it builds on their extant mechanical engineering capabilities (Landes, 1983). In turn, exploration entails a shift away from an organization's current knowledge base and skills. Such shifts can be related to new technical skills, market expertise, or external relationships (Lavie & Rosenkopf, 2006; Smith & Tushman, 2005). Thus, in the watch-industry example, the emergence of battery-powered watches entails exploration from the standpoint of the mechanical-energy and spring communities (Landes, 1983; Tushman & Anderson, 1986).

The distinction between exploration and exploitation is often a matter of degree rather than kind. Accordingly, exploration–exploitation should be viewed as a continuum rather than a choice between discrete options. As illustrated with the Swiss-watch example, the degree of relatedness between the knowledge embedded in a new innovation and the organization's existing knowledge base defines the position of this innovation on the exploration–exploitation continuum. Nevertheless, scholars have occasionally operationalized exploration and exploitation as separate activities. For instance, scholars studying inter-organizational alliances have associated new knowledge development with R&D alliances and existing knowledge application with marketing and production alliances (Grant & Baden-Fuller, 2004; Park, Chen, & Gallagher, 2002; Rothaermel, 2001; Rothaermel & Deeds, 2004). This dichotomy does not effectively capture the notion of exploration–exploitation, since R&D alliances may involve varying degrees of basic research and incremental development. Some scholars have recognized intermediate activities that combine new knowledge development and leveraging of prior knowledge in this context (Koza & Lewin, 2000; Lavie & Rosenkopf, 2006), referring to hybrid alliances that involve both exploration and exploitation.

Conceptualizing exploration–exploitation as a continuum is also consistent with the tendency of organizations to transition from exploration to exploitation and vice versa over time. The ability to acquire and develop new knowledge depends on the organization's current knowledge base (Cohen & Levinthal, 1990). In turn, exploration gives way to exploitation with subsequent knowledge application. The first time an organization experiments with a new technology, it enacts exploration, but as the organization repeats these experiments or the application of newly acquired knowledge, it develops exploitative routines and becomes more familiar with that knowledge. Consequently, exploration evolves into exploitation (e.g., Brunner, Staats, Tushman, & Upton, 2009). Similarly, an organization that develops its alliance portfolio may shift from technology alliances to marketing alliances, but

at any given time its alliance portfolio will feature a combination of exploration and exploitation alliances. Hence, there is a natural cycle of exploration–exploitation (Rothaermel & Deeds, 2004) that blurs the distinction between these two activities. In certain contexts, such as innovation, exploration and exploitation serve as successive stages, whereby exploitation follows exploration. Such transitivity of exploration–exploitation is best described with a continuum rather than a discrete choice model.

Besides transitivity, the notion of exploration–exploitation is subject to relativity because it must be defined from the viewpoint of a given organization or unit. Certain knowledge, technology, or markets may be new to one organization but familiar to another. Consequently, one organization's exploration may be considered exploitation by another. For example, while radial-tire technology was exploratory to incumbent American tire producers, the very same technology was exploitative to Michelin (Sull, 1999). Even within a particular organization, uneven distribution of knowledge and experience across units will cause a certain activity to be perceived as exploration by one unit and exploitation by another.

Given the transitivity and relativity of exploration and exploitation, and despite their occasional operationalization as discrete choices, we suggest that these activities be conceptualized along the exploration–exploitation continuum. This recommendation is especially prevalent in the organizational context in which discrete subunit activities are aggregated to form a range of exploration–exploitation activities at the organization level (Gupta et al., 2006). Studies that conceptualize exploration and exploitation as independent activities and measure them with separate variables (e.g., Auh & Menguc, 2005; He & Wong, 2004; Jansen et al., 2006; Katila & Ahuja, 2002) underestimate the inherent trade-offs between these activities.

Trade-offs between Exploration and Exploitation

A central premise of March's (1991) framework concerns the inherent trade-offs between exploration and exploitation. The opposing nature of these activities derives from several stylized facts about resource-allocation constraints, organizational inertia, and desirable organizational outcomes. First, organizations make conscious choices to support exploration or exploitation activities by making resource-allocation decisions, thereby facing trade-offs between the expected consequences of these activities. Organizations trade off short-term productivity for long-term innovation by supporting the search for new knowledge and prospective opportunities instead of leveraging currently available knowledge to address immediate needs (March, 1991). Similarly, by allocating resources to refinement of existing technologies and the leveraging of existing competencies rather than to developing new skills and capabilities, organizations achieve immediate reliability at the future risk of becoming obsolete (Holmqvist, 2004; Leonard-Barton, 1992). The tension between

exploration and exploitation is akin to the problem of deciding whether the present should be hedged for the future.

Another aspect of the trade-off between exploration and exploitation concerns the choice between stability and adaptability. Whereas flexibility and change are associated with exploration, stability and inertia are associated with exploitation that confines adaptation to things already known (Lewin, Long, & Carroll, 1999; March, 1991). Organizations that focus on exploitation trade flexibility for stability. They build organizational inertia, making it difficult to introduce changes in the face of environmental threats (Hannan & Freeman, 1977, 1984). Organizations that have invested in exploitation face major organizational challenges when attempting exploration, and vice versa (e.g., Sorensen & Stuart, 2000).

Finally, exploration and exploitation often produce divergent organizational outcomes. Although both exploration and exploitation are essential for survival and prosperity, limited resource availability compels organizations to favor one type of activity over the other. The trade-offs between exploration and exploitation underscore these inherent differences. Compared to returns from exploitation, returns from exploration are less certain, more remote in time, and more distant from the locus of action (March, 1991). Nevertheless, organizations must invest in discovery of new knowledge and market opportunities in order to secure future economic gains. In sum, resource-allocation constraints and discrepancies in organizational adaptation and outcomes dictate trade-offs between exploration and exploitation. These trade-offs are reinforced by path dependencies when deploying these activities such that investment in one activity drives out the other (Benner & Tushman, 2002; Levinthal & March, 1993).

A qualification to the above concerns the temporal spillover between exploration and exploitation. Even though at any given moment exploration and exploitation are at odds, over time exploration generates opportunities that the organization can later exploit. In turn, exploitation can produce income that can be then invested in future exploration. Thus, as depicted in Figure 2, the simultaneous trade-offs between exploration and exploitation do not rule out an indirect reinforcing association between these activities over time (Eisenhardt & Brown, 1997; Rothaermel & Deeds, 2004).

What is the observed association between exploitation and exploration? If exploration and exploitation compete for the organization's scarce resources and entail distinctive sets of skills and capabilities, exploration must be inversely related to exploitation at any given time. However, empirical studies that separately measure exploration and exploitation report mixed findings on the association between these activities. Whereas some studies report negative correlations between exploration and exploitation (e.g., Park et al., 2002; Van Deusen & Mueller, 1999), others find no significant association (e.g., Jansen et al., 2006) or even positive correlations (e.g., Katila & Ahuja, 2002; Knott,

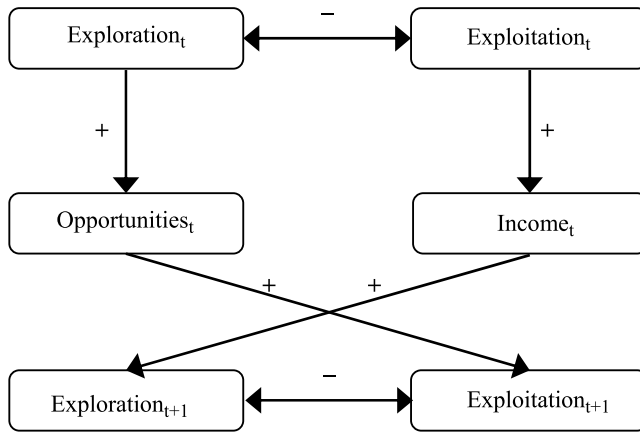


Figure 2 The Paradoxical Association between Exploration and Exploitation.

2002; Rothaermel & Deeds, 2004). For example, Knott (2002) observed that exploration and exploitation coexisted in Toyota's product development, and concluded that the two activities are complementary. Similarly, in their study of the robotics industry, Katila and Ahuja (2002) found a positive interaction effect on new product development of knowledge search scope (i.e., exploration) and depth (i.e., exploitation), suggesting that some organizations can pursue both search activities simultaneously.

These inconsistencies can be resolved once we realize that organizations can take action to relax the inherent tension between exploration and exploitation. This tension can be mitigated by exploring and exploiting across different, loosely coupled units (Beckman et al., 2004; Koza & Lewin, 1998) or by leveraging external resources (Katila & Ahuja, 2002). The observed association between exploration and exploitation reflects an organization's ability—and in particular its senior-management team's capacity—to offset such trade-offs (Helfat & Peteraf, 2009). Scholars have measured only the net effect of exploration–exploitation trade-offs and organizations' proactive efforts to reconcile these activities. Studies that fail to distinguish between the trade-offs and organizations' efforts to reconcile these conflicting activities may reach erroneous conclusions. The coexistence of exploration and exploitation does not negate the inherent trade-offs between them, so that scholars should avoid assuming away these trade-offs and ascribing a positive association between exploration and exploitation to complementarity.

The inherent trade-offs between exploration and exploitation reinforce their operationalization as opposing activities along a continuum. To align measurement with conceptualization of the construct, we advise the use of a single variable for capturing exploration–exploitation (e.g., Lavie & Rosenkopf, 2006; Lin et al., 2007; Uotila, Maula, Keil, & Zahra, 2009). Scholars seeking to

distinguish trade-offs from reconciliation efforts should attempt to capture directly these trade-offs and organizations' attempts to manage exploration–exploitation. One should not confuse the inherent inverse association between exploration and exploitation with an organization's limited ability to balance these activities.

Another advantage of operationalizing exploration and exploitation with a single variable is the straightforward measurement of balance between these activities. Studies that separately measure exploration and exploitation use various operationalizations for their balance, such as adding exploration and exploitation, measuring the relative difference between the two, or calculating their multiplicative interactions (e.g., Auh & Menguc, 2005; He & Wong, 2004). There is no compelling rationale for preferring one measure over the other, yet the results are highly sensitive to the particular operationalization. Considering exploration–exploitation as a continuum, we can circumvent this empirical challenge by studying the curvilinear function of exploration–exploitation and detecting its inflection points.

Antecedents of Exploration and Exploitation

Given the inherent tension between exploration and exploitation, what contexts trigger these contradictory activities? There has been little attempt to uncover why some organizations emphasize exploration while others mostly pursue exploitation. Empirical research has produced limited or mixed evidence on the causes of exploration and exploitation. The antecedents of exploration and exploitation include environmental factors such as dynamism, exogenous shocks, and competitive intensity. The tendency to explore versus exploit is also affected by an organization's history captured by its age, size, slack resources, absorptive capacity, organizational structure, and culture. Finally, managerial biases may drive the organization toward exploration and/or exploitation. Together, these factors influence an organization's propensity to explore, exploit, or strive toward balance (see Figure 1). Given our conceptualization of exploration and exploitation as resting at the opposite ends of a continuum, we assume that antecedents of exploration undermine exploitation, and vice versa.

Environmental Antecedents

A few studies have noted systematic differences across industries with respect to organizations' tendencies to engage in exploration and exploitation. These differences relate to environmental factors that influence organizations' learning requirements and the roles of environmental dynamism, exogenous shocks, competitive intensity, and appropriability regime.

Environmental dynamism. Environmental dynamism is defined by the extent of unpredictable change in an organization's environment (Dess &

Beard, 1984), rooted in changes in customer preferences, technologies, or market demand. Dynamic environments often render extant products and services obsolete (Jansen, Van den Bosch, & Volberda, 2005; Sorensen & Stuart, 2000), requiring organizations to explore. Whereas organizations that exploit have better chances of survival in stable environments, turbulent environments favor organizations that can promptly take advantage of emerging opportunities and abandon expiring certainties (Hannan & Freeman, 1984). This assertion has found support by Sidhu, Volberda, and Commandeur (2004), who report that environmental dynamism leads to expanded search for information that reduces managerial uncertainty. Nevertheless, these results refer only to the scope of information acquisition rather than to the broader notion of exploration (March, 1991).

Alternatively, organizations may deal with market uncertainty by seeking external resources from similar and familiar partners (Beckman et al., 2004). Accordingly, Lant and Mezias (1992) report in a simulation study that organizations allocate more resources toward exploration in uncertain and turbulent environments. They contend that environmental uncertainty increases the rate of innovation required for survival and, hence, organizations' investments in exploration. However, recent simulation studies suggest that continuous environmental turbulence undermines exploration efforts because it not only devalues prior knowledge but also degrades new knowledge garnered via exploration (Kim & Rhee, 2009; Levinthal & Posen, 2009). Yet, in addition to frequent change, organizations must also cope with varying levels of environmental change. The combination of frequency and amplitude of environmental turbulence determines the degree of exploration needed to support organizational adaptation (Kim & Rhee, 2009). Note, however, that these results rely on simulation techniques that assume stylized environmental attributes, with no findings yet available for samples of real organizations and realistic environmental conditions (Davis, Eisenhardt, & Bingham, 2009).

