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Jean-François Harvey
Henrik Bresman
Amy C. Edmondson

Working Paper 19-059

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Jean-François Harvey
HEC Montréal

Henrik Bresman
INSEAD

Amy C. Edmondson
Harvard Business School

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Acknowledgements
This work was supported by the Division of Research at Harvard Business School; the R&D Committee at INSEAD; and the Social Sciences and Humanities Research Council of Canada [430-2017-00527]. An earlier version of this paper was presented at the Academy of Management meeting in Chicago, IL. We also gratefully acknowledge the help of several colleagues for their insightful comments and feedback in preparing this manuscript, including Henry Chesbrough, Johnathan Cromwell, Ann Langley, Suzanne Rivard, and David Teece.

TEAM LEARNING CAPABILITIES: A MESO MODEL OF SUSTAINED INNOVATION AND SUPERIOR FIRM PERFORMANCE

Jean-François Harvey
HEC Montréal
jfharvey@hec.ca

Henrik Bresman
INSEAD
henrik.bresman@insead.edu

Amy C. Edmondson
Harvard Business School
aedmondson@hbs.edu

5 December 2018

Abstract: This paper complements the manager-centered analysis of dynamic capabilities with a team-based approach focused on team learning. We argue that team learning capabilities intertwine with managerial cognitive capabilities to support the processes of sensing, seizing, and reconfiguring. We draw from the literature on team learning 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 to show their particular relevance at different points along the sensing-seizing-reconfiguring pathway, and assess their potential impact on innovation and strategic change. The framework contributes by adding a meso lens to research on dynamic capabilities to help scholars better understand how learning that occurs in teams may support entrepreneurial managers in enacting their cognitive capabilities in service of sustained innovation and superior firm performance.

Keywords: Dynamic capabilities, Innovation, Strategic change, Team learning

INTRODUCTION

Over the last two decades, the dynamic capabilities framework has moved to the forefront of strategic management research and enabled a "helicopter view" of how firms achieve and support sustainable competitive advantage. Originally focused at the firm level, later work brought attention to the manager level. Specifically, scholars have broken new ground in understanding strategic change by arguing that the entrepreneurial attributes and superior cognitive abilities of some managers are especially relevant for a firm's ability to continuously create and capture value in an evolving environment (see Helfat & Martin, 2015 for a review). In this paper we expand this body of work by integrating theory on the critical role of work teams[1] in superior firm performance. Indeed, teams are crucial actors who support entrepreneurial managers in sustaining evolutionary fitness; that is, achieving congruence between the organization's capabilities and changing environmental conditions (Augier & Teece, 2008, 2009; Helfat et al., 2007).

According to the dynamic-capabilities perspective (Teece, 2007, 2009, 2012), decisions by entrepreneurial managers are "strategic acts" that play a critical role through three key processes: (1) sensing opportunities, (2) seizing them, and (3) reconfiguring the business organization to profit from them. These decisions are conceptualized in the face of the economic environment and they affect existing routines or resource configurations, thus stimulating strategic change. This view suggests first that *sensing* new opportunities is a scanning and interpretive activity, based on analytical systems from which entrepreneurial managers gain insights. Second, *seizing* entails product or service development, commercialization or other investment decisions that entrepreneurial managers

[1] 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).

make on the basis of methodical, cognitive activities. Third, *reconfiguring* encompasses decisions that align or realign the firm's governance and coordination mechanisms through asset orchestration, to manipulate resources to generate rents.

Helfat and Peteraf (2015) built on Teece's suggestion of the role of cognition in the firm-level sensing, seizing, and reconfiguring processes (2007) to further understanding of managerial cognitive capabilities. They added a fine-grained analysis of the mental activities that underpin entrepreneurial managers' strategic acts, namely perception and attention (sensing), problem-solving and reasoning (seizing), and communication and social cognition (reconfiguring).

We propose to round out this view by incorporating theory on the critical role of work teams in superior firm performance. Entrepreneurial endeavors require coordinated actions of multiple specialized teams that address subcomponents of a larger enterprise (e.g., Martin, 2011). For this reason, entrepreneurial managers are at the center of what has been referred to as *multiteam systems* (MTSs; Mathieu, Marks, & Zaccaro, 2001), and, as we argue in this paper, must leverage the knowledge generated by various teams supporting innovation and strategic change. Indeed, an important stream of strategic management scholarship has hinted at the collective nature of opportunity development (e.g., Floyd & Wooldridge, 1999) or suggested that interlocking activities of multiple participants are at the heart of innovation and strategic change (e.g., Burgelman, 1983). Expanding our attention beyond managerial cognition thus may extend our understanding of what drives superior firm performance. As Dosi, Nelson, and Winter posited, "the structure of capabilities at the highest level reflects the outcome of a self-organizing, bottom-up process rather than realization of any comprehensive intention" (2000: 2).

We seek to further develop the foundations of dynamic capabilities in a socially embedded context rooted in interaction. To do so, we propose that research on teams—in particular, on team learning—provides a useful lens. The learning that occurs in teams is an important element of organizational responsiveness to change (Edmondson, 2002). Knowledge found in skilled work teams represents firm resources that are idiosyncratic in nature and thus a significant foundation of dynamic capabilities (Argote & Ren, 2012; Teece, 2009), e.g., cross-functional R&D teams (Eisenhardt & Martin, 2000). Given the centrality of teams in organizational learning (e.g., Crossan, Lane, & White, 1999; Huber, 1991; Senge, 1990), itself at the heart of the dynamic capabilities framework (Bingham, Heimeriks, Schijven, & Gates, 2015; Schilke, Hu, & Helfat, 2017; Teece, 2009), the role of teams should be fully integrated throughout the three processes of sensing, seizing, and reconfiguring. Moreover, different team learning activities may be better suited for each of these organizational processes. Therefore, we ask: *What team learning activities help enact sensing-seizing-reconfiguring in service of superior firm performance?*

To answer this question we integrate a team learning perspective with the work of Teece (2007) and Helfat and Peteraf (2015). We argue that team learning capabilities intertwine with managerial cognitive capabilities to support the processes of sensing, seizing, and reconfiguring. We draw from the literature on team learning to develop categories based on the orientation (exploration and exploitation) and locus (internal and external) of the learning activity. Specifically, we identify four categories of team learning activities, namely reflexive, experimental, contextual, and vicarious learning, and elaborate on the heterogeneity of these activities. We then integrate them into the dynamic capabilities framework to show their particular relevance at different points in the sensing-seizing-reconfiguring pathway.

