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# **TEAM LEARNING AND SUPERIOR FIRM PERFORMANCE: A MESO-LEVEL PERSPECTIVE ON DYNAMIC CAPABILITIES**

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## **Abstract**

This paper proposes a team-based, meso-level perspective on dynamic capabilities. We argue that team-learning routines constitute a critical link between managerial cognition and organization-level processes of sensing, seizing, and reconfiguring. We draw from the literature to develop four categories based on the orientation (exploration/exploitation) and locus (internal/external) of learning in teams: reflexive, experimental, contextual, and vicarious learning. We integrate these categories into the dynamic capabilities framework, propose that their relative importance differs along the sensing-seizing-reconfiguring pathway, and assess their impact on innovation and strategic change. Our framework contributes by adding a meso lens to research on dynamic capabilities, thereby offering an explanation for *how* senior managers' cognitive abilities can produce superior firm performance, through learning in teams.

## **Keywords**

Dynamic capabilities, Innovation, Strategic change, Teams, Team learning

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## INTRODUCTION

There is continuing interest in how firms can achieve and sustain superior performance. Integrating the resource-based view (Wernerfelt, 1984) and evolutionary economics (Nelson & Winter, 1982), the dynamic capabilities framework (DCF) emphasizes the evolution of the firm's resource base in a turbulent environment (Helfat et al., 2007; Teece, Pisano, & Shuen, 1997). Firms move from intention to outcome by deploying organizational routines (Nelson & Winter, 1982), and the ability to reliably perform and adapt these routines best describes their dynamic capabilities (Helfat & Winter, 2011; Winter, 2003). By drawing on their dynamic capabilities, firms sense opportunities, seize them, and reconfigure the organization to profit from them (Teece, 2007, 2009, 2012).

To enact these processes effectively, firms depend on the cognitive abilities of their senior managers (Adner & Helfat, 2003; Helfat & Peteraf, 2015; Helfat & Martin, 2015). This view suggests, first, that *sensing* opportunities is a scanning and interpretive activity through which senior managers gain insights. Second, *seizing* entails product or service development, commercialization, or other investment decisions made on the basis of methodical analysis. Third, *reconfiguring* encompasses aligning or realigning the firm's governance and coordination mechanisms through asset orchestration to generate rents. Taken as a whole, the DCF literature thus provides both a macro-level view of how firms achieve superior performance, and a micro-level view of the abilities that senior managers need.

However, while senior managers are crucial, over-emphasizing their cognition risks hindering our understanding of why some firms perform better than others in the long term. Steve Jobs surrounded himself with teams who could execute his strategy, but those teams also generated unique knowledge that was crucial to Apple's success (Gladwell, 2011). There are numerous

cases of executives who rely on a network of high-performing teams (e.g., Edmondson & Harvey, 2016; Pisano & Shulman, 2018). Yet, all this is underexplored in the current manager-centered analysis, which risks obscuring the key contributions of other actors.

We need theory that better reflects the evolutionary economics view at the roots of the DCF (Nelson & Winter, 1982; Teece & Pisano, 1994; Teece et al., 1997). After all, the routines that underpin dynamic capabilities are not born from senior managers' cognitive capacity alone (Dosi, Nelson, & Winter, 2000). In fact, *ex ante*, it is almost always impossible for managers to predict exactly what the firm can learn, or how far it can extend its existing capabilities (Pisano, 2017). Other organizational mechanisms are likely at play (Cohen et al., 1996), but with only high-level prescriptive guidance, we cannot deeply understand the routines that underpin dynamic capabilities.

In this paper, we argue that teams play a critical role in shaping the routines that underpin dynamic capabilities.<sup>1</sup> Teams comprise the missing link between senior managers' cognitive abilities and the firm's dynamic capabilities. Strategy scholars generally agree that senior managers must leverage knowledge generated by teams to spur innovation and strategic change, but mention it only in passing (e.g., Eisenhardt & Martin, 2000; Helfat & Raubitschek, 2000; Stadler, Helfat, & Verona, 2013; Teece et al., 1997; Teece, 2009). Indeed, what goes on at the team level has received little attention in the DCF literature, even though firms increasingly rely on teams to innovate and change (Anderson, Potočnik, & Zhou, 2014)—an approach often termed “agile” organizing.<sup>2</sup>

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<sup>1</sup> Following Kozlowski and Ilgen, “teams are (a) two or more individuals who; (b) socially interact; (c) possess one or more common goals; (d) are brought together to perform organizationally relevant tasks; (e) exhibit interdependencies with respect to workflow, goals, and outcomes; (f) have different roles and responsibilities; and (g) are together embedded in an encompassing organizational system, with boundaries and linkages to the broader system context and task environment” (2006: 79).

<sup>2</sup> Management consultants have defined an agile organization as “a network of teams... that operates in rapid learning and fast decision cycles” (Source: Agile Compendium, McKinsey & Co, October 2018).

Teams do not just carry out existing routines, but also actively create new ones. Indeed, learning within teams is a key element of organizational responsiveness to change (Edmondson, Bohmer, & Pisano, 2001; Edmondson, 2002; Senge, 1990). If superior “systems of learning” can secure long-term advantage (Helfat & Raubitschek, 2000), we need to understand them, starting with where and how such learnings take place. Overlooking teams omits a central part of the answer to these key issues (Crossan, Lane, & White, 1999; Huber, 1991).

Teams acquire, process, share, and consolidate knowledge through a set of routines that have been well examined in the organizational behavior literature (Edmondson, Dillon, & Roloff, 2007), and these routines can inform the role of teams from a strategic perspective. Indeed, they represent a realistic, empirically informed account of multi-person action—essential for building useful theory about firms and their routines (Cohen et al., 1996). Capabilities are said to “rest on accumulated learning that can atrophy if not exercised” (Helfat & Campo-Rembado, 2016: 254), and team-learning research can show us the routines involved, where capabilities are manifested, and how they are updated and are made dynamic. Furthermore, by linking with the DCF, we can develop a sophisticated understanding of when certain team-learning routines are most valuable.

This link between team learning and dynamic capabilities is important, because the impact of an activity does not necessarily come only from the *extent* to which it is performed (Stadler et al., 2013); some team-learning routines may generate more valuable knowledge depending on context. We argue that when firms leverage the cognitive abilities of their senior managers together with appropriate team-learning routines, they are positioned to create innovative resource configurations and achieve superior firm performance.

This paper aims to further develop the DCF by complementing two existing perspectives on dynamic capabilities—macro and micro—with a third, meso perspective. We do this by adding

team-learning routines to the managerial cognitive abilities that support sensing, seizing, and reconfiguring. An overview is shown in Figure 1. We draw from the literature on team learning to develop four distinct types of learning based on the orientation (exploration and exploitation) and locus (internal and external) of the learning routine. Specifically, teams can engage in *contextual learning* to gather knowledge on their environment (Ancona & Caldwell, 1992a; Bresman, 2010; Hargadon & Sutton, 1997; Wong, 2004) or *experimental learning* to learn through trial and error (Wheelwright & Clark, 1992; Thomke, 1998; Thomke & Bell, 2001). *Vicarious learning* gathers knowledge from non-members who have had similar experiences in the past (Bresman, 2010; Darr, Argote, & Epple, 1995; Edmondson et al., 2003), while *reflexive learning* allows the team to ponder their work as a group and build a common understanding (Schippers, West, & Dawson, 2015; Edmondson, 1999; Carter & West, 1998). The aim here is to surface how different team-learning routines have varying relevance at different points along the sensing-seizing-reconfiguring pathway.

