SEARCH AND INNOVATION:
HOW FIRMS DISTRIBUTE LEARNING AND PATTERNS OF SEARCH

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ABSTRACT

Ling Xiao: Search and Innovation: How Firms Distribute Learning and Patterns of Search
(Under the direction of Dr. Hugh O'Neill)

This dissertation follows the research tradition that looks at firm change from the behavioral perspective. After an introduction and initial literature review, the dissertation proceeds with three studies on related topics. First, based on the BTOF perspectives on how performance patterns affect search and change, and psychology literature on risk taking, I develop theoretical arguments regarding the performance feedback process in multidivisional organizations. I found that the feedback learning process can be influenced by the multidivisional structure, resulting in different risk taking behaviors in large complex organizations. Given this insight, I looked into the details of the search process inside large organizations as they adopted a new technology, blockchain. This second study demonstrated that the search process can take multiple steps. This insight led to a related question for the third study: given that search is motivated by goals, how do goals evolve in the search process? In this study, I found an iterative process of search and goals, in which initial goals motivate search, and those goals evolve as the search filters through the goal hierarchy. Importantly, the filter influences whether the use of the adopted technology explores new options for strategy, or exploits legacy options.

Overall, my dissertation contributes to the BTOF and search perspective. First, my dissertation extends this classic theory into the context of diversified and multidivisional firms. I show that the response to performance attainment discrepancy varies when firms are more or less diversified. Second, I look into the "black box" of search, and uncover a multiple step process of

search that might be more typical in complex corporations. I contribute to better understanding of this process of search and how the search influences innovation decisions by focusing on three key aspects of search: the divisionalization of firms, how search is distributed in firms, and search and subsequent organizational goals. My dissertation also contributes to the large literature on how firms change, and suggest new paths forward on understanding inertial and novel forms of change.

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CHAPTER 1: INTRODUCTION

The issues of how, when, and if existing companies change their legacy strategies remain a central topic in strategic management research. For decades, strategy scholars have studied questions such as different modes of change, whether existing firms can really change, how they strategize and make decisions regarding change, and how they implement change. Rumelt (1974), for example, looked at how these companies adopt different diversification strategies as means for change. The following decades witnessed healthy, and sometimes contentious, debate about success and failure across different types of strategy. Some evidence details effective adoption of new strategies (e.g. Hoskisson, Hitt, and Hill, 1991; Prahalad and Hamel, 1993). In contrast, Tripsas and Gavetti (2000), through a well-crafted qualitative study, cast doubt on whether existing companies can really change due to organizational inertia. Some studies suggest that firms successfully strategize and implement change through dynamic managerial capabilities (e.g. Eggers and Kaplan, 2009), or by building technological bridges (Cohen and Tripsas, 2018). Not all firms, though, navigate an effective passage from static capabilities to dynamic ones, and many companies fail to bridge across technological eras.

Researchers use a variety of theoretical perspectives to address the issue of strategic change. One core perspective describing how firms strategize changes was introduced in the Behavioral Theory of the Firm (Cyert and March, 1963). In this classical treatise on firm change, the process of firms strategizing changes is viewed as a process of search by the firms and the managers; a process of setting goals, identifying problems, searching for alternatives, and

choosing among alternatives. In response to gaps between firm goals and actual performance, firms and managers will look for alternatives to solve perceived problems, which may result in decisions to change the existing strategies and organizations. The search can also flow from an abundance of slack resources. For almost six decades, the search perspective has been crucial to help us understand firm change and the outcomes (e.g. Levinthal, 1997; Khanna, Guler, and Nerkar, 2016; Andriani and Mastrogiorgio, 2017).

However, despite the breadth of research that uses and extends the BTOF and, particularly, the search perspective as it affects change, gaps in our understanding remain. My ensuing literature review will show how these gaps cluster around three main issues. First, while the BTOF recognizes the variety of goals, and the potential for conflict across goals, the empirical studies presume that the firm has resolved that conflict at the apex of the organization. The BTOF views firm goals as a combination and abstraction of lower-level, individual goals. This underlying process that creates a goal hierarchy has not been well developed (Hu and Bettis, 2018). Accordingly, there is also lack of empirical studies on the complexity of goals and goal hierarchies. As a result, the goal, a central construct in the BTOF, needs clearer understanding and conceptualization.

Second, the mechanisms of learning and feedback, key steps in the change process, require further clarification. The process of search and learning in the BTOF follows a recursive loop of: setting goals, noticing performance problems, searching for alternatives, and implementing new alternatives and resetting goals, which results in the next loop of learning. This recursive process, given its essential abstraction and repetitive nature, is intellectually appealing. However, just as the BTOF pushes the theoretical front forward by conceptualizing and theorizing a simplified process of search, the evidence shows that searches, analysis of

choices, and implementation of new strategic directions often fail. In a well-developed literature review on the BTOF, Posen, Keil, Kim, and Meissner (2018) argues that the existing studies of search suffer from several problems, including: neglecting managerial cognition during search, lack of clarity on the process that leads to finding solutions, conjoining distinct elements of search, lack of understanding on how search leads to exploration versus exploitation, conflicting findings regarding the effect of performance feedback on risk taking, and focusing on a narrow range of organizational outcomes. Fundamentally, they argue that the search process is very much like a black box that deserves more attention to look into. The three studies of my dissertation will look into this black box by looking at three aspects related to search: the divisionalization of firms, how search is distributed in firms, and search and subsequent organizational goals.

A third important gap is a lack of integration between the BTOF studies and the strategies, structures and processes of existing firms. The BTOF and theories of corporate diversification are two main streams in strategy research. Both provide contributions that expand our understanding of firms. However, studies based on the BTOF have yet to fully embrace the findings and perspectives from the diversification literature (see Joseph and Gaba, 2020, for a detailed review). We know that the BTOF and search perspective is based on a complex process of information processing in firms, so the diversification structures that channel, facilitate, and distort information processing of firms and managers are crucial in the learning and search of firms. This is an important gap. I believe that there is much research opportunity in bringing together these two important theoretical streams.

In view of these aforementioned research gaps, in this dissertation, I will focus on three issues. First, I will look into general patterns of change in response to performance discrepancies

in multidivisional firms. This stream of performance feedback research suggests that negative performance discrepancies lead to search and change, and that bigger discrepancies lead to more distant search and significant changes. Although much research has studied this performance feedback hypothesis, few researchers have looked at how such feedback varies as diversification and the number of divisions increases. This is a crucial gap. Multidivisional firms have been a key construct in strategy research that motivate important theoretical insights (e.g. Prahalad and Bettis, 1986; Rumelt, 1974). In this study, I will look into how this performance feedback pattern varies among firms that are more and less diversified into different divisions. I will focus on a key dimension of change – the exploration and exploitation tradeoff, and look at how the performance feedback, moderated by the firm divisional structure, leads to different exploration and exploitation tradeoffs. I empirically execute this study with the data from power equipment manufacturers that are public listed in the US. The findings from this study shows that firms' divisional structure has a significant impact on how firms respond to performance attainment discrepancies.

After presenting this study on the general patterns of search in firms, I will then present a paper that provides further insight into the search process that leads to change in response to innovation opportunities. BTOF studies show that search is often myopic, simple minded, and goal oriented. However, search often provides a novel opportunity for firms to make changes and innovate. To understand how search avoids myopia, I undertook a grounded field study to look at how companies search and respond to an emerging technological innovation. I use qualitative methods to study how Chinese firms strategize about, and adapt to, blockchain. Because blockchain technology, at the time of my field study in 2018, was viewed as a radical

technology, the pattern of firm adoption poses a great opportunity to study and understand organizational change.

This field work provides the support for two papers in my dissertation. First, building on Posen, Keil, Kim, and Meissner (2018), I show that existing research has largely viewed the search step as a "black box" – there is lack of understanding of what happens during the search process. To help remedy this gap, in the second essay of this thesis, I present a detailed look into the search process. Through grounded study, I document detailed processes detailing how firms use a multiple step search process to reach a solution.

Following the second study, the third study focuses on a better understanding of goals in the search process. In the BTOF, the goal is central in triggering and initiating search that potentially leads to change. But most studies have looked at firm goals as an aggregate, unified construct (e.g. Greve, 1998; Shapira, 2017). But recent studies have started to look into the complexity of goals, and shown that the complexity of goals directly affects how firms search and learn (e.g. Hu and Bettis, 2018). Additionally, during my work on the first two essays of this dissertation, I found that this complexity of goals is intricately related to the complexity of organizations, such as the divisional structure – a multidivisional firm usually has more complex, multiple goals at multiple levels. As a result, my dissertation then looks into the interactions between goal variety and the search for change and innovation. I show that, in a multidivisional firm, corporate goals are developed and interpreted through the lenses of various business and operational units. In this process, corporate goals are specified into detailed business and operational goals. This goal specification process helps firms to match their specific goals with the blockchain technology, which in turn affects the pattern of adoption of the new technology.

My dissertation makes several contributions in the general framework of the BTOF and search perspective. First and foremost, I explores and extends this classic theory in the context of diversified and multidivisional firms. My first study looks at how firm diversification affects the general pattern of performance feedback. I show that firms' response to performance attainment discrepancy varies when the firms are more or less diversified. My second study looks into the "black box" of search, and uncovers a multiple step process of search that might be more typical in complex corporations. My third study further show that diversified firms will inherently have more complex goals and goal structure, which affects how these firms conduct goal-oriented search. My studies also contribute to the study of firms change. Previous studies on firm change have not fully accounted for the organizational structure of the companies. Here I observe that existing organizations tend to be complex, and diversified. This complexity opens an important path of inquiry about the drivers and derailleurs of firm change in the face of technological upheaval.

CHAPTER 2: PERFORMANCE, SEARCH AND CHOICE: AN EXAMINATION OF THE EXPLORATION AND EXPLOITATION TRADEOFF AND FIRM LEVEL DIVERSIFICATION[1]

Introduction

The diversification-risk relationship has a long tradition in strategy research (Rumelt, 1974). Numerous studies demonstrate how levels of organization diversification affects the risk and performance of the firms (e.g. Bettis and Hall, 1982; Haug, Pidun, and zu Knyphausen-Aufseß, 2018; Lubatkin and O'Neill, 1987; Montgomery and Singh, 1984; Van Mieghem, 2007; see Ahuja and Novelli, 2017, for a detailed review). However, these research efforts focus on the ex-post risks of performance variance, based on variance in stock market or accounting measures. We know less about how a firm's diversification structure affects the firms' search strategies related to performance feedback, and the effect of framing on a diversified firm's choices following search.

Several studies suggest that various features of firm diversification do affect risk taking activities. For example, studies show that the M-form structure and control systems of diversified firms can both induce and restrict managerial risk taking at the division level, depending on other organizational variables (Cardinal, 2001; Hoskisson, Hitt and Hill, 1991). Studies also show managerial incentives and equity ownership affect risk taking and R&D spending (Eisenmann, 2002; Hoskisson, Hitt and Hill, 1991). In addition, the organization design literature builds on

[1] This study is coauthored with Professor Rich Bettis and Professor Hugh O'Neill. It has been submitted to the Strategic Management Journal. We are preparing for resubmission to the journal.

the general premise that firm structure affects adaptation and risk taking (Burns and Stalker, 1961; Csaszar, 2013). In this section, I describe how a firm's diversification form – the breadth of their participation in multiple product-market segments – affects the ex-ante risk evaluation before decisions are made. I then analyze how firms (and their managers) perceive and weigh this risk, and how the perceptions influence the firm's level of exploration decisions.

The exploration of new activities is a form of managerial risk taking. Overtime, some level of exploration is crucial for the performance and survival of firms. Although exploitation helps firms with near-term performance, exploration of new technologies and markets are necessary in the long term (March, 1991). But exploring new activities is risky. Both the level of return, and the time necessary to achieve return, are unknown at the time of these decisions. For decades, scholars have analyzed the managerial, organizational, and environmental factors leading to managers' decisions to take risks and explore (e.g. Beckman, 2006; Martignoni, Menon and Siggelkow, 2016; Sørensen and Stuart, 2000). The antecedents of exploration include hierarchy, managerial mental logic, and organizational integration (Andriopoulos and Lewis, 2009; Martignoni, Menon and Siggelkow, 2016; Perretti and Negro, 2006; Taylor and Helfat, 2009). This paper builds on these studies by investigating how a firms' engagement in multiple product-market segments affects the corporate level risk perception and the proportion of decisions to explore new activities.

Exploration and exploitation decisions are fundamental properties of adaptive systems, and an appropriate balance across these two forms of activities is crucial for system survival and prosperity (March, 1991). Traditionally, reinforcement learning has been assumed as the key factor in the exploration versus exploitation tradeoff decision. Under this view, firms exploit their existing competencies when they perform well, and explore new activities and opportunities

only when they do not achieve desired outcomes. Surprisingly, despite the abundance of the exploration and exploitation literature, Lavie, Stettner, and Tushman (2010) and Raisch and Birkinshaw (2008) note that there has been generally a lack of research regarding the performance antecedent of the tradeoff. Studies tend to investigate single decisions within firms, rather than a tradeoff within a set of decisions. The traditional assumption of reinforcement learning has been held despite, or maybe due to, this lack of research across an emerging set of decisions within the firm.

Industry accounts describe a different link between performance and exploration. When firms fall short of desired outcomes, we often observe them streamlining existing processes and cutting discretionary spending, in order to focus on existing competencies. The more exploratory activities, such as technological innovation and new market entry, tend to be initiated by well-performing firms. For example, in response to its underperformance in 2017 Q3, General Electric announced its decision to divest several businesses that drain resources without the prospects of a substantial reward. More recently, General Motors, in response to its strong 2017 earnings, communicated a vision to lead "in the future of mobility" by pursuing opportunities in electric and self-driving vehicles and ride-sharing platforms. These observations show that, for these diversified firms, exploitation follows underperformance, while exploration accompanies good performance. This is opposite the traditional view of the relationship between performance and the choice of exploration. This presents an important puzzle.

In order to resolve this apparent discrepancy between theory and practice, I use prospect theory to analyze the decision process regarding the exploration versus exploitation tradeoff. I first note that perceived risk is a key factor in the choice of exploration versus exploitation (Levinthal and March, 1993; March, 1991; Posen, Keil, Kim, and Meissner, 2018). Separately, in

psychology and behavioral economics, prospect theory is a well-established theory regarding decision-making under risk (Barberis, 2012; 2013). Strategy research has used the insights from prospect theory to some degree. However, while most are familiar with the predictions of risk seeking in loss and risk aversion in gain, the value function and probability weighting function that underpin these predictions have seldom been discussed in strategy research. In particular, the probability weighting function of prospect theory suggests that managers view choices with moderate and high risks differently: risky choices with moderate probabilities of success tend to be underweighted in the actual decisions, while risky choices with very small probabilities of success tend to be overweighed (Kahneman and Tversky, 1979; Tversky and Kahneman, 1992). This difference in weighting results in a reversal of risk attitude when probabilities of success or failure changes from moderate to small (Gonzalez and Wu, 1999; Tversky and Kahneman, 1992). Based on these insights from prospect theory, we propose that the inconsistency between the usual reinforcement learning assumption and the empirical observations is due to the difference in risk perception at the corporate level, which is an aggregate of risk perceptions and responses across the divisions of diversified firms.

I note that there are many different risk levels across decisions in the diversified firm. Corporate managers, when making strategic resource allocation decisions for the overall firm, survey firm-wide information and alternatives, and then make joint, interdependent decisions on a variety of potential choices. These decisions often affect multiple business and functional units. The overall outcomes of these decisions then depend on all joint decisions, which we call decision components in this paper. Later in the paper, I show that the corporate wide probability of success and failure becomes lower than the probabilities of the isolated decision components. According to prospect theory, small probabilities tend to be over-weighted in the decision

process, making potential opportunities more attractive when framed in gain, and potential losses even larger when framed in loss. Carried into the exploration and exploitation tradeoff decisions, I expect that, at the corporate level, managers are likely to choose more exploration in firm strategy when they perform well, and decrease the amount of exploration when they underperform. This prediction may seem obvious but runs counter to the reinforcement learning assumption regarding the exploration and exploitation tradeoff.

I use data from the electric power equipment industry to test my predictions. I choose the quarterly earnings seasons as the empirical background in which top managers receive feedback of firms' immediate previous performance, and decide on broad decision components. I use content analysis to extract key words related to exploration and exploitation in the news releases from these firms during the earnings seasons. My results show that, as the number of business units increases, firms tend to increase the amount of exploration in their overall decisions when they perform above goals, and decrease the amount of exploration when they underperform.

This research contributes to the studies of performance feedback and risk taking, complex strategies, and the exploration and exploitation tradeoff. First, I argue that risk taking due to performance feedback can be understood as a joint function of framing and probability weighting, among other factors. For decades, research on performance feedback and risk taking has focused on the gain and loss framing of recent performance relative to aspirations based on historical performance. Prospect theory further proposes that people subjectively overweight small probabilities. This probability weighting reverses our familiar pattern of risk attitude, resulting in risk seeking in gain and risk aversion in loss when probabilities are small. This research thus establishes the necessity to consider the how probability weighting affects the riskiness of choices at the corporate level when we study decisions due to performance feedback.

Second, this research highlights the need to better understand the firm's strategic posture and the associated resource allocations, which tend to be complex and comprise multiple decision components. Existing research on complex strategies has studied the interdependence of components (e.g. Levinthal, 1997; Siggelkow, 2002) and intractability of these decisions (Bettis, 2017). Later in the paper, using probabilistic calculations and empirical illustrations, I show that the probabilities of complete success or failure at the firm wide level tend to be much smaller than those of the components. As result, firm-level decisions are both much riskier than decisions on single activities but also more robust to complete failure. Due to this non-linear property of complex decisions at the firm level, risk taking of top management may resemble extreme chance taking, which Kahneman and Tversky have termed *gambling in gain and taking insurance in loss* (1979). The finding that diversification increases risk in an ex-ante sense provides some insight into the nuances of the diversification- performance tradeoff, an important issue in strategy. My findings thus suggest the importance of increased attention to complex decision making at the aggregate firm level in strategy research.