Our work complements past research in the field of strategic management by adding a meso-level view to the micro- and macro-level views that the dynamic capabilities framework has provided to date. This contribution is important because it helps us better understand how dynamic capabilities are enacted. The dynamic capabilities framework has always been intentionally general, ranging from generating creative ideas to developing them into products and services, and designing business models that support their implementation (Helfat et al., 2007). Similarly, teams encompass activities such as conceptualizing, developing, designing, manufacturing, marketing, and distributing new products and services. Even when innovative ideas are first proposed by an individual, firms increasingly rely on teams to develop and implement them (Anderson, Potočnik, & Zhou, 2014). Therefore, by complementing the organizational processes of sensing, seizing, and reconfiguring (Teece, 2007) and the associated managerial cognitive capabilities (Helfat & Peteraf, 2015), team learning capabilities enrich our appreciation of the multilevel phenomena of dynamic capabilities. From a theoretical standpoint (see Hitt, Beamish, Jackson, & Mathieu, 2007; Sutton & Staw, 1995; Weick, 1995; Whetten, 1989), making connections or building bridges across levels of analysis also helps strengthen the dynamic capabilities framework's significance in our understanding of how firms achieve superior performance. It takes us a step closer to an operational theory of innovation and strategic change, in addition to enhancing its conceptual foundation (Floyd, Cornelissen, Wright, & Delios, 2011).

DYNAMIC CAPABILITIES: SENSING, SEIZING, AND RECONFIGURING

Teece and colleagues built on the resource-based view of the firm (RBV) (Barney, 1991; Wernerfelt, 1984) 25 years ago to conceptualize the dynamic capabilities framework (e.g., Teece, Pisano, & Shuen, 1990; 1997; Teece & Pisano, 1994). 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. RBV was heavily criticized for its overly static nature (e.g., Porter, 1991, 1996; Priem & Butler, 2001)—criticisms that the dynamic capabilities framework aimed to answer with its roots in evolutionary economics (Nelson & Winter, 1982; Schumpeter, 1961). Whereas RBV could not explicate the processes by which competitive advantage is gained and maintained over time, dynamic capabilities introduced a processual dimension to tackle this challenge by emphasizing the development and renewal of resources regarded as (mostly intangible) firm-specific assets that are difficult to imitate. The theory challenged the then-dominant paradigm in strategic management, the competitive forces approach (Porter, 1980), which was rooted in the structure-conduct-performance paradigm in industrial-organization economics (Mason, 1957; Bain, 1959). The dynamic capabilities framework 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).

The dynamic capabilities view has evolved considerably over the years to explain what enables firms to learn and change in a patterned manner (Schilke et al., 2017). One recent major evolution of this work expanded the framework by focusing on the role of managers in achieving the three firm-level processes (sensing, seizing, and reconfiguring) identified by Teece (2007). We discuss the cognitive underpinnings related to the three organizational processes in detail below.

Cognitive Underpinnings of Three Organizational Processes

The dynamic capabilities framework emphasizes the timely and efficient creation, extension, or modification of the firm's resource base and the achievement of evolutionary fitness by adapting to and/or shaping the external environment (Helfat et al., 2007; Winter, 2003). More specifically, it describes a meta-process that comprises three processes: (1) sensing opportunities, (2) seizing them, and (3) reconfiguring the business organization to profit from them (Teece, 2007). To make these processes more managerially tractable and to better understand what underpins superior firm performance, various scholars have suggested deconstructing them in terms of the micro-levels of actions (e.g., Abell, Felin, & Foss, 2008; Barney & Felin, 2013; Felin & Foss, 2005).

Much of this research has adopted the traditional individualistic models of decision-making that primarily relate to the field of economics (Casson, 1982), and built on the strategic-choice and upper-echelons views of organizations (Child, 1972; Hambrick & Mason, 1984). It has relied on 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 within this stream has shown that the myopic tendencies of managers can affect firm performance by limiting managers' ability to identify and predict the outcomes of courses of action that are significantly different from the firm's current activities (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 fail to sense new business opportunities emerging outside of their direct customer base, or when they do, why it is difficult to reap their full benefits due to their invested structure and procedures for information processing (Henderson & Clark, 1990).

The strategic agency deployed by *some* managers who can deal with demanding cognitive challenges has continued to be helpful in explaining the source of superior firm performance (for reviews, see Di Stefano, Peteraf, & Verona, 2014; Helfat & Martin, 2015). For instance, Adner and Helfat (2003) matched financial data from the U.S. Department of Energy with data on corporate-level decisions reported in the *Wall Street Journal* and showed that some managers were better at timing downsizing decisions as they influenced business performance. Smith and Tushman (2005) argued that top managers need to develop a paradoxical cognition that allows them to pursue exploration and exploitation concurrently. More recently, Danneels (2011) tapped into a large bulk of historical data covering the last two decades of Smith Corona and showed that top managers' inability to recognize firm resources and their fungibility contributed to the firm's demise. Experimental researchers have followed suit by using functional magnetic resonance imaging (fMRI) to identify and contrast specific brain regions and cognitive processes associated with exploitation and exploration decisions (Laureiro-Martínez, Brusoni, Canessa, & Zollo, 2015). Others have set up card games in which participants are informed of a sudden change of goal (e.g., to put 2♣ in the target position rather than 2♥) to give rise to observable characteristic qualities related to dynamic capabilities (Wollersheim & Heimeriks, 2016).