----- Insert Figure 1 about here -----

Adding a meso-level view to the DCF helps us better understand how dynamic capabilities are enacted. The DCF has always been intentionally general, ranging from generating creative ideas to developing them into products and services, and designing supporting business models (Helfat et al., 2007). Teams encompass a similar range of activities, and even when individuals first propose innovative ideas, firms increasingly rely on teams to develop and implement them (Anderson et al., 2014). Therefore, by complementing the organizational processes of sensing, seizing, and reconfiguring (Teece, 2007) and the associated managerial cognitive abilities (Helfat & Peteraf, 2015), team-learning routines enrich our appreciation of the multilevel nature of dynamic capabilities. Connecting levels of analysis also helps strengthen the DCF's contribution



to our understanding of how firms achieve innovation and strategic change. It takes us a step closer to an operational theory of superior firm performance, and opens up new avenues for cross-boundary research.

## **LEVELS OF ANALYSIS IN THE DYNAMIC CAPABILITIES LITERATURE**

### **Sensing, seizing, and reconfiguring: a macro perspective on dynamic capabilities**

Teece and colleagues drew from the resource-based view of the firm (RBV) (Barney, 1991; Wernerfelt, 1984) to conceptualize the DCF 25 years ago (Teece & Pisano, 1994; Teece et al., 1997). The RBV, in turn, stemmed from Penrose's work (1959) and stressed the significance of resources that are valuable, rare, inimitable, and non-substitutable for explicating superior firm performance. The RBV was criticized for being overly static (e.g., Porter, 1991, 1996; Priem & Butler, 2001)—concerns that the DCF, with its roots in evolutionary economics, was aimed at alleviating (Nelson & Winter, 1982; Schumpeter, 1961). Whereas the RBV did not say how competitive advantage is gained and sustained, the DCF emphasized the development and renewal of (mostly intangible) firm-specific assets that are difficult to imitate. The theory challenged the then-dominant competitive forces approach (Porter, 1980), which was rooted in the structure-conduct-performance paradigm in industrial-organization economics (Mason, 1957; Bain, 1959). The DCF moved the locus of attention from market structure to a firm's ability to integrate, build, and reconfigure internal and external competencies (Teece et al., 1997), emphasizing the importance of the firm's resource base and adapting to and/or shaping the external environment (Helfat et al., 2007; Winter, 2003).

Over time, firms acquire, maintain, and extend their resource base, which fundamentally consists of their knowledge of "how to do things" (Dosi et al., 2000). Firm knowledge accumulates as bundles of routines, or action patterns that are recurring, selectable, and set in an

organizational context (Cohen et al., 1996). Through such bundles, firms can move from intention to outcome in a regular and somewhat predictable manner (Nelson & Winter, 1982). Firm capabilities rest on routines (Helfat et al., 2007; Teece et al., 1997; Winter, 2003) and can be operational or dynamic. Operational capabilities allow clearly delineated activities to be performed reliably; they are necessary, but generally insufficient, to support sustainable competitive advantage in developed economies (Teece, 2014), and merely enable the firm to subsist in the present (Helfat & Winter, 2011).

Dynamic capabilities enable the firm to change how it “makes a living” (Helfat & Winter, 2011). They also rest on reliable patterned behaviors, but they are oriented toward the future. They have been termed “learning routines” because they give rise to new bundles of routines (Cohen et al., 1996). They alter the firm’s operational capabilities and/or its external environment to sustain superior performance (Teece et al., 1997). For instance, a firm may routinely engage in R&D to develop new products (Eisenhardt & Martin, 2000) or processes (Pisano, 1994). It might also pursue acquisitions or joint ventures (Eisenhardt & Martin, 2000), and post-acquisition integration, internationalization, and diversification are also dynamic capabilities (Schilke et al., 2018 for a review).

Importantly, Teece (2007) went on to suggest that dynamic capabilities are enacted within the context of three distinct organizational processes: (1) sensing opportunities, (2) seizing them, and (3) reconfiguring the business organization to profit from them. To understand these processes, scholars have suggested deconstructing them at the micro level of individuals (e.g., Abell, Felin, & Foss, 2008; Barney & Felin, 2013; Felin & Foss, 2005). This has led to the recent focus on the cognitive microfoundations of sensing, seizing, and reconfiguring.

## **The cognitive underpinnings of three organizational processes: a micro perspective on dynamic capabilities**

Most studies on the microfoundations of dynamic capabilities have drawn from the Carnegie School's contributions to the behavioral theory of the firm (Cyert & March, 1963; March & Simon, 1958; Simon, 1960) and the insights from strategy scholars who have built on this theory. For instance, research has shown that myopia can affect firm performance by limiting senior managers' ability to predict the outcomes of radical courses of action (March, 1991; Miller, 1990; Levinthal & March, 1993). This research has highlighted that most managers struggle to adapt their strategic representation (Gavetti & Levinthal, 2000; Tripsas & Gavetti, 2000). As a result, we now have a better understanding of why some firms miss opportunities beyond their direct customer base, or fail to reap their full benefits (Henderson & Clark, 1990).

The strategic agency deployed by *some* managers has helped to explain superior firm performance (for reviews, see Di Stefano, Peteraf, & Verona, 2014; Helfat & Martin, 2015). For instance, Adner and Helfat (2003) matched financial data with data on corporate-level decisions to show that some managers were better at timing downsizing decisions. Smith and Tushman (2005) argued that senior managers need a paradoxical cognition that allows them to pursue exploration and exploitation concurrently. Danneels (2011) showed that senior managers' inability to recognize firm resources and their fungibility can contribute to their firm's demise. Experimental researchers have followed suit by using functional magnetic resonance imaging (fMRI) to identify and contrast the cognitive processes associated with exploitation and exploration decisions (Laureiro-Martínez et al., 2015). Others have set up card games in which a sudden change of goal gives rise to observable characteristic qualities related to dynamic capabilities (Wollersheim & Heimeriks, 2016).

Recently, Helfat and Peteraf (2015) have explored the managerial cognitive abilities that underpin the processes of dynamic capabilities: perception and attention (sensing); problem-solving and reasoning (seizing); and communication and social skills (reconfiguring). They focused on senior managers' treatment of information; their thinking dispositions; and their aptitude for perceiving resistance and persuading others. While valuable, this approach remains centered on individual managers, and tells us less about the source of routines in firms—or, as we argue, the team-level underpinnings of dynamic capabilities.

### **Team learning: toward a meso perspective on dynamic capabilities**

Considering the underpinnings of dynamic capabilities in a socially embedded context can deliver valuable insights. After all, the DCF has a strong multilateral flavor (Teece et al., 1997; Helfat et al., 2007), and managerial work is essentially social (Kotter, 1982; Mintzberg, 1973). Because they constitute the fundamental mechanism by which firms learn (Edmondson, 2002), teams and their routines are crucial to understanding the sources of superior firm performance.

We build on the argument that competitive advantage lies in learning mechanisms that are fundamentally social and collective. Knowledge is developed throughout the firm with the purpose of doing useful things, and sometimes transforming what is done, or how (Nelson & Winter, 1982; Helfat & Winter, 2011; Pisano, 1996, 2000). Activities may take place on the factory floor, in the R&D lab, or in the boardroom, and all must be integrated, because interlocking activities of multiple participants are at the heart of innovation and strategic change (Teece & Pisano, 1994; Teece et al., 1997). This is why strategic change is difficult, costly, and usually incremental (Dosi et al., 2000). It requires coordinated actions by multiple specialized teams that address parts of a larger enterprise (Martin, 2011). Therefore, we argue that theoretical advances can be made if we consider the set of reliable patterned behaviors in work

teams that generate the knowledge that supports the processes of sensing, seizing, and reconfiguring. These advances can inform senior managers who must design, staff, and coach (henceforth “build”) teams that collectively encompass much of the expertise needed to make innovation and strategic change a reality.