Exogenous shocks. Whereas environmental dynamism presumes a certain degree of predictability, exogenous shocks refer to sudden and unexpected environmental jolts beyond the control of any organization (Meyer, 1982). Unlike environmental dynamism, which manifests in periods of volatility, exogenous shocks are prompted by unforeseen events, such as deregulation or technological breakthroughs (Meyer, Brooks, & Goes, 1990). These revolutionary transformations often render organizations' existing technologies and skills obsolete (Romanelli & Tushman, 1994; Tushman & Anderson, 1986). As documented in various industries, such as hospitals (Meyer et al., 1990), apparel (Siggelkow, 2003), and airlines (Tushman & O'Reilly, 1996), exogenous shocks call for immediate organizational response (Meyer et al., 1990; Murmann & Tushman, 1997). Nevertheless, under such conditions, some

organizations may facilitate their exploitation efforts in an attempt to salvage their past investments, whereas others may enhance their exploration efforts to prosper in the subsequent era of incremental change. Further research is needed to uncover the conditions under which organizations respond to environmental shocks by exploring versus exploiting.

Competitive intensity. Competitive intensity refers to the extent to which organizations are likely to maintain zero-sum relations with one another as they compete for the same pool of limited resources (Barnett, 1997). Competitive pressures intensify with increases in the number of competitors, resulting in price reductions, tighter margins, and reduced organizational slack (Porter, 1980). Under such conditions, continuous improvement of existing products, services, and organizational processes becomes insufficient for withstanding competition. Intensifying competitive pressures call for exploration that can drive change and nurture new sources of competitive advantage (Levinthal & March, 1993).

This line of reasoning highlights the need for internal resources that enable organizations to withstand pressures induced by competitive intensity. For instance, Park et al. (2002) reveal how semiconductor firms with extensive internal resources were better positioned to realize opportunities through strategic alliances. These alliances mitigated market threats associated with declining demand in a firm's primary products. Similarly, Voss, Sirdeshmukh, and Voss (2008) show, in a study of the professional nonprofit sector, how perceived environmental threat increasingly drives organizations to invest financial and customer-relations resources in search of new competencies instead of enhancing their current strategic positions. Hence, some evidence suggests that exploration is preferred to exploitation as a means for strengthening an organization's foothold in existing markets and establishing presence in new markets during periods of competitive rivalry. In contrast, the incentives to exploit dominate when the competitive tension is dampened and organizations generate reasonable return on investment by leveraging existing products, services, and technologies without incurring exploration risks.

Appropriability regime. The extent to which the environment enables organizations to appropriate value from their innovations defines the appropriability regime. When the appropriability regime is weak, such as in the case of insufficient government protection of intellectual property rights, organizations cannot effectively protect their proprietary assets (Teece, 1986). Under such conditions, the value of exploration is diminished so that organizations may withhold their investments in exploration and focus on exploitation. Thus, exploration may be positively related to the strength of the appropriability regime, at least when we adhere to the knowledge-based definition of

exploration–exploitation (Levinthal & March, 1993). Still, this assertion should be subjected to empirical validation. Overall, empirical evidence on the environmental antecedents of exploration and exploitation has been sparse, with more attention given to organizational factors that drive tendencies to explore versus exploit.

Organizational Antecedents

Environmental antecedents explain systematic tendencies of organizations to gravitate toward either exploration or exploitation, yet they cannot explain heterogeneity in exploration–exploitation tendencies across organizations within an industry. These latter tendencies are associated with organizations' accumulated resources, capabilities, structure, culture, age, and size, which are in turn rooted in organizations' history and identity.

Absorptive capacity. An organization's ability to explore is associated with its absorptive capacity, that is, its ability to assess the value of external knowledge, internalize it, and apply it (Cohen & Levinthal, 1990). An organization's absorptive capacity enhances its interaction with the external environment (Lane & Lubatkin, 1998; Rosenkopf & Nerkar, 2001) and improves learning that takes place within or between its subunits. Thus, absorptive capacity enables the organization to operate proactively and explore emerging technologies and market opportunities (Cohen & Levinthal, 1990; Hoang & Rothaermel, forthcoming; Lavie & Rosenkopf, 2006; Rothaermel & Alexandre, 2009).

Organizations that have developed their knowledge base are better positioned to build an absorptive capacity (Cohen & Levinthal, 1990; Van den Bosch, Volberda, & de Boer, 1999) and engage in exploration. Indeed, prior research has identified internal R&D efforts as a prerequisite for learning and nurturing absorptive capacity (Brierly & Chakrabarti, 1996; Deeds, 2001). Nevertheless, although absorptive capacity enables exploration, it can restrict the scale and scope of the external knowledge sought by an organization, since the organization better assesses and comprehends new knowledge that is related to its knowledge base (Cohen & Levinthal, 1990). Despite the expected positive association between absorptive capacity and exploration, given the broad scope of both constructs, scholars need to define and measure these constructs more carefully to distinguish them and validate the causal association between them.

Slack resources. Slack resources are excess resources available to an organization beyond what is necessary for carrying out ordinary operations (Nohria & Gulati, 1996). Slack resources include unabsorbed slack, which corresponds to uncommitted ready-to-deploy assets such as cash funds, as well as absorbed slack, which refers to excessive investments in the organization's current operations that could be recovered (Singh, 1986; Voss et al.,

2008). Scholars have opposing views on the impact of slack resources on innovation and, in turn, exploration.

Proponents of a positive association note that excess resources, in the form of both absorbed and unabsorbed slack, facilitate risk taking and innovation by buffering organizations from environmental fluctuations and downside risk, and thus legitimize experimentation (Greve, 2007; Sharfman, Wolf, Chase, & Tansik, 1988; Singh, 1986). Cyert and March (1992) suggest that slack resources are a necessary but insufficient condition for allocating resources to innovation. Slack facilitates search, experimentation, and innovation while avoiding some adverse consequences in case of failure (Levinthal & March, 1993; Nohria & Gulati, 1996), thus invoking exploration (Sidhu et al., 2004). In contrast, the opposing view notes that organizations with slack resources sustain current operations despite competitive pressures or market dynamism. They meet their performance objectives by consuming current slack resources rather than by innovating (Bourgeois, 1981). Their motivation to explore is weaker compared to organizations whose survival depends on their ability to come up with new engines of growth.

Slack resources may both facilitate and mitigate exploration. This seeming contradiction can be resolved with a contingency view. For instance, the ability to deploy absorbed or unabsorbed slack may depend on the properties of slack resources, such as their munificence or contribution to organizations' competitive advantage. The merits of deploying slack resources may also depend on perceived environmental threat. In the face of major threat, the availability of unabsorbed slack steers an organization toward exploration, whereas the same resources stimulate exploitation when competitive intensity is mitigated (Voss et al., 2008). Another approach for reconciling these opposing views advocates a curvilinear association. Accordingly, insufficient slack is detrimental to innovation because it discourages risky experimentation, whereas excessive slack may adversely affect innovation by loosening discipline and prompting dubious undertakings. This results in an inverse U-shaped association between slack resources and exploration (Nohria & Gulati, 1996).

Organizational structure. Organizations execute their operations via organizational structure that defines the distribution of power, resources, and responsibilities across different functions and units. Whereas mechanistic structures support routine operations, functional specialization, formal duties, responsibilities, and power, organic structures entail less rigid establishments (Burns & Wholey, 1993; Burns & Stalker, 1961). These alternative structures can correspondingly facilitate exploitation or exploration. Exploration entails non-routine problem solving and search for new knowledge that may make information processing inefficient under centralized decision making. In turn, formalization is expected to constrain exploration and facilitate exploitation

via incremental improvements in processes and products. For instance, a recent study shows that incumbents in the financial-services sector that adopted centralized decision making associated with the mechanistic structure were less likely to engage in exploratory innovation, whereas those that assumed a formalized structure revealed a tendency to exploit (Jansen et al., 2006). Nevertheless, that study does not demonstrate that exploitation is positively associated with centralization or that exploration is negatively associated with formalization, perhaps because of the use of separate measures for exploration and exploitation.

Organizational culture and identity. Organizational identity pertains to the distinctive and enduring organizational attributes that define the nature of an organization (Albert & Whetten, 2004). The organization's identity provides its members with a perspective on organizational goals, mission, and dominant logic that guides exploratory and exploitative activities (Miles & Snow, 1978; Tripsas, 2009). Identity also impacts exploration and exploitation by shaping the evolution of organizational culture. Organizational culture pertains to the attitudes, experiences, beliefs, and values that guide the behavior of organizational members (Alvesson, 2002). Some organizations feature a strong culture wherein organizational members share a set of strongly held norms and values throughout the organization (O'Reilly & Chatman, 1996). Such strong identity and associated culture impose social controls on appropriate behaviors (Anteby, 2008).

Strong cultures constrain an organization to stay within the realm of what is known and established (Andrews, Basler, & Coller, 1999). Sorensen (2002) demonstrated that strong cultures prompt exploitation of existing capabilities at the expense of exploration, since consensus on corporate goals and values provides a strong foundation for organizations' exploitation capabilities. Similarly, Andriopoulos and Lewis (2009) demonstrate that strong organizational cultures stunt the ability to observe and respond to identity-challenging environmental threats. Nevertheless, some studies suggest a positive association between a shared organizational context and exploration insofar as the organization's mission advocates continuous innovation. Such a mission may encourage a broader search for new information that facilitates experimentation (Ravasi & Schultz, 2006; Sidhu et al., 2004).

Organizational age. Young ventures are subject to liabilities that make them more susceptible to failure (Stinchcombe, 1965). Liabilities of newness arise from lack of specific resources, limited customer base, and needed investments in establishing organizational roles and structuring relations. Thus, young organizations invest in exploration. In turn, established organizations encounter difficulties in keeping up with technological advancements, as they become dependent on established routines and skills, which facilitate

inertial pressures (Hannan & Freeman, 1984). Aging organizations that are subject to strong inertial pressures rely on their existing knowledge and experiences to respond in a consistent and accountable manner to environmental challenges, so that they tend to engage in exploitation rather than exploration.

Further, maturing organizations become more efficient as they leverage accumulated experience and established ties to vendors and customers (Penrose, 1959). Stakeholders may favor organizations that demonstrate rational action, accountability, and reliable performance (Benner, 2007; Hannan & Freeman, 1984), encouraging further commitment of existing routines, structures, and competencies. These pressures reinforce the tendency to exploit existing capabilities and leverage past experience. Sorensen and Stuart (2000), for example, found in their study of semiconductor and biotech firms that mature organizations more actively engage in exploitation, as indicated by the sharp increase in self-citation compared to alter-citation in their patents. Mature organizations are also more likely to engage in exploitation alliances that contribute to productivity (Rothaermel & Deeds, 2004). Still, uncovering the underlying conceptual mechanisms and isolating the effects of age from other growth-related organizational characteristics remains a challenge for empirical research.

Organizational size. Conflicting findings exist concerning the impact of organizational size on the tendency to explore versus exploit. On the one hand, organizational inertia increases with size, leading to productivity along existing trajectories while restricting search for new opportunities (Hannan & Freeman, 1984). For example, Rothaermel and Deeds (2004) showed that size positively relates to the propensity to engage in exploitation alliances. On the other hand, Beckman et al. (2004) suggested that larger organizations may have better access to internal resources and thus can support exploration in their alliances. Nevertheless, other studies found no support for the association between organizational size and exploration with respect to the scope of information acquisition (Sidhu et al., 2004) or the value-chain function and prior ties to partners in alliances (Lavie & Rosenkopf, 2006). Hence, the association between organizational size and tendencies to explore versus exploit merits further attention.

Managerial Antecedents

Cognitive and behavioral inclinations of an organization's senior-management team may influence the organization's tendency to explore versus exploit. Managers' risk aversion and learning abilities reinforce either exploration or exploitation. Risk aversion drives exploitation, since the benefits from exploitation are more proximate, certain, and immediate, thus generally preferred by risk-averse decision makers (Lewin, Long, & Carroll, 1999; March, 1991). In turn, risk-prone managers may be motivated by either survival or performance

aspirations (March & Shapira, 1992). The optimal levels of exploration and exploitation required for survival may be different from those needed for pursuing growth strategies. To the extent that managers have been risk averse, their bias toward exploitation may cause organizations to deploy existing competencies persistently at the expense of exploration.