Recently, Helfat and Peteraf (2015) introduced the concept of managerial cognitive capabilities that facilitate innovation and strategic change. The authors argued that specific managers' mental activities underpin a firm's capacity to enact each of the processes of sensing, seizing, and reconfiguring: perception and attention capacities; problem-solving and reasoning prowess; and communication and social skills. They focused on managers' treatment of the information available to them; their thinking dispositions; and their ability to perceive resistance and persuade others by using the right words, facial expressions, metaphors, and stories. While there are brief mentions of other groups in the reconfiguring stage, the approach remains centered on individual managers, and tells us very little about the team-level underpinnings of dynamic capabilities. It offers, however, an excellent framework to build on, and complement with our team learning perspective.

A TYPOLOGY OF TEAM LEARNING ACTIVITIES

We build on Helfat and Peteraf's review of the term "capability" in the strategic management literature as describing "the capacity to perform a function of activity in a generally reliable manner when called upon to do so" (2015: 835). We make the link explicit between team capabilities and team learning activities and define the concept of "team learning capability" as *the capacity of a work team to perform one or more of the team activities that comprise learning.* To explicate its meaning, we need to dig deeper into the concept of team learning activities, and to this end we offer a typology.

Management scholarship started to focus explicitly on team learning in the early 1990s (Senge, 1990), and research on the topic has expanded substantially over time (see Edmondson, Dillon, & Roloff, 2007 for a review). This interest is driven by theoretical and methodological advances, and most importantly, by the notion that team learning has a key role to play in firms' ability to change

(Edmondson, 2002). Early research established team learning as a meaningful team-level construct (e.g., Edmondson, 1999) to counter prior arguments that held that learning was only meaningful at the individual level, not at the team level (e.g., Hunt, 1968). Additional research has provided support for the notion that learning at the team level is conceptually meaningful and empirically viable (e.g., Bunderson & Sutcliffe, 2003). Conceptually, it is important to note that team learning capabilities are not just learning that occurs when individual members of a team engage in learning activities; rather, team learning capabilities 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 interpersonal patterns of communication and coordination in teams that enhance shared, or collective, knowledge and skills.

While there is growing agreement about the validity and importance of learning as a viable team-level construct, definitions and views of the construct are heterogeneous and still evolving. Indeed, three separate streams of research have emerged to address team-level learning. One body of research that emerged from the social psychology laboratory looks at how members of small teams coordinate their actions to accomplish interdependent tasks (e.g., Liang, Moreland, & Argote, 1995). Team learning, in this work, 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 of research 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, the empirical studies in this stream tend to focus on real teams in organizational settings and to rely on both quantitative and qualitative data (e.g., Bresman, 2010, 2013).

This third stream (learning as a process rather than an outcome)—with a focus on mapping and measuring learning as meso-level activities, together with its inclusion of diverse firms and task contexts—bears the promise of increasing our understanding of the team-level underpinnings of the organizational processes depicted in the dynamic capabilities framework. This stream shows heterogeneity in the learning that teams can achieve in certain task contexts or in order to reap certain benefits. Some scholars have begun to unbundle team learning – to take a more in-depth look at many learning activities of different kinds. Edmondson (2002) suggested that team learning is a variegated construct, and others have similarly argued that we can now move toward a more fine-grained conceptualization (Argote, Gruenfeld, & Naquin, 2001).

Generally, literature has distinguished between internal and external learning in teams (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 other team members) or across the boundary between the team and its environment (carried out by team members interacting with others who are not on the team). Wong (2004) demonstrated empirically that internal learning ("local learning") and external learning ("distal learning") are two distinct constructs. The author also found that both types of team learning have contradictory effects on some team outcomes. The study found that external learning was significantly and positively associated with team innovativeness, while internal learning was significantly and positively related to group efficiency.

Others, however, have found certain internal learning activities to be related to creativity and innovation outcomes (e.g., Thomke, 2003), which leads us to emphasize another important element of heterogeneity in the learning activities teams can engage in: team learning can be centered on exploration or exploitation (Edmondson, 2002; c.f., March, 1991). 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. More recently, Bresman (2010) suggested and validated a model with two external learning types that are again closely linked to the exploration-exploitation dichotomy (contextual and vicarious learning). This research provided empirical support for the existence and value of learning from the experience of others and demonstrated discriminant validity of such vicarious learning as a team learning construct, distinct from contextual learning.

Drawing from previous studies, we suggest that internal learning activities can be either *reflexive or experimental*, while external learning activities can be either *contextual* or *vicarious*. Although more fine-grained notions may be possible, these four types of team learning activities provide a logical and parsimonious set. Particular mental activities of entrepreneurial managers support the sensing, seizing, and reconfiguring processes depicted in the dynamic capabilities framework. In successful firms, we argue, particular team learning activities are also more strongly associated with certain of these processes. Team learning activities and their features are described below and summarized in Table 1.

Insert Table 1 about here

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). Given the increasingly cognitive tasks completed by teams, careful discussion of team members' information, opinions, worries, or intuitions can help teams improve the quality of their outputs. Such *reflexive learning* allows teams to develop optimal routines that ultimately make their firm more proficient (Schippers, Edmondson, & West, 2014). Specifically, teams that engage in reflexive learning usually experience efficiency gains because they evaluate past actions and performance, and adapt their routines to current or anticipated circumstances or develop new ones in the face of change for improved future functioning (West, 1996). In other words, feedback that teams get from performing their tasks provides the opportunity to regulate themselves (DeShon et al., 2004) and update their usual routines in meaningful ways (cf. Gersick and 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 in specialized area, based on meeting customer and employee expectations, diagnose quality problems, and implement changes as needed (Edmondson, 2002).

Of course, reflexive learning is not a given for every team (see Konradt, Otte, Schippers, & Steenfatt, 2016 for a review). For instance, if teams are busy or accustomed to routine (Gersick & Hackman 1990), reflexive learning may simply not occur. Work teams may operate in ways that their *modus operandi* is never examined, and therefore do not gradually improve work practices or have trouble mastering new tasks.