## **A TYPOLOGY OF TEAM-LEARNING ROUTINES**

Industrial and organizational psychologists developing management scholarship began to focus explicitly on team learning in the early 1990s (Senge, 1990), and research on the topic has expanded substantially over time (see Edmondson et al., 2007 for a review). This interest has been largely driven by the notion that team learning plays a key role in firms’ capacity to change (Edmondson, 2002). Early research established team learning as a meaningful construct (e.g., Edmondson, 1999) to counter prior arguments that learning was only meaningful at the individual level (e.g., Hunt, 1968). Later research provided conceptual and empirical support (e.g., Bunderson & Sutcliffe, 2003). Conceptually, it is important to note that team-learning routines are more than just individual team members learning; they include and support building a shared understanding of the work group’s goals and means, or its environment. Learning, therefore, involves not only enhancing individual knowledge and skill sets, but most importantly involves patterns of interpersonal interactions within and between teams that enhance shared, or collective, knowledge and skills.

Team-learning routines have largely been studied outside strategy scholarship, but they can be linked to the research on routines for communication and coordination as the basis for dynamic capabilities (Nelson & Winter, 1982; Teece et al., 1997; Winter, 2003). Such routines are needed to develop and transfer knowledge throughout the firm, enabling it to learn and adapt (Henderson, 1994; Iansiti and Clark, 1994; Pisano, 1994; Wheelwright and Clark 1992). Strategy

research has shown the importance of such routines for superior firm performance (e.g., Helfat & Campo-Rambado, 2016), but team-level interactions have been left untouched as “complex patterns of interactions” (Grant, 1996: 115), and remain a black box for strategy scholars today (Zahra, Neubaum, & Hayton, 2020). Ongoing communication across hierarchical boundaries, for instance, has been identified as a crucial way for firms to learn (Helfat & Raubitschek, 2000; Monteverde, 1995; Srikanth & Puranam, 2014), but what should be communicated has seldom been considered in the DCF literature. Team-learning research can be particularly useful here, enabling us to go deeper “under the hood” to understand what underpins dynamic capabilities, or the bundle of routines used for communication and coordination (Winter, 2003). Strategy scholars have emphasized the importance of sharing relevant knowledge in a network of actors, and aligning activities dynamically throughout innovation and strategic change. To do so, they have argued that “teams must learn who to talk to, [and] for which purposes” (Helfat & Campo-Rambado, 2016: 254). Considering team-learning routines in association with managerial cognitive abilities could provide much-needed guidance for firms that must invest their limited resources to leverage routines for communication and coordination.

### **Team learning**

Definitions and views of team-level learning are heterogeneous and still evolving, and encompass at least three separate streams of research. Social psychologists have looked at how members of small teams coordinate their actions to accomplish interdependent tasks (e.g., Liang, Moreland, & Argote, 1995). Team learning, in this stream, is about encoding, storing, retrieving, and communicating knowledge (Wilson, Goodman, & Cronin, 2007), and studies have consistently found that teams do better when members know what each other knows. A second stream of team-learning research originates in classic work on learning curves in manufacturing

and service operations. This work traces its roots to Wright's (1936) finding that the cost of a produced unit decreases with experience. A robust result across this literature is that cumulative experience is associated with performance improvement (e.g., Pisano, Bohmer, & Edmondson, 2001). Finally, a third stream conceptualizes team learning as a process rather than an outcome, defining it as the activities through which a team obtains, processes, and develops knowledge that allows it to solve problems, improve, and change (e.g., Edmondson, 1999). Building on research on organizational learning and team effectiveness, empirical studies in this stream tend to focus on real teams in real organizational settings, and to rely on both quantitative and qualitative data (e.g., Bresman, 2010, 2013).

This third stream—with its focus on mapping and measuring learning as team-level activities, across diverse firms and task contexts—holds most promise for increasing our understanding of the underpinnings of dynamic capabilities. It highlights heterogeneity in the learning that teams can achieve in certain task contexts, or in order to reap certain benefits. Some scholars have begun to look in greater depth at many learning routines of different kinds. Edmondson (2002) has suggested that team learning is a variegated construct, and others have similarly argued for a finer-grained conceptualization (Argote, Gruenfeld, & Naquin, 2001).

Generally, the literature has distinguished between internal and external team learning (e.g., Bresman & Zellmer-Bruhn, 2013). This refers to whether learning occurs within the team (that is, is carried out by team members in interactions with each other) or across the boundary between the team and its environment (carried out by team members interacting with non-members). Wong (2004) demonstrated empirically that internal and external learning are distinct, and have contradictory effects on some team outcomes: external learning drives team innovativeness, while internal learning drives group efficiency.

Others, however, have found that internal learning is related to creativity and innovation outcomes (e.g., Thomke, 2003), which leads us to the important point that team learning can be centered on exploration or exploitation (Edmondson, 2002). The former is generally about producing creative insights or developing new things, while the latter is usually related to knowledge integration and doing things better or more efficiently. As illustrated in our theory, these two types of learning do not operate independently, and can build on each other to produce positive outcomes. More recently, Bresman (2010) suggested and validated a model with two types of external learning (contextual and vicarious) that are also closely linked to exploration and exploitation. This research provided empirical support for the existence and value of learning from others' experience, and demonstrated the discriminant validity of such vicarious learning as a team-learning construct, distinct from contextual learning.

Drawing from previous studies, we suggest that internal team-learning routines can be either *reflexive* or *experimental*, while external ones can be either *contextual* or *vicarious*. Although other, finer-grained distinctions are possible, we believe that these four types provide a logical and parsimonious set, given our purpose of enriching the understanding of dynamic capabilities. Particular cognitive abilities of senior managers support the sensing, seizing, and reconfiguring processes depicted in the DCF. In successful firms, we argue, particular team-learning routines are similarly more strongly associated with certain processes. The types of team-learning routine are described below and summarized in Table 1.

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### **Reflexive learning**

The view of teams as information-processing systems has highlighted internal, exploitation-oriented activities such as sharing, analyzing, storing, and using information in carrying out team tasks (Hinsz, Tindale, & Vollrath, 1997). Such *reflexive learning* allows teams to develop



optimal routines that ultimately make their firm more proficient (Edmondson, 2002; Schippers, Edmondson, & West, 2014). Specifically, teams that engage in reflexive learning usually experience efficiency gains because they evaluate past actions and performance, and adapt or create routines to improve future functioning (West, 1996). In other words, task feedback gives teams the opportunity to regulate themselves (DeShon et al., 2004) and update routines in meaningful ways (cf. Gersick & Hackman, 1990). Teams that are likely to engage in such learning include high-performing middle-management teams, internal services teams, and production teams. Such teams can better self-assess performance, diagnose quality problems, and implement changes (Edmondson, 2002).

Of course, reflexive learning is not a given for every team (see Konradt et al., 2016 for a review). For instance, if teams are busy or accustomed to routine (Gersick & Hackman 1990), reflexive learning may simply not occur. If their *modus operandi* is never examined, teams may leave work practices unimproved, or have trouble mastering new tasks.

### **Experimental learning**

*Experimental learning* is also internal, but more geared towards exploration. It allows teams to learn based on their members' direct experiences of working together on problems through experimentation and trial and error, such as when they develop digital mock-ups, carry out computer simulations, or build physical prototypes (Wheelwright & Clark, 1992). By engaging in such activities, teams generate new insights into problems where outcomes are uncertain and critical information is lacking (Thomke, 1998). Experimental learning lets teams assess the feasibility of their ideas and reveal problems. Indeed, it actively increases the team's chances of failure and recovery early on (Cannon & Edmondson, 2005), ultimately achieving better performance as a result (e.g., Thomke & Bell, 2001). R&D labs and new product development

units are filled with teams that test new concepts and must learn experimentally (Edmondson, 2002). Such teams often target high failure rates as an indication of sufficient risk-taking and novelty to spur experimental learning (Thomke, 2003). Several studies have shown its positive effect on exploration-related outputs such as creativity and innovativeness (e.g., Vera & Crossan, 2005).