Finally, this research contributes to a better understanding of the exploration versus exploitation tradeoff. Previous studies on the antecedents tend to look at the managerial, organizational, and environmental factors that affect the tradeoff. The process of evaluation of the performance antecedent, rarely studied, directly affects the tradeoff between exploration and exploitation. My results show that, at least at the firm-level decision making, there is a positive relationship between performance compared to goals and the extent of exploration. This pattern of exploration and exploitation tradeoff due to performance feedback has important implications for firms' future performance and for the rate of innovation across the economy.

Theory Development

In this section, I will briefly review the literature on the antecedents of the exploration and exploitation tradeoff and discuss the lack of research on variance on how evaluation of the performance antecedent occurs different types of firms. First, I argue that performance feedback theory provides a partial but useful answer to how learning from performance affects the tradeoff decision. Then I introduce prospect theory, particularly focusing on the probability weighting function. Throughout this process, I demonstrate the usefulness of prospect theory in understanding the feedback effect on risky decisions when the decision process is shared through different levels of management. I will show that, in the framework of feedback, search and decision-making, prospect theory nicely complements the traditional behavioral theory that focuses on the relationship between feedback and search. At the end of this section, I summarize the predictions based on the integration of prospect theory with the exploration and exploitation tradeoff decision at the corporate level.

The performance antecedent of the exploration and exploitation tradeoff

Scholars provide a variety of insights regarding exploration and exploitation, such as the antecedents of each form of learning (Martignoni, Menon and Siggelkow, 2016; Taylor and Helfat, 2009), the requirements for an appropriate tradeoff for optimal performance (Benner and Tushman, 2003; Siggelkow and Levinthal, 2003), and their impact performance results (Gibson and Birkinshaw, 2004; Katila and Ahuja, 2002). Among the antecedent studies, scholars have studied how various managerial, organizational and environmental factors affect this tradeoff. For example, Taylor and Helfat (2009) find that organizational communication and coordination affect whether firms successfully explore new technologies. Martignoni, Menon and Siggelkow, (2016) find that managers' mental models affect the extent of exploration versus exploitation.

The research also identifies industry and environment factors in the tradeoff (e.g. Perretti and Negro, 2006; Sørenson and Stuart, 2000). These studies tend to focus on relatively stable managerial and external environmental conditions that affect the tradeoff.

However, as March (1991) pointed out in his seminal paper, organizations learn to make tradeoffs based on feedback and learning from experience. According to March, "organizations learn from experience" to decide how much of their current strategies and activities they want to change. All else equal, as firms do more of an activity and hence become better at it, the return from this activity will increase, and firms are more likely to engage in this activity (i.e. to exploit) in the future. Levinthal and March extend this feedback mechanism as potentially leading to competency and failure traps (1993). Overall, these foundational works suggest that learning from performance feedback is a key mechanism to updating the tradeoff decision from period to period. Surprisingly, very few studies have looked at how performance affects the tradeoff across different decisions (Lavie, Stettner, and Tushman, 2010; Raisch and Birkinshaw, 2008). During my literature review, I only identified a few papers that deliberately link feedback learning with subsequent exploration and exploitation tradeoffs (e.g. Baum, Li, and Usher, 2000; Baum and Dahlin, 2007; Greve, 2007; Lavie and Rosenkopf, 2006).

In addition, among the limited papers that look at how performance feedback affects exploration and exploitation, all measure exploration and exploitation as regard to specific activities on single choices, such as shipbuilding technology (Greve, 2007), acquisitions (Baum, Li, and Usher, 2000), and alliances (Lavie and Rosenkopf, 2006). To the best of my knowledge, no existing studies have looked at how feedback affects organizations' exploration and exploitation tradeoff at the corporate level in large, diversified firms. This gap is crucial. Today, many companies, especially the largest ones, are diversified and multidivisional. CEOs of these

firms make strategic decisions regarding resource allocations among broad activities. The components of these strategies, as well as the resources allocated to each activity, need to be integrated and coordinated to achieve desired outcomes at the firm level. Because of resource constraints some choices may vary from what might be considered desired or optimal in any particular division or business. Current research has generally studied these firm-level decisions in the framework of complex strategies and heuristics (e.g. Levinthal, 1997; Siggelkow, 2002). These strategic decisions, with the challenge of resource allocation across the decision components, determine the corporate directions and future performance, and deserve much research attention. How firms achieve a mix exploration and exploitation choices at the corporate level is an important issue for both the exploration and exploitation literature and for the diversification literature. In this research, I attempt to show how performance feedback as interpreted within disparate units affects the level of exploration and exploitation balance at the corporate level.

Performance feedback and the exploration and exploitation tradeoff

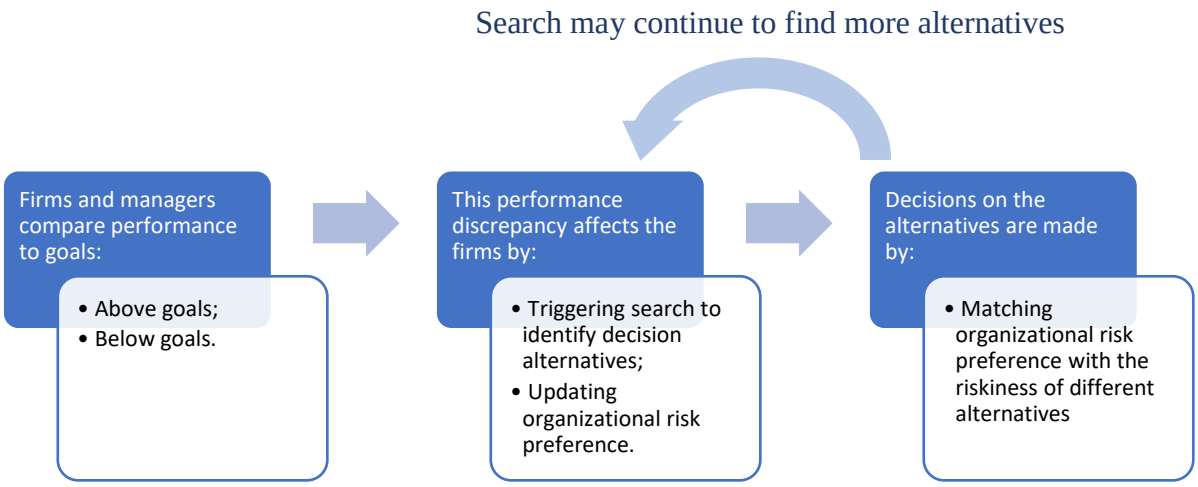
Based on A Behavioral Theory of the Firm (Cyert and March, 1963), performance feedback theory predicts that performance below goals triggers problemistic search that can lead to change. This is usually depicted as a feedback loop: that firms and managers will first evaluate performance as to their goals, the performance discrepancy relative to goals will trigger search, and the search process leads to firm decisions and change (Figure 2.1). This change in the firms will further affect the performance of the next period, leading to further search, decisions, and changes. Hence the feedback learning runs in a looping, repeating, process inside firms. In addition, an abundance of slack can also lead to slack search that may result in change. In this

study, I will focus on the feedback learning process based on performance patterns. This is also usually called the problemistic search.

Broad types of organizational activities have been studied as related to performance feedback, such as new product introduction (Gaba and Joseph, 2013), divestitures (Vidal and Mitchell, 2015), and market entry (Shapira, 2017). Over the years, researchers find performance feedback theory a useful tool to explain firm search and change in response to previous performance.

However, despite substantial research on performance feedback, the theory may understate the role of risk (Denrell, 2008; Kacperczyk, Beckman, and Moliterno, 2015). The Behavioral Theory of the Firm concerns the search for alternatives. Whether this search leads to change, however, depends on the riskiness of potential alternatives and the risk preference of the organization that decides among the alternatives. Thus, the decision depends on how firms and managers, with varied risk preferences, choose alternatives with acceptable risk. If our goal is to understand how performance feedback affects corporate level patterns across decisions, especially risky decisions, we need insight regarding decision-making under risk.

Figure 2.1: A feedback process of search and risky decisions[2]



Prospect theory provides some of this insight (Greve, 2003b; Kacperczyk, Beckman, and Moliterno, 2015). Performance change can lead to both search and risk-taking decisions: performance below goals leads to more search and greater risk taking, and performance above goals leads to a reduction in search and risk taking. This updated approach has been validated in limited cases (e.g. Greve, 2003a; Kacperczyk, Beckman, and Moliterno, 2015). However, since search for alternatives and decision choices are sequential steps, the effects of performance feedback on search and risk taking will likely differ, albeit with possible correlations. In fact, some studies have findings that are *inconsistent with performance feedback theory predictions when risks are obvious in the decision alternatives* (e.g. Eberhart, Eesley, and Eisenhardt, 2017; Hardisty and Pfeffer, 2017; Haliblian, Kim, and Rajagopalan, 2006; Park, 2007). For example, Iyer and Miller (2008) find that the data do not support the hypothesis that performance

[2] Figure 2.1 is similar to Posen, Keil, Kim, and Meissner (2018), except that I emphasize the iterative, recursive process between search and decisions. While search and decision-making are qualitatively different processes, they sometimes overlap. It can be useful to bundle them together for the big picture. In this paper, as Posen *et al.* (2018), I separate them for conceptual clarity and better understanding.

shortfalls lead to more acquisitions. They argue that the mechanisms of performance feedback need further study. Eberhart, Eesley, and Eisenhardt (2017) also observe that when people perceive loss, they are less likely to take a risk; instead, they are more likely to take entrepreneurial risks they perceive as gains. This is opposite to performance feedback theory predictions on risk taking (Table 2.1). These counter examples show feedback revealing poor performance may not lead to greater risk taking. Performance feedback theory is quite useful in predicting search activities, but both the empirical inconsistencies and the theory's lack of detail regarding risk taking suggest the theory may not predict variance in the choice of actions following the search. Particularly in the present empirical study, performance feedback theory alone is inadequate to understand how feedback affects the exploration and exploitation tradeoff at the corporate level.

Table 2.1: Comparison of prospect theory, BTOF, and exploration and exploitation perspectives on search and decision-making

		Prospect theory	BTOF / Performance feedback	Exploration and exploitation tradeoff / reinforcement learning
Trigger Mechanism:		Comparison against reference points, including goals		
Focus Phenomena:		Decision regarding tradeoff of alternatives	Search for alternatives	Decision regarding tradeoff of alternatives; search for alternatives
Predictions:	Above reference point	Risk averse (exploit) when facing choices of moderate probabilities; risk seeking (explore) when facing choices of small probabilities	Slack search	Exploit
	Below reference point	Risk seeking (explore) when facing choices of moderate probabilities; risk averse (exploit) when facing choices of small probabilities	Problemistic search	Explore

Prospect theory and probability weighting

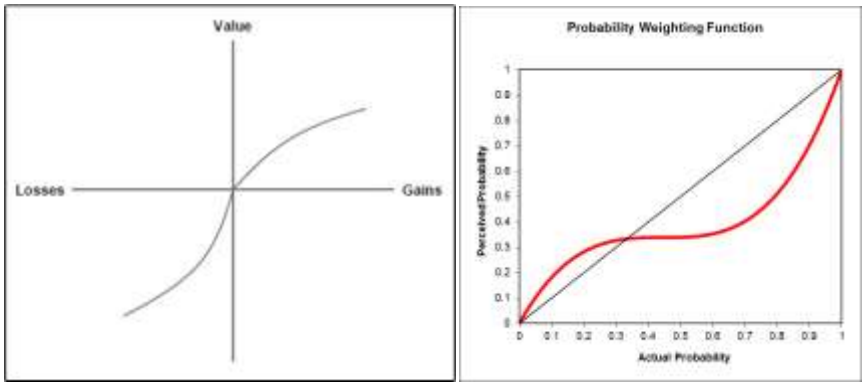
Prospect theory seems a natural fit with performance feedback theory. The two key predictions from prospect theory, that people are risk averse in gain and risk seeking in loss (Kahneman and Tversky, 1979), are widely known. This change in risk preference is explained by the framing effect which occurs as people compare their current position relative to some reference point, including goals. Positive discrepancy makes people risk averse, while negative discrepancy induces risk seeking. These two predictions share apparent similarities with the problemistic search predictions from BTOF.

What has been less obvious, however, are the different phenomena that prospect theory and performance feedback theory (BTOF) try to explain, and the different evaluation criteria. As aforementioned, performance feedback theory concerns the process in which performance change triggers the search for decision alternatives. *Prospect theory, on the other hand, tries to understand how people make decisions when they have a choice.* In studies on prospect theory, the choices with different risk properties are *given* and people make decisions on the *given* choices (e.g. Barberis, 2012; Kahneman and Tversky, 1979; Tversky and Kahneman, 1992; Gonzales and Wu, 1999). As a result, *these two theories seek to explain two different steps after feedback* – search and subsequent choice. These two processes can be iterative, and are both essential to organizational learning and adaptation (Figure 2.1).

More importantly, prospect theory further proposes an evaluation criterion that considers both the value and probability of alternatives. In performance feedback theory, managers and organizations compare their performance with a reference point, usually their previous performance or goals. This discrepancy, if any, drives firms to search and, potentially, change. *However, prospect theory further proposes a two-step process of evaluation in which people subjectively evaluate the values and probabilities of choices.* Then a subjective weighted value is

calculated as the product of the subjective value and subjective probability. The value transformation function is denoted V(x), that is, the choice with objective value x is transformed by some function V. The probability transformation function is denoted W(p), that is, the choice with objective probability p is subjectively weighted by some function W. This results in a decision criterion of the product of the two: V(x)W(p) (Kahneman and Tversky, 1979; Tversky and Kahneman, 1992). Kahneman and Tversky named these two functions as the *value function* and the *probability weighting function* (1979). The key insight from the value function is loss aversion and decreasing sensitivity to large gains or losses. This results in an *S-shaped* value function that is steeper for losses than for gains (Figure 2.2a). The key insight from probability weighting is that people overweight small probabilities and underweight moderate to high probabilities (Abdellaoui, 2000; Barberis, 2013; Bruhin, Fehr-Duda, and Epper, 2010; Kahneman and Tversky, 1979). This transformation can be illustrated by an *inverse S-shaped* curve (Figure 2.2b). Further details of the probability weighting are provided in Appendix 1.

Figure 2.2: Value function and probability weighting function (adapted from Kahneman and Tversky, 1979; Tversky and Kahneman, 1992)



a b

I illustrate the combined effects of the value function and probability weighting function through examples. In Table 2.2, I have four pairs of choices. In each pair, there is a risky one (Choice 1) with objective probability of occurrence of either 50% or 10%. Hence the probability of not occurring is 50% or 90%. In each pair, there is also a less risky choice (Choice 2) with probability of 90%. These probabilities represent the risk underlying each choice. I also assume that the objective value of an event not occurring is zero. Hence all eight choices have objective weighted value of positive or negative 5. This ensures that the choices have a comparable objective basis.

Table 2.2: Subjective weighted value as the product of subjective value and subjective probability.

	Choice 1 (Risky Choice)						Choice 2 (Sure Choice)						Choice with higher weighted value	Implication for risk attitude
	Obj. value	Obj. prob.	Obj. weighted value	Subj. value	Subj. prob.	Subj. weighted value	Obj. value	Obj. prob.	Obj. weighted value	Subj. value	Subj. prob.	Subj. weighted value		
Moderate probabilities vs. high probabilities														
1)	10	50%	**5.00**	7.6	42%	**3.19**	5.26	95%	**5.00**	4.3	79%	**3.42**	Choice 2	Risk averse in gain
2)	-10	50%	**-5.00**	-17.1	45%	**-7.75**	-5.26	95%	**-5.00**	-9.7	85%	**-8.25**	Choice 1	Risk seeking in loss
Low probabilities vs. high probabilities														
3)	50	10%	**5.00**	31.3	19%	**5.83**	5.26	95%	**5.00**	4.3	79%	**3.42**	Choice 1	Risk seeking in gain
4)	-50	10%	**-5.00**	-70.4	17%	**-11.97**	-5.26	95%	**-5.00**	-9.7	85%	**-8.25**	Choice 2	Risk averse in loss

*Calculations are based on Tversky and Kahneman (1992).

An important source of variance in choice is based on how managers subjectively view these values and probabilities. Tversky and Kahneman have estimated the parameters of the functions V and W (1992). Subsequent studies used more advanced parametric and non-parametric methods to estimate the parameters, with qualitatively similar results (Abdellaoui, 2000; Bruhin, Fehr-Duda, and Epper, 2010; Gonzales and Wu, 1999). Assisted by these studies, we can calculate the subjective weighted values of alternatives – the decision criterion according to prospect theory.

In the first two pairs of choices (Set 1 and 2 in Table 2.2), the risky choices have moderate probabilities of 50%. I calculate subjective weighted values using parameters from Tversky and Kahneman (1992). The calculations show that, in gain, the values of both risky and sure choices are adjusted lower due to the mirror effect of loss aversion, but risky choice is adjusted downward more due to its higher objective value and decreasing sensitivity (from 10 to 7.6 versus from 5.26 to 4.3 in the sure choice). We also see that the probabilities of risky choices and sure choices are both underweighted. In loss, both risky and sure choices' objective values are transformed further downward (more negative) to allow for loss aversion. Due to decreasing sensitivity and the fact that risky choice has lower (more negative) objective values, the reduction of subjective value in the less risky choice is more pronounced (from -5.26 to -9.7). Comparing these two sets of choices, we find that: in gain, the less risky choice has higher subjective weighted value; in loss, the risky choice has higher (less negative) subjective weighted value. If managers follow the decision rule of choosing the alternatives with higher subjective weighted values, they will appear to be risk averse in gain and risk seeking in loss. In the second two pairs of choices (Set 3 and 4 in Table 2.2), the risky choices have much lower probabilities. This is compensated by higher values, which results in the same objective weighted value as

basis of comparison. Here we find that: in gain, the risky choice has higher subjective weighted value; in loss, the less risky choice has higher (less negative) subjective weighted value. If decision makers choose the alternatives with higher subjective weighted values, they will appear to be risk seeking in gain and risk averse in loss.