Over time, repeated use of exploitation routines generates reliable feedback that enables organizations to further refine their existing competencies and evaluate better the likely success of exploitation efforts. Successful exploitation enhances the efficiency of existing technologies and restricts the search for new competencies. This bias toward short-term exploitation may lead to a “success trap” that exacerbates exploitation at the cost of exploration (Leonard-Barton, 1992; Levinthal & March, 1993). Similarly, as senior-management teams mature, they get more internally focused and more homogeneous. This homogenizing process is accentuated in high-performing organizations and, in turn, facilitates exploitation while driving out exploration (Hambrick, Finkelstein, & Mooney, 2005; O'Reilly & Tushman, 2008).

This scenario reveals how the self-reinforcing nature of learning from experience guides resource allocation, thereby fortifying the tendency to trade off exploration for exploitation. Given that exploration and exploitation require distinct sets of skills, capabilities, resources, and routines, as organizations gain more experience with either exploration or exploitation, they find it more efficient to engage in the activity with which they have gained experience. This results in path dependence that reinforces the dominant activity. For example, in their study of alliances in the software industry, Lavie and Rosenkopf (2006) found that prior exploration experience reinforces an organization's tendency to explore in the particular domain in which such experience has been accumulated. However, they shed little light on the routines and managerial inclinations that underlie such path dependencies.

In addition to experience, the senior-management team may rely on performance feedback in making decisions about the desirable extent of exploration versus exploitation. When organizational performance drops below aspirations subsequent to exploitation efforts, dissatisfaction may prompt management to engage in exploration (March, 1991; Sull, 1999). Similarly, as organizations search for new competencies, they run the risk of engaging in excessive exploration, which may trap them in an “endless cycle of failure and unrewarding change” (Levinthal & March, 1993, p. 106). Hence, as managers learn from experience and performance feedback, they may emphasize either exploration or exploitation.

In sum, environmental, organizational, and managerial antecedents prompt an organization's inclination to explore versus exploit. Empirically, very few factors have been shown to produce consistent effects on these activities. Prior research has also offered little insight into the tendencies to balance the conflicting pressures for exploration and exploitation (Mom, Van den

Bosch, & Volberda, 2009; Raisch & Birkinshaw, 2008; Siggelkow & Levinthal, 2003). A careful examination reveals that the literature has mostly concentrated on forces that drive organizations toward imbalance between these activities. For example, Jansen et al. (2006) demonstrated that environmental forces independently drive organizations toward imbalance, since the effectiveness of exploratory innovation improves under turbulent environments, whereas exploitative innovation becomes more effective in competitive environments. Nevertheless, when organizations face opposing forces that simultaneously call for exploration and exploitation, they attempt to reconcile these conflicting pressures (Andriopoulos & Lewis, 2009; Smith & Tushman, 2005). Furthermore, adverse combinations of environmental forces and organizational pressures may explain organizations' efforts to balance exploration and exploitation.

Balancing Exploration and Exploitation

In light of the complementary benefits of exploration and exploitation, scholars have suggested that maintaining a balance between these activities is key for survival and prosperity (March, 1991). Organizations that engage in exploitation to the exclusion of exploration become trapped in suboptimal equilibrium (Levinthal & March, 1993), which makes adaptation difficult. Similarly, organizations that explore to the exclusion of exploitation suffer the costs of experimentation without gaining the benefits associated with exploiting extant opportunities (March, 1991). Therefore, organizations seek to balance the conflicting demands for short-term efficiency and long-term effectiveness (March, 1991; Siggelkow, 2003; Smith & Tushman, 2005; Tushman & O'Reilly, 1996; Venkatraman, Lee, & Iyer, 2007).

Balancing exploration and exploitation is not trivial, given the aforementioned trade-offs between these activities and the need to manage contradictions. The emerging paradox is that exploration and exploitation are contradictory activities, yet an organization cannot achieve desirable performance objectives without engaging in both. This social paradox can be resolved by considering the temporal and spatial nature of the phenomenon (Poole & Van de Ven, 1989). Specifically, a resolution involves relaxing the tension between these activities by buffering exploration from exploitation at a certain time or place. As a result, exploration and exploitation are not pursued concurrently by the same organizational unit or domain. In either case, a precondition for resolving the paradox involves recognizing the contradictions rather than denying the tension between exploration and exploitation (Smith & Tushman, 2005).

The notion of balance between exploration and exploitation is implicit in many studies. Some studies underscore the importance of enabling "simultaneous capacities for alignment and adaptability" (Gibson & Birkinshaw, 2004, p. 223). Others note that successful organizations balance the opposing needs

for broad search for real options and stable decision making (Rivkin & Siggelkow, 2003). Hence, an organization should engage in “sufficient exploitation to ensure its current viability and, at the same time, devote sufficient attention to exploration in order to ensure the organization’s future viability” (Levinthal & March, 1993, p. 105). Even though some studies have used the notion of ambidexterity when referring to the balance between exploration and exploitation (He & Wong, 2004; Hess & Rothaermel, 2009; Lin et al., 2007; Simsek, Heavey, Veiga, & Souder, 2009), we suggest that ambidexterity is only one approach for simultaneously exploring and exploiting.

A key question concerns the appropriate level of balance between exploration and exploitation. Exploitation could be kept at minimal yet sufficient level, with all remaining resources invested in exploration (Levinthal & March, 1993). Alternatively, exploration could meet some minimal threshold while the organization invests mostly in exploitation. In contrast to these skewed resource-allocation positions, some studies suggest that organizations should maintain equal proportions of exploratory and exploitative activities (e.g., He & Wong, 2004), so that they operate around the middle point of the exploration–exploitation continuum. Although these studies offer alternative approaches to the appropriate level of balance, they concur that “survival requires a balance, and the precise mix of exploitation and exploration that is optimal is hard to specify” (Levinthal & March, 1993, p. 105). Nevertheless, most scholars contend that the appropriate levels of exploration and exploitation are contingent on the organization’s mission, dominant logic (Miles & Snow, 1978), and industry conditions (Lavie & Rosenkopf, 2006; March, 1991; Venkatraman et al., 2007). Consequently, a change in the organization’s strategy or environmental conditions entails adjusting the corresponding levels of exploration and exploitation (Auh & Menguc, 2005).

Achieving a balance between exploration and exploitation is complicated because the outcomes of these two types of activities are distinctive and differ “with respect to their variability, their timing, and their distribution within and beyond the organization” (March, 1991, p. 71). Besides the inherent trade-off in allocating resources to support either exploration or exploitation, these two activities entail conflicting organizational routines that offset each other (Lavie, Kang, & Rosenkopf, 2009). Given the challenges of achieving a balance, some scholars have shifted attention from the notion of balance to the process of balancing, referring to an organization’s efforts to strive toward balance irrespective of the actual proportions of exploration and exploitation at any given moment (Gibson & Birkinshaw, 2004; Lavie & Rosenkopf, 2006; Tushman & O’Reilly, 1996). In this sense, an organization may operate on any point on the exploration–exploitation continuum as long as it strives to reach the intermediate point on that continuum that corresponds to its natural balance. Consequently, organizations that demonstrate strong tendencies to exploit at the present time may engage in significant exploration efforts that

steer them toward balance over time. To counter inherent path dependencies and inertial pressures, continuous investment in exploration or exploitation is needed in order to maintain the balance between exploration and exploitation over time (Holmqvist, 2003).

Although much research suggests that an appropriate balance between exploration and exploitation is essential for superior organizational performance and long-term survival (e.g., March, 1991; Rivkin & Siggelkow, 2003), scholars have also observed the inherent challenges encountered when organizations attempt to balance these activities (Eisenhardt & Brown, 1997; Lavie & Rosenkopf, 2006; Levinthal & March, 1993; Siggelkow & Rivkin, 2006; Tushman & O'Reilly, 1996). This observation calls attention to the questions of whether and how organizations achieve that objective. While the literature on balancing exploration and exploitation has burgeoned, there still exists an inherent contradiction between the normative assumption that organizations should balance exploration and exploitation, on the one hand, and behavioral tendencies that reinforce either activity, on the other hand (Lavie & Rosenkopf, 2006).

Prior research has resorted to theoretical arguments (e.g., Koza & Lewin, 1998; March, 1991) or simulation studies (e.g., Davis et al., 2009; Ethiraj & Levinthal, 2009; Fang, Lee, & Schilling, forthcoming; Rivkin & Siggelkow, 2003) to underscore the importance of overcoming the trade-offs between exploration and exploitation. Recently, a few empirical studies have demonstrated that organizations indeed benefit from balancing these activities. For instance, He and Wong (2004) demonstrate that equally proportionate exploration and exploitation tendencies are needed for superior performance to be achieved. Other studies, however, have departed from viewing the middle point as an optimum, showing instead how environmental dynamism dictates the desirable proportions of local versus non-local search for innovation (e.g., Sidhu, Commandeur, & Volberda, 2007). Taking a different perspective, Gibson and Birkinshaw (2004) relate the ability to balance exploratory and exploitative activities to an "organizational context characterized by an interaction of stretch, discipline, support, and trust" (p. 214), thus considering organizational factors rather than environmental contingencies as determining the balance point.

Whereas the prior studies consider the implications of balancing exploration and exploitation within organizational boundaries, others have focused on boundary-spanning activities across organizations. In particular, Lavie and Rosenkopf (2006) show how organizations balance exploration and exploitation in their alliance portfolios over time and across distinctive domains. They reveal how, in balancing the conflicting pressures of exploration and exploitation, organizations select alliance partners based on prior experience with those partners, the partners' organizational attributes, and the value-chain function that their joint alliances serves (Lavie & Rosenkopf,

2006). Collectively, these studies not only stress the importance of balancing exploration and exploitation but also demonstrate that such balance may be achieved within and across various domains, over time, and at multiple organizational levels.

Modes of Balancing Exploration and Exploitation

There is consensus about the merits of balancing exploration and exploitation, yet little agreement on the means by which organizations achieve such balance (Adler et al., 2009). The question of how organizations reach and maintain balance between exploration and exploitation has drawn much attention. Prior research has identified four fundamental modes for coping with the conflicting demands of exploration and exploitation: contextual ambidexterity (no separation), organizational separation, temporal separation, and domain separation (see Figure 1). These approaches for maintaining balance correspond to fundamental methods for managing contradictions and resolving paradoxes (Poole & Van de Ven, 1989).

Contextual ambidexterity resolves the tension between exploration and exploitation by suggesting that these activities are maintained simultaneously at any given organizational level. Organizational separation is a form of spatial buffering, whereby exploration and exploitation occur simultaneously but are situated within distinct organizational units. With temporal separation, exploration and exploitation coexist in the same organizational unit but at different points in time, so that organizations switch between exploration and exploitation. Finally, domain separation suggests that organizations specialize in either exploration or exploitation in particular organizational domains while balancing these activities across domains. Unlike organizational separation, which buffers exploration from exploitation across organizational units, domain separation may involve the same unit that simultaneously explores in one domain and exploits in another. The notion of balance does not necessarily entail coordination of conflicting activities (Smith & Tushman, 2005) but rather separating exploration from exploitation by either structure, time, or domain. Table 1 compares the alternative modes of balancing, which serve for relaxing inconsistencies and trade-offs between exploration and exploitation. These balancing modes represent different approaches for resolving the paradox of exploration–exploitation (Poole & Van de Ven, 1989; Smith & Tushman, 2005).

Contextual Ambidexterity

Notwithstanding the trade-offs between exploration and exploitation, some scholars suggest that organizations can effectively balance these activities by nurturing an appropriate organizational context that combines stretch, discipline, support, and trust (Gibson & Birkinshaw, 2004). Specifically, such a supportive context empowers organizational members to meet

Table 1 Alternative Modes of Balancing Exploration and Exploitation

Balancing Mode	Contextual Ambidexterity	Organizational Separation	Temporal Separation	Domain Separation
Locus of balance	Individual and group levels	Organizational level	Organizational level	Organizational level
Mechanism of balance	No buffers between concurrent exploration and exploitation	Separate units dedicated to either exploration or exploitation, simultaneously coordinated at the corporate level	Sequential shifts over time from exploration to exploitation and vice versa	Exploring in one domain while simultaneously exploiting in another
Management role	Management provides a supportive infrastructure	Proactive management is essential	Proactive management is essential	Proactive management is not a necessary condition
Challenges	Managing contradictions within organizational units	Coordinating across units and managing contradictions at the senior management team	Managing transitions between exploration and exploitation and dislodging from inertial pressures	Identifying applicable domains and deciding whether to explore or exploit in any given domain

performance standards guided by shared ambitions and a collective identity (Ghoshal & Bartlett, 1994). Hence, nurturing well-designed systems, culture, and processes enables simultaneous alignment and adaptability (Gibson & Birkinshaw, 2004).