Experimental learning does not come naturally to many teams. Engaging in trial-and-error experimentation is particularly difficult when the risk of failure is high and team members feel their actions and contributions are being scrutinized or evaluated (Lee et al., 2004). In many firms today, an intense demand for quick execution and stellar results may create conditions that are detrimental to leveraging this team-learning routine.

### **Contextual learning**

The earliest studies on external learning can be found in the research on boundary spanning. Starting with the work of Allen and colleagues (e.g., Allen, 1970, 1977; Allen & Cohen, 1969), researchers have focused on the amount of information exchanged between teams and their environment. Further research showed the need to match information-processing capacity to the demands of the environment (Tushman & Nadler, 1979), and the importance of boundary roles (Allen, 1977; Tushman, 1977). In line with this research, Ancona (1990) found that teams that engage most with their external environment perform better. Yet, such external, exploration-oriented learning is associated with team members' role overload, which makes it difficult for teams to benefit from these activities over time (Marrone, Tesluk, & Carson, 2007).

Ancona and Caldwell's (1992a) work on what team members actually do when spanning boundaries greatly helps our understanding of *contextual learning* (cf. Bresman, 2010). They showed that teams engage in "general scanning for ideas and information about the competition,

the market, or the technology” (1992a: 641). This type of learning is particularly relevant to senior management and new product development teams (Edmondson, 2002). Scanning reveals knowledge that can be recombined with existing knowledge to generate innovative ideas (Sutton & Hargadon, 1996). Previously unrelated technological components can be combined to open up new business opportunities (e.g., Hargadon & Sutton, 1997). As a result, teams that engage most in contextual learning have been shown to be more innovative (Ancona & Caldwell, 1992b).

### **Vicarious learning**

*Vicarious learning* is mainly exploitation-oriented, and has its roots in the knowledge-based theory of the firm (e.g., Kogut & Zander, 1992) and work on learning curves (e.g., Epple, Argote, & Devadas, 1991). Though these studies did not explicate any behavioral underpinnings, they showed that learning transferred between groups within firms affects performance. Darr et al. (1995), for example, investigated pizza stores with clear team characteristics, and found that unit costs improved with experience. However, stores that were part of a franchise chain showed a higher rate of improvement, due to shared learning across branches. Thus, organizational subunits and work teams may learn from each other based on similar experiences (see also von Hippel & Tyre, 1995).

Correspondingly, research has shown that teams can learn from the experience of similar teams in other firms, such that later adopters of a new technology or process can progress faster (on some dimensions) than earlier adopters (Edmondson et al., 2003). In a study of pharmaceutical drug development, teams substantially improved performance by identifying and learning from teams that had carried out similar projects in the past (Bresman, 2010, 2013). Learning from other teams’ similar experiences involved such behaviors as identifying

experienced others and inviting them to talk about what had and had not worked for them, and drawing applicable lessons.

## **MANAGERIAL COGNITIVE ABILITIES, TEAM-LEARNING ROUTINES, AND DYNAMIC CAPABILITIES**

Next, we integrate the existing macro (Teece, 2007) and micro perspectives (Helfat & Peteraf, 2015) with a meso approach rooted in team learning routines. We argue that team-learning routines provide a crucial link between the individual-level cognitive abilities of senior managers and the organization-level dynamic capabilities of sensing, seizing, and reconfiguring to support superior firm performance. Specifically, guided by managerial cognitive abilities, team-learning routines generate the knowledge needed to enact the sensing, seizing, and reconfiguring processes effectively. This is well illustrated by the story of the Sony PlayStation®.<sup>3</sup>

### **The story of PlayStation**

*Sensing.* Sony engineer Ken Kutaragi had always been curious about videogames and marketing new technologies. In 1984, he ran into a team of engineers at the Sony Information Processing Research Institute that included Akio Oba and Masaaki Oka. They had come up with System G, a 3D software engine. Around the same time, Kutaragi also hung out with teams of designers studying the future potential of computer graphics. These teams also engaged with engineering groups inside and outside Sony, who were interested in worldwide trends in the semiconductor industry. Based on his various relationships, Kutaragi sensed that shifting trends in semiconductor prices, the pace of technological progress, and Sony's work on 3D technology

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<sup>3</sup> As suggested by Glaser and Strauss, "the researcher needs only to discover the voices in the library to release them for his analytic use" (1967: 163). In addition to several other sources from the popular press, the information presented here comes from the work of Asakura (2000), which is based on many hours of interviews with executives, engineers, and other professionals at Sony, and from other companies in the games industry. The description is not presented as an accurate case study. Rather, it is a story we use to help illustrate our theoretical perspective.

together opened up a major opportunity in videogames: a paradigm shift from two-dimensional to three-dimensional game worlds.

In 1988, Kutaragi set up a team to collaborate with Nintendo on a CD-ROM peripheral for the cartridge-based Super Nintendo Entertainment System. The team gained valuable insider information about the games industry's distribution and inventory woes. Many problems stemmed from the limitations of mask ROM (i.e., removable cartridges) as a distribution medium. Mask ROMs were extremely slow to produce—two-month lead times were typical—which meant that while high-quality titles were often in short supply, repeat production was unviable. Software houses whose titles sold out sometimes found that by the time stock was replenished, gamers' interest had moved on.

Users, for their part, liked mask ROM's access speed—but the benefits ended there. Its high production cost, plus the OEM fee of \$30 payable to Nintendo on every copy sold, pushed unit retail prices up towards \$100. On top of that, Nintendo's strategy was to increase prices over time as it released new consoles. If gamers wanted fun, they had to pay.

It became clear to Kutaragi that the industry needed to ditch cartridges and move to cheaper and higher-capacity CD-ROMs. The Sony-Nintendo alliance held great promise, but in 1991, Nintendo abruptly dumped Sony for Philips, its greatest rival. Sony President Norio Ohga was so incensed by this betrayal that he put his full weight behind Kutaragi's venture, urging him to develop a console beyond anything Nintendo had produced. To do so, Kutaragi would have to grapple with a fiendish problem: developing a product that was technologically advanced yet reasonably priced for mass production, and designing a business model that would allow for scalable and repeatable sales, thus sustaining profitability and customer satisfaction. In search of the answers, he turned to several teams in the fields of hardware, software, and entertainment.

*Seizing.* Kutaragi assembled teams to develop the PlayStation's hardware, beginning with 3D innovators Oba and Oka. PlayStation inherited many advanced techniques from System G, but the main challenge lay in incorporating them into hardware that could offer the speed and responsiveness of a home gaming console—without costing the earth.

Kutaragi had always taken a long-term view of technology; in 1985, he had foreseen a console release in 10 years. As his teams' development work began in earnest, their feedback convinced him that the next three years would deliver an eightfold improvement in processor performance, and he built such projections into his plans. At the time, consoles used a mix of general-purpose microprocessors and customized chips. But as his teams tested various options, Kutaragi recognized that PlayStation would run too slowly with this method, so he opted for 100% customized chips—truly radical for the 1990s.

The design of the console and its interface fell to a team led by Teiyu Gotoh. The touchstones were simplicity and ease of manufacture, which would be essential to achieving volume production. All members of the PlayStation team were based at the same site and mixed with each other constantly, making it easy for them to understand each other's needs. For instance, Gotoh often visited the production floor with his team, where they would discuss design with engineers. When told that his design was not technically feasible, he invited designers and engineers to keep working together to find out how his concept could be achieved in a way that could improve overall productivity. When ideas were hard to express, designers relied on sketches and prototypes, while engineers produced demos.

Unlike Sony's conventional appliance business, which depended on direct profits from hardware sales, videogames allowed profits to be made from sales of software as well as consoles. Because of this, Kutaragi decided that all development work for the PlayStation would

take place at Sony Music, which had much in common with videogames in terms of its commercial setup and distribution channels. Key contributions from this source included an artist-management mindset that helped the team deal with game developers and publishers, and recruit developers very early on. Unlike its rival Sega, Sony depended on third parties for software supply. If they didn't commit to the new console, it would be game over.