Experimental Learning

Another learning—*experimental learning*—takes place within the team but is more geared towards exploration. It allows teams to learn based on the direct experiences of their members 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 is such activities, teams generate new insights on problems for which outcomes are uncertain and where critical sources of information are lacking (Thomke, 1998). Teams can assess the feasibility of their ideas through experimental learning; they can recognize problems in their plans that are otherwise undetectable. Indeed, they actively increase their chances of dealing with failures (Cannon & Edmondson, 2005), and because of these (early) failures, teams can ultimately achieve better performance (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 teams. For instance, engaging in trial-and-error experimentation, where the chance of success is uncertain and failure is a strong possibility, was shown to be extremely difficult when there was a sense that team member actions and contributions were being scrutinized or evaluated (Lee, Edmondson, Thomke, & Worline, 2004). In many firms today, an intense demand for quick or lucrative results—the result of which could be a mixed message for teams with regard to how safe it is to really experiment—may create conditions that are detrimental to leveraging this team learning capability.

Contextual Learning

The earliest studies related to external learning can be found in the research on boundary spanning. Starting with the seminal 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 information-processing 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 most engage with their external environment perform better. Yet this 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 makes the research stream on boundary spanning particularly informative for our understanding of *contextual learning* (cf. Bresman, 2010). They showed that teams engage in "behaviors that involve general scanning for ideas and information about the competition, the market, or the technology" (1992a: 641). Considering the nature of their task, this type of learning is particularly relevant to top management teams and new product development teams (Edmondson, 2002). Scanning activities allow a team to obtain knowledge that can be recombined with its existing knowledge to generate innovative ideas (Kurtzberg & Amabile, 2001; Sutton & Hargadon 1996). Previously unrelated technological components can be mixed together to give rise to new business opportunities, especially when moving them across various industries (e.g., Hargadon & Sutton, 1997). As a result, teams that most engage in contextual learning have been shown to be more innovative (Ancona & Caldwell, 1992b).

Vicarious Learning

Vicarious learning, another important branch of interest in external learning, is exploitation-oriented, and has its roots in work on the knowledge-based theory of the firm (e.g., Kogut & Zander, 1992) and on team learning curves by Argote and colleagues (e.g., Epple, Argote, & Devadas, 1991). Though these studies did not explicate the behavioral underpinnings, they showed that learning transferred between groups within firms, specifically learning about how to carry out a task, affects performance. Darr, Argote, and Epple (1995), for example, investigated pizza stores with clear team characteristics (they each consisted of a small group of people working interdependently to accomplish a common task) and found that unit costs improved with experience, but they also found that the rate of improvement varied across stores. Specifically, stores that were part of a franchise of multiple stores showed a greater rate of improvement due to shared learning across the stores in the franchise. Organizational subunits and work teams may thus 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 other similar teams in other firms, through meaningful interactions with them, such that later adopters of a new technology or process can progress faster (on some dimensions) than earlier adopters (Edmondson, Winslow, Bohmer, & Pisano 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 the similar experiences of other teams involved such behaviors as identifying experienced others and inviting them to talk about past failures, for example, in testing and marketing a product, and about how to avoid them. These teams also discussed what had worked in past projects with the experienced other team members, and what lessons could be extracted and applied to the current project.

DYNAMIC TEAM LEARNING CAPABILITIES

We now integrate team learning capabilities with the work of Teece (2007) and Helfat and Peteraf (2015). Working together with managerial cognitive capabilities at the individual level (Helfat & Peteraf, 2015), we argue that team learning capabilities support the three processes put forward by Teece (2007). Specifically, team learning capabilities generate knowledge that fuels managerial cognitive capabilities at the different stages of the sensing-seizing-reconfiguring framework. This is well illustrated by the story of PlayStation®[2].

The Story of PlayStation

[2] 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 game industry. The description is not presented as an accurate case history. Rather, it is a story we use to help illustrate our theoretical perspective.

Sensing. Sony engineer Ken Kutaragi had always been curious about the commercialization of new technology, and had become interested in video games while still honing his hardware engineering and digital skills. In 1984, he ran into Sony engineers Akio Oba and Masaaki Oka. Left to their own devices at the Sony Information Processing Research Institute, these two amateur coders had come up with System G, a 3D software engine. During the same period, Kutaragi liked to hang out with Sony graphic designers, who enjoyed speculating on the future of computer graphics and what designers could achieve in the future. He also engaged with engineering groups at Samsung Electronics, who were interested in worldwide trends in the semiconductor industry. Based on his various encounters, Kutaragi sensed that shifting trends in semiconductor prices, the pace of technological progress, and Sony's work on 3D technology together opened up a major opportunity in video games: a paradigm shift from two-dimensional to three-dimensional game worlds.

In 1988, Kutaragi was invited to set up a team that would collaborate with Nintendo in trying to create a CD-ROM peripheral for the cartridge-based Super Nintendo Entertainment System. The team could access valuable knowledge about the industry's distribution and inventory woes. Many problems stemmed from the limitations of mask ROM (cartridge) as a distribution medium. It was extremely slow to produce, with two-month lead times being typical. This meant that there was often a shortage of high-quality titles, but repeat production was unviable. Software houses whose titles sold out sometimes found that by the time stock was replenished, gamers' interest had moved on. The physical shortcomings of mask ROM gave wholesalers several perverse incentives. Fearing stock shortages, wholesalers would do a bulk deal with a software firm. If the title was a hit, they would sometimes hoard their stock, hoping for the price to rise. But if it wasn't a hit—and most games weren't—the wholesaler would end up with excess stock, which they would then try to offload to other wholesalers as quickly as possible. Users 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 followed a strategy of increasing prices over time as it released new generations of its consoles. If gamers wanted fun, they had to pay.