In summary, prospect theory predicts that when the probabilities of risky choices are moderate, people are risk averse in gain and risk seeking in loss; however, *when the probabilities of risky choices are small, people are risk seeking in gain and risk averse in loss. This reversal due to probability weighting has been noted by studies in behavioral economics* (Barberis, 2013; Rottenstreich and Hsee, 2001; Gonzales and Wu, 1999), and most notably by Tversky and Kahneman when they formalized the "fourfold pattern of risk attitudes" in a later paper (1992). Since firms, and managers across firms, make decisions with varying degrees of risk, this has important implications for research on corporate level decisions. This reversal based on probability weighting may help to explain some of the inconsistencies in empirical research on performance feedback. For example, in Eberhart, Eesley, and Eisenhardt (2017), the probability of successful startup in a traditional society like Japan is likely very small, and potential entrepreneurs may be risk seeking in gain and risk averse in loss in this case. Prospect theory, with its value function and probability weighting function, gives more nuanced realism to our understanding of decision-making under risk. The weighting function illustrated here has a direct influence on the pattern of emergent choices in diversified corporations.

Risk and the exploration and exploitation tradeoff

When managers make the exploitation and exploration tradeoff, they choose between the known and less known, and between using their existing competencies and developing new capabilities. Exploitation appears less risky; therefore, these choices will have expected

outcomes with high probability. For example, firms know the needs of current customers, the strengths and weaknesses of competitors in current markets, and the technologies that work in these markets. They often possess the skills and knowledge to stay in competition and survive.

Conversely, exploration tends to be riskier, which prompts estimates of lower probability. For instance, the needs of new customers are less well known, particularly if the customers are in a different market or segment. The motives and strategies of potential competitors in a new market less predictable. Technologies are less mature. The development of new knowledge and skill takes time and effort, with the outcomes uncertain. In fact, how firms make these tradeoffs is as much a question about the old versus new as about risks (Levinthal and March, 1993; Posen, Keil, Kim, and Meissner, 2018). Hence the pattern of exploitation and exploration decisions emerges from the interaction of risk perceptions across the managers within the firm. Prospect theory, as a theory of decision-making under risk (Kahneman and Tversky, 1979; Tversky and Kahneman, 1992) explains a wide range of risky decisions (Barberis, 2012; 2013), such as the decisions made in diversified firms.

The levels of risk vary across the high-risk choices, as well as across low risk choices. The risk difference between risky and less risky choices is obvious. For example, in empirical research, the difference between risks versus certainty has usually been measured as a clear demarcation of change versus no change, since change itself is risky (Greve, 1998). Risky choices have been further gauged as related to activities such as R&D (e.g. Lim and McCann, 2013), new product introduction and market entry (e.g. Shapira, 2017), and entrepreneurship (e.g. Eberhart, Eesley, and Eisenhardt, 2017). In typical research, risky choices can be measured as regard to almost any organizational activity.

But each risky choice may represent a different level of risk. For example, *a risky choice with 70% probability of success surely feels different from another one with 10% probability of success*. When R&D expenses are used for enhancing existing technologies, rather than developing new ones, the probability of success can differ greatly. New product introduction, a risky decision, has an average success rate of 60% but the risk changes between incremental upgrades and entirely new product categories (Castellion and Markham, 2013). In the aforementioned psychology and behavioral economics literature, risky choices have ranged from those with success probabilities between 0.1% and 80% (Kahneman and Tversky, 1979; Tversky and Kahneman, 1992; Gonzales and Wu, 1999). This variance within categories of risk suggests that there is as much difference regarding risk within exploratory choices as between exploratory and exploitative choices. Therefore, the study of performance feedback effect on the exploration and exploitation tradeoff across a set of decisions within the firm requires attention to the impact of the variance in risk levels associated with these activities.

Empirical papers on performance feedback and exploration and exploitation tend to focus on specific activities, such as product introduction, R&D and market entry. These are important exploration and exploitation choices that form firms' day-to-day decisions. However, March cautioned that the tradeoff decisions "occur at levels of a nested system" (1991). The issue of how risk perceptions affect tradeoff at the top level of the nested system, i.e. the corporate level, is important, and understudied. These corporate, firm-level, joint decisions determine how resources are allocated and used between divisions, and hence the direction of the firms. For example, a corporation may choose a five-pronged strategy for the next fiscal year: entering an emerging market, adopting a new technology, forming alliances, reorganizing for greater effectiveness and efficiency, and filling a few key managerial positions to manage the market

entry, technology adoption and alliances. The firm then allocates financial and human resources among these five different yet interdependent activities. This configuration of exploration and exploitation choices, with resulting resource allocation, determines firm strategy. In a qualitative study of Vanguard, Siggelkow vividly illustrates this configuration of interdependent decisions at the firm level (2002). The *aggregate* of these decisions *jointly* determines the strategy of the firm. Firm success depends on the success of combinations of these activities.

Paradoxically, a strategy of joint decisions tends to have small probabilities for both full success and complete failure. This may seem counterintuitive, but can be easily shown with probability theory and real-world examples. Company performance included both successes and failures. For example, Vanguard's success is built on the success of multiple decisions regarding the organizational structure, costing, distribution, etc. (Siggelkow, 2002). Similarly, Nokia's downfall is not due to the failure of one decision, but failures of multiple decisions in the strategic configuration, such as product innovation, reorganization and platform transitions (Doz and Wilson, 2017). The ascent and near collapse of Uber as an investor darling demonstrates both great success and catastrophic failure across successive decisions.

We can model a pattern of outcomes based on the above five-pronged strategy. Since all activities are risky in their own right, we assume moderate probabilities of success for each of them, say, 50%. When firms make decisions on them individually, 50% will be the objective probability for each of them. But when firms make decisions with multiple components, the success depends on the success of all decisions. *If we assume that the success of each activity is independent of the success of others, the probability of the overall success is 50% to the power of five, 3.125%.* As a result, the success probability of joint decisions becomes much lower. Strategies of joint decisions also have low probability of complete failure, since it is quite

unlikely that all activities fail. In the above example, to have a complete failure, we need all five prongs to fail, which has a probability of, again, 3.125%. As a result, the probabilities of success and failure are very small at the aggregate, firm level compared to the probabilities of their individual components. In studying risk taking at the corporate level, we need to pay attention to how these aggregated probabilities which, perceived as small due to the interactive effects, may affect managers' perception differently than large probabilities. This will help us understand how beyond gain and loss framing, the influence of weighing probabilities across choices affects the exploration and exploitation tradeoff at the firm level. Further details on probability aggregation are provided in Appendix 2.

Summary of theory and predictions

We now apply prospect theory to the exploration and exploitation tradeoff patterns in a corporate arena. As firms receive feedback of previous performance, they frame the outcomes as gain or loss by comparing them with reference points. Framing of loss triggers problemistic search, as performance feedback theory suggests. Search may also follow from gain, based on slack search and institutionalized search (Greve, 2003b). In the next step, the gain or loss framing affects how managers, when making decisions for the next period, view the search results and alternatives. Given recent success, they tend to view some risks in a positive light, as opportunities. In case of loss, they may view exploitation alternatives more negatively, as potential losses, and may favor exploration. In both cases, they subjectively view the values and probabilities of these choices. Managers then choose alternatives, and as these choices aggregate into a corporate level set of decisions, a configuration of alternatives, based on subjective weighted values. According to the calculations in Table 2.2, we expect that, when performing above goals, firms will explore less when the success probability of the more exploratory choice

is moderate, mainly due to underweighting of moderate probabilities that makes the subjective value of the exploratory choice lower; but we expect firms to explore more when the probability is small, due to overweighting of small probabilities that results in higher subjective weighted value. Conversely, when below goals, firms will explore more when the probability of loss for the more exploratory choice is moderate and underweighted, but explore less when the probability is small and overweighed.

> Hypothesis 1: as firms become more diversified with more divisions, both risks and rewards are diluted, resulting in the general pattern that more diversified firms take less risk and exploration activities in their overall activities, regardless of performance.

> Hypothesis 2a: due to the higher compound probabilities from more divisions resulting in underweighted gains, firms with higher numbers of divisions decrease their levels of risk taking and exploration activities in their overall activities when performing above goals.

> Hypothesis 2b: due to the higher compound probabilities from more divisions resulting in underweighted loss, firms with higher numbers of divisions increase their level of risk taking and exploration activities in their overall activities when performing below goals.

So far in this paper, we have used prospect theory to analyze how corporate firms make risky decisions. We show that the probability of complete success or failure of joint decisions at the firm level is small. Based on the framing effect, value function and probability weighting function, we illustrate that, at the corporate level where probabilities of total success or failure are very low, firms are likely to be risk seeking in gain and risk averse in loss when choosing between alternatives with similar objective weighted values. At a result, they are more likely to increase exploration in the strategic configuration when they outperform their goals, and decrease exploration when they underperform. In the next section, I will detail the empirical strategy to test these predictions.

Empirical Design

Industry setting

The industry setting for this research is the electric power equipment industry. This industry develops, designs, manufactures, and sells electric power equipment to utilities, oil and gas companies, renewable energy companies, governments, and end-users. Many multinational conglomerates compete in this industry, such as GE, Siemens and Schneider Electric. The electric power equipment industry is a crucial portion of the competitive landscape of in the global economy.

In this industry, companies frequently choose between exploring new opportunities and exploiting existing competencies. The companies face tradeoffs between capital investments for capacity expansion to increase market share during an economic expansion, versus maintaining current capacity for safety during a contraction. There are frequent risky decisions about technology, customers, and market. Because new forms of energy production rely on immature technologies and undefined markets, investments in capital and human resources in these new technologies often fall short of desired outcomes. In addition to these specific areas of tradeoff, top managers need to make the tradeoff based on the corporate level strategic configuration. As unit level choices pass through the corporate level review process, the tradeoffs between exploration and exploitation leads to aggregate risk profile, a profile which includes both forms of choices.

I use Corporate Affiliations to identify the U.S. public companies associated with the NACIS codes of power generation, transmission, distribution, and storage manufacturing. To ensure the comparability of performance and learning context, I focus on the companies listed in the New York Stock Exchange and competing mainly in the U.S. market. The final sample

includes 22 companies with quarterly data from 2005 to 2018 calendar 2nd quarter, a total of 911 firm-quarter observations. Table 2.3 shows descriptive statistics and correlations.

Table 2.3: Descriptive statistics and correlations

Variables	Mean	S.D.	Exploration ratio	Perf. change	Perf. change, squared	Slack	Slack, squared	Log age	Log asset	US power generate	US GDP growth	Sales per employee	CEO change	4th Qr	M-form (div)
Exploration ratio	0.37	0.16	1.00												
Performance change	0.18	1.68	0.05	1.00											
Performance change, squared	2.84	11.97	-0.06	0.37	1.00										
Slack	2.04	0.65	0.17	0.05	0.06	1.00									
Slack, squared	4.59	3.07	0.16	0.04	0.04	0.98	1.00								
Asset, logged	4.19	0.70	-0.16	-0.02	-0.05	-0.41	-0.37	1.00							
Age, logged	8.63	1.84	0.00	0.02	0.00	0.10	0.09	0.07	1.00						
US power generation, lagged	1.02	0.07	0.08	0.05	0.04	-0.03	-0.03	0.00	-0.02	1.00					
US GDP growth, lagged	1.47	2.47	0.10	0.14	-0.05	0.03	0.03	0.01	0.04	0.02	1.00				
Sales per employee	0.07	0.03	-0.02	0.05	0.04	-0.22	-0.16	0.51	-0.07	0.03	0.04	1.00			
CEO change dummy	0.02	0.12	0.04	-0.01	-0.01	-0.03	-0.04	-0.04	0.02	0.04	-0.01	0.00	1.00		
4th quarter dummy	0.24	0.43	0.03	0.04	0.07	-0.02	-0.01	0.00	-0.01	0.95	0.07	0.02	0.03	1.00	
M-form (#of divisions)	3.21	1.54	-0.13	-0.04	0.07	-0.42	-0.36	-0.14	0.75	-0.00	-0.00	0.49	0.01	0.01	1.00

*n = 911

The exploration and exploitation tradeoff in response to quarterly feedback

To observe feedback and the consequent choices, I focus on the news releases from the firms during the quarterly and annual earnings seasons. The quarterly earnings report is a quarterly filing made by public companies to report their performance, including sales, net income, earnings per share, etc. The annual report is filed for each fiscal year in a more comprehensive manner. These earnings reports are an integral component of companies' management feedback and control systems (Simons, 1994). They are usually followed by news releases that document managerial response to firm performance. These releases document managerial decisions on many dimensions, and provide a way of assessing the patterns in the exploration and exploitation tradeoff. In addition, because managers make these decisions in direct response to the immediate past performance, the earnings releases can be an ideal setting to understand whether and how performance feedback affects decision-making.

For example, in response to GE's fiscal year 2015 Q1 performance shortfall, Jeff Immelt, then CEO of GE, announced in the earnings release that:

> "We have laid out a clear plan to reshape GE for the future. We will reduce the size of our financial business through the sale of most GE Capital assets over the next 24 months... and we will continue to invest in our competitive advantages built on the GE Store. We will continue to boost margins and returns. This is the plan for the future of GE as a fast-growth, high-tech industrial company." (ge.com)

By reducing non-core financial business, investing in existing advantages and capabilities, and drawing attention to margins and returns, GE's response to poor performance is an emphasis on exploitation, balanced by some exploration in high-tech. In this research, I use earnings releases to obtain a timely snapshot of the tradeoff across decisions in response to performance feedback from the immediate past quarter.

The use of earning releases provides further advantage. Previously, I discussed that search and decision-making are sequential processes (Figure 2.1). In reality, these two steps overlap and iterate. I observe that earnings releases have become rituals for the communication between public companies and their investors, and as a result, search is institutionalized. At the end of each quarter, after receiving performance results, managers are held responsible for leading the firms forward with strategies and decisions, regardless of whether performance is above or below goals. In both cases, managers search for the alternatives in response to the quarterly feedback, make decisions, and communicate these decisions to investors. The rituals of earnings seasons lead prompt search, and the news releases inform investors about decisions. These earnings release thus provides a suitable setting to study decision-making in response to performance feedback.

Measurement of the exploration and exploitation tradeoff

The process of matching the theoretical concepts of exploration and exploitation with specific decisions is difficult. Researchers must define suitable activities, and assess the extent of "newness" to make an activity exploration instead of exploitation. Past research measured exploration and exploitation based on specific activities, such as alliances (Lavie and Rosenkopf, 2006) and acquisitions (Baum, Li, and Usher, 2000). This focus on specific activities help us understand adaptation in specific activities, but the research emphasis on "distinctive phenomena with the unifying lens of exploration-exploitation framework" causes difficulty in synthesizing findings (Lavie, Stettner, and Tushman, 2010; Uotila, Maula, Keil, and Zahra, 2009). In this study, because my goal is to assess tradeoffs at the aggregate firm level, I need an alternative measure.

Other studies have used surveys, case studies, and content analysis to measure exploration and exploitation at the firm level (e.g. He and Wong, 2004; Jansen, Tempelaar, Van den Bosch, and Volberda, 2009; Uotila, Maula, Keil, and Zahra, 2009). These studies use single measures to cover broad activities, such cost reduction, process management, first-mover positioning, new markets, and new technologies. This paper follows and extends this approach. I use content analysis to measure exploration and exploitation in earnings releases. Similar to Uotila, Maula, Keil, and Zahra (2009), I count the numbers of exploration and exploitation expressions based on predefined dictionaries, and divide the number of exploration expressions by the total of exploration and exploitation expressions. This ratio measures the extent of exploration in firms' strategic configuration.

The main difference between this paper and Uotila, Maula, Keil, and Zahra (2009) is the use of dictionaries, that is, lists of common words that are often associated with exploration or exploitation. Uotila, Maula, Keil, and Zahra (2009) used the words directly from March (1991): search, variation, risk taking, experimentation, play, flexibility, discovery, and innovation for exploration; refinement, choice, production, efficiency, selection, implementation, and execution for exploitation. This use of words from the seminal paper is consistent with the original concepts in March (1991). However, decades have passed since the original paper, during which new words have been added to corporate vocabulary. I found it necessary to develop up-to-date dictionaries to capture firm decisions regarding exploration and exploitation in better detail.

To build the dictionaries, I generally followed the suggestions from McKenny, Aguinis, Short, and Anglin (2016) and Short, Broberg, Cogliser, and Brigham (2010). I first identified the highly-cited papers on exploration and exploitation, including theoretical and conceptual papers, review articles, and empirical papers. We identified 23 such papers. Though there are many

more, these papers in total have over 66,000 citations as of end of 2017 in Google Scholar, and these represent the best work on this topic. First, a coder thoroughly reviewed each of these articles and compiled the words related to exploration and exploitation. This process was repeated several times until no additional words could be added to the lists. Second, the coder read sample earnings releases (85 releases, 11% of the sample) to find additional words used by companies but may be colloquial and not used in academic writing. Most of these words are synonyms, such as "spinoff" for "divestiture," and "product launch" for "product introduction." At this point, I had two lists: one for exploration and one for exploitation. Then I mixed all them, and asked a second coder, a senior professor in strategic management, to blindly review all words and rate their relevance to exploration and exploitation. The agreement between the first and second coders was 79%. Then the first and second coders discussed and reached an agreement on the final dictionaries. In the next step, I surveyed eight doctoral students in a top-20 business school in the U.S. The survey resulted in 88% agreement. While the measures of exploration and exploitation will always, like other measures of theoretical concepts, be subject to individual judgement, I feel that the dictionaries are comprehensive and suitable for this empirical setting. This dictionary captures the exploration versus exploitation tradeoff of sample companies to a reasonable extent.