Contextual ambidexterity is advocated by research that shows how cultural values that promote innovation coexist with values of quality and efficiency. In particular, individuals can maintain a balance between creativity, attention to detail, and quality so that innovative performance does not necessarily undermine quality and efficiency (Miron, Erez, & Naveh, 2004). Building on the observation that Toyota has been able to explore and exploit for decades (Takeuchi, Osono, & Shimizu, 2008), Brunner et al. (2009) argue that organizations can simultaneously explore and exploit if they develop the ability to perturb stable patterns of interaction throughout the organization. It may be that Toyota's ability to maintain contradictions is rooted in the ability of its employees at all organizational levels to engage in problem solving.

Nevertheless, scrutiny of contextual ambidexterity reveals micro-level focus on either exploration or exploitation at a given time or location (Adler, Goldoftas, & Levine, 1999). At the individual and team levels, goal conflict and bounded rationality lead to sequential allocation of attention to divergent goals, so that a particular task environment draws attention to either exploration or exploitation (Levinthal & March, 1993). Consequently, buffering exploration from exploitation localizes learning via either departmentalization or sequential goal attention.

Organizational Separation

Organizational separation offers a primary solution to the balance dilemma in the literature on ambidexterity (Cao, Gedajlovic, & Zhang, 2009; He & Wong, 2004; Jansen, Tempelaar, Van den Bosch, & Volberda, 2009; Jansen et al., 2005; Tushman & O'Reilly, 1996; Tushman et al., 2003). This literature recognizes the importance of designing organizational forms that provide a strong fit between an organization's activities and its changing context (Duncan, 1976; Tushman & O'Reilly, 1996). Structurally ambidextrous organizations consist of highly differentiated units with targeted structural integration. Each unit exhibits internal consistency in tasks, culture, and organizational arrangements, but across units there is inconsistency in the activities being pursued (Tushman & O'Reilly, 1996).

In structural ambidextrous organizations, exploitative units are larger and more centralized, with tight cultures that focus on maximizing efficiency and control through process management (Benner & Tushman, 2002, 2003). In turn, exploratory units are designed to generate innovation through experimentation. Accordingly, they are typically small and decentralized with rather loose cultures and flexible processes. Hence, fundamentally distinctive learning contexts are physically and culturally separated from one another in order

to avoid cultural and procedural spillovers (Christensen, 1997). In addition, these highly differentiated units employ separate managerial teams and different measurement and incentive systems (O'Reilly & Tushman, 2008; Taylor & Helfat, 2009).

Organizational separation entails coordination of distinctive learning contexts so that the organization can simultaneously explore through experimentation and exploit via fine-tuned processes. By loosely integrating their exploratory and exploitative units, organizations simultaneously perform both activities and balance them within their boundaries through active integration of the senior-management teams (Jansen et al., 2009). Thus, ambidextrous organizations do not “rely on spin-outs, internal venture groups, or venture capital, to generate innovation options—they develop options internally” (Tushman et al., 2003, p. 9).

By coordinating streams of fundamentally different activities, organizational separation enables organizations to evolve both through sustained incremental change in exploitative subunits and through proactive punctuated change in exploratory units (Gibson & Birkinshaw, 2004; Tushman & O'Reilly, 1996; Tushman et al., 2003). Organizational separation entails harmonizing conflicting activities and reconfiguring them within particular organizational units that engage in distinct tasks. This mode of balancing requires that senior-management teams recognize and manage the contradictions inherent to exploration and exploitation (Andriopoulos & Lewis, 2009; Smith & Tushman, 2005, 2009; Westerman, McFarlan, & Iansiti, 2006).

Whereas organizational separation offers a plausible solution to the balancing problem, it is not trivial, since the strategic trade-offs between exploration and exploitation give way to organizational trade-offs. Although each organizational unit maintains coherent operations, the coordination effort shifts to the senior-management team. This team faces the challenge of reconciling and synchronizing conflicting pressures. Most evidence on ambidextrous organizations has been anecdotal and limited to successful organizations (O'Reilly & Tushman, 2008; Tushman & O'Reilly, 1996). It is unclear to what extent senior management can manage contradictions that emerge at the operational level. The empirical studies that test the effectiveness of ambidextrous organizations fall short of measuring ambidexterity (e.g., He & Wong, 2004; Lin et al., 2007). In fact, the notion of ambidexterity has been often used synonymously with the notion of balance, thus obscuring the actual mode by which organizations seek to balance exploration and exploitation.

Recent research on organizational separation considers separation between organizational units not only at a given level but also across hierarchical levels. It explains how the emphasis on exploration versus exploitation shifts across organizational units positioned at different hierarchical levels (Brunner et al., 2009; Lin et al., 2007; Lubatkin, Simsek, Ling, & Veiga, 2006; Smith & Tushman, 2005). This emerging research demonstrates the complexity of

the organizational separation mode and the role of organizational design in enabling ambidexterity. A related stream of research on innovation advocates a more extreme form of organizational separation that involves skunk-works, spinouts, and corporate venture capital investments, whereby exploration takes place in an external autonomous unit (Ahuja, Lampert, & Tandon, 2008). Although these solutions facilitate simultaneous exploration and exploitation, they impose further challenges of coordination across exploratory and exploitative units.

Temporal Separation

Organizational separation involves distinct organizational units that either explore or exploit. Alternatively, temporal separation involves cycles of exploration and exploitation, during which an organization focuses only on one dominant activity and later shifts to the other. Temporal separation is rooted in the notion of punctuated equilibrium. Drawing on evolutionary theory, the punctuated-equilibrium model describes the organizational transformation through cycles of convergence and upheaval in which technology evolves during long periods of stability and incremental change punctuated by short, radical technological breakthroughs (Lant & Mezias, 1992; Romanelli & Tushman, 1994; Tushman & Anderson, 1986; Tushman & Romanelli, 1985). Temporal separation at the organizational level assumes that organizations proactively manage the transition between exploratory and exploitative efforts irrespective of environmental conditions (Siggelkow & Levinthal, 2003). For instance, in a study of multi-business firms in the computer industry, Eisenhardt and Brown (1997) show how organizations synchronize their product-innovation efforts and effectively manage transitions between periods of exploration and exploitation in product-development projects.

Temporal separation enables organizations to balance exploration and exploitation by shifting from one activity to the other over time (Duncan, 1976). Organizations strive for balance by exploring at a certain time and then shifting to exploitation, and vice versa. In so doing, they evade conflicting pressures of simultaneous exploration and exploitation (Lavie & Rosenkopf, 2006). The temporal shifts from one activity to the other are not trivial, given that conflicting pressures for exploration and exploitation still operate at the time of transition. The fact that an organization has concentrated on a particular activity at a given point in time only reinforces path dependence in exploration or exploitation, which may delay subsequent transitions and make them costly to implement. Hence, temporal separation entails developing efficient procedures for managing transitions from one mode to the other (Eisenhardt & Brown, 1997).

Temporal separation only alters the type of organizational challenge that organizations face compared with organizational separation. Whereas organizational separation calls for an ambidextrous organization that can manage

concurrent yet contradictory activities, temporal separation requires an agile organization that excels in managing transitions between contradictory activities. Indeed, Venkatraman et al. (2007) consider temporal separation as a form of sequential ambidexterity that involves a time-paced sequence of exploration and exploitation. As much as coordination between units that simultaneously engage in opposing activities is challenging, so is the transition between periods of exploration and exploitation.

Some studies demonstrate that, in the quest for maintaining balance over time, shifts between exploration and exploitation involve slow and gradual transitions (e.g., Lavie & Rosenkopf, 2006; Rothaermel & Deeds, 2004) rather than sudden shifts, as predicted by punctuated-equilibrium theory. In particular, Rothaermel and Deeds (2004) show how organizations gravitate toward exploitation alliances as they conclude early knowledge-generating R&D efforts and proceed to commercialization and production. In turn, they reengage in technological exploration alliances as they exhaust current initiatives. Similarly, Lavie and Rosenkopf (2006) show how organizations balance exploration and exploitation in their alliance portfolios by gradually transitioning between exploration and exploitation in particular domains, such as in the value-chain function that alliances serve.

In sum, temporal separation suggests an alternative approach to organizational separation whereby exploration and exploitation are separated over time rather than across organizational units. Nevertheless, organizations trade off the challenge of coordinating conflicting activities with the need to manage transitions and dislodge path dependence.

Domain Separation

The notion of domain separation has been recently introduced as an approach for balancing exploration and exploitation. The fundamental assumption here is that exploration and exploitation activities can be carried out in multiple domains. As organizations strive toward balance, they do not need to reconcile exploration and exploitation within each domain, as long as an overall balance is maintained across domains. Accordingly, Lavie and Rosenkopf (2006) state that alliances can serve for simultaneously exploring and exploiting in different domains. They demonstrate how U.S. software firms maintain a balance between exploration and exploitation across distinctive domains of alliance formation. Specifically, they consider three domains of alliance portfolios: the value-chain function (upstream vs. downstream alliances), the network structure (existing vs. new partners), and partner attributes (similar vs. dissimilar to prior partners). They show that organizations rarely balance exploration and exploitation within each domain, instead seeking balance across domains and over time. For example, organizations engage in recurrent R&D alliances with their existing partners, thereby trading off exploration in the function domain with exploitation in the structure domain.

The main advantage of domain separation relative to organizational separation and temporal separation is that it enables organizations to avoid the inherent trade-offs that emerge when seeking to balance exploration and exploitation within a given domain (either across specialized organizational units or over subsequent time periods). In particular, organizations can relax resource-allocation constraints and circumvent the need to coordinate conflicting organizational routines by specializing in either exploration or exploitation within a given domain (Lavie et al., 2009). Consistent with this observation, Lin et al. (2007) show that balance within the structure domain does not improve performance outcomes, although some resource-based gains are observed for large organizations under conditions of environmental uncertainty.

In contrast, balance across domains can be considered more efficient and easier to pursue. Lavie et al. (2009) provide supporting evidence on the relative merits of balance across domains compared to balance within domains of alliance formation. Specifically, they show how the market value and net profit of software firms decline when balancing exploration and exploitation within domains of their alliance portfolios, but improve when balance is sought across such domains. Nevertheless, research on the domain-separation approach has been scarce and mostly limited to the context of alliances. An exception is Hess and Rothaermel's (2009) recent study that considers the distinction between star scientists and staff scientists as corresponding proxies for internal exploration and exploitation activities. Further research is needed to uncover relevant domains within and across organizational boundaries in an attempt to fully assess the domain-separation approach.

Managing the Balance between Exploration and Exploitation

An open issue in empirical studies that document organizations' balancing efforts concerns the proactive nature of these efforts. Is the observable balance between exploration and exploitation indicative of organizations' intentional efforts to strive toward balance, or simply a response to exogenous pressures? The notion that exploration and exploitation decisions are intentional is well received, yet it remains to be shown that organizations plan and carry out plans for balancing these tendencies. The level of mindfulness in organizations' balancing efforts may vary by the mode of balance. For contextual balance, the responsibility to craft a supportive organizational context (Gibson & Birkinshaw, 2004) is assigned to the senior-management team, and, if the context is implemented successfully, it enables organizational units to engage simultaneously in exploration and exploitation (e.g., Osono, Shimizu, Takeuchi, & Dorton, 2008).

The senior-management team also plays a proactive role in managing balance by means of temporal separation. The transitions between exploration and exploitation require planning and execution of synchronized operations

(Eisenhardt & Brown, 1997). Creating the organizational conditions and providing the impetus for managing these transitions entail proactive and dedicated managerial intervention. Specifically, managers actively fuse autonomy and support via disciplined project management to deal with current projects while, at the same time, exploring new product solutions by means of low-cost experimentation. Hence, management must “link the present to the future by using predictable product intervals and choreographed transition procedures” (Eisenhardt & Brown, 1997, p. 25). In contrast, domain separation does not require managers’ proactive balancing efforts, since activities in each domain can be carried out independently. In this mode, coordination is limited to deciding whether to pursue exploration or exploitation in each domain.

The organizational ambidexterity literature is most elaborate on the proactive role of senior-management teams in light of the organizational restructuring associated with this mode (Tushman & O’Reilly, 1996; Westerman et al., 2006). Successful implementation of organizational separation entails a senior-management team that can realize, control, direct, and organize within and across organizational units, as well as develop a supportive context for enhancing learning capabilities. O’Reilly and Tushman (2008) maintain that organizations can achieve long-term competitive advantage by developing and deploying capabilities that are internally consistent within units but inconsistent across units. Managing internally inconsistent organizational architectures requires developing an overarching strategic intent and core values (O’Reilly & Tushman, 2008), as well as coping with paradoxes at multiple organizational levels (Andriopoulos & Lewis, 2009). Senior management seeks to develop accurate cognitive representations of these complex activities in an attempt to overcome paradoxical cognitive impediments and biases for consistency (Smith & Tushman, 2005, 2009). These cognitive representations in turn guide reorganization efforts.