It became clear to Kutaragi that the industry needed to ditch cartridges and move to CD-ROM. CD-ROM was cheaper than mask ROM and could store more data, including images and sound. The experimental endeavors between Sony and Nintendo held great promise, yet the alliance ended badly. In 1991, Nintendo abruptly dumped Sony for Phillips, its greatest rival. Sony President Norio Ohga was so incensed by the betrayal that he put his full weight behind Kutaragi's venture, urging him to develop a console way beyond anything Nintendo had produced. Kutaragi started resolving a very complex 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. To do so, he relied on several teams in the fields of hardware, software, and entertainment.

Seizing. Kutaragi assembled a team to develop the PlayStation's hardware, beginning with 3D innovators Oba and Oka, who were working on projects in graphics, animation, and human-machine interfaces. PlayStation inherited numerous techniques from System G, such as the simplification of calculations. However, the main challenge lay in incorporating these advances into hardware that could offer the real-time capabilities and responsiveness of a home gaming console – and still be affordable.

Early on, Kutaragi had taken a long-term view of technology – in 1985, he had foreseen a console release 10 years later. As the team's development work began in earnest, he realized that the next three years would deliver an eightfold improvement in processor performance, and built such projections into his plans. At the time, consoles used a mix of general-purpose microprocessors and customized chips. But as the team tested various options, Kutaragi recognized PlayStation would not achieve enough processing speed 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 industrial designer Teiyu Gotoh. The touchstones were simplicity and ease of manufacture, which would be essential to achieving volume production. The aim was a design that operatives could make with their eyes closed. The team's members were based at the same site and enjoyed frequent contact, making it easy for them to understand each other's requirements. For instance, Gotoh considered form and raw materials, but also productivity. "[He] often visited the production floor, where he would discuss design with engineers. Even when he was told that his design was not technically feasible, he did not abandon it. On the contrary, [designers and engineers] would work together to find out what needed to be done to achieve his design concept in a way that improved overall productivity" (Asakura, 2000: 166). 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, video games allowed profits to be made from sales of software as well as the consoles. Because of this, it was decided that all the development work for the PlayStation would take place at Sony Music, since that business had much in common with video games in terms of its commercial setup and distribution channels. The team responsible for designing the business model of the PlayStation could then integrate insights from Sony Music and Columbia Pictures. Key contributors included people like Shigeo Maruyama and Akira Sato, who had an artist-management mindset that the team could draw upon when dealing with game developers and publishers, Olaf Olafsson and Terry Tokunaka, who had extensive knowledge of the entertainment business, and Phil Harrison, a former game designer and UK graphic artist. Their experience helped the team in recruiting software developers very early in the venture. Unlike its rival Sega, which had the in-house skills to port its own arcade games to the Saturn, Sony depended on third parties for software supply. If they didn't commit to the new console, it would have been game over.

The business model was such that if Sony followed Nintendo in adopting mask ROM for its new console, they would have to replicate a similar distribution structure, and suffer all the same problems that were identified earlier. With PlayStation, the team reflected and aimed to do something different—and better. They 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, the team 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. The technology had been in use as a game medium since 1990, but not with the express intention of reforming distribution. Considering their options, the team designed a system based on direct selling to retailers, cutting wholesalers out of the picture completely. The method was called "purchase for resale." Sony, as the developer of the platform, would function as a wholesaler, purchasing products from software houses and taking on responsibility for setting production volumes and optimizing inventory.

Reconfiguring. Sony Music had its own CD pressing plants, which could now be used to produce games, in addition to the wealth of knowledge on 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. However, flexible production was all very well, but Kutaragi and Sony executives had to know what was happening in-store, or demand would still go unmet. And with mask ROM experiences still fresh in the mind, there was no guarantee that everyone in the distribution chain would adopt new processes in the way Sony needed them to. Software developers had to change their marketing approach. The PlayStation team members joined them to reflect on some of their practices, providing concrete examples of what replenishment stock for a particular software title would look like if manufactured according to a given schedule. So time-sensitive was the market, they realized, that games had to take priority over music.

The production flexibility was increased over time as teams distributed across the value chain became accustomed to the new business, and allowed Sony to finesse its techniques for releasing and restocking new titles. From July 1997, it began to release new titles on a Thursday rather than a Friday. With a Friday release, repeat orders were placed on Saturday based on Friday's volumes, with delivery by the following Thursday. But with a Thursday release, repeat volumes could be estimated more accurately, based on two days' data, and delivered the next Wednesday.

Soon after PlayStation hit the market, the priority became to maximize the number of titles the developers produced. Taking its cue from Sony Music, which revered musicians rather than commercial executives or business leaders, the PlayStation team continued to put game developers at the center of its thinking. To motivate them to produce more games more quickly, the team set up a creator-friendly environment and insisted that a library of hardware functions be developed in-house. This saved developers from having to analyze the hardware themselves and produce every line of code from scratch, so they had more time for creative thinking.

The library aimed to support all developers equally. Even custom elements added for specific games were later rolled out and made available to all. However, not all developers welcomed the library. They didn't like using someone else's code, because they couldn't fix problems that arose with it. They preferred to code everything themselves, even if it meant more work, because they were able to own and resolve every issue. Existing consoles allowed developers 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 developers' code and the hardware. This frustrated developers, 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. 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 less than a year – a story that became key in Kutaragi's communication. Later, the team created Performance Analyzer, which showed developers 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.

Eventually, Sony acquired game developer 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 over the company's business right away, as the PlayStation team also needed to learn from their experience with developing, selling, and distributing games. Although Psygnosis already had efficient development routines in place, it now 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 US with Wal-Mart, K-mart, Toys-R-Us, and Sears. This was instrumental in ensuring that as sales in Japan began to slow, the US and European markets continued to deliver strong growth.

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

Team Learning Capability in Support of Sensing

Perception and attention are at the heart of the managerial cognitive capability that allows firms to sense opportunities as they arise and anticipate competitive threats. Drawing from Helfat and Peteraf (2015), perception relates to the ability of managers 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 form a team learning capability that intertwines with this managerial cognitive capability, in support of the sensing process.