I took additional steps to ensure validity. I used a computer program to search for exploration and exploitation words in the earnings releases, using dictionaries from the first coder and the final agreement. Then I calculated the ratio of exploration words over the sum of exploration and exploitation words with these two sets of dictionaries. The correlation between the two sets of ratios is 0.99. The high correlation suggests that the words that were not initially agreed upon are also low-frequency words and do not significantly affect the measurement of the

dependent variable. I further checked the predictive validity of the ratios on several dimensions. Since exploration is traditionally associated with R&D activities, I regressed firms R&D expenditure amount on lagged exploration ratio. In addition, exploratory choices, such as new products or new markets, often involve adding employees and assets, while exploitative choices, such as restructuring and productivity improvement, are often associated with the reduction of employees and assets. So, I also regressed logged asset amount and logged employee counts on lagged exploration ratio. Most of these validity tests show positive, statistically significant relationships. This supports the dictionaries, as well as the ratio approach to measure the exploration and exploitation tradeoff. The dictionaries are in Appendix 3.

The dependent variable was then be calculated after the word counts of exploration and exploitation decisions, based on the dictions. The DV of this study is the degree of exploration and risk taking by firms in each quarter. This is a ratio – the proportion of exploration decisions divided by the total number of exploration and exploitation decisions, as found in the firms' quarterly and annual earnings releases.

Independent and control variables

The main independent variable is the patterns of performance change relative to goals, including both the ups and downs of performance changes. I use ROA as an indicator of performance. ROA is a composite measure of firm performance, hence suitable for this study of compound decision-making at the firm level. I adopt the "natural aspiration level" approach (Greve, 2003b) in the calculation of performance change. When reading the earnings releases, there is direct evidence that firms compare their current performance with their performance of the same quarter of the previous year. In these releases, the central focus is the difference from firms' own past performance. I calculate the percentage changes of ROA of the current quarter

from that of the same quarter of the preceding year. I added algebraic and quadratic terms sequentially to model potentially nonlinear relationship between performance change and the tradeoff. I use the number of product divisions (M-form) as the measure of extent of diversification.

I control for several variables that may also affect the exploration versus exploitation tradeoff. Since Cyert and March (1963), research has generally found that slack affects firm innovation. Similar to Nohria and Gulati (1996) and Gaba and Joseph (2013), this research uses the "more easily deployable" available slack. Also the abundance or lack of opportunities may affect firms' willingness to explore. Especially, my data span 2005 to 2018, which includes the great depression of 2008 to 2010 that the economic opportunities are significantly different. To control for these opportunities due to the broad economic changes, I used two variables to control for opportunity shifts: the amount of U.S. electric power generation in trillion kilowatt-hours of each calendar quarter, and U.S. quarterly GDP growth, both lagged by one period. The natural logs of firm size and age are among the control variables. I further control for different strategic positioning of each firm, which is approximated by sales per employee, a suitable measure in this industry. Furthermore, given that CEOs are important figures in post-earnings decisions, I use a dummy variable to control for the change of CEO. Finally, there is greater investor scrutiny and managerial attention on year-end results, so I include a 4th quarter dummy as an additional control variable.

Results and Robustness

Regression results

Because I have a long panel dataset, in which the number of periods is more than the number of firms, I use the *xtgls* command in Stata to estimate the parameters. *xtgls* models

autocorrelation within firms and allows for heteroscedasticity between firms, hence is suitable for the data (Cameron and Trivedi, 2010). I first enter all control variables (Model 1), and then add explanatory variables. After estimating the full data with the M-form variable (Model 2), I separately estimate the parameters using data of performance above and below goals (Model 3 and 4). The results are presented in Table 2.4.

Table 2.4: Panel-Feasible GLS regression results

DV: logged exploration/(exploration+exploitation) ratio

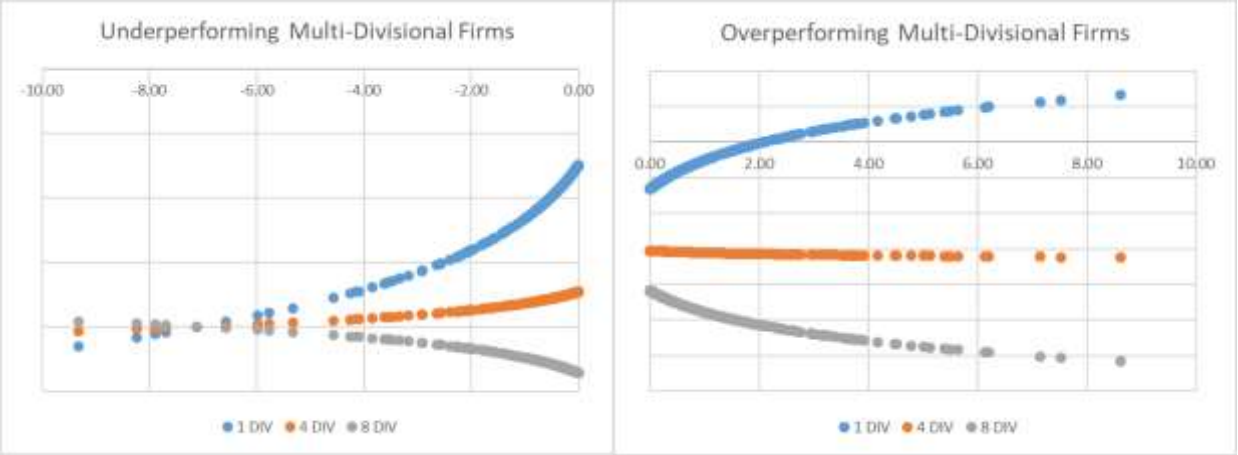
	1	2	3	4
VARIABLES	Only control variables	M-form hypothesis	Positive performance change	Negative performance change
Mform, logged		-0.0609**	-0.0436	-0.104***
		(0.0252)	(0.0326)	(0.0305)
Positive performance change, logged			0.0388	
			(0.0373)	
Positive performance change x Mform			-0.0248	
			(0.0262)	
Negative performance change, logged				-0.0979***
				(0.0362)
Negative performance change x Mform				0.0522**
				(0.0236)
US Power Generation, logged	0.0437	0.0449	0.00741	0.0714
	(0.0329)	(0.0328)	(0.0493)	(0.0516)
US GDP Growth, logged	0.00810*	0.00829*	-0.00829	0.0125**
	(0.00446)	(0.00445)	(0.00766)	(0.00559)
Sales per employee	0.243	0.394**	0.381*	0.299
	(0.156)	(0.170)	(0.209)	(0.190)
Employee, logged	-0.0115***	-0.000668	-0.00299	4.81e-05
	(0.00418)	(0.00566)	(0.00710)	(0.00585)
Age, logged	0.00187	-0.00391	-0.00775	-0.00399
	(0.00762)	(0.00784)	(0.0102)	(0.00855)
CEO Change	0.0442**	0.0450**	-0.0169	0.0632**
	(0.0198)	(0.0198)	(0.0435)	(0.0271)
Q4	-0.00449	-0.00501	-0.0101	0.0120
	(0.00571)	(0.00570)	(0.00819)	(0.00893)
Constant	0.265***	0.329***	0.377***	0.377***
	(0.0478)	(0.0556)	(0.0777)	(0.0753)
Total firm-quarter observations	872	872	445	427
Number of firms	22	22	22	22
Standard errors in parentheses				
*** p<0.01, ** p<0.05, * p<0.1				

Most control variables are estimated as expected. The coefficients of slack, power generation, GDP growth and change of CEO are mostly statistically significant and positive. This suggests that they are positively related to the extent of exploration in firms' overall decisions. Larger firms explore less, a result that is consistent with inertia theory. In addition, companies that make higher value products seem to explore more. I notice a difference from existing theory as older firms seem to explore more. This inconsistency with the inertia theory has been documented by several studies (Baum and Shipilov, 2006). While older firms like GE and Siemens are diversifying and exploring the frontiers of new technologies and markets, younger firms have sprung up to supply products of limited scope in focused markets. Concurring with Baum and Shipilov (2006), theories on age dependence deserve more study.

Next, I look at the key explanatory variable of performance relative to goals (performance change in Table 2.4). Since I have second-order terms in the models, I graph predicted exploration ratio over performance change to visually examine the relationship (Figure 2.3). Based on the results table and particularly the graph, there is a positive relationship between performance change and exploration when performance is below goals. This suggests that as performance drops below goals, managers are likely to decrease exploration. When performance is above goals, the relationship is inverse U-shaped. This suggests that as performance increases above goals, managers are likely to increase exploration; but the amount of exploration drops as performance is significantly above goals. Given the sparse data to the right of the turn point, the validity of this drop is questionable. Particularly, the model with full data has a very shallow arch. Based on both models, it appears likely that as firms have better performance, they increase exploration, but exploration will eventually plateau when exploration is too high. Overall, the

predictions based on prospect theory are supported: at the corporate level, firms are likely to explore more when they outperform their goals, and explore less when they underperform.

Figure 2.3: Actual performance changes against predicted exploration



The x-axis is actual performance. The y-axis is the predicted exploration in the overall decisions, excluding the effects of all control variables and the constants.

Robustness

I took several steps to ensure the robustness of the empirical design and results. First, before and during the course of this study, I personally experienced and closely observed the earnings seasons for several years. In these years, which included dozens of earnings seasons, I observed the performance of public listed firms, managerial decisions and investor responses. These observations confirm that the earnings season gives us one of the best contexts to study the effects of performance feedback on managerial decisions. To ensure the accuracy of the tradeoff measure, I used a combination of procedures, including additional coders, surveys, and interviews with industry insiders, and validations with alternative measures. These procedures have been detailed in the empirical design.

Second, I consider the statistical and causality concerns that are typical in strategy and organizational research. I used the *xtgls* command in Stata, which is suitable for long panels. Because my dataset has 22 firms and a maximum of 46 periods, and the firms in the industry differ greatly, I had concerns about autocorrelation and heteroscedasticity. The *xtgls* command models both of these processes and are suitable for my data (Cameron and Trivedi, 2010). To prevent the possibility of reverse causality, I lagged the earnings releases after the time when performance occurred. In addition, to better understand the causal story, I interviewed insiders of two firms in this industry. For example, a CEO of a global firm commented that they "usually don't explore unless doing really well." These qualitative checks further confirm the findings.

Finally, I consider the issue of generalizability. This research probed a mature industry. This is an industry in which managers care about survival as well as performance, and investors expect profits and dividends. This differs from nascent industries in which profits are yet to be made and founders look for buy-out opportunities. Therefore, I do not assume that the findings apply equally to these industries. However, the focus on a specific industry adds several advantages. First, this provides a clear context to delve into and understand the numbers. This is almost impossible when the number of industries is large. The deep understanding of the feedback context helps us build theory when existing theories are lacking as regard to the effect of feedback on corporate wide level of exploration and exploitation. Second, given the importance of this industry and the large players in this industry, a good understanding of this industry clearly gives us a better view of the competitive landscape in this important industry. In addition, as nascent industries get older, this analysis will apply to them. The learning and adaptation patterns of firms in the power equipment industry sheds some light on what newer industries face in the coming decades.

In summary, I have taken careful steps to ensure the robustness of this study. The empirical setting is valid for the theoretical question of feedback and decision-making, and the empirical design provides insight into the exploration and exploitation tradeoff decision at the firm level. While the industry focus may limit some generalizability, it helps us gain deep insight into the feedback and decision-making process, and shed light on the framing of corporate level decisions.

Discussion

In this study, I look at how the firms' breadth of diversification affects their learning from experience and subsequent decisions on change and risk taking. I find that, with increased diversification, the risk at the firm level changes due to compounding probabilities. As a result, the firms learn to respond to feedback from previous performance in different ways, based on their diversification. I observe risk avoidance in gain and risk taking in loss for highly diversified firms, but vice versa for undiversified firms. Both the findings and my analytical approach have important implications to strategic management.

M-form firms and decisions of change

Insights from the BTOF on firm response to feedback suggests firms and managers tend to exploit when things work, and explore only when current knowledge or processes do not lead to desired outcomes. My findings suggest important nuances to this traditional view. Based on the existing diversification strategy and structure, there are great differences between firms in their exploratory, risk-taking decisions.

Some existing studies have suggested that, as firms diversify and their structures become different, there are differences in feedback learning and risk taking. For example, Gaba and Joseph (2013) studies how the corporate and business levels of the same firms might learn

differently from previous performance patterns, based on a sample of mobile handset manufacturers. They found that the corporate level and business unit level respond to negative performance feedback quite differently: while the business unit tends to increase their new product introduction, the corporate level responses are a decrease of new product introduction. In another study, Vissa, Greve, and Chen (2010) found that the business units in India that are affiliated with large corporations are more externally oriented in goal setting and more likely to respond to low performance compared to competitors. In general, these studies show that diversified firms under a corporate structure exhibit different feedback learning and risk taking.

Following some of these earlier insights, my results further show the importance of understanding feedback learning and decisions within the nested levels in corporate firms. The past work on performance feedback and exploration and exploitation, especially the empirical studies, has largely focused on specific decisions as related to R&D, innovation, alliances, etc. The work investigates the firm search, decisions and risk taking about specific decisions, leading to the conclusions that are well known. However, in this study, I turn to corporate level decision-making across a range of decisions, where the emergent set of choices form a composite that included exploratory and exploitative choices. These corporate level decisions blend evaluations across multiple activities, BUs, and functions. Due to this compounding as these decisions filter up the hierarchy, the probabilities of the corporate level decisions are generally lower than those of the components.

The difference in levels and patterns of exploration and exploitation is not trivial. For decades, strategy scholars have studied the counter-intuitive effects of decision aggregation. Mintzberg showed that firm strategies often arise as an emergent process with the outcomes different than those from individual, lower components (Mintzberg, Raisinghani, and Theoret,

1976); Burgelman (1983) depicted an emergent strategy process in which lower level components compete for attention and resources at the firm level. Both suggest that firm-level strategies are not simple sums of the components. More recent studies have looked at the firm-level decision-making as complex, interdependent processes, in which decisions emerge non-additively and non-linearly from lower-level components (e.g. Levinthal, 1997; Rivkin, 2000; Siggelkow, 2002). In this study, I look at the probabilistic patterns resulting from aggregation, and investigate how decision makers subjectively view these different probabilities. The results show that the change of probabilities due to difference in levels leads to reversal of the performance feedback effect on exploration at the firm level. Indeed, making decisions on the firms' overall risk posture is a key responsibility of top management, but the interactive effects of the dispersion of analysis for performance evaluation has received limited research attention. Much research is needed to better understand complex strategies.

Performance feedback and risk taking

Performance feedback theory has viewed firm risk taking as a function of framing: framing of better performance leads to risk aversion while framing of worse performance leads to risk seeking. When the risk is moderate, these predictions coincide with prospect theory predictions. However, prospect theory further proposes that this the impact of framing is non-linear across the range of probabilities, and nonsymmetric across gain and loss states. In this paper, we have investigated risk attitude based on a model of a two-step evaluation process. We demonstrate that change in risk taking is affected by the probability and magnitude of alternatives. In particular, we stress the importance of the weighting function that subjectively overweighs small probabilities but underweights moderate and high probabilities. *This*

probabilistic distortion likely explains the difference between performance feedback theory predictions and my findings.

A limited number of studies in management and strategy have suggested that there is more nuance to the feedback learning process than the simple paradigm of "risk taking in loss, and risk averse in gain." In an early paper, Payne, Laughhunn, and Crum (1984) find that gambles with the same marginal distribution on specific attributes are evaluated differently. They show, besides the framing effect, there is an intricate process of editing as decision makers evaluate choices. However, such studies have been few, while many studies under the theme of "performance feedback" have taken prevalence in the literature in the last two decades.

The novel findings from this study further show that risk taking patterns involve more than a simple function of framing. The probability and magnitude of choices are also important factors in risky decisions. But I am not alone in this insight. Previously, I listed some empirical studies with results inconsistent with performance feedback theory predictions. These studies suggest that performance feedback theory is at least incomplete as an explanation for decisions involving risk. I also note that threat rigidity theory shares some similarity with prospect theory in distinguishing high-value, small-probability risks from low-value ones. In addition, in a survey on risk taking, March and Shapira note that "risk taking is not connected to adversity in a simple way" (1987). They find that, while risk aversion in gain and risk seeking in loss was noted in literature, "the idea that major innovations and change are produced by misery is not well supported by history" (March and Shapira, 1987). All these studies suggest that framing alone does not explain risk taking.

Risk taking is an important topic in strategy, economics, psychology, and finance. In this study, I demonstrated how advancement from psychology and behavioral economics can provide

important insight into performance evaluation and patterns in learning across a set of decisions. Admittedly, in the strategy field, traditional studies on managerial risk taking are usually based on accounting and performance measures of risks (e.g. Bettis and Hall, 1982; March and Shapira, 1987). Strategy researchers, for example, investigate the relationship between systemic risk in the stock market, and diversification strategy (Montgomery and Singh, 1984). The type of diversification (related vs unrelated) affects the level of systematic risk. As I do not directly measure the type of strategy, I do not assess how the strategy type might impact the evaluation of quarterly performance. Similarly, and perhaps more importantly, studies in strategy find that the responsibility for decision making in centralized in related strategies, and decentralized in unrelated strategies. Further, the relationships between the units in the M-form organization can be cooperative or competitive (Hill, Hitt, and Hoskisson, 1992).