If Sony followed Nintendo in adopting mask ROM for its new console, it would have to replicate a similar distribution structure, and suffer all the same problems. Kutaragi's teams had to build a system that meant developers could make money, retailers could forecast sales, and users could afford the product. With the CD-ROM, they could transplant a music-industry business model into the world of games: small-lot production of a large range, with quick response to demand and accurate predictions of sales volume. In the distribution system they came up with, called "purchase for resale," Sony itself would act as a wholesaler, purchasing products from software houses for direct sale to retailers and taking on responsibility for setting production volumes and optimizing inventory.

***Reconfiguring.*** Kutaragi could draw on Sony Music's knowledge of how to manufacture, market, and distribute optical digital discs. As in the music world, CD-ROM production was flexible enough to respond to the market: the master copy could be delivered just one month before the release date, and replenishing stock took only three days. Retailers received their order the following day if a title was in stock, or within six days if it wasn't. The feedback that PlayStation teams received from retailers enabled Kutaragi and executives to know what was happening in-store. This was important because there was no guarantee that everyone in the distribution chain would work the way Sony needed them to. Software developers also had to change their marketing approach. Kutaragi invited team members to provide developers with

concrete examples of what replenishing stock for a particular software title would mean, given manufacturing schedules. Given the feedback they received, they realized the market was so time-sensitive that games would have to take priority over music.

Once PlayStation hit the market, the main aim was to maximize the number of titles developers produced. Taking its cue from Sony Music's reverence towards its artists, the PlayStation teams put game developers at the center of their thinking. To motivate them to produce more games more quickly, they set up a creator-friendly environment and developed a software library in-house. This saved developers' teams from having to produce every line of code from scratch, so they had more time for creative thinking. The library aimed to support all game development teams equally, but not all developers welcomed it. They preferred to code everything themselves, even if it meant more work, so they could own and resolve every issue.

On a technical level, existing consoles had allowed game development teams to issue instructions to the hardware directly, but PlayStation was too complex for that. To ensure compatibility, its operating system and device drivers had to act as a bridge, or perhaps a barrier, between game developers' code and the hardware. This frustrated game development teams, who felt it was holding them back and making their games run too slowly.

All this came as a surprise to the PlayStation team, which hadn't worked with game developers before. Nevertheless, the team continued to argue for the benefits of the library, citing the growth in PC software following the release of Windows. Pondering over such pushback, the team came to the realization that a "performance analyzer" was needed to show game development teams how much of the PlayStation's computing power their software was actually using—even long into the 1990s, few titles came close to utilizing it all. Little by little, developers came round to the idea, even admitting that their work was quicker and easier thanks



to the library. Indeed, it was the library that allowed Namco to bring *Ridge Racer* from the arcade to the PlayStation in under a year—an achievement that figured strongly in the story Kutaragi told to potential developers, senior Sony managers, and other stakeholders.

Eventually, Sony acquired game developer company Psygnosis, based on the studio's impressive work with 3D graphics. Following this deal, people from both companies slowly started to familiarize themselves with each other's perspectives. Sony didn't assert full control right away, as the PlayStation teams also needed to learn from Psygnosis's experience of developing, selling, and distributing games. For its part, Psygnosis had to learn to create games with a much stronger financial backbone, and to deal with the associated pressure and control from its new owners.

By the late 1990s, PlayStation was gaining a lot of traction. Sega, meanwhile, failed to learn from Sony's distribution innovations, and its persistence with the wholesaler approach was the main cause of the Sega Saturn's failure. By 1997 PlayStation accounted for 22 per cent of Sony's consolidated operating profit—more than any other Sony business unit, and an unprecedented success, even for Sony. By then, strong relationships were being forged in the U.S. with Wal-Mart, K-mart, Toys-R-Us, and Sears. This ensured that as sales in Japan began to slow, the U.S. and European markets continued to deliver strong growth.

In sum, the story of the Sony PlayStation illustrates the significance of the team-learning routines as they interact with managerial cognitive abilities throughout the sensing, seizing, and reconfiguring processes. The senior manager, Kutaragi, was at the center of a network of teams that supported him at those different stages, and the learning routines (reflexive, experimental, contextual, and vicarious) in which they engaged varied accordingly. We now elaborate on how these concepts interrelate as they enable innovation and strategic change.

### **Team-learning routines that underpin sensing**

Perception and attention are at the heart of the managerial cognitive abilities that allow firms to sense opportunities as they arise and anticipate competitive threats. Drawing from Helfat and Peteraf (2015), perception relates to managers' ability to make sense of a fuzzy environment, while attention refers to the ability to remain alert and open to discoveries. We argue that contextual and experimental learning in teams are the team-learning routines guided by these managerial cognitive abilities in support of the sensing process.

Ken Kutaragi drew from knowledge generated by several teams, in several areas—the future of computer graphics, worldwide trends in the semiconductor industry, and the 3D engine developed at a research lab. In the same way, senior managers must build teams that engage in both contextual and experimental learning in order to fuel their cognitive abilities, if the firm is to sense new opportunities. The knowledge gained from contextual and experimental learning can give rise to new options for the firm, or it can help to firm up potential new options that senior managers have already identified, but must learn more about before they commit to them (Helfat & Raubitschek, 2000).

Team contextual learning helps keep senior managers in step with their surroundings. Most importantly, it allows them to fill “structural holes” (Burt, 1992)—loci at which discrete domains' non-redundant fragments of knowledge are blended together. The knowledge domains of videogames, business, hardware, and digital engineering were diverse but complementary, and spanning the boundaries between them sparked Kutaragi's big idea. To generate such knowledge, teams may attend trade fairs and shows, or collaborate with university research centers. They may interview current and prospective customers, or research the market using other methods, such as big data analysis and ethnographic work (e.g., von Hippel, 1986).

Sourcing new knowledge in this way may provide a clearer, fuller picture of the environment, and further fuel senior managers' cognition in the generation, evaluation, and selection of creative insights for the business.

Team experimental learning also enables the generation of knowledge in service of the managerial cognitive abilities at the heart of the sensing process. Teams that tinker with new possibilities and explore untested ideas generate knowledge that is not always readily available via market exchanges. 3M, for example, is famous for profiting from team experimental learning (e.g., von Hippel, Thomke, & Sonnack, 1999). Its teams' many discoveries, famously including the Post-It Note and its many derivative products, direct managers' attention towards particular opportunities that they can scrutinize further, and potentially invest resources in order to seize.

When sensing new opportunities, vicarious and reflexive learning are not strong options. No models are available to learn from, and no particular plan has yet been laid out. Contextual and experimental learning, however, are critical (Wheelwright & Clark, 1992)—but both are required in combination. If teams over-emphasize experimental learning, the firm may produce a flawless technology, but it may be the wrong one—a solution without a problem. Conversely, if teams only engage in contextual learning, senior managers may focus on the right technology, but the firm may struggle to produce a functional design later on (Pisano, 1994). Therefore, we posit that:

***Proposition 1:*** *Firms with senior managers who build teams to prioritize contextual learning and experimental learning when performing the sensing process are likely to be more effective than firms with senior managers who build teams to prioritize other team-learning routines, or who do not prioritize among team-learning routines.*

### **Team-learning routines that underpin seizing**

Firms exploring uncharted territory characterize the seizing process (Pisano, 2017). If a firm aims at developing an innovative product, for example, few technical parameters will have been

defined and tested yet, and the firm will have to rely heavily on trial and error to push the technology forward. The managerial cognitive abilities most appropriate to this context are problem-solving and reasoning (Helfat & Peteraf, 2015), and we argue that experimental and vicarious learning in teams form the team-learning routines that promote their translation into organizational capabilities.