As exemplified by Kutaragi who drew from knowledge generated by several teams – the future of computer graphics, worldwide trends in the semiconductor industry, and the 3D engine developed at a research lab – entrepreneurial managers must count on teams that engage in both contextual and experimental learning to fuel their mental activities for the firm to sense new opportunities.

Team contextual learning helps ensure entrepreneurial managers are in step with their surroundings, and most importantly have the possibility of bridging "structural holes" (Burt, 1992) – loci at which discrete domains' non-redundant fragments of knowledge are blended together. Video games, business, hardware, and digital engineering were diverse but complementary knowledge domains, and spanning the boundaries between them stimulated Kutaragi's big idea. To generate such knowledge, teams may go to fairs and trade shows, or collaborate with university research centers. They may interview both known and prospective customers or conduct extensive market analysis using other methods, such as big data analysis and ethnographic work. Sourcing new knowledge in such a manner may provide a clearer picture, or a more complete understanding, of the environment, and fuels entrepreneurial managers' cognition in the generation of creative insights for the business.

Team experimental learning also enables the generation of knowledge in service of the managerial cognitive capability 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 the experimental learning activities of some of their teams (e.g., von Hippel, Thomke, & Sonnack, 1999). Their many discoveries direct managers' attention towards particular opportunities that may then be scrutinized further and potentially lead to investing resources to seize them.

When sensing new opportunities, vicarious and reflexive learning are not strong options. No models are available to learn from, and no particular plan has been laid out yet. Both contextual and experimental learning, however, are critical (Wheelwright & Clark, 1992). If the teams in support of entrepreneurial managers devote their learning chiefly to experimental learning, then the firm may produce a flawless technology, but it may be the wrong one – a technology that no one values. If the teams devote themselves solely to contextual learning, on the other hand, the entrepreneurial manager may focus on the right technology but the firm risk not being able to produce a functional design later on. Therefore, we posit that:

> ***Proposition 1:*** *Firms that organize their team learning activities to prioritize contextual learning and experimental learning when performing the sensing process are likely to be more effective than firms that prioritize other team learning activities or do not prioritize among team learning activities.*

Team Learning Capability in Support of Seizing

The seizing process is characterized by firms facing new territory that is somewhat unexplored. If the firm aims at developing an innovative product, for example, it means that few technical parameters of the product are defined and tested. It 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 and Peteraf, 2015). We argue, therefore, that experimental and vicarious learning in teams form a team learning capability that intertwines with this managerial cognitive capability, in support of the seizing process.

Solving problems generally involves designing and testing several alternatives. Supporting teams engaging in experimental learning lead these tests, for their outcomes to 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 entrepreneurial managers to encounter unforeseen or changing requirements. Like Kutaragi, entrepreneurial managers may prefer one alternative at the outset of the seizing process but this preference will evolve as the supporting teams involved engage in experimental learning. When teams hold off experimental learning, entrepreneurial managers have less to reason with, and thus firms going through the seizing process run the risk of finding out about costly and time-consuming changes needed later on during the reconfiguring process (i.e., functionality or manufacturability). Instead of adjusting requirement specifications following early experimental learning, correcting design errors later on mean updating a much larger inventory of specifications, code, user and/or maintenance manuals, training materials, and indirect operational problems in the field (Thomke & Fujimoto, 2000).

Furthermore, seizing opportunities is not only a matter of developing a product or service that is technologically advanced. The latter must also be supported by an adequate business model; for instance, using a set of resources for activities that ultimately makes 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 the heart of doing so too (cf. the lean start-up methodology described by Ries, 2011). Second, teams must also engage intensively in vicarious learning during the seizing process. Prior innovation endeavors will typically have generated knowledge that can be leveraged in current projects – even the firm's suppliers may have developed knowledge that can be useful (Dyer & Hatch, 2006). Supporting teams learning from others' experience leading innovation projects alert entrepreneurial managers to past mistakes that can be avoided or unnecessary steps that should be skipped (von Hippel & Tyre, 1995). They can apply their mental abilities to key, novel aspects of the problem. Doing so has been found to improve product development performance (Adler, 1995; Thomke & Fujimoto, 2000). Indeed, as a firm moves through the seizing process, the collective knowledge associated with the task context will take on both more breadth and depth. While this enables entrepreneurial managers to operate at higher levels of competence, it also presents them with a more competitive environment. For example, as parameters become progressively well 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 re-inventing the wheel goes up. To meet the challenges, entrepreneurial managers must rely on teams through which they 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). In this way, entrepreneurial managers can make better decisions thanks to the knowledge acquired about aspects of how to do the task (e.g., how to design a product, how to reach the market).

Teams supporting entrepreneurial managers during 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 activities has detrimental effects. Knowledge generated through team contextual learning may help entrepreneurial 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 to a certain extent. By spending a lot of time reflecting together at the onset of the seizing process, supporting teams may develop a clear, yet rigid view of the goal or methods used to achieve that goal. They risk engaging in confirmatory experimentation and limit 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 that organize their team learning activities to prioritize experimental learning and vicarious learning when performing the seizing process are likely to be more effective than firms that prioritize other team learning activities or do not prioritize among team learning activities.*

Team Learning Capability in Support of 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. Asset orchestration involves implementing new routines or transforming existing ones, and honing them to reach maximum efficiency and sustain growth and profitability (Teece, 2007). Because routines are patterns of interactions, their implementation is always a collective endeavor (Becker, 2004).

Therefore, we argue that reflexive and vicarious learning in teams form a team learning capability that intertwines with this managerial cognitive capability, in support of the reconfiguration process.