In the psychology literature on individual risk taking, however, the risks are usually measured as regard to the probabilities of success and failure, and the magnitude of risks. To better utilize the insights from the psychology literature, my study has adopted the probability measures of risk. Future studies can extend my findings by using the accounting measures of risks. In addition, future studies should observe how managers outside the C-suite influence the search processes following performance outcomes. Future research can also generalize my findings by looking at broader industries and contexts. However, the message from this and previous research is clear: studies on risk taking almost have to consider the probability and magnitude of potential gain or loss, as well as the framing effect.

Conclusions

In this paper, I look at how learning from previous performance affects the distribution of decisions to take risk – and how these decisions affect the balance between exploration and

exploitation at the firm level. I use examples and probabilistic calculations to show that the probability of success and failure of decisions at the firm level of less diversified firms is generally smaller than that of the components. Based on prospect theory, in particular the probability weighting function, we illustrate how these small probabilities are overweighed during the decision process, thereby distorting the decision criterion of choices. This results in an increase in exploration when performance is above goals and decrease in exploration during underperformance at the firm-level decision-making for less diversified firms, and vice versa for highly diversified firms. Compared to existing theories of performance feedback and exploration and exploitation, my findings highlight the importance of understanding firm change and decision making at the corporate level, in which the probability and magnitude deviate from the components. Future research on performance feedback may benefit by taking these additional factors into consideration, complementing the framing effect.

This essay addresses the outcomes of a variety of decision searches across a corporation, and shows that the aggregation of decisions at the corporate level results in a pattern that includes both exploration and exploitation. For the diversified firm, exploratory learning occurs in times of gain and in times of loss. The pattern of learning provides the firm with an ability to overcome performance shortfalls. This pattern of exploratory learning appears in both gain and loss situations. When losses mount, though, firm decreased exploration, and moves to exploitation.

While most studies of firm failure imply that firms fail because they do not explore, these results suggest that firms fail even when they do explore. These firms do not need to be sensitive to the fact that they need to shift from exploitation to exploration; rather, they need to recognize the patterns of the diminishing impact of exploration on the firms' performance.

The next essays adopt a different perspective, in assessing the search processes firms use as they consider the adoption and application of a potential technology. I will show that the search process influences the direction of learning within the firm. The search, rather than the technology, determines whether the firm uses the technology for exploration or exploitation. Put differently, while the performance of the firm may influence the choice of exploration or exploitation, the variance within each form of search can also shape the learning direction.

CHAPTER 3: HOW SEARCH AFFECTS LEARNING OUTCOMES: EVIDENCE FROM CHINESE COMPANIES' ADOPTION OF BLOCKCHAIN TECHNOLOGY[3]

Introduction

The processes of how firms learn from search, and how the search affects the firm's response to innovative opportunities, have received only limited research attention (Eggers and Kaplan, 2009; Eggers and Park, 2018; Henderson and Clark, 1990; Tripsas and Gavetti, 2000). While digital transformation is purported to change existing business processes and create new business models (Deloitte, 2019), legacy strategies influence both the direction of search and may introduce bias toward preserving past practices, which limits the extent of innovation. In this chapter, I present the results of a study of managers considering the use of an emerging technological tool, the blockchain.

Managerial cognition is an important determinant of innovation. (Barr, Stimpert and Huff, 1992; Prahalad and Bettis, 1986; Tripsas and Gavetti, 2000). Managerial cognition crucially affects whether firms successfully recognize and implement new technologies. Since cognition builds on past experience, the search process may be myopic, and become an impediment to change and innovation. The presence of myopia in decision, defined as initial search in the neighborhood of the problem, is a central component of the Behavioral Theory of the Firm (Cyert and March, 1963).

[3] This study is coauthored with Professor Hugh O'Neill.

However, some firms overcome the limits of myopia, and innovate. For example, Sidhu, Commandeur, and Volberda find that managers explore new products more as environmental dynamism increases (2007). Taylor and Helfat (2009) demonstrate how complementary assets to help firms search and transition into new technologies. Berry (2018) shows how embeddedness in host and home country networks encourage distant search by multinational firms.

This leads to a conundrum. If legacy linked forms of cognition are a factor impeding depth or breadth of search and learning, how do firms overcome the potential impediments that limit innovation? What is the relationship between the search process and the choice of an innovative strategy? While there is ample evidence demonstrating the performance and slack are antecedents of change, there have been few studies of how firms overcome cognitive limits as they search. In the case of digital transformation, for example, many traditional firms attempt to innovate, such as Walmart and Kroger. But the extent of innovation may be dampened by the legacy strategy of brick-and-mortar retailing. This field study investigates how firms might overcome the constraints of legacy strategies and cognitions as they search.

The previous chapter demonstrated that firms use a combination of exploration and exploitation choices following the evaluation of performance. Performance above and below aspiration can lead to both exploration and exploitation. Just as perceptual frames can be influenced by performance, in a way that a pattern of choices might include use of either search style, perceptual frames may lead different firms to evaluate a specific choice differently. More directly, the same option could be viewed by one firm as means for exploration, and by another firm as a path to exploitation. What factors, other than performance shortfalls, lead firms to respond differently, when they evaluate options observed in the external background? I address

these questions through the use of a qualitative study of Chinese firms considering the use of blockchain technology[4].

The data of the next two empirical chapters draws from the same sample of eight Chinese companies that had adopted a blockchain innovation by the end of 2018. For the purpose of my dissertation, these blockchain adoption decisions provide an opportunity to learn how firms experience different forms of learning with the same technology. The application can be chosen to maintain the firm's legacy strategy (a form of exploitation), or it could change the firm's legacy strategy (a form of exploration). While the choice might be influenced by past performance, based on the equivocal results of the previous essay, I expected that the pattern of the choice would be influenced by other factors.

I implement this research through a multiple-case study of eight Chinese firms that adopted blockchain technology for the governance of digital platforms. At the time of my grounded investigation in 2018, much uncertainty existed regarding the technological development and business value of blockchain. Specifically it was unclear why a technology of decentralized digital governance, which blockchain can provide, might be useful for centralized physical firms or firm networks. Given this uncertainty, the barriers to adoption were high. This context provides an opportunity to increase our understanding of the process of search and learning when there is a clear gap between legacy strategy and the potential applications of the new technologies. Based on over 30 hours' interview with 19 informants and industry experts, triangulated by annual reports, blockchain whitepapers and analyst reports, the study shows how

[4] The data was obtained with the help of my data collaborator in China. The data collection is also generously funded by the Kenan Institute of UNC Chapel Hill.

the search process helps shape the emergent pattern of adoption, which can be inertial, incremental, or path-breaking.

My main finding is that search, which bridges legacy strategy and innovation, can be described as a multi-step process. The initial search often results in high-level solutions that solve broader or different problems than those that triggered the search. These solutions – the intermediate solutions – prompt further search. Through sequential steps, managers move away from the limited lens of the legacy strategy, into the new technological space.

Under the more classic view, search leads directly to strategic decisions and organizational change (Figure 3.1). Based on A Behavioral Theory of the Firm (Cyert and March, 1963), performance feedback theory predicts that performance below goals triggers problemistic search that can lead to change. First, firms and managers will first evaluate performance as to their goals, then the performance discrepancy relative to goals will trigger search, and ultimately, the search process leads to firm decisions and change. This change in the firms will further affect the performance of the next period, leading to further search, decisions, and changes. Hence the feedback learning runs in a looping, repeating, process inside firms. In addition, an abundance of slack can also lead to slack search that may result in change. In this study, I will focus on the feedback learning process based on performance patterns. This is also usually called the problemistic search.

A main problem with this view of search is that search is usually treated as a monolithic concept, or a black box (Posen, Kim, Keil, and Meissner, 2018). We know that search can vary in attributes and dimensions, such as distance, frequency and timing. However, there has been little research which directly investigated the details within search. This chapter shows how managers create intermediate strategies that prompt further search, leading to the adoption of

digital technologies (Figure 3.2). In this alternative model, strategizing is a multi-step process, in which each step hinges on the previous. Complete solutions are defined as those that have all decision components specified for implementation. For example, increasing R&D can be a complete, fully specified solution to R&D output problems. Incomplete solutions are defined as those that have components that require further strategizing to be implemented. For example, changing supply chain configuration could be a solution to outdated supply chain problems. But it is unclear how this can be implemented without further search. In a sense, most decisions are incomplete since some parts of the decisions need to be further considered. Hence the intermediate strategies form a crucial linkage between legacy strategy and digital technologies.

Figure 3.1: A traditional model of search and strategic change

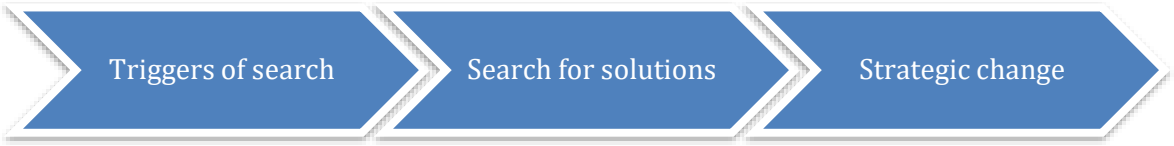
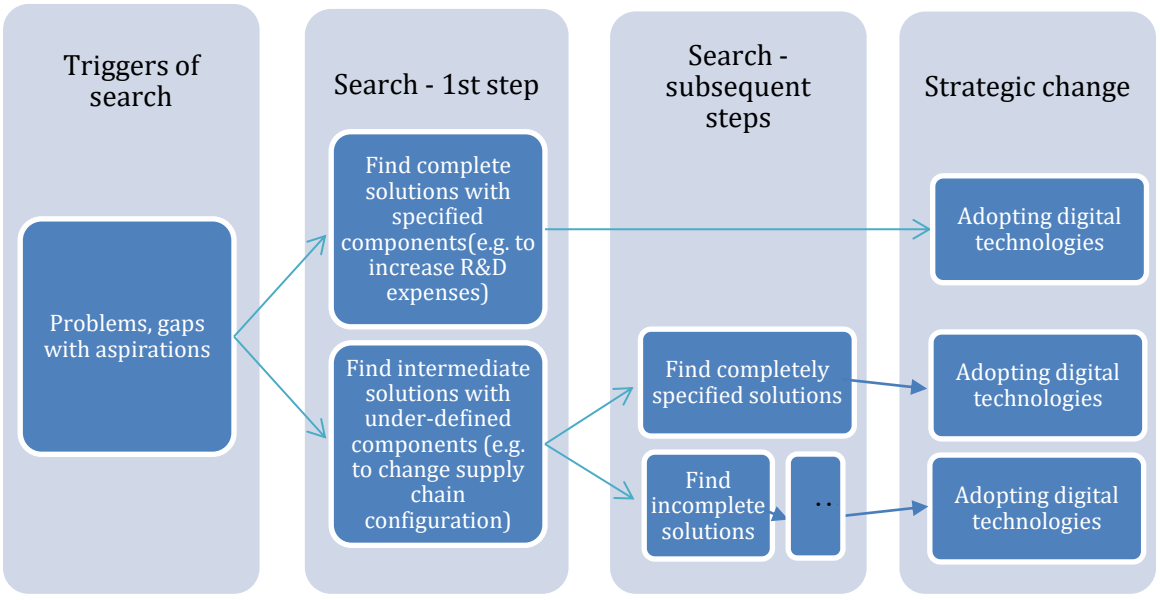


Figure 3.2: A multi-step search model of strategic change



I identified two ways the intermediate strategies help managers search beyond legacy strategy – they expand or redirect the search space. Some firms reached intermediate strategies that could be applied beyond the domain of the initial problem. Here the intermediate solutions expand the search space, leading to broader use of the digital technologies. Others decide on intermediate strategies that redirect them to search in solution spaces that differ from the initially defined search space. Overall, I find that the patterns of search crucially affect the breadth of innovation for reaching innovation decisions.

Literature

Legacy strategy and change

Prahalad and Bettis (1986) conceptualized that the goals and tasks of diversified firms' dominant business crucially shape managerial cognition. The legacy strategy of the dominant business follows a dominant logic, which affects the way managers evaluate problems and search for solutions. Empirical research has shown how this logic shapes search. For example, Tripsas and Gavetti's (2000) influential work on Polaroid demonstrated how managers' cognition prevented them from successfully identifying and using new photographic technologies. Eggers and Kaplan (2009) found that managerial attention, also derived from the dominant logic, affects the search and adoption of the new technologies. Sosa (2014), based on a study of biotech investments across new and established firms, concluded that new technologies challenge firms' existing strategic lens. These studies confirm that legacy strategy is a key factor that affects search and innovation.

But firms can move beyond their legacies, and reshape their dominant logic. Studies have linked various managerial, organizational, and environmental factors to strategic innovation decisions. For example, Sørenson and Stuart (2000) identified environmental dynamism as a key

factor in propelling firms to search to change. Roy and Sarkar (2016) found that firms with the right knowledge and market capabilities tend to be the leaders in emerging technologies. Chen and Nadkarni (2017) found that CEO temporal disposition toward urgency is positively related to corporate entrepreneurial strategies. So, managers can overcome the barriers of existing strategy and cognition. In this study, I examine the process how managers search and make innovation decisions when there that extend beyond their legacy strategy.

To be sure, many studies have recognized that cognitions evolve and change. For example, Barr, Stimpert and Huff (1992) studied the process of strategic renewal of two railroad firms in a 25-year period. They found strategic renewal to be an incremental process through which managers updates their cognitive framework to environment changes over time. Similarly, using a simulation model with 200 iterations of learning, Johnson and Hoopes (2003) identified an evolving pattern in which managerial cognition expanded due to competitive pressure. Bingham and Kahl (2013) studied the process of life insurance industry breaking down its previous schematic logic to adopt computers in a 30-year period. However, these studies take a long-term, adaptive view of the interaction between cognitions and strategic change. In this evolving process, dominant strategies change, and cognitions become endogenous with strategic decisions. But in the short term, cognitions are less flexible. Little is known about the patterns of search as managers that managers use if they shift from myopic to broader search. This study will address this gap by looking at how firms search to adopt blockchain technology – a digital governance technology that rapidly rose in the past decade. Why do some firms choose blockchain as a form of exploitation (that is, they extend their legacy strategies), while other firms use blockchain to explore new strategies?

Search and strategic change

The search perspective is instrumental in explaining how managers make strategic decisions. It involves a process in which managers identify problems, search for solutions, and make strategic decisions about change and risk taking. Organizational attributes affect search. For example, Argyres and Silverman (2004) investigated organizational antecedents of search, and found that the centralization of firm R&D activities is positively associated with innovative breadth. Khanna, Guler, and Nerkar, (2016) found that frequent small failures prompt managers to search often, leading to better R&D performance. Similarly, Berry (2018) showed how network embeddedness affects search and innovation. These studies improve our knowledge and understanding of how variance in search processes affect how firms learn.

One important insight about searches addresses how the locus of search affects the depth or breadth of change. Classic theory describes how search starts as local and myopic (Cyert and March, 1963). However, some recent studies on innovation found that local search can lead to innovations. Kaplan and Vakili (2015) found that local search is more likely than distant search to be associated with originality in patenting. Jung and Lee (2016) also found that local search creates innovative performance more effectively than boundary-spanning distant search. However, based on the traditional search perspective (Figure 3.1), it is unclear how search, which usually starts in proximity of existing problems, leads to innovation. By qualitatively examining the strategizing process across firms considering blockchain adoption, I investigated how the link between search extends beyond its initial local focus, and leads to strategic change.

Empirical Context: Blockchain Technology

An important feature of digital transformation is that it includes several catalysts to drive the innovation through organizations – process automation, radical technologies, data intelligence, connectivity, cyber security, and risk management (Deloitte, 2019). Particularly

regarding radical change, digitalization involves the use of several technologies, such as AI, cloud, and blockchain. These technologies, individually or combined, contribute to achieving automation and/or experiencing radical innovation. Viewed this way, digitalization is a journey, rather than an outcome. Most of today's firms have adopted some of the digital technologies, such as machine learning, to achieve some level of digital innovation, such as process automation. Thus, I recognize how firms might be at different milestones of the digital journey as managers consider blockchain adoption.

The Bitcoin whitepaper (Nakamoto, 2008) is sometimes seen as the advent of blockchain technology[5]. A simple definition of blockchain is that it is a distributed ledger shared across a number of participants (McKinsey, 2018). Although the technology is immature, I note that the central problem that it *seeks* to solve regards trust in transactions. This is a key role that traditionally has been played by various government agencies, legal authorities, and industry associations. These governance bodies document transactions and adjudicate disputes, thereby creating trust in transactions of multiple parties. But in recent years, as more individuals and organizations move their activities into digital ecosystems, they frequently find that the existing governance is inadequate. In many respects, the rise of blockchain represents an attempt by individuals and organizations to digitally modulate and govern transactions within a legal and regulatory void.

Methodology

Blockchain adoption by established firms provides a suitable and timely context to study patterns of search and change. More so than other technologies such as AI and IoT, blockchain is

[5] Since blockchain technology is at the intersection of several fields, including cryptography and distributed databases, I can trace its advent to earlier times. However, for managers of companies and organizations, blockchain as a technology with its own identity did not enter into their attention and decision choices until after the whitepaper.

seen as a hype, an immature technology with few established business uses and doubtful business value. This perception fits well into existing depictions of change, innovation, and exploration as risky, as inconsistent with existing processes, and as somewhat "foolish" from the perspective of rational strategy processes (Hannan and Freeman, 1984; Henderson and Clark, 1990; March, 2006). This study of blockchain adoption is well positioned to help us understand how the search process leads to change. In addition, because the blockchain innovation is currently in early stages of diffusion, this sample affords a great opportunity to concurrently examine the search process with minimal recollection bias.

My sample includes eight Chinese firms that recently adopted blockchain technology. These public companies have been in business for at least ten years at the time of my study. All have annual sales of over 100 million US dollars in the most recent fiscal year. Table 3.1 contains a summary of the sample firms.