Reconfiguration of existing resources and capabilities is demanding, as it entails changes to existing operations and routines (Lavie, 2006). Besides financial risk, capability reconfiguration signals shifts in organizational identity that create tensions among the affected business units and stakeholders (Tripsas & Gavetti, 2000). O’Reilly and Tushman (2008) suggest that the senior-management team must act in unison to justify and control the transitions, to avoid stakeholder resistance, and to retain a distinctive identity. It must effectively synchronize its social and task processes, including the quality of information exchange, collaborative behavior, and joint decision making (Hambrick, 1994; Lubatkin et al., 2006; Taylor & Helfat, 2009). In fact, the “level of behavioral integration directly influences how its members deal with the contradictory knowledge processes that underpin the attainment of an exploitative and exploratory orientation, such that greater integration enhances the likelihood of jointly pursuing both” (Lubatkin et al., 2006, p. 647). Overcoming organizational inertia and directing strategic change is

rooted in building heterogeneous senior-management teams with the associated processes to attend to contradictions associated with exploration and exploitation (Boeker, 1997; Virany, Tushman, & Romanelli, 1992).

Temporal separation and organizational separation entail proactive management as a precondition for effective balancing of exploration and exploitation. Whether and how managers proactively strive for balance via other balancing modes remains an open question. It is yet to be shown how proactive efforts enhance the benefits associated with balancing efforts. Contextual ambidexterity and domain separation are probably less demanding than temporal separation and organizational separation with respect to intentional and proactive management. Nevertheless, senior management may contribute by furnishing supportive systems and deciding whether to pursue exploration or exploitation in particular domains.

The Performance Implications of Exploration and Exploitation

A fundamental conjecture in the exploration–exploitation literature concerns the impact of these activities on organizational performance. Scholars have long argued that exploration and exploitation are expected to produce differential performance effects. In particular, March (1991) posits that an organization's investments in reducing variety, increasing efficiency, and enhancing adaptation to the current environment can generate predictable benefits in the short run. Organizations allocate resources to maintain and improve their current operations. However, such short-term improvements may produce negative long-term consequences, since reduced variety and adaptation to current conditions become liabilities as environments change. Organizations counteract the long-term performance effects attributable to exploitation by allocating resources to innovation. Engaging in exploration enhances an organization's future adaptability while incurring greater risk and opportunity costs.

Until recently, however, research on the performance implications of exploration and exploitation has been sparse. Few studies report differential performance effects of exploration and exploitation. For example, Auh and Menguc (2005) demonstrate that exploration contributes to long-term performance, captured by market-share growth and sales growth, more than to short-term performance, measured with return on assets. Further evidence suggests that exploitation is associated with short-term performance. Nevertheless, the relationship between exploration, exploitation, and organizational performance is not always straightforward. For instance, Siggelkow and Rivkin (2006) reveal in a simulation study how search conducted by lower-level managers may negatively affect performance. They argue that self-interested and narrow-minded managers are more likely to exploit existing opportunities related to established competencies than to explore remote options. Still, the evidence in support of the performance implications of exploration and exploitation is relatively limited and idiosyncratic.

The outcomes of exploratory versus exploitative activities may depend not only on managerial inclinations but also on environmental contingencies. For example, in a study of financial institutions in Europe, Jansen et al. (2006) showed that the impact of exploratory and exploitative innovation on financial performance is moderated by environmental dynamism and competitiveness. Competitive pressures enhance the contribution of exploitative innovation to performance, whereas environmental dynamism attenuates it. In turn, environmental dynamics intensify the positive association between exploratory innovation and financial performance. When environmental dynamism is limited so that competitive forces are stable and adaptation requirements are minimal, an organization is better off focusing on exploiting internal resources, as well as reliable external resources (Lin et al., 2007). Even then, the effect of environmental contingencies may depend on the organization's orientation. Organizations that traditionally emphasize exploitation may face declining short-term performance under conditions of competitive intensity, whereas organizations with exploratory tendencies can enhance their short-term performance under these conditions (Auh & Menguc, 2005).

In sum, exploration and exploitation both enhance performance, yet the likelihood and nature of such gains vary across activities and depend on the interplay of organizational and environmental contingencies. More empirical research is needed to reveal the multifaceted performance implications of exploration and exploitation in various contexts.

The Performance Outcomes of Balancing Exploration and Exploitation

In striking contrast to the limited evidence on the direct performance implications of exploration and exploitation, there is an abundance of empirical research on the performance outcomes of balancing these activities. This evidence is mixed and complex. The implicit premise of March's (1991) balance hypothesis is that organizations gain superior performance by pursuing both exploration and exploitation, instead of trading off one activity for the other. This premise is made explicit in ambidexterity research (e.g., Tushman & O'Reilly, 1996).

Until recently, however, the ambidexterity literature has provided only anecdotal evidence on the positive performance implications of such balance. More recent studies have used simulation techniques (Fang & Levinthal, 2009; Levinthal & Posen, 2009; Siggelkow & Levinthal, 2003; Siggelkow & Rivkin, 2006) or attempted to measure the performance effects of balance between exploration and exploitation empirically (He & Wong, 2004; Jansen et al., 2006; Lavie et al., 2009; Uotila et al., 2009; Venkatraman et al., 2007). These studies consider various performance outcomes but rarely take into account both short-term and long-term performance implications. Such duality in performance measurement is needed, given that exploration is more critical

for long-term performance outcomes, whereas exploitation is beneficial in the short term (Lin et al., 2007; March, 1991).

Few studies have considered both short-term and long-term performance effects of exploration and exploitation (e.g., Auh & Menguc, 2005). One study on the performance implications of balance in alliances assesses both net profit and market value as corresponding proxies for short-term and long-term performance (Lavie et al., 2009). Yet it does not reveal significant performance effects of balance within the function domain on either short- or long-term performance. Rather, it shows that balance across domains enhances both performance outcomes. These findings raise the question of whether the performance implications of balance depend on the mode of balancing. An emerging research stream sheds some light on this issue.

Balance via organizational or temporal separation. Most empirical studies assume either organizational or temporal separation, thus focusing on balancing exploration and exploitation within a single domain. For instance, several studies have demonstrated how such balancing positively contributes to an organization's sales growth (He & Wong, 2004; Venkatraman et al., 2007). Other studies have furnished evidence at the business-unit level, revealing that a business unit's ability to balance alignment and adaptability is positively associated with its perceived performance in terms of capacity utilization and employee motivation (Gibson & Birkinshaw, 2004). Still other studies have considered the implications of restructuring, predicting long-term benefits of temporal sequencing of different organizational structures as organizations shift from a decentralized to an integrated structure (Siggelkow & Levinthal, 2003). Hence, organizations may gain by engaging in temporal separation of exploratory and exploitative activities.

Nevertheless, most studies on organizational separation fail to provide clear evidence of the performance of ambidextrous designs. In those studies, organizational separation is assumed rather than demonstrated. Scholars should carefully discern whether simultaneous exploration and exploitation is executed via organizational separation or other balancing modes, since alternative modes may produce contrasting performance effects. For instance, a recent study reports that simultaneous balancing of exploration and exploitation by means of organizational separation yields a weaker effect on sales growth relative to temporal separation (Venkatraman et al., 2007). Future research may relate performance heterogeneity to the balancing mode rather than to balance per se. It may also relax the latent assumption in prior research on organizational or temporal separation that exploration and exploitation are conducted in a single domain.

Balance via domain separation. Whereas most prior research underscores the positive performance implications of balance between exploration and

exploitation within particular domains, recent research has offered some contradictory evidence. For instance, Lin et al. (2007) found that balance between alliances with prior versus new partners limits resource accumulation. Along the same lines, Lavie et al. (2009) demonstrated that balance within the function or structure domain of the alliance portfolio undermines market value and net profit. Evidently, striving toward balance within domains entails reconciliation of conflicting pressures, which may offset the potential gains from such balance. Hence, organizations that follow organizational separation within particular domains may suffer a decline in performance because of overhead costs associated with the need to dedicate resources to both exploratory and exploitative units (Van Looy, Martens, & Debackere, 2005).

Only a few studies have examined the performance implications of balance following the domain-separation approach. In the context of alliances, Lavie et al. (2009) found that organizations can enhance their market value and net profit by exploring in one domain while exploiting in another. They argue that balancing across domains eliminates resource-allocation trade-offs and conflicting partnering routines within domains. In the same vein, Hess and Rothaermel (2009) argue that organizations that explore with the help of star scientists while exploiting via alliances, or exploit with their staff scientists while exploring through alliances, enhance their innovation efforts. These studies counter the traditional ambidexterity research, which has focused on balance by means of organizational separation within a single domain (He & Wong, 2004; Katila & Ahuja, 2002; Lubatkin et al., 2006; Rosenkopf & Nerkar, 2001).

Contingency approach for balancing effects. The different modes for balancing exploration and exploitation only partially explain the mixed evidence on the performance implications of balance. In an attempt to reconcile this conflicting evidence, several studies have considered environmental and organizational contingencies. For instance, some studies have underscored the implications of organizational size, showing that the benefits of balancing exploration and exploitation in alliances increase with organizational size (Lin et al., 2007). In contrast, Lavie et al. (2009) reveal that, as organizations grow, balancing within alliance domains becomes less effective, while balancing across domains becomes a more effective means for enhancing performance. Thus, whereas some studies suggest that large organizations are subject to stronger path dependence, others find that such organizations leverage their experience to maintain balance between exploration and exploitation.

Besides organizational contingencies, several studies have considered environmental factors that shape the balance–performance relationship. Venkatraman et al. (2007), for instance, find that multi-market competition weakens the positive performance effect of balance by means of temporal

separation. In contrast, market dominance increases the return on balance in the case of temporal separation but limits the gains from balance by means of organizational separation. In addition, environmental dynamism and competitive intensity may moderate the performance effects of balance by means of organizational separation, so that the effectiveness of exploratory innovation improves in turbulent environments, whereas exploitative innovation becomes more beneficial in competitive environments (Jansen et al., 2006). The benefits of balancing these activities are more apparent in uncertain and instable environments (Lin et al., 2007). Overall, this research suggests that differences in the performance effects of balance depend not only on the mode by which organizations seek to achieve this balance but also on organizational and environmental contingencies.

Despite recent progress in studying the performance effects of balancing exploration and exploitation, several questions remain open concerning the conditions under which organizations benefit from such balance. Scholars still debate the nature of trade-offs between exploration and exploitation, with some claiming that these activities can coexist while others noting inherent contradictions. The evidence on the performance effects of balance is mixed, showing both negative and positive effects. Furthermore, the context in which balance has been observed merits attention. Some studies focus on the intra-organizational context, whereas others study alliances, with almost no attention paid to the extent to which these organizational settings differ.

Directions for Future Research

Despite recent progress in the study of exploration and exploitation, several challenges lie ahead, which call for further research of this important phenomenon (see Table 2). Whereas in its infancy, research on exploration and exploitation has been applied narrowly with a focus on knowledge management and learning, it has now become an all-encompassing framework that relates to distinctive phenomena in various contexts. This trend makes it more difficult to generalize findings. We caution scholars to recognize the specific conceptualization, operationalization, and context in which they study exploration and exploitation in order to avoid unwarranted generalization. A related task for future research involves defining relevant domains in which exploration and exploitation are studied. Such an approach can help reveal the contingent nature and contextuality of exploration and exploitation, as well as facilitate comparison of findings in particular domains. The emerging research on domain separation (Lavie & Rosenkopf, 2006) makes some strides in this regard by defining several domains in the inter-organizational context. Future research may need to identify equivalent domains in the intra-organizational context and study trade-offs across domains and organizational boundaries. In particular, an organization's efforts to explore internally may balance its

Table 2 The Exploration–Exploitation Framework: Current Challenges and Future Directions**Current challenges**

- Scope of phenomenon: Should exploration–exploitation be narrowly defined in the knowledge domain or broadly in various domains?
- Discerning exploitation from exploration: Should existing knowledge development be considered an act of exploration or exploitation?
- Conceptualization: Should exploration and exploitation be viewed as opposing ends of a continuum or as discrete choices?
- The nature of association: Are exploration and exploitation complementary or contradictory endeavors?
- Performance implications: Do organizations benefit from balancing exploration and exploitation or from specialization in either activity?
- Antecedents: Why do some organizations pursue exploration while others opt for exploitation?
- The notion of balance: Should organizations seek equal proportions of exploration and exploitation or some other optimal mix?
- Assumptions: Can we reconcile normative assumptions about desirable balance and behavioral tendencies to specialize?
- Conceptual clarity: What is the difference between balance and ambidexterity?
- Modes of balancing: What is the best mode for balancing exploration and exploitation?
- Intentionality: How important is intentionality for managing the balance between exploration and exploitation?