Transforming 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 raves and garners executive support, it still must survive numerous downstream choices by other groups in engineering, production, sales, or even from suppliers. Each step is an occasion for an opportunity to be hijacked by other groups' priorities or to move toward the safety of incremental change rather than the uncertain ground of radical innovation (Christensen & Bowers, 1996). Sales teams, for instance, usually believe good profits can be sustained simply by using existing technology to make existing products a bit better and a bit faster. In another example, part makers may be unwilling to collaborate, hence cutting down the chances of producing a new design. The game developers and retailers were good examples of such parties in the PlayStation story. The knowledge acquired by supporting teams engaging with game developers fueled the social craftsmanship that eventually merged different expectations and was attentive to tensions when trying to reach positive common ground. Counting on teams that can empathize with other various groups throughout the reconfiguring process helps entrepreneurial managers leverage their mental abilities in ways that ensure that the innovation and the transformation necessary to leverage it prevail. Given the large number of activities that exist in firms, and their distance from top management, reconfiguring can be hampered by a shallow understanding between entrepreneurial managers and the groups involved in asset orchestration.

Team vicarious learning is crucial because 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 exchanges that spanned groups' boundaries and, consequently, facilitated the forging of new interaction patterns (see also Edmondson, Bohmer, & Pisano, 2001). Throughout this process, the vicarious learning that occurs on teams may generate knowledge that helps frame managers' approach in terms of the various groups' own practice and interests, sometimes unraveling misunderstandings regarding their respective constraints. As interests become shared across groups, entrepreneurial managers' messages may then become a springboard for the firm to embrace innovation and strategic change.

Team reflexive learning also gains in importance as entrepreneurial managers become concerned about orchestrating assets to exploit the opportunity. Issues of quality and costs (i.e., the number of rejects in the production of the components of their new product or the time the first few dozens customers are waiting before enjoying their new service) are central to the reconfiguring process (Teece, 2007). By embracing careful and thorough information processing about their ways of doing things, supporting teams may help entrepreneurial managers grasp in detail the way routines should evolve. These team learning activities enable error detection and correction, improves collective understanding of an interdependent task and helps uncover unexpected consequences of previous actions (Schippers et al., 2014). The knowledge generated may thus inform entrepreneurial managers' communication as they aim to facilitate the emergence of new routines, and reduce variability and uncertainty. Over time, entrepreneurial managers in contact with such teams are better positioned to develop optimal strategies that make the firm more efficient. Quite the reverse, failing to engage in reflexive learning can lead to confusion or misunderstandings, which make it difficult for those participating in reconfiguration to process newly available information effectively. Difficulties tend to stay hidden for team members, and for entrepreneurial managers who must apply their mental abilities, if the supporting teams remain passive and "wait to see what happens" (Moreland & Levine, 1992).

Together, vicarious and reflexive learning allows the firm to develop the “transactive memory systems” (TMS) of its teams (Wegner, 1987), which 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. 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. In fact, strong TMS is one of the few team-level variables that have been argued to sit at the microfoundation of dynamic capabilities (Argote & Ren, 2012).

Research looking into change implementation among distinct types of team learning in medical teams 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 place. Therefore teams engaging continuously in contextual learning can still have a beneficial influence on entrepreneurial managers’ cognitive abilities, 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 activities would eventually become a mismatch. It would waste resources in a task context in which most of the knowledge about the environment or the technology has been developed and now need to be leveraged. Therefore, we posit:

Proposition 3: *Firms that organize their team learning activities to prioritize vicarious learning and reflexive learning when performing the reconfiguring process are likely to be more effective than firms that prioritize other team learning activities or do not prioritize among team learning activities.*

Building on Helfat and Peteraf's (2015) argument that particular lower-level capabilities 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 activities that forms a team learning capability fuels a managerial cognitive capability in the service one of these processes. In other words, we expect the types of team learning activities to vary in order of importance depending on the process in which the firm is engaged. An overview of this multi-level understanding of the dynamic capabilities framework is shown in Figure 1. We argue, therefore, that undifferentiated (or one-size-fits-all) models of team learning would be inadequate for understanding the effectiveness of teams in dramatically different contexts that the dynamic capabilities framework has laid out. This is not to say that a given firm would not benefit from the other types of learning activities in teams; rather, we suggest that for a particular process one set of learning activities will be most valuable. With limited time and resources, teams should thus emphasize these types over the others.

Insert Figure 1 about here

DISCUSSION

Our model proposes that work teams must enact different kinds of learning capabilities for firms to sustain superior performance. It helps refine the theory of dynamic capabilities by describing a set of meso-level activities that integrate the concept of team learning with the organizational processes of sensing, seizing, and reconfiguring. Prior research has examined how resource allocation among exploratory and exploitative innovation project teams are made by top management (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 teams enable the firm's sensing, seizing and reconfiguring processes is an important area for furthering our understanding of dynamic capabilities.

Our model is also a first step at better understanding the rich interplay between the managerial cognitive capabilities described by Helfat and Peteraf (2015) and the learning that occurs in teams. The interplay between entrepreneurial managers' mental abilities and the knowledge generated by teams engaging effectively in different kinds of learning activities promotes strategic foresight and managerial awareness (sensing), supports inquiry and problem solving (seizing), and facilitates common understanding and continuous improvement (reconfiguring). While entrepreneurial managers need to master analytical systems and make good decisions about commercialization and investment, as well as orchestrate formal governance and coordination mechanisms that help generate rents, they must also create and maintain an environment that is conducive to social interactions with the various teams that populate the firm. Developing such understanding places significant demands on both researchers and practitioners because it affords a sophisticated picture of what lays at the foundations of firm performance, thus highlighting expertise shortages that are multifaceted, hence difficult to tackle. We hope that our work will provide clarity, promote dialogue, and encourage new research directions that further examine how entrepreneurial managers and teams *together* enable innovation and strategic change in firms.

Theoretical Implications

We have argued that different team learning activities serve different purposes in cultivating dynamic capabilities. We build on Teece (2007) and Helfat and Peteraf (2015), and also extend the work of Burgelman (1983), which emphasizes the need to develop linkages between top management and the rest of the firm to nurture innovation and strategic change. By integrating team learning capabilities with managerial cognitive capabilities to enact the processes of sensing, seizing, and reconfiguring, we offer additional insight into the nature and benefits of these linkages. We explain further how innovation and strategic change is facilitated by social dialogue that blooms through interactions between entrepreneurial managers and teams across the firm. The potential to develop an understanding of the foundations of firm performance by exploring dynamic capabilities processes is immense, and these explorations must consider interactions between teams and entrepreneurial managers in connection with the evolution of opportunities, rather than thinking of opportunities purely as products of the entrepreneurial managers' own mental processes.