Table 3.1: Descriptive information

	A	B	C	D	E	F	G	H
Main industry (revenue %)	Ecommerce /retail (80%)	Search / Advertising (80%)	Social media (60%)	Financial tech (90%)	Ecommerce /retail (90%)	Financial tech (90%)	Ecommerce /retail (80%)	Social media (100%)
Main customers	Individual consumers	Individuals	Individuals	Banks	Individual consumers	Small businesses	Individual consumers	Individuals
Sales	> 500M USD	>500M USD	>500M USD	>100M USD	>500M USD	>30M USD	>500M USD	>100M USD
Does the company use or operate digital platforms?	Yes	Yes	Yes	No	Yes	No	Yes	Yes
Are transactions of goods and services a main business of the company?	Yes	No	No	No	Yes	No	Yes	No
Does the company provide tech services or products?	Yes, but not a main business	Yes, but not a main business	Yes, but not a main business	Yes, a main business	Yes, but not a main business	Yes, a main business	No.	Yes, a main business

I primarily relied on semi-structured interviews with senior managers in these firms to understand the process that led to the adoption of blockchain. I also interviewed industry experts to understand blockchain technology, its definitions and uses. In addition, I use company news releases, third-party news and analyst reports for triangulation. In collecting all the information, I focus on five key areas: the organizations and their problems, their current strategies, their key resources, their environments and the blockchain initiatives in their companies. The main part of each interview followed an interview protocol (Appendices 4 and 5), plus open questions and discussions. In total, I completed over 30 hours of interview with senior managers and blockchain experts (Table 3.2).

To ensure the rigor and quality of this qualitative study, I followed the procedures articulated by Eisenhardt in her 1989 classic paper on qualitative case research. I also drew insight from more recent articles on the conduct of qualitative research, and from empirical studies that use qualitative methods. My study design follows the following steps suggested in Eisenhardt (1989).

Definition of research questions and key constructs

The research question of is: why do organizations vary in the way they use an adopted technological innovation? As mentioned in the introduction of my thesis, I rely on a search and learning perspective to understand the question. Here, the emphasis is on variance in learning based on the search of a similar option (rather that proposing the search is the definitive signal of the learning outcome).

Based on the main theories of this study (BTOF and exploration and exploitation), the key organizational constructs are search, problems and slack; the key constructs related to the external environment are resources, competitors, collaborators, and stakeholders. Follow the

advice of Eisenhardt (1989), I also pay attention to any new concepts that emerge, strongly and repetitively, during data collection and analysis.

Sampling

Following the suggestions of Eisenhardt (1989) and Suddaby (2006), I used theoretical sampling and identified companies that are more likely to generate the insights to answer the research questions. They have suggested that, in some cases, it might be better to use extreme or polar cases that most clearly demonstrate the process under study. In the case of this thesis, I studied firms that were early adopters of blockchain technology, some of whom came from an industry with direct contact with new entrants (the use of bitcoin was becoming known in finance), and firms from industries in which the technology was in an earlier stage of diffusion. The use of these early adopters, in a stage which lacks well developed recipes or standards for the technology, allows greater insight into how the firm's context affects the form of learning induced by blockchain.

My research question builds on the use of blockchain technology. This technology offers insight into change, innovation, and exploration due to its potential to affect usual business and organizational processes. At the time of my data collection in 2018, doubt remained, and debate raged, regarding the merits of blockchain in companies. Blockchain adoption can thus be viewed as an exemplary case of an ambiguous technology, with an uncertain impact of the form of firm adoption or learning change.

The companies I chose were established organizations in the process of considering blockchain technology. These firms have relatively stable business and organizational processes. These companies come from a combination of financial, technology, retail, and ecommerce industries, and as such, support generalizable theories (see Table 3.1, for descriptions of the

firms). This created a diverse sample representing different industry applications related to blockchain. I interviewed in total ten such firms, but two firms dropped out during the study. However, since these two companies did not drop out due to reasons related to their blockchain adoption or general strategy (the managers from these two firms cited privacy concerns), this should not induce bias to the final sample.

Data collection

Most of my data collection focused on interviewing company managers. The interviews were conducted by me and a collaborator in China. To ensure interview consistency, I used an interview protocol (see Appendix 4). To gain access to interviewees, I agreed to keep their names and key identification information confidential.

To ensure that the interview data are kept true to the original meaning, my collaborator and I transcripted the interview data usually within two hours after the end of each interview, and within 24 hours at the latest. These transcripts were uploaded in real time onto Google Drive. Google drive thus documented the whole history of our interview transcripts, so the dates of interviews and data in the transcripts could be verified later on, as needed.

Both my data collaborator and I are bilingual. The interviews were conducted in Chinese. After my collaborator finalized each interview transcript, I would then, working on my own, blindly translate the transcripts from Chinese to English. She would then verify the translation. For each hour of interview, we spent at least five to six hours to discuss the translation and concept fit. The whole process of interviewing, transcripting, translating, and concept checking lasted for three months almost daily.

To control for possible biases of company interviewees, I complemented interviews with other sources of information. I used relevant company news, third-party news and analysis whenever possible. These information sources helped to complement and triangulate the interview data.

Because blockchain is a highly complicated technology, I consulted expert opinions on what blockchain is and what it can do for companies and organizations. My collaborators and I also interviewed several industry experts. We used an interview protocol (see Appendix 5).

Coding

The coding process followed immediately after each interview was concluded. Based on the advice of Gioia, Corley, and Hamilton (2013), the coding process followed a step-by-step process, by first identifying the first-order concepts, then grouping these first-order concepts into second-order themes, finally leading to aggregate dimensions.

I first coded the first-order concepts and constructs. These concepts and constructs are based on the core strategic words such as the external environments, internal processes, customers, competitors, etc. These provide a nuanced picture of the various concepts that arose during each interview with the managers. Next, I group these concepts into second-order themes. By observing the similarity and connections between these first-order concepts, I could group these concepts under the themes of attention, goals, problems, etc. Finally, aggregate dimensions emerge from these second-order themes, which then lead to more nuanced pictures at the first-order level of concepts.

As advised by Gioia, Corley, and Hamilton (2013), the coding process between the three layers were iterative, shifting back and forth between emerging insights and the data. This is due

to the grounded nature of this field study. As each additional interview completed, new first-order concepts might arise, leading to an update of second-order themes and aggregate dimensions. In the meantime, as the emerging theories become more evident, additional themes and concepts could be identified in the interview texts, leading to an update of the concepts and themes.

For example, one firm mentioned the following regarding the goals of the firm:

> *"The company aims to build an inclusive, smart retail ecosystem. It will build smart retail tools to satisfy the customers' demand regarding any products or services, at any time and location."*

In the above text, the first sentence is coded as firm-level goals as the first-level concept. This then merges into the second-order theme of goals as a general term. The second sentence is coded with customer focus as the first-level concept. This then merges into the second-order theme of organizational attention and focus. Ultimately, these second-order themes of goals and organizational attention merge into the aggregate process of firms' search that is motivated by goals and driven by attention.

In another example, the manager of another firm commented the following regarding why they adopted the blockchain technology:

> *"The company believes that blockchain represents the direction of technology development. If it uses this technology, it won't be behind peers."*

The above quote provides an example of attention to competitors as the first-order concept. This is subsequently merged into the second-order theme of organizational attention and focus, as was the customer focus in the previous example. This further evolves into the aggregate process of search that is driven by organizational attention.

Analysis

Following the advice of Glaser and Strauss (1967) and Eisenhardt (1989), data collection and analysis overlapped and iterated. Within-case analysis usually occurred soon after data collection. In our case, my data collaborator and I always had at least two hours discussion immediately after each interview concluded and transcripts finished. Hence, we discussed while our memories were most fresh. This helped generate timely insights fresh from data collection. It also helped to refine questions, or the ways to ask questions, during later interviews and data collection.

Cross-case analysis started once I had more than a couple of company cases for comparison. In this stage, I identified similarities and differences between cases. This helped identify possible inconsistencies in data collection, and gain interesting insights for theories.

Finding relationships and theory building

With the data in hand, I attempted to generalize previous findings into theories. I looked at the relations and patterns between categories and subcategories of concepts, to uncover relevant relationships. I focused on formulating theories relevant to research questions. As noted in the analysis, these theories relate to the strategy and structure of the firm, and to the nature of the firm's articulated set of goals.

Links to literature

The findings of this study are compared and contrasted with existing theories in the subsequent chapters.

In these chapters, I compare my results to past work, and identify both similarities and contrasts with past findings. These discussions, through comparison and reconciliation, position

the findings of this study. The discussions also identify issues that deserve research attention moving forward.

As with all qualitative studies, the process involved multiple iterations among construct definitions, data collection, and data analysis. The six steps just presented represent a linear simplification of the actual process. However, this methodology took care to preserve the reliability and validity of the qualitative research findings. The study provides important insights into the how a singular option (i.e., blockchain technology) can vary in its learning impact on the firm. The search, rather than the technology or the searcher, affects whether exploration or exploitation emerges. I will consider the evidence about sources of variance in the search process in each of the next two chapters.

Table 3.2: Interview information

Company code	Number of interviewees	Hours of interview	Interviewee job titles and responsibilities
A	3	5	Product manager, senior engineer, senior architect
B	2	4	Product manager, managing director
C	2	4	Senior product manager, product chief
D	1	2	Senior product manager
E	3	5	Senior product managers, managing director
F	2	3	Managing director, finance manager
G	2	4	Chief architect, senior engineer
H	1	2	Product manager
Experts	3	6	Experts from a blockchain provider, a blockchain research institute, and a large VC firm
Total	19	34	

To summarize, in this qualitative study, I iterate between theories, data, and analysis. I ensure that the theories and analysis are coherent with the phenomenon of search and blockchain adoption. I also made sure that my data and analysis are suitable and appropriate to contribute to

further understanding of the theories of search and innovation. This coherence ensures the rigor of emerging insights.

Findings

Legacy strategy – the anchor of search

Extant research emphasizes the power of legacy strategy and cognition in strategic decision making. Cognitions based on existing strategies and capabilities often restrict managers' consideration of new technologies, while cognitions attuned to new technologies can help managers make changes and innovate (Eggers and Kaplan, 2009; Ellis, Aharonson, Drori, and Shapira, 2017). This study aimed to increase our understanding of search in the presence of strategic and cognitive barriers. I define cognition as the dominant managerial perception of firms' strategies and positioning – what they do, who they serve, and how they do it. First, I needed to identify these cognitions and strategies.

Existing studies often use secondary data to assess dominant cognitions and strategies. For example, companies' industry associations and managerial background have traditionally been used as approximations (e.g. Benner and Tripsas, 2012; Hambrick and Mason, 1984; Prahalad and Bettis, 1986). Recent studies have used shareholder letters and other textual documents (e.g. Eggers and Kaplan, 2009; Surroca, Prior, and Tribo Gine, 2016). In my analysis, I primarily rely on interviews to understand the legacy strategies. In the interviews, I directed questions to the managers regarding strategic goals. I also referred to various company documents, such as annual reports, shareholder letters, and blockchain whitepapers, when available. In addition, I used public data and third-party analysis to identify the primary industries and main customers of these companies. Both the company and external documents confirmed the reliability of the insights derived from interviews (Table 3.3).

Table 3.3: Existing strategies and managerial cognitive frameworks

	1	2	3	4
	Existing lens	Main industry/ business	Main customers	Notable quotes
A	Be an effective e-commerce platform	Ecommerce /retail (>70% of revenue)	Individual consumers	"Our company goal is to solve all pain points in the 2C market." – interview We aim to "help small vendors compete more effectively." – company document
B	Generate advertising sales through online search	Search / Advertising (>70% of revenue)	Individual consumers	"Our main strategy is to increase online search related revenue." – interview "Our main search business is challenged by..." – interview
C	Increase and monetize consumer traffic on its platforms	Social media (>50% of revenue)	Individual consumers	"We are a platform company. We use customer traffic to grab market shares in new segments." – interview The main strategy is "enriching content and promoting interactions by users on our platform." – company document
D	Be competitive in financial technology services	Financial technology provider (>80% of revenue)	Middle to large size banks	"Our goal is to be one of the best FinTech providers." – interview "In our industry, customer trust and recognition is most important." – interview
E	Be a market leader in retail	Ecommerce /retail (>80% of revenue)	Individual consumers	"Our strategy is to increase our reach to consumers." – interview "We are a leading ecommerce and retail provider." – company document
F	Be a market leader in financial technologies and services	Financial technology provider (>80% of revenue)	Small businesses	"Our business model is to provide services related to financial technologies and payment…We will continue to develop our expertise in our main business." – company document
G	Be a market leader in retail	Ecommerce /retail (>80% of revenue)	Individual consumers	"We are a leading retailer…with value-added services building on the retail infrastructure." – company document
H	Provide social platforms	Social media (>80%)	Individual consumers	"Our goal is to upgrade our social media platform." – interview

For example, Firm B is in the online search business and operates on a revenue model of online advertising. This strategy is confirmed by an interviewee statement that the company's

"main strategy is to increase online search related revenue." For Firm E, ecommerce and retail business generates over 80% of its revenue, and both the interviewees and company documents identified the company as a retailer serving consumers. On the other hand, Firm A has a strategy that that is more nuanced than its industry classification. Though online retail also generates 80% of its revenue, its strategy is more appropriately summarized as a retail platform provider. An interviewee informed us that the goal of the firm is to "solve pain points in the 2C market." This shows that my interviews have been effective in that they both verify and deepen my knowledge of main strategies and cognitions.

With the existing strategies delineated, I continued my analysis by observing the relationship between mental models and decision making. Consistent with existing studies (e.g. Tripsas and Gavetti, 2000), my analysis shows that existing cognitions play an important role in strategic decision making. Specifically, my interviews and review of company documents reveal that these cognitive mindsets served as a decision anchor that managers constantly referred to at various points of the decision process. Specifically, I observe that these cognitions serve as a decision anchor in three ways.

First, existing strategies and cognitions are expressed in managers' interpretation of goals. For all eight firms, stated goals are in fact extensions of the existing strategy. An informant from Firm A stated that an important goal of the firm was to solve problems on a 2C platform. Here the goal is a task specification derived from the mental model related to the strategy. Similarly, Firm E had a goal to be one of the best online retailers – an extension of existing strategies based on social comparison.

Second, existing cognitions determine how managers evaluate firm performance. When asked to evaluate performance, informants naturally talked about performance evaluated through

the main business and logic. Documents from Firm C discussed internal and external problems regarding its main social platform business, an evidence that existing cognitions were at play during performance evaluation. An informant from Firm E discussed the progress of internationalization and diversification, both of which are related to its retail business logic.

Third, existing cognitions steered managers to focus on certain risks. Informants and company documents frequently mentioned competitors as a source of risk. Technological and regulatory changes were viewed as risky if they could affect existing strategies. Overall, I observed that existing strategies and cognitions, a learned outcome from managerial and firm experience, served as the primary anchor for evaluating goals, performance, and risks. This observation is consistent with many studies which show how managerial cognitions influence strategic decision making.

Developing innovative strategies within existing mental models

I then sought to understand whether and how managers innovate beyond the constraint of existing cognitions. Because existing cognitions are based on existing capabilities and strategies, I expected a mismatch between the firms' capabilities and the requirements of blockchain technologies. However, I found that some firms adopted blockchain technology within the framework of their existing strategies and cognitions.

Earlier, I noted that the main problem that blockchain seeks to solve is regards trust in transactions. While perusing this problem within the context of this sample, I noticed that although blockchain technology is somewhat new, the need for trust in inter- and intra-organizational transactions is not. In fact, transaction uncertainty is a classic economic problem confronting managers. While innovations, digital or otherwise, often require strategic change, it is important to also recognize that these innovations may solve some *recurring systemic*

problems. This dual nature of technological impact has been articulated in existing theories, such as through the lens of exploration (March, 1991), change (Hannan and Freeman, 1984), and organizational evolutions (Nelson and Winter, 1985). But existing studies tend to focus on the difficulties required to use technologies which might be disruptive to the core business. The emerging blockchain technology, however, offers solutions to longstanding existing problems which, therefore, reinforces existing processes. As a result, for some firms, legacy strategies do not significantly impede the adoption of blockchain. Managers chose to adopt blockchain within the logic of their long-standing cognitive frameworks. For these firms, blockchain directly solve problems that managers had previously identified (Table 3.4).

Table 3.4: Blockchain as a direct, within-cognition, solution to existing problems

	1	2	3	4
	Cognitive model	Organization problem	Blockchain solutions	Blockchain use
A	Selling goods	Lack of consumer trust due to possible fake products supplied by many vendors	Provenance tracking use case helps to assure customers of product authenticity; supply chain finance case further improves transparency.	Record keeping; transaction registry
B	Online search services	Lack of trust in the authenticity of contents on its platforms	Blockchain can track the real source of contents, proving authenticity and build customer trust.	Record keeping
D	Provide financial technology	Fast change in financial technologies, which is the main offering of the company	The Letter of Credit (LoC) use case was developed in direct response to customer demand to upgrade technologies.	Adopting blockchain as a demonstration of technology capability
E	Selling goods	Many suppliers; transaction uncertainty as an ongoing concern.	Provenance tracking and supply chain finance use cases can improve supply chain transparency and efficiency.	Record keeping; transaction registry

F	Provide financial technology	Much uncertainty with partners regarding responsibility attribution	The company used blockchain to prove its activities in transactions and establish transaction trust.	Transaction registry

For example, Firm B mainly provides online content through web search. The authenticity of content is crucial to customers. After some loss of customer trust due unreliable sources, the managers adopted blockchain to register transactions of content generation and distribution. In this case, transaction registry provided a direct solution to an extant problem, even though that problem did not trigger the initial search. Firm E, with the dominant logic of a retailer, worked with many suppliers and logistic partners. The firm adopted blockchain to solve problems of uncertainty with these transaction partners. In both cases, managers anchored on their legacy models, and linked blockchain solutions to existing problems. Blockchain was then adopted in an incremental manner, within these existing frameworks.