Future directions

- Specify the domains of exploration–exploitation
- Systematically study the antecedents to exploration–exploitation tendencies
- Empirically discern the tradeoffs between exploration and exploitation from organizations' balancing efforts
- Study cross-national differences in organizations' inclinations to explore versus exploit
- Explore how different types of resources facilitate either exploration or exploitation
- Study the costs and challenges associated with organizations' balancing efforts
- Find the optimal balance levels for exploration and exploitation under varying conditions
- Uncover the conditions under which organizations benefit from balanced exploration and exploitation
- Juxtapose exploration and exploitation in intra-organizational and inter-organizational contexts
- Study how organizations simultaneously balance exploration and exploitation using multiple modes of balance
- Examine whether proactive management of balance improves performance outcomes

Table 2 The Exploration–Exploitation Framework: Current Challenges and Future Directions (Continued)

-
- Relate exploration and exploitation at multiple levels of analysis
 - Study how exploration and exploitation contribute to industry evolution
 - Reconcile the short-term and long-term performance implications of exploration and exploitation
-

tendencies to exploit via alliances (Hess & Rothaermel, 2009). By recognizing the multidimensionality of this phenomenon, we can learn more about how organizations balance exploration and exploitation.

Besides delimiting the scope of the exploration–exploitation construct at the intra-organizational and inter-organizational levels, future research may focus on other levels of analysis. For instance, it may consider the industry level to study how organizations' exploration and exploitation efforts contribute to the emergence of industry sectors and to changing industry conditions. A coevolutionary perspective (Koza & Lewin, 1998; Murmann, 2003) is needed to isolate the causal influences of environmental conditions on exploration and exploitation from the consequences of these activities. Also important is the study of exploration and exploitation at the individual and team levels of analysis (Gibson & Birkinshaw, 2004; Jansen, George, Van den Bosch, & Volberda, 2008; Lubatkin et al., 2006; Smith & Tushman, 2005).

Prior research has focused on the role of the senior-management team in managing the contradictory forces of exploration and exploitation. This stream of research suggests that the design of such teams and the behavior of their members can support cognitive integration and differentiation that allow for embracing and managing concurrent exploration and exploitation (Smith & Tushman, 2005, 2009). The underlying assumption has been that conflict cannot be eliminated (Cameron & Quinn, 1988), which forces the senior-management team to cope proactively with organizational inertia and psychological biases for consistency. Nevertheless, we can relax the above assumption by considering how temporal or domain separation buffers exploration from exploitation and reduces the tension between them. Thus, further research may be needed at the individual and group levels to uncover the underlying processes at different levels of analysis that support the balancing of exploration and exploitation.

To derive further conclusions from the literature on exploration and exploitation, scholars also need to clarify conceptual distinctions and connections to related terms and research streams. For instance, we have used the notion of ambidexterity quite narrowly when referring to contextual balancing and organizational separation, whereas many studies consider ambidexterity as a general term for describing balance between exploration and exploitation (e.g., Jansen et al., 2009; Raisch et al., 2009; Simsek, 2009). The

notion of absorptive capacity (Cohen & Levinthal, 1990) can also enrich our understanding of how firms manage exploration and exploitation. Most scholars associate absorptive capacity with exploration; yet applying external knowledge calls for exploitation. Additionally, studies of exploration and exploitation tend to underscore the creation and application of internally developed knowledge (Levinthal & March, 1993). The notion of absorptive capacity can complement this stream of research by bringing some insights on the role of externally imported knowledge. Furthermore, future research may borrow from the exploration–exploitation literature to uncover implicit trade-offs between the elements of an organization’s absorptive capacity, since recognizing and internalizing external knowledge may create impediments that restrict its subsequent application.

Another task for future research involves elucidating the association between exploration and exploitation. We suggested that, empirically, one may observe correlations that range from negative to positive when separately measuring these activities. Nevertheless, the real challenge is to discern the inherent trade-offs from organizations’ efforts to manage these contradictions. The complementary benefits of exploration and exploitation should not be confused with the divergent characteristics of these activities and the administrative burden associated with their reconciliation. The more competently an organization balances exploration and exploitation, the more likely it will enjoy the complementary benefits of these activities. More insights are needed from field research to discern essential trade-offs that result from balancing efforts and to learn more about the driving forces and techniques used by organizations to balance exploration and exploitation. Case studies can also shed light on the agency of the senior-management team and intentionality in balancing exploration and exploitation activities.

Methodologically, we uncovered inconsistent approaches for modeling balance between exploration and exploitation. Scholars who separately measure exploration and exploitation debate about the operationalization of balance as an additive, multiplicative, or relative function, with results sensitive to the modeling choice. Instead, we advocate the use of a single continuous variable to capture exploration–exploitation, wherein balance is modeled with a quadratic function that reaches maximum value at an intermediate point. Future research may contrast and evaluate the results obtained when alternative operationalizations of balance are employed.

Once scholars concur on the relevant domains of exploration–exploitation and the formulation of the balance function, a remaining challenge involves the domain-specific operationalization of the construct. Overall, this effort should aim for consistency in the measurement of exploration–exploitation. A related methodological challenge concerns the measurement of organizations’ efforts to balance exploration and exploitation. Given the different modes of balance, scholars may need to develop specific scales for measuring the bal-

ancing modes of organizations. Separating the measurement of balancing efforts from the measurement of exploration–exploitation trade-offs is critical for advancing this field of research. Finally, future research may seek to test some of the latent assumptions and features of the exploration–exploitation construct empirically, such as its transitivity and relativity that may account for further heterogeneity in its antecedents and consequences.

When studying the antecedents to organizations' exploration and exploitation tendencies, future research may seek to identify additional drivers while empirically validating the effects of the factors that we identified. For instance, scholars may delineate how structural properties of the networks in which organizations are embedded facilitate either exploration or exploitation (Jansen et al., 2006; Lazer & Friedman, 2007; Rowley, Behrens, & Krackhardt, 2000). They may also consider how characteristics of the senior-management team, such as demographics and leadership skills, contribute to inclinations to explore versus exploit (Vera & Crossan, 2004).

More attention may be paid to inter-industry heterogeneity and cross-national differences that encompass cultural, political, economic, and institutional characteristics of organizations' countries of origin (Ghemawat, 2001). Research on exploration and exploitation has not considered national culture as a relevant antecedent. National cultures differ with respect to tolerance for uncertainty, risk taking, and individualism (Hofstede, 1984; Kogut & Singh, 1988), which affect entrepreneurship, innovation, and cooperation (Shane, Venkataraman, & MacMillan, 1995). Cooperative values and uncertainty avoidance are related to organizations' propensity to engage in exploratory technology alliances (Steensma, Marino, Weaver, & Dickson, 2000). Furthermore, local governments may institute policies that influence organizations' predisposition toward either exploration or exploitation. Trends for globalization entail greater attention to such socio-environmental antecedents of exploration–exploitation.

One of our central themes concerns the balancing of exploration and exploitation. We have discussed the various modes of balancing, underscoring organizational, temporal, and domain separation. Our discussion departs from the traditional call for embracing contradictions and integrating exploration and exploitation by means of managerial cognition (Smith & Tushman, 2005). Instead, we underscore the role of separation that buffers exploration from exploitation, thus enabling organizations to circumvent the inherent tension between these activities. Future research may empirically examine the merits of integration versus separation, and perhaps identify the appropriate organizational level for integrating these activities.

We encourage future research to go beyond the study of pure modes of balance to examine how organizations combine several balancing modes when seeking to resolve the inherent trade-offs imposed by exploration and exploitation. For example, temporal separation can be supported by balancing

exploration and exploitation across multiple domains. Indeed, Lavie and Rosenkopf (2006) reveal that organizations shift from exploration to exploitation in the function domain (from R&D alliances to marketing alliances) while at the same time transitioning from exploitation to exploration in the structure domain (from prior partners to new partners). By so doing, they maintain a global balance over time and across domains of alliances.

Scholars have yet to define equivalent domains within organizational boundaries. For instance, to the extent that we consider different product lines as independent organizational domains, an organization can separately determine the levels of exploration and exploitation for certain products, thus maintaining balance across these product lines over time. In this sense, Lavie and Rosenkopf's (2006) study illustrates a special case that involves a combination of temporal separation and domain separation in alliances. Future research may uncover the inherent merits of exploring or exploiting in particular domains.

Besides identifying trade-offs in balancing exploration and exploitation across organizational boundaries, more research is needed to elucidate the short-term versus long-term implications of balancing exploration and exploitation. This attempt should be accompanied by an effort to define specific performance measures and study how the effects of balancing exploration and exploitation vary by performance measures. Overall, convergence of modeling techniques, specification of exploration–exploitation domains, and attention to the operationalization of related variables can help resolve apparent inconsistencies in the literature.

Finally, we hope that our approach for balancing exploration and exploitation informs the broader research agenda on managing organizational tensions and resolving social paradoxes in organizations (Poole & Van de Ven, 1989). Whereas prior research has advocated cognitive and behavioral complexity that skillful managers exert when coping with paradoxes and conflicting pressures (Cameron & Quinn, 1988; Denison, Hooijberg, & Quinn, 1995; Smith & Tushman, 2005), we propose that organizations can also establish temporal, organizational, or categorical buffers to separate contradictory forces and circumvent trade-offs.

A similar approach can be applied when seeking to resolve other social paradoxes. For instance, when internationalizing their operations, organizations benefit from access to remote and diverse resources, yet face challenges because of increasing cultural, institutional, economic, and geographical distance. Whereas one approach for resolving this tension involves leveraging partnering experience to build relational capabilities that mitigate some liabilities of foreignness, another approach is to circumvent these distances and avoid the managerial challenges by establishing wholly owned subsidiaries in partners' countries of origin (Lavie & Miller, 2008). Generally, when facing contradictions, organizations can either develop managerial skills to maintain

conflicting activities or seek to separate these activities. In both cases, the senior-management team needs to recognize the trade-offs. However, it can decide whether to manage contradictions or avoid the tension altogether. These alternative approaches entail distinct organizational capabilities, and future research may assess the antecedents and consequences of adopting each approach, as well as elaborate on the organizational processes that support it.

Conclusion

Interest in the exploration–exploitation framework has grown significantly in the past decade. Although much progress has been made, many open questions remain, and several fertile debates have emerged that merit further attention. In this review, we discussed the various facets of this framework, underscoring the antecedents and consequences of exploration and exploitation and the balance between them. In particular, we discussed how environmental pressures such as dynamism, shocks, and competitive intensity, as well as organization history involving absorptive capacity, slack resources, organizational structure, culture, age, and size, together with managerial inclinations, steer organizations toward either exploration or exploitation.

We also elaborated on the notion of balance between exploration and exploitation. As exploration and exploitation are in tension, balance can be executed contextually, via organizational separation, temporal separation, or domain separation. We further argued that exploration and exploitation are expected to produce distinctive benefits, although supporting evidence has been scarce. Few studies demonstrate how balance between exploration and exploitation generates favorable outcomes. We have identified conceptual and empirical gaps in the literature and pointed out specific directions for future research that can contribute to a more coherent and complete body of work on this phenomenon.

Clearly, March's insights on the trade-offs and implications of exploration and exploitation have captured the imagination of scholars. Balancing the past with the future is also relevant to practitioners. Still, while our understanding of the determinants and effects of exploration and exploitation has improved, more research is needed to sort out and refine the fundamental terms and concepts associated with these activities. We call for research on the mechanisms and agency associated with balancing exploration and exploitation at various levels of analysis. As our field makes progress toward understanding the antecedents and consequences of exploration and exploitation, we should also attempt to relate the exploration–exploitation framework to the pressing problems of practitioners. This field of research has the potential to be theoretically and empirically rigorous, as well as profoundly managerially relevant.

Acknowledgments

We would like to thank the editors, Art Brief and Jim Walsh, for their thoughtful comments, as well as Kostas Grigoriou, Justin Jansen, Lori Rosenkopf, and Frank Rothaermel for their valuable feedback.