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 has 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 and Waterman, 1982). Reich (1987), for instance, has long argued that firms need to reduce their levels of organizational hierarchy and adopt a more heterarchical system, which 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 their teams and entrepreneurial managers remains an open question. While there is abundant literature about cultivating a learning climate in teams (e.g., Edmondson, 1999), we have little knowledge of how firms create and maintain an environment in which entrepreneurial managers and supporting teams naturally convey knowledge to one another. Part of the answer may relate to personal relationships, which remain largely unexplored by strategic management scholars (Mahoney & McGahan, 2007). We would argue that such relationships do not develop through mechanisms that exist outside of the relationship itself (e.g., formal incentives), but further evidence is greatly 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 but not 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 teams' and entrepreneurial managers' capabilities.

Another important question is how much boundary spanning between teams and entrepreneurial managers is required for firms to thrive. While our work here has emphasized the benefits of team learning capabilities, and suggest that linkages with managerial cognitive capabilities is beneficial, setting boundaries between such groups 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 the linkages worthwhile, since boundary-spanning conversations can only be meaningful if the individuals 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, and Stark (2009) suggests that to reap the benefits of diverse knowledge, firms must retain enough "pockets of cohesion" and enough random linkages among them. Consider the development of System G, at Sony. If their relationship with management had been stronger, the team of engineers that was allowed to tinker freely with this one piece of equipment may have been restricted by management views, and thus unable to push the technological envelope that ultimately contributed to the spark that was generated in Kutaragi's mind. 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 teams–management boundary setting and boundary spanning during the sensing, seizing, or reconfiguring process.

Additional investigation also could shed light on the involvement of key actors promoting linkages between teams across the firm and the top team. 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 teams—management linkages may be contingent on the process in which the leadership operates (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 identifying promising routes, 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 considerably different contexts that firms face throughout the sensing-seizing-reconfiguring pathway. More research on the subject would definitely be timely.

Finally, scholars outside of the strategy stream may also benefit from our theory, especially organizational behavior researchers interested in teams. An important factor that may influence the ability of teams to leverage learning activities 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, team scholars provide rich and substantial details on team-level activities, but 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 activities 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 may be explained by unattended context characteristics (Johns, 2006). Future survey research on team learning can benefit from the definition of the sensing, seizing, and reconfiguring processes. The dynamic capabilities framework sets parameters that can help contextualize the effectiveness of teams and the benefits of their learning activities.

Practical Implications

Translating our theory into practice involves challenges that merit mention. The propositions of our model assume that it is possible to know, in practical terms, in which dynamic capability process (i.e., sensing, seizing, or reconfiguring) a team (or entrepreneurial manager) is situated, and that one can help the team enact the appropriate learning capability 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 go through the three processes rather quickly (Eisenhardt, 1989). In other words, it may not be easy to match team learning capability to managerial cognitive capability in real-time. Furthermore, factors may hinder a team from carrying out certain learning activities – missing out on their benefits – even when a good match between team learning capability and managerial cognitive capability can be identified. The theoretical benefits do not ensure that it occurs. Consider team vicarious learning in support of reasoning and problem solving during seizing. The 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 their situation is unique and others would not understand it or be able to provide useful help. Furthermore, pride or a belief that asking for help is a sign of weakness also may 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 the context (Hansen, 1999), vicarious learning may create unique social costs in an organizational setting, such as a reputation for not having the team project under control. Nonetheless, although action is imperfect, our contention is that new theory can offer useful strategic management guidelines to direct team efforts.

CONCLUSION

Team learning has been overlooked in research on the microfoundations of dynamic capabilities. The central contribution of this paper is connecting managerial cognitive capabilities (sensing, seizing, and reconfiguring) with team learning capabilities (contextual/experimental, experimental/vicarious, vicarious/reflexive) that *together* support the sensing, seizing, and reconfiguring processes that underlie firm dynamic capabilities. We believe that complementing the manager-focused analysis of these processes with a team-based approach is vital for future strategy research. If the focus remains only on entrepreneurial managers' cognitive activities, then we risk viewing firms as being made up of entrepreneurial managers alone – so much so that researchers may myopically fail to observe the key contributions of various work teams and fall into the attractive, yet misleading, fallacy of a few individuals acting as innovation superheroes. We hope our model will draw a reaction from the fields of strategic management and organizational behavior, and help extend our understanding of dynamic capabilities as they unfold to support superior firm performance.

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Table 1. Types of Team Learning Activities and their Features

Construct Features / Team Learning Types	Location of Knowledge	Orientation of Behavior	Activities	Outcomes
Reflexive Learning	Inside the team	Exploitation oriented	Team members discuss about their processes, analyze their outputs, and review the objectives of their work	• Continuous improvement through the detection and elimination of errors • Development of best practices supporting efficiency gains
Experimental Learning	Inside the team	Exploration oriented	Team members complete experiments using methods and tools such as prototyping, simulation, and mock-ups	• Generation of novel insights through fast failures and early hypothesis-testing • Development of collective understanding of the task facilitating the integration of diverse knowledge
Contextual Learning	Outside the team	Exploration oriented	Team members scan the environment, perform market watch, and try out new products, services, and technologies	• Identification of new trends regarding other companies, customers, and technologies • Development of collective understanding of competitive context highlighting threats and opportunities
Vicarious Learning	Outside the team	Exploitation oriented	Team members observe other groups and engage outsiders with a similar experience in their group discussions	• Use of key lessons learned to avoid repeating mistakes, skip unnecessary steps and avoid reinventing the wheel • Development of collective understanding of the process and sociopolitical context, aligning group activities

Figure 1. Supporting Team and Manager Activities throughout the Sensing-Seizing-Reconfiguring Processes