Intermediate steps – a linkage between legacy strategy and new technology

As this incremental fit explained some, but not all, adoption, I then attempted to understand the strategic process for other firms: why (and how) did they search beyond existing strategies and cognitions to adopt blockchain? I unpacked the strategic process in two steps. First, my interview protocol started with high-level, broad questions about the firms, their organizational structure, and strategies. Although the goal of my study was to understand how managers search and evaluate blockchain, I did not restrict my questions solely to the events and activities immediately related to the adoption. With these broader questions, I was able to map the blockchain adoption decisions onto the firms' search processes. My inductive design provided the flexibility to allow the possibility that blockchain adoptions were indeed "foolish,"

and based on hype. My broad strategic mapping approach helped me understand how the process of search and interacted with other firm actions that then led to blockchain adoption.

Second, when I asked for the reasons for blockchain adoption, I drilled down through layers of causal links. Do to my live interactions with interviewees, I could inquire deeply into the decisions. I not only asked for the reasons of adoption, I also asked interviewees to explain the relevance of these reasons. In this way, I traced the search process and its strategic logic broadly. I supplemented these discussions with public information and third-party analysis about these firms and associated industries, to verify each logical linkage as stated by interviewees.

The main insight from my grounded theory building is that some firms search and adopt the technology though a multi-step process (Figure 3.2). Blockchain often requires new knowledge and capabilities, but managers usually prefer exploiting existing knowledge and capabilities to exploring new ones. But the legacy knowledge base may not provide a clear logic for firms to adopt the technology. This is especially true for blockchain which is purported to disintermediate transactions, a process quite different from more traditional centralized transactions. However, a logic did emerge through multiple steps of search, each following a precedent search result – a result that I call an intermediate solution. In this multi-step search model, managers first sought to solve an existing problem. The initial search resulted in cascading insights that prompted further search. According to the traditional model (Figure 3.1), search results in a specific choice that then leads to in strategic change. Here I found that managers first found partial solutions, and then searched further to refine these solutions. The search continued even after adopting blockchain, as the technology offered alternative paths for organizing transactions with vendors, human resources, and technology. Most initial solutions were intermediate as initial searches led to wider search by the managers. In this study, I defined

the adoption of blockchain as the end of the search sequence. The intermediate steps between the initial search effort and the blockchain decisions created the opportunity for further exploration and more radical adoptions of the technology.

Five sample firms used a multiple-step approach to strategize digital innovation (Table 3.5). In these cases, after initial strategizing, firms reach some intermediate solutions to solve existing problems. Because these intermediate strategies solve broader or different problems than the initial problems, they help managers move beyond existing cognitive framework to strategize further. For example, Firm C faced competitors and new entrants in its main businesses. The regulatory environment for its main businesses was also changing. The managers recognized both issues as important problems. They initially strategized to increase FinTech in service offerings – a strategic reorientation. However, this solution was not executable without elaboration regarding other technologies. Blockchain was then chosen for its potential of disrupting FinTech.

Table 3.5: Blockchain as an indirect solution to existing problems.

	1	2	3	4	5
	Existing strategies and cognitions	Organization problems	Intermediate solutions	Blockchain solutions	Characteristics of intermediate solutions
A	Retail platform	Maturity and slowdown in Chinese consumer retail.	The company will digitally upgrade its retail business; it also plans to make it a strong player in FinTech.	Cross-border payment and supply chain finance cases demonstrate the company's capabilities in FinTech; it also digitizes and upgrades the supply chain.	Expand and redirect
C	Facilitate online social networks	The company's main businesses are challenged by competitors, entrants, and regulations.	The company decided to strategically re-orient to FinTech.	Blockchain for invoice tracking and supply chain develops its FinTech capabilities and strategically re-positions the firm.	Redirect
E	Selling goods	Though a big player in retail, the company's technology capabilities is behind peers.	The company has embarked on a technology-driven retail strategy.	Using blockchain helps to develop the company's technological capabilities.	Redirect
G	Selling goods	Changes in retail customer demand and requirements	The company will upgrade supply chain structure.	Logistics information sharing using blockchain improves supply chain transparency and efficiency.	Expand
H	Provide a social platform	Emerging strong competitors in social platforms	Upgrade the existing platform for better customer experience.	Blockchain identity management will provide greater user privacy.	Expand

Similarly, managers at Firm H found themselves in increasing competition with similar digital platforms. While the firm initially occupied a niche in digital platforms, this niche was encroached upon by competitors. After some search, the managers chose to upgrade their digital platform to enhance user experience. However, this solution – an intermediate solution – lacked technological specificity. Since a key problem in digital platforms is user privacy, the managers subsequently decided to use blockchain to identify the users on its digital platforms. In both examples, managers did not identify blockchain in their initial search. Blockchain became a subsequent item of search, connected by intermediate steps.

To summarize, these five cases showed how managers extend beyond a legacy strategy to develop new strategies. This search process involved a *bride through existing strategies and cognitions to the new technology.* This required a series of incremental adjustments than a breakthrough transformation of existing strategies. Based on an initial sensing of a concern, managers searched and reached intermediate solutions that might resolve the problem. These solutions did not fully match initial expectations, which then prompted further search and more critical inquiry about the legacy strategy. Existing strategies and cognitions became less binding as gained more information about the inadequacy of their initial assumptions and the potential opportunity offered by blockchain.

Characteristics of intermediate solutions

In this section, I describe the intermediate solutions. I did find some variance in the patterns in the intermediate solutions. My analysis focuses on the five cases of that adopted blockchain subsequent to an earlier choice (Table 3.5).

I followed a sequence of analytical steps. First, I compared the legacy strategy with the initial articulation of organizational problems (Table 3.5: Column 1 and 2). I argued earlier that

existing strategies are the lens through which managers view problems. For example, managers from Firm A, mainly in the retail business, saw the potential slowdown of consumer spending as a main problem. Interviewees with Firm C, which held the view that the firm operates digital platforms, cited competitors and regulators in digital platforms as the main problems. When problems were initially identified, these managers were still thinking within the framework of existing strategies.

Second, I compared existing strategies with the blockchain solutions (Table 3.5: Column 1 and 4). I expected that it was unlikely that the use of blockchain would provide an exact match with their initial strategy. If blockchain were a close match, it would have been a choice that emerged in the initial search.

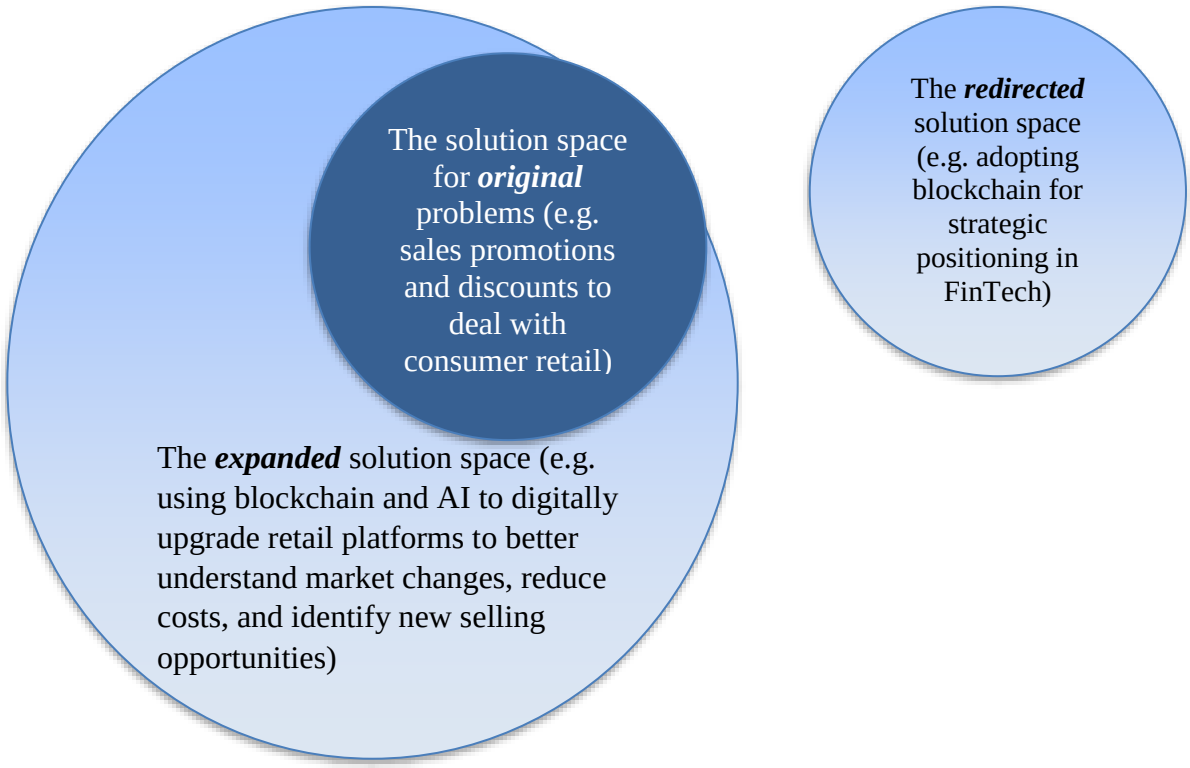
As expected, the blockchain solutions lacked coherence with existing strategies. For example, Firm C, which was chiefly in the business of social networks, adopted blockchain to enter the FinTech business, several steps removed from social networks. Managers from Firm G, a consumer retail firm, chose blockchain as a path for more efficient logistic information sharing. In these cases, a leap in logic was required (Table 3.5: Column 3). The leap in logic required a reevaluation of the initial assumptions, and subsequent search, which led to a broader consideration of change in the initial strategy.

In the third step, I compared the legacy strategic mindset with the intermediate solutions (Table 3.5: Column 1 and 3). I considered these solutions intermediate because they did not specify blockchain as an initial focus in their search. By comparing existing cognitions with intermediate solutions, I noticed that while these intermediate solutions overlapped the "neighborhood" of the legacy strategy, the solutions exposed the firm to the potential offered in

the blockchain space. The intermediate solutions sought to solve the problems perceived through existing lens, but these solutions then extended the domain of subsequent search.

Finally, I compared the intermediate solutions to find if there were common characteristics or mechanisms (Table 3.5: Column 3). I observed two different dominant patterns across these intermediate solutions – 1) expanding the search space and 2) redirecting the search space (Figure 3.3). First, in expanding the search space, intermediate solutions addressed a broader set of problems than those in the original problem specification. When the initial solution offered new opportunities, managers searched and analyzed more comprehensively. This mechanism might look similar to innovating within the limits of precedent mental models (e.g. Table 3.4). However, an important difference is that, by defining intermediate solutions that seem to meet the initial problems' requirements but actually offer more opportunity, managers subsequently searched more broadly and considered wider applications of a technology option (viz., blockchain). For example, managers at Firm G perceived changing customer preferences as a main problem. A direct solution might have been to make its supply chain faster and more responsive to changes in the end market. Instead, the managers decided to fully upgrade the supply chain, including new technologies, new design, and a different operating model. This fully upgraded supply chain will be faster but likely also more intelligent and secure. So, this solution is broader than initial problem requirements. This broader solution also proved complex, and the complexity led to the consideration of blockchain. The advantage of choosing the intermediate solution is that it expanded the subsequent search space to the use of blockchain, as means for upgrade of the company's supply chain. Hence this is an example of intermediate solutions that expanded search.

Figure 3.3: Mechanisms of overcoming existing lens – expanding and redirecting the search space (Firm A as example in brackets).



The second mechanism that I observed relied on redirecting the search space. Intermediate solutions can also help managers cross existing strategic boundaries by redirecting subsequent search into new opportunities. Firm C provides such an example. The managers perceived increasing competition in social platforms. The managers decided to re-orient the firm toward FinTech supported transactions based on its peripheral involvement in the finance industry. This strategic re-orientation did not seek to directly deal with social platform competitors, rather it was a response to redirecting the subsequent search to find options with less competition. This spawned further search to solve problems about markets, customers and

technologies. Through a sequence of linked searches, the intermediate solutions redirected managers toward the FinTech space, which required the adoption of blockchain technology.

I also observed that sometimes managers relied on both extension and re-direction toward search beyond their initial perception of the problem. For example, when facing problems in the retail industry, the managers of Firm A decided to digitally upgrade its retail platform. Similar to Firm G, this prompted expanded search into technologies and options that could help the upgrade. In addition, the managers also decided to put greater focus on FinTech-based transactions. In this way, search was redirected to financial technologies, which exposed the firm to the blockchain option.

To summarize, I identified the mechanisms through which managers extended beyond the shadow of their legacies and adopt blockchain. Managers crossed from existing frameworks through the use of intermediate solutions, which sought to solve existing problems but also opened up opportunities to for wider and different search space. In expanding search, intermediate searches helped managers identify solution space beyond the original problems requirements. In redirecting search, intermediate solutions facilitate the analysis of new strategic opportunities. My data also suggested that these two mechanisms are not mutually exclusive and the firms may go through an iterative process that involves finding and adopting a technology which, in turn, leads the firm to a new strategy.

Environment uncertainty

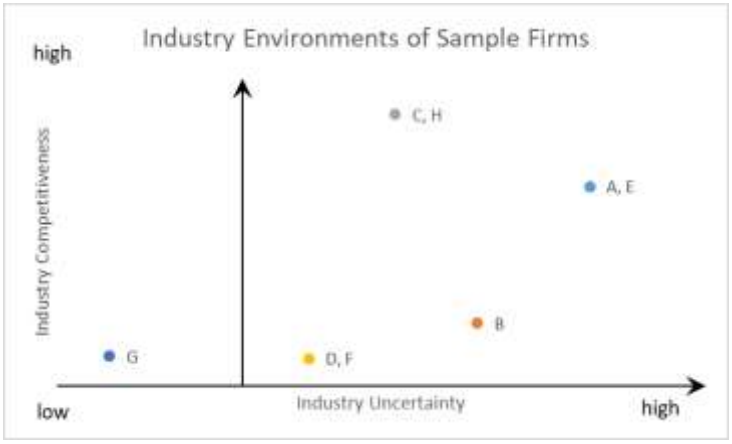
Why do managers use these intermediate steps to gain broader and different perspectives? My sample offered the opportunity to compare managers that matched blockchain to their existing lens (Table 3.4), and with managers who moved beyond existing strategies (Table 3.5). In this analytical step, I compared the three firms that adopted blockchain within existing mental

models (Firm B, D, and F) with the other five. Particularly, I focus on how these two groups of firms differ in the search triggers.

I relied on multiple data sources for triangulation. I first compared the initial problem statements from the interviews to uncover consistent themes in either group. I observed that the problems of Firm B, D, and F were initially more internally focused, compared to the other five firms. For example, Firm B's main problem addressed the credibility of its product offering. Firm D's managers cited responsibility attribution with its partners as the main problem. Both problem statements limit attention to firm practices and firm networks. Conversely, managers from Firm A defined the problems as major changes in the broad consumer retail market. Firm H's managers cited variety of competitors and new entrants as the main problems. Both problems statements created expectations of a wide scope of search.

I also used industry statistics associated with these firms to measure the uncertainty and competitiveness of the industry environment. All the firms were in established industries; therefore, an increase in entrants would likely crowd the market and increase competitiveness. I used the change of the number of companies in the industries, averaged between 2015 and 2018, to approximate industry competitiveness. I used the change of industry growth across the same period to measure industry uncertainty, with large negative change representing high uncertainty. This provided a quick snapshot of the environment (Figure 3.4). As expected, Firm B, D, and F clustered at the lower left corner where environment uncertainty and competitiveness were relatively low. However, Firm G is also positioned in low uncertainty and competitiveness. This outlier suggests that there are factors other than increases in environmental turbulence that motivate managers to search broadly and innovate in a different pattern.

Figure 3.4: Industry environments of sample firms



The X-axis is industry uncertainty, measured by the change of industry growth from 2015 to 2018. The Y-axis is industry competitiveness, measured by the change of the number of companies in the industries in the same period.

As a final step, I discussed my observations with managers from one firm from each group (Firm A and F). The informant from Firm A concurred that problems in the broad environment prompted them to think more broadly, outside of their existing competitive environments. Senior managers from Firm H commented that, although they also face market pressure, they have managed to survive and even thrive without too much direct impact from the external uncertainties. Both confirmed that environmental uncertainty and competitiveness is an important factor leading to managers consider new strategy options.

Discussion

Legacy strategy and learning new paths

There is an established literature detailing how different organizational and managerial triggers lead to strategic change (e.g. Greve, 2003a). Researchers have shown that the distance, timing, and frequency of search is related to innovation outcomes (e.g. Kang, Kang, and Kim, 2017; Katila and Chen, 2008; Khanna, Guler, and Nerkar, 2016). However, there is limited

understanding of the interaction of the search process and the constraints imposed by legacy mindsets within the firm. This study probed the search processes that resulted in firms adopting blockchain technology. I focused on the effects of the existing strategy lens on blockchain innovation, and how managers extend beyond the focal point of these lenses.

It is worthwhile to note that all eight cases represent adoptions that are embedded in the organizations. That is, these adoption cases emerge from the legacy processes in the firms. Based on the findings of this study, this is likely due to the reason that these eight firms have pursued a problemistic search that is motivated and driven by real organizational problems. Hence the adoption needs to be embedded into the organization, in order to solve the problem – mimetic, superficial adoption does not solve the underlying problem. But in many cases, the adoption of new technologies seem to be more mimetic, following the fads and fashion (Abrahamson, 1991). This difference provides an interesting path for future research, to understand under what conditions the new technology adoption is mimetic, and under what conditions it is embedded in the organizations.

This study corresponds to recent research on the step-by-step process of search. One of the most relevant paper is by Cohen and Tripsas (2018), in which they studied how firms search to adopt new technologies by bridging on their existing technological capabilities. This "bridging" mechanism, as they termed in the paper, resembles the multi-step search process that I identify in this study. However, I generate further insights into this bridging process of search by linking to several important constructs of strategy research. I develop a search process that provides the bridge from existing strategies to the new technology that is further affected by managerial cognitions and the external environment.