Solving problems generally involves designing and testing several alternatives. Teams that engage in experimental learning are well placed to lead these tests, so that their outcomes can be analyzed and used to revise and refine the solutions under development. Progress is made iteratively toward an acceptable solution (e.g., Pisano, 1996). Even when a solution path has been identified, it is common for senior managers to encounter unforeseen or changing requirements. Like Kutaragi's on microprocessors, senior managers may prefer one alternative at the outset of the seizing process, but their preference may evolve as the supporting teams involved engage in experimental learning. When teams hold off experimental learning, senior managers have less to base their reasoning on, and thus firms going through the seizing process run the risk of discovering that costly and time-consuming changes are needed later on during the reconfiguring process (i.e., functionality or manufacturability) (Thomke & Fujimoto, 2000).

Furthermore, seizing opportunities is not just a matter of developing a technologically advanced product or service. It must also be supported by an adequate business model; for instance, using a set of resources for activities that ultimately make the product or service reasonably priced, hence allowing for scalable and repeatable sales and sustaining profitability and customer satisfaction (Teece, 2010). Experimental learning is at also at the heart of this endeavor (cf. the Lean start-up methodology described by Ries, 2011).

Teams must also engage intensively in vicarious learning during seizing. As the firm moves through the seizing process, the collective knowledge associated with the task context will broaden and deepen. While this enables senior managers to operate at higher levels of competence, it also presents them with a more competitive environment. For example, as parameters become progressively better defined, an increasing number of competing firms engage in the development of a similar product or service. The room for error in trial-and-error goes down, and the cost of reinventing the wheel goes up. To meet these challenges, senior managers must build teams that can access knowledge about key aspects of the task from the prior experience or concurrent similar experiences of others outside the project boundary (Bresman, 2010, 2013). These teams may observe other teams as they test a product, or gather data about how other teams have completed certain activities in the past (see Cusumano & Selby, 1998 on the use of postmortems at Microsoft). Prior innovation endeavors will typically have generated knowledge that can be leveraged in current projects—every actor in the value chain may have developed knowledge that can be useful (e.g., Dyer & Hatch, 2006). By learning from others' experience of leading innovation projects, teams help the firm to avoid past mistakes or skip unnecessary steps (von Hippel & Tyre, 1995). Doing so has been found to improve product-development performance (Adler, 1995; Thomke & Fujimoto, 2000).

Teams involved in the seizing process may benefit from engaging in contextual or reflexive learning, but we argue that concentrating efforts on either of these two types of learning routines has detrimental effects. Knowledge generated through team contextual learning may help senior managers identify a range of technological options. Yet the heart of the work during the seizing process is integrating these various options with the application context, which relies mostly on experimental and vicarious learning (Iansiti, 1997; Wheelwright & Clark, 1992). Similarly,

reflexive learning may also be useful, but only to a certain extent. If supporting teams spend a lot of time reflecting together at the onset of the seizing process, they may develop a view of their goal, or the methods required to achieve it, that is clear but rigid. They then risk engaging in confirmatory experimentation and limiting their knowledge search to their early interpretation, instead of exploring a wide range of potential solutions or welcoming diverse knowledge inputs (De Dreu, 2002; Janis, 1972). Therefore, we posit:

***Proposition 2:*** *Firms with senior managers who build teams to prioritize experimental learning and vicarious learning when performing the seizing process are likely to be more effective than firms with senior managers who build teams to prioritize other team-learning routines, or who do not prioritize among team-learning routines.*

### **Team-learning routines that underpin reconfiguring**

Reconfiguring is about reaping the long-term benefits of the innovation by enhancing, combining, or transforming assets in ways that can generate rents. According to Helfat and Peteraf (2015), the managerial cognitive abilities that are key to this process are related to the use of communication to engage interdependent parties and social cognition to help deal with resistance to change. Orchestrating assets involves implementing new operational routines or transforming existing ones, and honing them to reach maximum efficiency and sustain growth and profitability (Teece, 2007). Such routines may include technical specifications and a complete set of standard operating procedures to monitor and control production and manufacturing activities (Pisano, 1994). Because routines are patterns of interactions, their implementation is always a collective endeavor (Becker, 2004; Dosi et al., 2000). Therefore, we argue that reflexive learning and vicarious learning in teams are the team-learning routines that can best leverage managerial cognitive abilities in support of the reconfiguration process.

Transforming operational routines can be quite challenging, because not everyone is interested in changing the system in place (Van Maanen & Barley, 1984). Even if a new product

concept wins rave reviews and garners executive support, it still must survive numerous downstream choices by other groups in engineering, production, and sales. Each step is an occasion for the opportunity to be hijacked by these other groups' priorities, or retreat from the uncertain ground of radical innovation to the safety of incremental change. Sales teams, for instance, usually believe good profits can be sustained simply by using existing technology to make existing products a bit better and faster (Christensen & Bower, 1996). Given the large number of activities that exist in firms, and their distance from senior management, reconfiguring can be hampered by a shallow understanding between senior managers and the teams involved in asset orchestration. Senior managers who nurture teams with the capacity to empathize with various stakeholders throughout the reconfiguring process can better leverage their cognitive abilities in service of strategic change.

External downstream parties such as suppliers and distribution partners can also influence the reconfiguring process. For instance, component manufacturers may be unwilling to collaborate, making it harder to develop a new design. In the PlayStation story, game developers and retailers were good examples of significant external players. The technical and commercial insights acquired by Kuturagi's teams facilitated engagement with developers, and supported the social craftsmanship that eventually merged divergent expectations and enabled Sony to reach positive common ground.

Team vicarious learning is crucial because operational routines cannot be designed *a priori*, in a top-down manner, or framed independently of practice (Beer, Eisenstat, & Spector, 1993). Barley (1986) illustrated these dynamics well in his ethnographic study of introducing CT scanners to radiology departments: The roles and responsibilities of the various teams involved evolved over time into an emergent, negotiated division of labor. Team vicarious learning

supported the regular boundary-spanning exchanges and, consequently, facilitated the forging of new interaction patterns (see also Edmondson et al., 2001). Throughout this process, vicarious learning in teams may generate knowledge that helps carry managers' approach to the various groups' own practices and interests, sometimes unraveling misunderstandings regarding their respective constraints. As interests become shared across groups, senior managers' messages may then become a springboard for the firm to embrace innovation and strategic change.

Team reflexive learning also gains in importance as senior managers focus on orchestrating assets. Issues of product/service quality and cost are central to the reconfiguring process (Teece, 2007). Through careful and diligent reflection on their ways of doing things, supporting teams can better grasp how routines should evolve. This team-learning routine enables error detection and correction, improves collective understanding of an interdependent task, and helps reveal unexpected consequences of previous actions (Schippers et al., 2014). The knowledge generated may thus inform senior managers' communication, and more importantly help to implement successful change by facilitating the emergence of new operational routines, and reducing variability and uncertainty. Over time, senior managers, in relationship with such teams, see their strategic plans more easily transformed into optimal resource configurations that make the firm more efficient.

On the other hand, when senior managers do not rely on reflexive learning teams, their communications are more likely to lead to confusion or misunderstanding, which makes it difficult for those participating in reconfiguration to process new information. Difficulties tend to stay hidden if the supporting teams remain passive and "wait to see what happens" (Moreland & Levine, 1992).



Together, vicarious and reflexive learning allow senior managers and their teams to develop “transactive memory systems” (TMSs) (Wegner, 1987). The TMS concept refers to the notion that people in continuing work relationships develop specialized roles or divisions of labor with respect to the encoding, storage, and retrieval of information from different substantive domains (see Srikanth & Puranam, 2014). An implication is that multi-team systems—such as the ones at play during reconfiguring—whose participants know what other participants know, thus having a well-developed TMS, perform better in interdependent tasks (Argote & Ren, 2012).