References

- Adler, P., Benner, M.J., Brunner, D.J., MacDuffie, J.P., Osono, E., Staats, B.R., Takeuchi, H., Tushman, M., & Winter, S.G. (2009). Perspectives on the productivity dilemma. *Journal of Operations Management*, 27, 99–113.
- Adler, P., Goldoftas, B., & Levine, D. (1999). Flexibility versus efficiency? A case study of model changeovers in the Toyota production system. *Organization Science*, 10(1), 43–68.
- Ahuja, G., Lampert, C.M., & Tandon, V. (2008). Moving beyond Schumpeter: Management research on the determinants of technological innovation. *Academy of Management Annals*, 2(1), 1–98.
- Albert, S., & Whetten, D.A. (2004). Organizational identity. In M.J. Hatch & M. Schultz (Eds.), *Organizational identity* (pp. 89–117). New York: Oxford University Press.
- Alvesson, M. (2002). *Understanding organizational culture*. London: Sage.
- Andrews, S.B., Basler, C.R., & Coller, X. (1999). Organizational structures, cultures, and identities: Overlaps and divergences. In S.B. Andrews & D. Knoke (Eds.), *Research in the sociology of organizations* (Vol. 16, pp. 213–235). Greenwich, CT: JAI Press.
- Andriopoulos, C., & Lewis, M.W. (2009). Exploitation–exploration tensions and organizational ambidexterity: Managing paradoxes of innovation. *Organization Science*, 20(4), 696–717.
- Anteby, M. (2008). Identity incentives as an engaging form of control: Revisiting leniencies in an aeronautic plant. *Organization Science*, 19(2), 202–220.
- Auh, S., & Menguc, B. (2005). Balancing exploration and exploitation: The moderating role of competitive intensity. *Journal of Business Research*, 58(12), 1652–1661.
- Barnett, W.P. (1997). The dynamics of competitive intensity. *Administrative Science Quarterly*, 42(1), 128–160.
- Beckman, C.M. (2006). The influence of founding team company affiliations on firm behavior. *Academy of Management Journal*, 49(4), 741–758.
- Beckman, C.M., Haunschild, P.R., & Phillips, D.J. (2004). Friends or strangers? Firm-specific uncertainty, market uncertainty, and network partner selection. *Organization Science*, 15(3), 259–275.
- Benner, M.J. (2007). The incumbent discount: Stock market categories and response to radical technological change. *Academy of Management Review*, 32(3), 703–720.
- Benner, M.J., & Tushman, M. (2002). Process management and technological innovation: A longitudinal study of the photography and paint industries. *Administrative Science Quarterly*, 47(4), 676–706.
- Benner, M.J., & Tushman, M. (2003). Exploitation, exploration, and process management: The productivity dilemma revisited. *Academy of Management Review*, 28(2), 238–256.
- Boeker, W. (1997). Strategic change: The influence of managerial characteristics and organizational growth. *Academy of Management Journal*, 40(1), 152–170.

- Bourgeois, L.J. (1981). On the measurement of organizational slack. *Academy of Management Review*, 6(1), 29–39.
- Brierly, P., & Chakrabarti, A. (1996). Generic knowledge strategies in the US pharmaceutical industry. *Strategic Management Journal*, 17, 123–135.
- Brown, J.S., & Duguid, P. (2001). Knowledge and organization: A social-practice perspective. *Organization Science*, 12(2), 198–213.
- Brunner, D.J., Staats, B.R., Tushman, M.L., & Upton, D.M. (2009). *Wellsprings of creation: Perturbation and the paradox of the highly disciplined organization*. (Working Paper No. 09-011). Cambridge, MA: Harvard Business School.
- Burns, L.R., & Wholey, D.R. (1993). Adoption and abandonment of matrix management programs: Effects of organizational characteristics and interorganizational networks. *Academy of Management Journal*, 36(1), 108–138.
- Burns, T., & Stalker, G.M. (1961). Mechanistic and organic systems of management. In T. Burns & G.M. Stalker (Eds.), *The management of innovation* (pp. 96–125). New York: Oxford University Press.
- Cameron, K., & Quinn, R. (1988). Organizational paradox and transformation. In R. Quinn & K. Cameron (Eds.), *Paradox and transformation* (pp. 1–18). Cambridge, MA: Ballinger.
- Cao, Q., Gedajlovic, E., & Zhang, H. (2009). Unpacking organizational ambidexterity: Dimensions, contingencies, and synergistic effects. *Organization Science*, 20(4), 781–796.
- Christensen, C.M. (1997). *The innovator's dilemma: When new technologies cause great firms to fail*. Boston: Harvard Business School Press.
- Cohen, W.M., & Levinthal, D.A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, 35(1), 128–152.
- Cyert, R.M., & March, J.G. (1992). *A behavioral theory of the firm* (2nd ed.). Oxford: Blackwell Publishing.
- Danneels, E. (2002). The dynamics of product innovation and firm competences. *Strategic Management Journal*, 23(12), 1095–1121.
- Davis, J., Eisenhardt, K., & Bingham, C. (2009). Optimal structure, market dynamism, and the strategy of simple rules. *Administrative Science Quarterly*, 54(3), 413–452.
- Deeds, D.L. (2001). The role of R&D intensity, technical development and absorptive capacity in creating entrepreneurial wealth in high technology start-ups. *Journal of Engineering and Technology Management*, 18(1), 29–47.
- Denison, D., Hooijberg, R., & Quinn, R. (1995). Paradox and performance: Toward a theory of behavioral complexity in managerial leadership. *Organization Science*, 6(5), 524–540.
- Dess, G.G., & Beard, D.W. (1984). Dimensions of organizational task environments. *Administrative Science Quarterly*, 29(1), 52–73.
- Duncan, R.B. (1976). The ambidextrous organization: Designing dual structures for innovation. In R.H. Killman, L.R. Pondy, & D. Slevin (Eds.), *The management of organization design* (Vol. 1, pp. 167–188). New York: North-Holland.
- Ebben, J., & Johnson, A. (2005). Efficiency, flexibility, or both? Evidence linking strategy to performance in small firms. *Strategic Management Journal*, 26(13), 1249–1259.
- Eisenhardt, K.M., & Brown, S.L. (1997). The art of continuous change: Linking complexity theory and time-paced evolution in relentlessly shifting organizations. *Administrative Science Quarterly*, 42(1), 1–34.

- Ethiraj, S., & Levinthal, D. (2009). Hoping for A to Z while rewarding only A: Complex organizations and multiple goals. *Organization Science*, 20(1), 4–21.
- Fang, C., & Levinthal, D.A. (2009). The near-term liability of exploitation: Exploration and exploitation in multi-stage problems. *Organization Science*, 20(3), 538–551.
- Fang, C., Lee, J., & Schilling, M.A. (forthcoming). Balancing exploration and exploitation through structural design: The isolation of subgroups and organizational learning. *Organization Science*.
- Ghemawat, P. (2001). Distance still matters: The hard reality of global expansion. *Harvard Business Review*, 79(8), 137–147.
- Ghoshal, S., & Bartlett, C. (1994). Linking organizational context and managerial action: The dimensions of quality of management [Special issue]. *Strategic Management Journal*, 15, 91–112.
- Gibson, C.B., & Birkinshaw, J. (2004). The antecedents, consequences, and mediating role of organizational ambidexterity. *Academy of Management Journal*, 47(2), 209–226.
- Gilsing, V., & Nooteboom, B. (2006). Exploration and exploitation in innovation systems: The case of pharmaceutical biotechnology. *Research Policy*, 35(1), 1–23.
- Grant, R.M., & Baden-Fuller, C. (2004). A knowledge accessing theory of strategic alliances. *Journal of Management Studies*, 41(1), 61–84.
- Greve, H.R. (2007). Exploration and exploitation in product innovation. *Industrial and Corporate Change*, 16(5), 945–975.
- Gupta, A.K., Smith, K., & Shalley, C.E. (2006). The interplay between exploration and exploitation. *Academy of Management Journal*, 49(4), 693–706.
- Hambrick, D.C. (1994). Top management groups: A conceptual integration and reconsideration of the “team” label. In B.M. Staw & L.L. Cummings (Eds.), *Research in organizational behavior* (Vol. 16, pp. 171–213). Greenwich, CT: JAI Press.
- Hambrick, D.C., Finkelstein, S., & Mooney, A.C. (2005). Executive job demands: New insights for explaining strategic decisions and leader behaviors. *Academy of Management Review*, 30(3), 472–491.
- Hannan, M.T., & Freeman, J. (1977). The population ecology of organizations. *American Journal of Sociology*, 82(5), 929–964.
- Hannan, M.T., & Freeman, J. (1984). Structural inertia and organizational change. *American Sociological Review*, 49(2), 149–164.
- Harreld, J., O’Reilly, C.A., III., & Tushman, M. (2007). Dynamic capabilities at IBM: Driving strategy into action. *California Management Review*, 49(4), 21–43.
- He, Z.L., & Wong, P.K. (2004). Exploration vs. exploitation: An empirical test of the ambidexterity hypothesis. *Organization Science*, 15(4), 481–494.
- Helfat, C., & Peteraf, M. (2009). Understanding dynamic capabilities: Progress along a developmental path. *Strategic Organization*, 7(1), 91–102.
- Hess, A.M., & Rothaermel, F.T. (2009). *Ambidexterity and innovative performance: The role of intellectual human capital and strategic alliances*. (Working Paper). Georgia Tech University.
- Hoang, H., & Rothaermel, F.T. (forthcoming). Leveraging internal and external experience: Exploration, exploitation, and R&D project performance. *Strategic Management Journal*.
- Hofstede, G. (1984). *Culture’s consequences: International differences in work-related values*. Newbury Park, CA: Sage.

- Holmqvist, M. (2003). A dynamic model of intra- and interorganizational learning. *Organization Studies*, 24(1), 95–103.
- Holmqvist, M. (2004). Experiential learning processes of exploitation and exploration within and between organizations: An empirical study of product development. *Organization Science*, 15(1), 70–81.
- Jansen, J.J.P., George, G., Van den Bosch, F.A.J., & Volberda, H.W. (2008). Senior team attributes and organizational ambidexterity: The moderating role of transformational leadership. *Journal of Management Studies*, 45(5), 982–1007.
- Jansen, J.J.P., Tempelaar, M.P., Van den Bosch, F.A.J., & Volberda, H.W. (2009). Structural differentiation and ambidexterity: The mediating role of integration mechanisms. *Organization Science*, 20(4), 797–811.
- Jansen, J.J.P., Van den Bosch, F.A.J., & Volberda, H.W. (2005). Exploratory innovation, exploitative innovation, and ambidexterity: The impact of environmental and organizational antecedents. *Schmalenbach Business Review*, 57, 351–363.
- Jansen, J.J.P., Van den Bosch, F.A.J., & Volberda, H.W. (2006). Exploratory innovation, exploitative innovation, and performance: Effects of organizational antecedents and environmental moderators. *Management Science*, 52(11), 1661–1674.
- Katila, R., & Ahuja, G. (2002). Something old, something new: A longitudinal study of search behavior and new product introduction. *Academy of Management Journal*, 45(6), 1183–1194.
- Kim, T., & Rhee, M. (2009). Exploration and exploitation: Internal variety and environmental dynamism. *Strategic Organization*, 7(1), 11–41.
- Knott, A.M. (2002). Exploration and exploitation as complements. In N. Bontis & C.W. Choo (Eds.), *The strategic management of intellectual capital and organizational knowledge* (pp. 339–358). New York: Oxford University Press.
- Kogut, B., & Singh, H. (1988). The effect of national culture on the choice of entry mode. *Journal of International Business Studies*, 19(3), 411–432.
- Koza, M.P., & Lewin, A.Y. (1998). The co-evolution of strategic alliances. *Organization Science*, 9(3), 255–264.
- Koza, M.P., & Lewin, A.Y. (2000). Managing partnerships and strategic alliances: Raising the odds of success. *European Management Journal*, 18(2), 146–151.
- Landes, D. (1983). *Revolution in time: Clocks and the making of the modern world*. Cambridge, MA: Harvard University Press.
- Lane, P.J., & Lubatkin, M. (1998). Relative absorptive capacity and interorganizational learning. *Strategic Management Journal*, 19(5), 461–477.
- Lant, T.K., & Mezias, S.J. (1992). An organizational learning model of convergence and reorientation. *Organization Science*, 3(1), 47–71.
- Lavie, D. (2006). Capability reconfiguration: An analysis of incumbent responses to technological change. *Academy of Management Review*, 31(1), 153–174.
- Lavie, D., & Miller, S. (2008). Alliance portfolio internationalization and firm performance. *Organization Science*, 19(4), 623–646.
- Lavie, D., & Rosenkopf, L. (2006). Balancing exploration and exploitation in alliance formation. *Academy of Management Journal*, 49(4), 797–818.
- Lavie, D., Kang, J., & Rosenkopf, L. (2009). *The performance effects of balancing exploration and exploitation within and across alliance domains*. Paper presented at the Academy of Management Best Paper Proceedings, Chicago.
- Lazer, D., & Friedman, A. (2007). The network structure of exploration and exploitation. *Administrative Science Quarterly*, 52(4), 667–694.