Research looking into change implementation among distinct types of team learning in medical teams has identified “learning-what” (similar to contextual and experimental learning) and “learning-how” (similar to vicarious and reflexive learning), and found that only learning-how predicted implementation success in neonatal intensive care improvement teams (Tucker, Nembhard, & Edmondson, 2007). Because technology trends, customer preferences, and competitor offerings may shift during the course of a project, it is important to match a technology to its external market. Therefore, teams that engage continuously in contextual learning can still support senior managers, and thus impact firm performance. Similarly, even in pursuit of efficiency gains, small improvements won through experimental learning can have positive implications. On the whole, however, concentrating efforts on contextual or experimental learning during the reconfiguring process would eventually result in a mismatch. It would waste resources in a task context where most knowledge about the environment or the technology has already been developed, and now needs to be leveraged. Therefore, we posit:

***Proposition 3:*** *Firms with senior managers who build teams to prioritize vicarious learning and reflexive learning when performing the reconfiguring process are likely to be more effective than firms with senior managers who build teams to prioritize other team-learning routines, or who do not prioritize among team-learning routines.*

Building on Helfat and Peteraf's (2015) micro-level analysis that particular cognitive abilities have the greatest benefits when firms perform one of the three processes of sensing, seizing, and reconfiguring, each of our propositions focuses on how a set of team-learning routines helps translate senior managers' efforts to the firm level. In other words, we expect the types of team-learning routines to vary in relative importance depending on the process in which the firm is engaged. We argue, therefore, that undifferentiated (or one-size-fits-all) models of team learning are inadequate. This is not to say that a given firm would not benefit from the other types of learning routines in teams; rather, we suggest that one specific set of learning routines will be most valuable for any one process. Given limited time and resources, teams should thus emphasize this set over the others.

## **DISCUSSION**

Our model proposes that teams must enact a variety of learning routines for firms to achieve and sustain superior performance. Drawing from team-learning research, we shed light on the reliable patterned behaviors that form learning routines in firms and underpin organizational capabilities. We integrate them with the DCF by describing how they contribute to the organizational processes of sensing, seizing, and reconfiguring (Teece, 2007). Prior research has examined how senior managers allocate resources among exploratory and exploitative innovation project teams (e.g., Smith & Tushman, 2005), or how the learning that occurs on different teams located in a same firm may support incremental change or radical innovation (e.g., Edmondson, 2002). However, team learning has yet to be associated with the three core processes that underlie dynamic capabilities (sensing, seizing, and reconfiguring). Given that the superior performance of the firm and the learning that occurs in its teams are closely linked (Senge, 1990),

understanding how team-learning routines enable the firm's sensing, seizing, and reconfiguring processes is an important area for furthering our understanding of dynamic capabilities.

Our model also takes a first step towards better understanding the connection between the cognitive abilities of senior managers described by Helfat and Peteraf (2015) and the learning that occurs in teams charged with executing those senior managers' strategies. Such "execution as learning" is increasingly the reality of firms facing fast-changing environments (Edmondson, 2012), and team-learning routines provide the missing link between managerial cognition and organizational capabilities. The interplay between senior managers' cognitive abilities and the knowledge generated by teams carrying out different kinds of learning routines promotes strategic foresight and managerial awareness (sensing); supports inquiry and problem-solving (seizing); and facilitates common understanding and continuous improvement (reconfiguring). While senior managers need to master analytical systems and make good decisions about commercialization and investment, as well as orchestrate resource arrangements that help generate rents, they must also design, staff, and coach teams that engage in reliable patterned behaviors that are conducive to their own activities. Developing such understanding places significant demands on both researchers and practitioners, because it requires a detailed picture of what lies at the foundations of superior firm performance, thus highlighting expertise shortages that are multifaceted and hence difficult to tackle. We hope that our work will provide clarity, promote dialogue, and encourage new research directions that further examine how senior managers and teams *together* enable innovation and strategic change in firms.

### **Theoretical implications**

Integrating team-learning research with the DCF allows us to make important contributions to the theory. Fundamentally, it allows us to make a compelling argument for considering teams as

the repositories of routines in firms. This question has been at the center of evolutionary economics for decades (Cohen et al., 1996; Dosi et al., 2000), but the location of routines, and the mechanics behind their evolution, have largely remained a black box. The organizational behavior literature on team learning enables a fine-grained understanding of this important phenomenon. It is particularly important in the context of the DCF, which has its roots in evolutionary economics (Teece & Pisano, 1994; Teece et al., 1997). It is largely accepted that routines underpin organizational capabilities (Helfat & Peteraf, 2011; Winter, 2003), so understanding their manifestation is of the utmost importance. We show that teams are not only a product of routines, but that teams also themselves create, select, and update routines in firms. We can thus better understand the mechanics behind the sensing, seizing, and reconfiguring processes presented in Teece (2007).

A further contribution is our proposition that different team-learning routines serve different purposes in cultivating dynamic capabilities depending on the process that they underpin. This gives a truly strategic perspective on team learning, and helps answer some of the most recent critiques of the DCF. Indeed, Pisano (2017) has recently warned that the DCF will lose some of its strategic flavor if future theory does not acknowledge tradeoffs, which are key to strategic scholarship. Over the years, the DCF has emphasized learning as a recipe for superior firm performance, suggested that firms must learn to survive, and held that more learning is always better. As a result, most theory development has neglected strategic choices or tradeoffs (see Stadler et al., 2013 for an exception). The value of our theory is that it forces us to think through the tradeoffs between different patterns of team learning. We show that team learning always involves strategic choices, and argue that firms are likely to fail if they make the wrong ones.

This does not mean, however, that senior managers have no role to play in applying their cognitive abilities throughout sensing, seizing, and reconfiguring. They will often be the trigger for capability development or renewal, but, as we have argued, their job is not necessarily done once the trigger is pulled. By connecting managerial cognitive abilities to team-learning routines, we build a bridge between the DCF and the classic work of Burgelman (1983), which advocates forging links between senior management and the rest of the firm to nurture innovation and strategic change. We offer additional insight into the nature and benefits of such links. We explain further what needs to take place in teams as innovation and strategic change are facilitated by social dialogue that blooms through interactions between senior managers and their teams. There is immense potential to understand the foundations of superior firm performance by exploring dynamic capability processes, and such explorations must consider interactions between teams and senior managers in connection with the evolution of opportunities—rather than thinking of opportunities purely as products of the senior managers' own cognition.

The theory of dynamic capabilities could be enhanced by integrating a more relational view of its processes, further embracing strategic management scholarship that has hinted at the collective nature of opportunity development (e.g., Floyd & Wooldridge, 1999) and advocated for loose intra-organizational boundaries (Burgelman & Sayles, 1986; Kuratko, Montagno, & Hornsby, 1990; Stevenson & Jarillo, 1990) and open communication across hierarchical levels (Kanter, 1984; Peters & Waterman, 1982). Reich (1987), for instance, has long argued that firms need to have fewer levels of organizational hierarchy and adopt a more heterarchical system that encourages close working ties across levels and promotes the engagement of all work teams in decision-making. Yet, much is left to be explored, as less-hierarchical organizing has remained at the margins of scholarly and practitioner attention up until very recently (Lee & Edmondson,

2017). Integrating organizational behavior insights about teams into strategic management research may offer a singular lens for doing so.

There are numerous avenues of research where this new lens could be applied. First, how firms can coordinate their activities to stimulate the necessary linkages between senior managers and their teams remains an open question. While there is abundant literature about cultivating a learning climate in teams (e.g., Edmondson, 1999), we know little of how firms create and maintain an environment in which senior managers and their teams can share knowledge in a natural way. Part of the answer may lie in personal relationships, which remain largely unexplored by strategic management scholars (Mahoney & McGahan, 2007). We would argue that such relationships do not develop through external mechanisms (e.g., formal incentives), but more evidence is sorely needed to understand this phenomenon. Literature on coordination has focused almost exclusively on the roles of formal organizational structure and incentives, rather than social relationships (Kleinbaum & Tushman, 2007). Social-network analysis tends to oversimplify social interactions by focusing on patterns of linkages, neglecting the emotions at the heart of such patterns. Developing hybrid research designs that include ethnographic data could enrich social-network studies and further our understanding of informal social mechanisms in the interconnection of senior managers' cognitive abilities and their teams' learning routines.