- Leonard-Barton, D. (1992). Core capabilities and core rigidities: A paradox in managing new product development. *Strategic Management Journal*, 13(5), 111–125.
- Levinthal, D.A., & March, J.G. (1993). The myopia of learning [Special issue]. *Strategic Management Journal*, 14, 95–112.
- Levinthal, D.A., & Posen, H.E. (2009). *Bringing context to the exploration–exploitation trade-off: Considering the impact of selection and turbulent environments*. (Working paper). University of Michigan.
- Lewin, A.Y., Long, C.P., & Carroll, T.N. (1999). The coevolution of new organizational forms. *Organization Science*, 10(5), 535–550.
- Li, Y., Vanhaverbeke, W., & Schoenmakers, W. (2008). Exploration and exploitation in innovation: Reframing the interpretation. *Creativity and Innovation Management*, 17(2), 107–126.
- Lin, Z.J., Yang, H., & Demirkan, I. (2007). The performance consequences of ambidexterity in strategic alliance formations: Empirical investigation and computational theorizing. *Management Science*, 53(10), 1645–1658.
- Lubatkin, M.H., Simsek, Z., Ling, Y., & Veiga, J.F. (2006). Ambidexterity and performance in small-to medium-sized firms: The pivotal role of top management team behavioral integration. *Journal of Management*, 32(5), 646–672.
- March, J.G. (1991). Exploration and exploitation in organizational learning. *Organization Science*, 2(1), 71–87.
- March, J.G., & Shapira, Z. (1992). Variable risk preferences and the focus of attention. *Psychological Review*, 99(1), 172–183.
- McGrath, R.G. (2001). Exploratory learning, innovative capacity, and managerial oversight. *Academy of Management Journal*, 44(1), 118–131.
- Meyer, A. (1982). Adapting to environmental jolts. *Administrative Science Quarterly*, 27(4), 515–537.
- Meyer, A., Brooks, G., & Goes, J. (1990). Environmental jolts and industry revolutions: Organizational responses to discontinuous change. *Strategic Management Journal*, 11(1), 93–110.
- Miles, R.E., & Snow, C.C. (1978). *Organizational strategy, structure and process*. New York: McGraw-Hill.
- Miron, E., Erez, M., & Naveh, E. (2004). Do personal characteristics and cultural values that promote innovation, quality, and efficiency compete or complement each other? *Journal of Organizational Behavior*, 25(2), 175–199.
- Mom, T.J.M., Van den Bosch, F.A.J., & Volberda, H.W. (2007). Investigating managers' exploration and exploitation activities: The influence of top-down, bottom-up, and horizontal knowledge inflows. *Journal of Management Studies*, 44(6), 910–931.
- Mom, T.J.M., Van den Bosch, F.A.J., & Volberda, H.W. (2009). Understanding variation in managers' ambidexterity: Investigating direct and interaction effects of formal structural and personal coordination mechanisms. *Organization Science*, 20(4), 812–828.
- Murmann, J.P. (2003). *Knowledge and competitive advantage: The coevolution of firms, technology and national institutions*. Cambridge, England: Cambridge University Press.
- Murmann, J., & Tushman, M. (1997). Organizational responsiveness to environmental shock as an indicator of organizational foresight and oversight: The role of

- executive team characteristics and organizational context. In R. Garud, P.R. Nayar, & Z.B. Shapira (Eds.), *Technological innovation: Oversights and fore-sights* (pp. 261–278). Cambridge, England: Cambridge University Press.
- Nohria, N., & Gulati, R. (1996). Is slack good or bad for innovation? *Academy of Management Journal*, 39(5), 1245–1264.
- O'Reilly, C.A., III, & Chatman, J.A. (1996). Culture as social control: Corporations, culture and commitment. In B.M. Staw & L.L. Cummings (Eds.), *Research in organizational behavior* (Vol. 18, pp. 157–200). Greenwich, CT: JAI Press.
- O'Reilly, C.A., III, & Tushman, M.L. (2008). Ambidexterity as a dynamic capability: Resolving the innovator's dilemma. *Research in Organizational Behavior*, 28, 185–206.
- Osono, E., Shimizu, N., Takeuchi, H., & Dorton, J. (2008). *Extreme Toyota: Radical contradictions that drive success at the world's best manufacturer*. Hoboken, NJ: Wiley.
- Park, S.H., Chen, R., & Gallagher, S. (2002). Firm resources as moderators of the relationship between market growth and strategic alliances in semiconductor start-ups. *Academy of Management Journal*, 45(3), 527–545.
- Penrose, E.T. (1959). *The theory of the growth of the firm* (3rd ed.). New York: Oxford University Press.
- Poole, M.S., & Van de Ven, A.H. (1989). Using paradox to build management and organization theories. *Academy of Management Review*, 14(4), 562–578.
- Porter, M.E. (1980). *Competitive strategy: Techniques for analyzing industries and competitors*. New York: Free Press.
- Raisch, S., & Birkinshaw, J. (2008). Organizational ambidexterity: Antecedents, outcomes, and moderators. *Journal of Management*, 34(3), 375–409.
- Raisch, S., Birkinshaw, J., Probst, G., & Tushman, M. (2009). Organizational ambidexterity: Balancing exploitation and exploration for sustained performance. *Organization Science*, 20(4), 685–695.
- Ravasi, D., & Schultz, M. (2006). Responding to organizational identity threats: Exploring the role of organizational culture. *Academy of Management Journal*, 49(3), 433–458.
- Rivkin, J.W., & Siggelkow, N. (2003). Balancing search and stability: Interdependencies among elements of organizational design. *Management Science*, 49(3), 290–311.
- Romanelli, E., & Tushman, M.L. (1994). Organizational transformation as punctuated equilibrium: An empirical test. *Academy of Management Journal*, 37(5), 1141–1166.
- Rosenkopf, L., & Nerkar, A. (2001). Beyond local search: Boundary-spanning, exploration, and impact in the optical disk industry. *Strategic Management Journal*, 22(4), 287–306.
- Rothaermel, F.T. (2001). Incumbent's advantage through exploiting complementary assets via interfirm cooperation. *Strategic Management Journal*, 22, 687–699.
- Rothaermel, F.T., & Alexandre, M.T. (2009). Ambidexterity in technology sourcing: The moderating role of absorptive capacity. *Organization Science*, 20(4), 759–780.
- Rothaermel, F.T., & Deeds, D.L. (2004). Exploration and exploitation alliances in biotechnology: A system of new product development. *Strategic Management Journal*, 25(3), 201–221.
- Rowley, T.B., Behrens, D., & Krackhardt, D. (2000). Redundant governance structures: An analysis of structural and relational embeddedness in the steel and semiconductor industries. *Strategic Management Journal*, 21, 369–386.

- Shane, S., Venkataraman, S., & MacMillan, I. (1995). Cultural differences in innovation championing strategies. *Journal of Management*, 21(5), 931–952.
- Sharfman, M.P., Wolf, G., Chase, R.B., & Tansik, D.A. (1988). Antecedents of organizational slack. *Academy of Management Review*, 13(4), 601–614.
- Sidhu, J.S., Commandeur, H.R., & Volberda, H.W. (2007). The multifaceted nature of exploration and exploitation: Value of supply, demand, and spatial search for innovation. *Organization Science*, 18(1), 20–38.
- Sidhu, J.S., Volberda, H.W., & Commandeur, H.R. (2004). Exploring exploration orientation and its determinants: Some empirical evidence. *Journal of Management Studies*, 41(6), 913–932.
- Siggelkow, N. (2003). Change in the presence of fit: The rise, the fall, and the renaissance of Liz Claiborne. In B. Chakravarthy, G. Mueller-Stewens, P. Lorange, & C. Lechner (Eds.), *Strategy process: Shaping the contours of the field* (pp. 46–76). Malden, MA: Blackwell.
- Siggelkow, N., & Levinthal, D.A. (2003). Temporarily divide to conquer: Centralized, decentralized, and reintegrated organizational approaches to exploration and adaptation. *Organization Science*, 14(6), 650–669.
- Siggelkow, N., & Rivkin, J. (2006). When exploration backfires: Unintended consequences of multilevel organizational search. *Academy of Management Journal*, 49(4), 779–795.
- Simsek, Z. (2009). Organizational ambidexterity: Towards a multilevel understanding. *Journal of Management Studies*, 46(4), 597–624.
- Simsek, Z., Heavey, C., Veiga, J.F., & Souder, D. (2009). A typology for aligning organizational ambidexterity's conceptualizations, antecedents, and outcomes. *Journal of Management Studies*, 46(5), 864–894.
- Singh, J.V. (1986). Performance, slack, and risk taking in organizational decision making. *Academy of Management Journal*, 29(3), 562–585.
- Smith, W.K., & Tushman, M.L. (2005). Managing strategic contradictions: A top management model for managing innovation streams. *Organization Science*, 16(5), 522–536.
- Smith, W.K., & Tushman, M.L. (2009). *Dynamic decision making: Supporting multiple strategic goals simultaneously*. (Working paper). Harvard University.
- Sorensen, J.B. (2002). The strength of corporate culture and the reliability of firm performance. *Administrative Science Quarterly*, 47(1), 70–91.
- Sorensen, J.B., & Stuart, T.E. (2000). Aging, obsolescence, and organizational innovation. *Administrative Science Quarterly*, 45(1), 81–112.
- Steensma, H.K., Marino, L., Weaver, K.M., & Dickson, P.H. (2000). The influence of national culture on the formation of technology alliances by entrepreneurial firms. *Academy of Management Journal*, 43(5), 951–973.
- Stinchcombe, A.L. (1965). Social structure and organizations. In J.G. March (Ed.), *Handbook of organizations* (pp. 142–193). Chicago: Rand McNally.
- Sull, D. (1999). The dynamics of standing still: Firestone Tire & Rubber and the radial revolution. *Business History Review*, 73, 430–464.
- Takeuchi, H., Osono, E., & Shimizu, N. (2008). The contradictions that drive Toyota's success. *Harvard Business Review*, 86(6), 96–104.
- Taylor, A., & Helfat, C. (2009). Organizational linkages for surviving technological change: Complementary assets, middle management, and ambidexterity. *Organization Science*, 20(4), 718–739.

- Teece, D. (1986). Profiting from technological innovation: Implications for integration, collaboration, licensing, and public policy. *Research Policy*, 15, 285–305.
- Tripsas, M. (2009). Technology, identity, and inertia through the lens of “the digital photography company.” *Organization Science*, 20(2), 441–460.
- Tripsas, M., & Gavetti, G. (2000). Capabilities, cognition, and inertia: Evidence from digital imaging. *Strategic Management Journal*, 21, 1147–1161.
- Tushman, M.L., & Anderson, P. (1986). Technological discontinuities and organizational environments. *Administrative Science Quarterly*, 31(3), 439–465.
- Tushman, M.L., & O'Reilly, C.A., III. (1996). Ambidextrous organizations: Managing evolutionary and revolutionary change. *California Management Review*, 38(4), 8–30.
- Tushman, M., & Romanelli, E. (1985). Organizational evolution: A metamorphosis model of convergence and reorientation. In L.L. Cummings & B.M. Staw (Eds.), *Research in organizational behavior* (pp. 171–222). Greenwich, CT: JAI Press.
- Tushman, M.L., Smith, W.K., Wood, R., Westerman, G., & O'Reilly, C.A., III. (2003). *Innovation streams and ambidextrous organizational designs: On building dynamic capabilities*. (Working paper). Harvard University.
- Uotila, J., Maula, M.V.J., Keil, T., & Zahra, S.A. (2009). Exploration, exploitation, and financial performance: Analysis of S&P 500 corporations. *Strategic Management Journal*, 30, 221–231.
- Van den Bosch, F.A.J., Volberda, H.W., & de Boer, M. (1999). Coevolution of firm absorptive capacity and knowledge environment: Organizational forms and combinative capabilities. *Organization Science*, 10(5), 551–568.
- Van Deusen, C.A., & Mueller, C.B. (1999). Learning in acquisitions: Understanding the relationship between exploration, exploitation and performance. *The Learning Organization*, 6(4), 186–193.
- Van Looy, B., Martens, T., & Debackere, K. (2005). Organizing for continuous innovation: On the sustainability of ambidextrous organizations. *Creativity and Innovation Management*, 14(3), 208–221.
- Vassolo, R.S., Anand, J., & Folta, T.B. (2004). Non-additivity in portfolios of exploration activities: A real options-based analysis of equity alliances in biotechnology. *Strategic Management Journal*, 25(11), 1045–1061.
- Venkatraman, N., Lee, C.H., & Iyer, B. (2007). *Strategic ambidexterity and sales growth: A longitudinal test in the software sector*. (Working paper). Boston University.
- Vera, D., & Crossan, M. (2004). Strategic leadership and organizational learning. *Academy of Management Review*, 29(2), 222–240.
- Vermeulen, F., & Barkema, H. (2001). Learning through acquisitions. *Academy of Management Journal*, 44(3), 457–476.
- Virany, B., Tushman, M., & Romanelli, E. (1992). Executive succession and organization outcomes in turbulent environments: An organization learning approach. *Organization Science*, 3(1), 72–91.
- Voss, G.B., Sirdeshmukh, D., & Voss, Z.G. (2008). The effects of slack resources and environmental threat on products exploration exploitation. *Academy of Management Journal*, 51(1), 147–164.
- Westerman, G., McFarlan, F.W., & Iansiti, M. (2006). Organization design and effectiveness over the innovation life cycle. *Organization Science*, 17(2), 230–238.