Another important question is how much boundary spanning between senior managers and their teams is required for firms to thrive. While our work here has emphasized the benefits of team-learning routines, and suggested that linkages with managerial cognitive abilities are necessary, setting boundaries between these actors may also be key to allowing the growth of knowledge in one particular domain, or for one particular purpose. The development of specialized knowledge is what makes these linkages worthwhile, since boundary-spanning

conversations can only be meaningful if the actors involved in them also engage in domain-specific conversations within their respective group. Indeed, Clark (1997) argues that premature communication between people can dissipate the benefits of integrating multiple thought worlds in a collective, while Stark (2009) suggests that in order to reap the benefits of diverse knowledge, firms must retain enough “pockets of cohesion,” as well as enough random linkages among them. Consider the development of System G at Sony. If the team’s relationship with senior management had been closer, the engineers who were free to tinker with this one technology might have been restricted by senior managers’ views, and thus unable to push the technological envelope that ultimately sparked Kutaragi’s ideas. Similarly, developers at Psygnosis may have had difficulties adapting their practices for the PlayStation if they had been too closely tied with Kutaragi from the get-go. Longitudinal studies could provide useful insights on the tradeoff between setting the boundaries between senior management and work teams on one hand, and boundary spanning during the sensing, seizing, or reconfiguring process on the other.

Additional investigation also could shed light on the involvement of key actors in promoting linkages between teams across the firm and senior management. Those leading these activities may very well be actors other than managers. Indeed, research on boundary-spanning leadership tends to highlight the contrasts between two leadership types: Boundary spanners have been shown to emerge slowly in group-based activities (Fleming & Waguespack, 2007; Levina & Vaast, 2005) as opposed to individuals who are promoted to management positions. In fact, firms that have nominated individuals as boundary spanners have seen them achieve limited results (Nochur & Allen, 1992). Cross-boundary leadership may thus be quite different from traditional, decision-making leadership (Edmondson & Harvey, 2017). Besides, the set of competencies

needed to leverage team-management linkages may be contingent on the process in which the leadership is currently situated (sensing, seizing, or reconfiguring). For instance, although some leaders may be attuned to changing market and technological reality, and good at linking knowledge in ways that help to identify promising avenues, they may find it difficult to facilitate the evaluation of an opportunity's economic potential under the principles of a final go/no-go decision procedure. General models of leadership may be inappropriate in the widely varying contexts that firms face throughout the sensing-seizing-reconfiguring pathway. More research on this subject would definitely be timely.

Finally, scholars outside the strategy stream may also benefit from our theory, especially organizational behavior researchers with an interest in teams. An important factor that may influence the ability of teams to leverage learning routines for performance is the context in which they are located. A central aspect of context is the opportunities and constraints that drive certain courses of action and relationships among groups (Huber, 1990). However, while team scholars provide rich and substantial details on team-level activities, they tend to treat external, contextual factors in a more cursory way (Edmondson et al., 2007). Lack of clarity about the relationship between types of team-learning routines and types of task contexts hinders our understanding of the consequences of learning in teams. It can lead to confusing findings—potentially contradictory empirical results that could be explained by overlooked contextual characteristics (Johns, 2006). Future survey research on team learning can benefit from the definition of the sensing, seizing, and reconfiguring processes. The DCF sets parameters that can help contextualize the effectiveness of teams and the benefits of their behaviors.

### **Practical implications**



Translating our theory into practice involves challenges that merit mention. The propositions of our model make two assumptions: first, that one can know, in practical terms, which dynamic capability process a team (or senior manager) is situated in; and second, that one can help the team enact the appropriate learning routines for that process. Yet, in practice, it may be difficult to locate a task in its dynamic capabilities process *ex ante*, especially in high-velocity environments where firms must move through the three processes rather quickly (Eisenhardt, 1989). In other words, it may not be easy to match team-learning routines to managerial cognitive abilities in real time. Furthermore, factors may hinder a team from carrying out certain learning routines, precluding the benefits of those routines from being realized—even when a good match between team-learning routines and managerial cognitive abilities can be identified. Consider team vicarious learning in support of reasoning and problem-solving during seizing. “Not invented here” syndrome (Katz & Allen, 1982) can inhibit team members from seeking assistance from experienced others with their project; it is natural for teams to assume that their situation is unique, and that others would not understand it, or would be unable to provide useful help. Furthermore, pride, or a belief that asking for help is a sign of weakness, may also limit a team’s willingness to seek assistance from experienced others. Whereas both reflexive and experimental learning are enabled when within-team members have high psychological safety (Lee et al., 2004), and contextual learning is enabled by the obvious rational utility of seeking market and technological data on context (Hansen, 1999), vicarious learning may exact unique social costs in an organizational setting, such as a reputation for not having the team project under control. Such considerations notwithstanding, we believe that the theory introduced in this paper can offer a starting point for useful and practical strategic management guidelines to direct team efforts.

## CONCLUSION

Theorizing about the foundations of dynamic capabilities has intensified in the last few years. It invited an effort such as ours to develop theory on the locus of routines and what are the reliable patterned behaviors that enable learning. This paper further expands our understanding by connecting managerial cognitive abilities to team-learning routines, and theorizing about how these micro- and meso-level concepts come together to support firm-level sensing, seizing, and reconfiguring capabilities. We believe that complementing the manager-focused analysis of these processes with a team-based approach helps extend our understanding of dynamic capabilities as they unfold to support superior firm performance, and that it opens up several exciting and important paths for future research in the fields of strategic management and organizational behavior.

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**Table 1. Types of team-learning routines and their features**

| <b>Construct Features</b><br><b>Team Learning Types</b> | <b>Location of Knowledge</b> | <b>Orientation of Behavior</b> | <b>Activities</b>   | <b>Outcomes</b>  |
|---|------------------------------|--------------------------------|---|--|
| <b>Reflexive Learning</b>                               | Inside the team              | Exploitation oriented          | Team members discuss about their processes, analyze their outputs, and review the objectives of their work    | <ul style="list-style-type: none"> <li>▪ Continuous improvement through the detection and elimination of errors</li> <li>▪ Development of best practices supporting efficiency gains</li> </ul>  |
| <b>Experimental Learning</b>                            | Inside the team              | Exploration oriented           | Team members complete experiments using methods and tools such as prototyping, simulation, and mock-ups       | <ul style="list-style-type: none"> <li>▪ Generation of novel insights through fast failures and early hypothesis-testing</li> <li>▪ Development of collective understanding of the task facilitating the integration of diverse knowledge</li> </ul>                                       |
| <b>Contextual Learning</b>                              | Outside the team             | Exploration oriented           | Team members scan the environment, perform market watch, and try out new products, services, and technologies | <ul style="list-style-type: none"> <li>▪ Identification of new trends regarding other companies, customers, and technologies</li> <li>▪ Development of collective understanding of competitive context highlighting threats and opportunities</li> </ul>                                   |
| <b>Vicarious Learning</b>                               | Outside the team             | Exploitation oriented          | Team members observe other groups and engage outsiders with a similar experience in their group discussions   | <ul style="list-style-type: none"> <li>▪ Use of key lessons learned to avoid repeating mistakes, skip unnecessary steps and avoid reinventing the wheel</li> <li>▪ Development of collective understanding of the process and sociopolitical context, aligning group activities</li> </ul> |

**Figure 1. Supporting team and manager activities throughout the sensing-seizing-reconfiguring processes**