In summary, I highlight key findings and contributions. First, I found search anchored on existing strategies and cognitive frameworks, at least initially. Extant research emphasizes existing cognition as an important impediment to search and strategic change. My qualitative data confirmed this view. Furthermore, I showed that existing cognitions affect how managers initially view problems and provide boundaries to the search. When managers search, they start with an existing lens, based on legacy business models and strategies.

Second, I found that these legacy strategies do not always impede innovation decisions. Often, new technologies offer solutions for longstanding problems. In the case of blockchain, the problem of transaction uncertainty has existed for as long as economic transactions have existed. Because managers recognized transaction uncertainty as a source of important organizational problems, blockchain technology provided a possible solution that fits within the existing strategic framework. As a result, there was a match between firms' existing problems and blockchain technology, and managers could adopt the technology within the boundary of existing framework.

Most importantly, I found that when managers did use blockchain to change their legacy strategy, they followed a multi-step search process. Compared to adopting blockchain technology within existing lens, the cases of search beyond existing lens are marked by early solutions that expand or redirect managers' subsequent strategizing space. These intermediate solutions usually required further search regarding technology, market, or product. For example, in my sample some managers initially searched and found intermediate solutions such as a supply chain upgrade and strategic business re-orientation, but the initial solutions required further search for supporting technologies and new market positioning. Hence search continued

until these solutions components were developed. Through expansion and redirection of the search, these intermediate steps extended the search beyond the firm's initial strategic profile.

Finally, I briefly investigated the factors affecting managers' use of sequential searches. I observed that environment uncertainty seems to prompt managers to search more broadly outside of the existing business in which their firms operate. As a result, environment uncertainty may be an important determinant of search in broader or redirected space that include new digital technologies.

Conclusions

In this chapter, I analyzed how adoption of a technology (blockchain) result in a form of exploitation (the application of the technology to improve the efficiency of the firm's initial strategy) or a form of exploration (the use of the technology to change the firm's legacy strategy). I found that the existing lenses, to a large extent, determine initial search. These cognitive lenses anchor the search process with as regard to identifying problems, and viewing risks. I also found that, because new technologies are often built on existing technologies and meant to solve existing problems, managers do not necessarily have to search beyond the initial lens for the adoption of new technologies. Furthermore, when managers do successfully search beyond existing cognitive boundaries to innovate, they do so through a multi-step search process that is connected by intermediate strategies. These intermediate searches emerge from an attempt to solve existing problems. They also opened up opportunities to search more broadly, sometimes extending the search to initially unanticipated technologies and markets, and sometimes redirecting the search to apply the technology more broadly. Finally, I briefly investigated and found that the environment uncertainty of the firms' current positioning crucially affects whether managers search for broader and different intermediate solutions.

The analysis presented in Chapter 2 showed that within firms, managers adopt a blend of both exploitation and exploration options, in response to historical comparisons. The range in the proportion of responses is influenced by the extent of diversification and decentralization in the firm.

This chapter presented the results of an analysis of a single choice, the adoption of blockchain, and showed how the same option might be used for either exploitation or exploration. In turn, the choice was related the use of a sequence of intermediate searches, each of which increased the amount of exploration in the search, resulting in an exploratory choice. The level of competition and uncertainty in the environment offers one explanation for the different, emergent choice strategies. Exploration occurred more frequently in environments with high levels of competitiveness and uncertainty. In contrast, exploitation occurred frequently is stable environments.

Like the firms analyzed in Chapter 2, the firms studied in the current chapter differed how diverse and decentralized they were. The next chapter presents an analysis of how these factors influenced the form of the search strategies and the emergence of exploitation or exploration in the adoption of blockchain.

CHAPTER 4: EXISTING GOALS AND INNOVATION: HOW GOAL DEFINITIONS AFFECT SEARCH[6]

Summary of Previous Chapters

Overall, my thesis looks at how the search patterns of firms affect their learning and innovation. I started by looking at how firms' divisional structure affects learning from previous performance. By using quantitative data and analysis of manufacturing firms in the U.S., in Chapter 2, I found that divisional structures change the feedback learning loop and leads to different patterns of exploration versus exploitation choices across firms with different degrees of diversification.

To gain further understanding of the search and learning process, I then investigate the search process in more detail. I conducted a grounded investigation of eight Chinese firms' adoption of blockchain technology, which offered the potential for radical innovation at the time of my grounded data gathering in 2018. Chapter 3 detailed how the patterns of search affect the firm's use of the technology to either strengthen or change their legacy strategies. I found that in these large, complex organizations, the search that leads to innovation follows a multi-step process. Triggered by perceived problems, these firms searched and identified intermediate solutions. These intermediate solutions usually require further definition and specification, which leads to further search. This sequential search process leads to the identification of blockchain

[6] This study is coauthored with Professor Hugh O'Neill.

technology as a solution, though usually prompted by intermediate solutions and emergent problems, not necessarily suggested by the original problem definition.

Extension to Goals

The previous chapters suggest an important question in the next step of my thesis. Diversified organization structure distorts the feedback learning from goals, as shown in my quantitative study in Chapter 2. Learning outcomes evolve through a multi-step process, as found in Chapter 3. This prompted a derived research question: How does the initial specification of the goals affect the learning outcomes during a multi-step search process?

The literature on search and innovation (e.g. Berry, 2018; Katila and Ahuja, 2002; Khanna, Guler, and Nerkar, 2016) generally finds that firms are more likely to identify innovative solutions if they search beyond their normal solution space. These studies show that, by scanning for strategic alternatives more broadly, deeply, and frequently, companies are more likely to identify and adopt innovative alternatives. And because existing goals define problems and shape attention, it is natural to speculate how the initial goal statements influence the depth and breadth of the firm's search.

But Chapter 3 of my thesis suggests a nuanced picture. These firms in my sample all started with the existing problems, and searched in several steps until they reach the decisions to adopt blockchain technology. My findings in Chapter 3 (Figure 3.2) lack evidence of obvious "jumps" in search suggested in some literatures (e.g. Levinthal, 1997). Indeed, Figure 3.2 shows relatively smooth transitions between steps of search. This transition suggests the search that leads to blockchain adoption emerges through a gradual restatement/redefinition of past goals of these firms. The findings in Chapter 3 led me take a focused look at the role of goal across different hierarchal levels during the search and learning process.

In this Chapter, I focus on the role of goal factoring in firms' search process and how the sub-division of goals across levels relates to firms' learning of innovative solutions. Specifically, I ask the question: what roles do firms' existing operational goals play in their search for innovations? As some existing papers have suggested, organizations tend to have a hierarchy of goals (Gaba and Joseph, 2013; Hu and Bettis, 2018). In this paper, I first focus on the top-level, organizational goal. The question then becomes: what is the role of derivative goals (that is, goals in the hierarchy) in firms' search and innovation decisions?

In behavioral strategy research, goals have been used interchangeably with aspirations (e.g. Greve, 1998). These are general terms that could refer to the targets or goals at various levels in an organization. For most of BTOF, goals usually refer to corporate goals. Within firms, though, goals differ in specificity and focus. For example, there strategic goals (firm level), but are sales goals for marketing and other operations (functional goals). I study the breakdown of strategic goals to business goals, and operational goals. For example, an ecommerce firm might aspire to provide the best ecommerce platform to consumers and merchants. This is a firm-level goal.. At the business unit level, the various functional units will likely include accounting, IT, logistics, etc. These functional units will aspire to achieve some goals that are more specific, such as providing excellent accounting services and efficient logistics and supply chains. These l goals, although more specific than the goals at the firm level, can be further broken down. For example, within the logistics unit, various operational departments might aspire to achieve low cost of purchasing supplies, reliable transactions, or productivity increases. As a result, the goals within the same firms are different at the different levels of the firm, business, and operations.

To gain a full picture of the role of goals in innovation search, I consider the presence of additional organizational goals at lower levels of the firms, and try to delineate the relationship

between firm goals and lower-level goals. Consistent with the literature on multiple goals and goal hierarchy (Gaba and Joseph, 2013; Hu and Bettis, 2018; Klein, 1989; Unsworth, Yeo, and Beck, 2014; Vissa, Greve, and Chen, 2010), I define three levels of goals. At the top is the organizational goal at the corporate level. This top-level goal tends to be abstract and inclusive (Unsworth, Yeo, and Beck, 2014). Then there are business goals that are expressed at the divisional or business unit level (e.g. Gaba and Joseph, 2013). For the purpose of this study, the third level goals are operational goals derived to operationalize and implement business goals. As theories indicated, the hierarchy of goals can include many layers (Klein, 1989). This study will focus on the role of these three levels of goals in firms' search and innovation decisions. Where much of the behavioral research implicitly positions the decision process within a top management coalition, few studies investigate how the members of the coalition (or members beyond the top management coalition) may differ in their interpretations of goal requirements and/or in their preferences.

I use the same sample gathered for the study on blockchain adoption by Chinese firms. Blockchain technology is a relevant research context because the adopting firms did not participate in the development of the technology, hence the technology is an external innovation. This provides an opportunity to identify the links between goals, search, and the adoption of external innovations.

Given the lack of empirical research on the link between goals across hierarchy and their impact of the outcome of search, I combine theory elaboration and theory generation (Bingham and Kahl, 2013). I use the goal construct to elaborate the multi-step search process uncovered in Chapter 3. A description of firm-level goals branching down into specific business and operational goals emerges from this process of elaboration. I observe that, as the BTOF has

predicted, firms search for solutions to problems, and the search is goal oriented. However, during search, innovation decisions were not automatic. Instead, the firms developed business and operational goals that were subordinate to, but consistent with, the organizational-level goals. Operational goals help firms identify innovative technologies, as technologies are specific to processes. This goal branching helps firms identify how the technologies might satisfy their needs. Hence operational goals provide the crucial linkage between organizational goals and the patterns of use for the new technologies.

This chapter contributes to research on search, goals, and the adoption of innovation. Search is a key concept regarding the strategic decision process. But the interactions among goals, search, and the breadth of learning are not fully understood. I uncover a goal-oriented search process in which initial firm-level goals are specified in subordinated goals regarding specific operations and tasks. The specification of these lower level goals affects whether the firm adopts the innovation for incremental or radical shifts in strategy. This paper investigates the influence of goal hierarchies, and describes an iterative process of search branching down from high-level firm goals into lower-level operational goals. This contributes to the ongoing understanding of how the hierarchal process of decomposing abstract aspirations into concrete goals influences the pattern of learning. Finally, I show a strategic process of innovation that evolves within a legacy strategy framework. This insight of innovating within legacy strategy contributes to a more comprehensive understanding of innovation.

Literatures on Multiple, Hierarchical Goals

Goal hierarchy has been shown as an important concept in some of the early works on psychology, organizational behavior and behavioral strategy (Cyert and March, 1963; Klein, 1989; Locke, Cartledge, and Knerr, 1970). For example, in Locke, Cartledge, and Knerr (1970),

the authors found that individuals develop subgoals as they try to fulfill existing, overall goals. Klein (1989) conceptualized hierarchies of organizational goals as organizational motivations and controls. In addition, behavioral strategy has long theorized that firms have multiple goals that are held by various individuals and coalitions (Cyert and March, 1963).

Most recent works have focused on specific goals, such as financial performance or a specific innovation choice. For example, Shapira (2016) and Vidal and Mitchell (2015) looked at how firms, due to a performance-goal disparity, enter into new markets or reconfigure resources. In these studies, less attention is paid to the links between differing goals within organizations, and how goals interact across a hierarchical network.

Some organizational scholars begun to uncover how firm changes and decisions occur within contexts where multiple, hierarchical goals are present (e.g. Gaba and Joseph, 2013; Greve, 2008; Hu and Bettis, 2018; Vissa, Greve, and Chen, 2010). For example, Gaba and Joseph (2013) found that the corporate and divisional levels of an organization react differently to a performance-goal disparity. Hu and Bettis (2018) described the uncertainties that emerge as multiple goals, across differing parts of the firm, create inconsistent feedback within shared task environments. These studies provide timely insight into influence that hat multiple, hierarchical goals have on firm search and learning.

A question that is yet to be addressed is the interaction between hierarchical goals during innovative search. However, in the BTOF, it appears clear that the managers, after being tasked to search for solutions to specific goals, develop subordinate tasks, steps, and actions – subgoals – to achieve the original goals. More importantly, it seems that these subgoals are generated throughout the search process. However, there is lack of study on how goals across the hierarchy interact during the search process. Empirical work is needed to understand how the searches

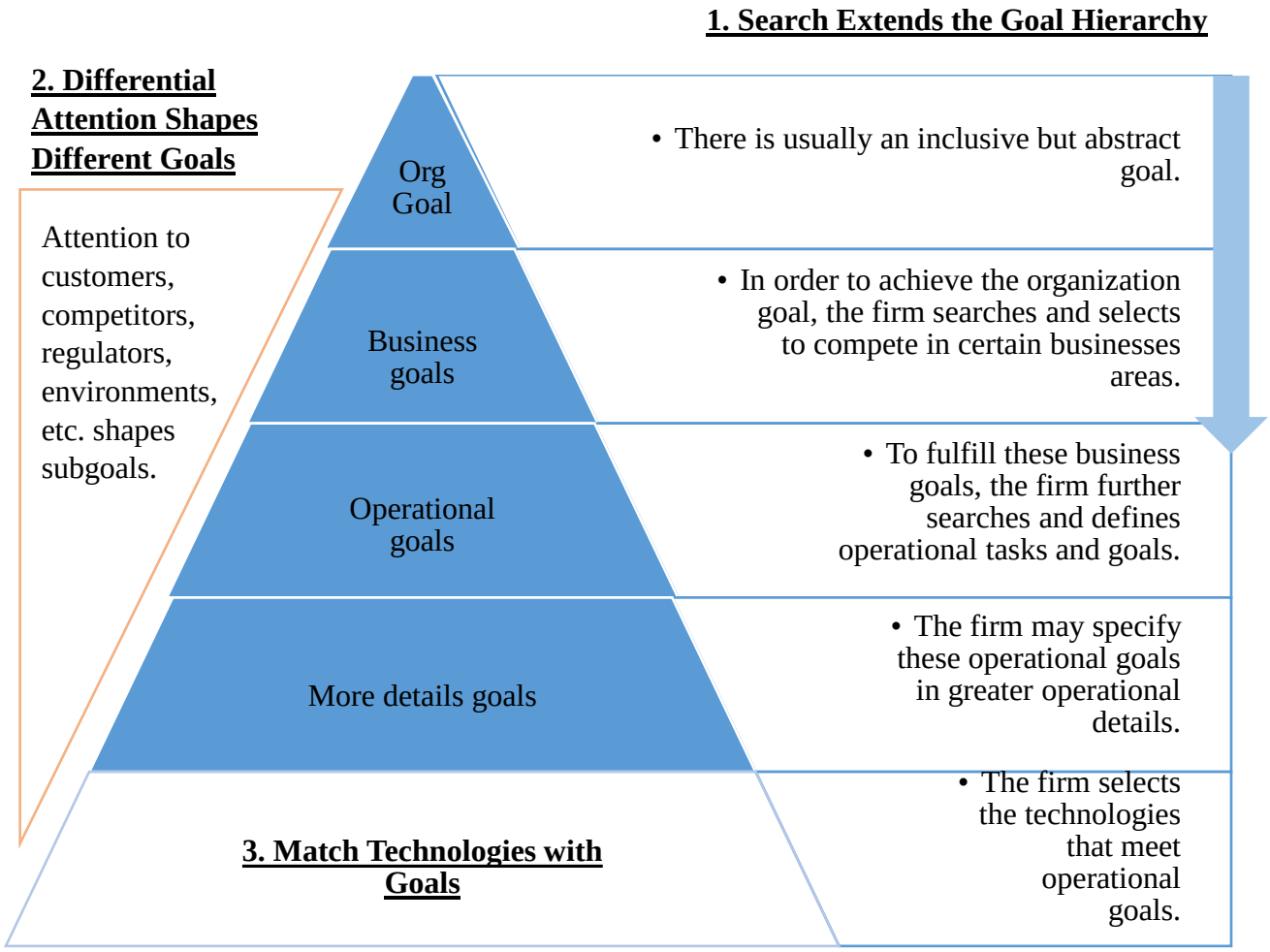
across a goal hierarchy interact, and how the interaction process influences the outcome of the search process.

To summarize, there are important limitations in the existing literature on goals and search. First, there is yet to be research on how firms' goal hierarchies influence the patterns of search. Also, there is especially a lack of understanding on the relationship between search, goal hierarchy, and the patterns of learning during the search. In this Chapter, I will focus on these two gaps.

Analysis: Search, Goal Hierarchy, and the Use of a New Technology

As discussed in Chapter 3 regarding the grounded methodology, a study of blockchain adoption is well positioned to help us understand search and innovation, as well as the role of goals in search and selection. I rely on the annual reports, blockchain whitepapers, and semi-structured interviews with senior managers of these firms for the analysis. My goal, through the analysis in this chapter, is to understand the role of dividing responsibility and subdividing goals during the search process that led to blockchain innovation in these companies. The annual reports help me understand the organizational goals, business goals, layers of operational goals, and the relationship among these goals. Some firms published blockchain whitepapers. These blockchain whitepapers provide crucial information on why the companies think blockchain can be useful in their organizations. The hours of interviews with each firm provide a comprehensive picture of the variety of goals across the organization, and their impact on the search for innovation. Through use of the methodologies described in Chapter 3, I observed a search process that emerges as firm-level goals affect the patterns of attention for managers at different levels of the firm, which leads to the adoption of a new technology (Figure 4.1). In turn, the adoption of the new technology can have an incremental or radical impact on the firm's strategy.

Figure 4.1: A framework of search, goal hierarchy, and technology innovation



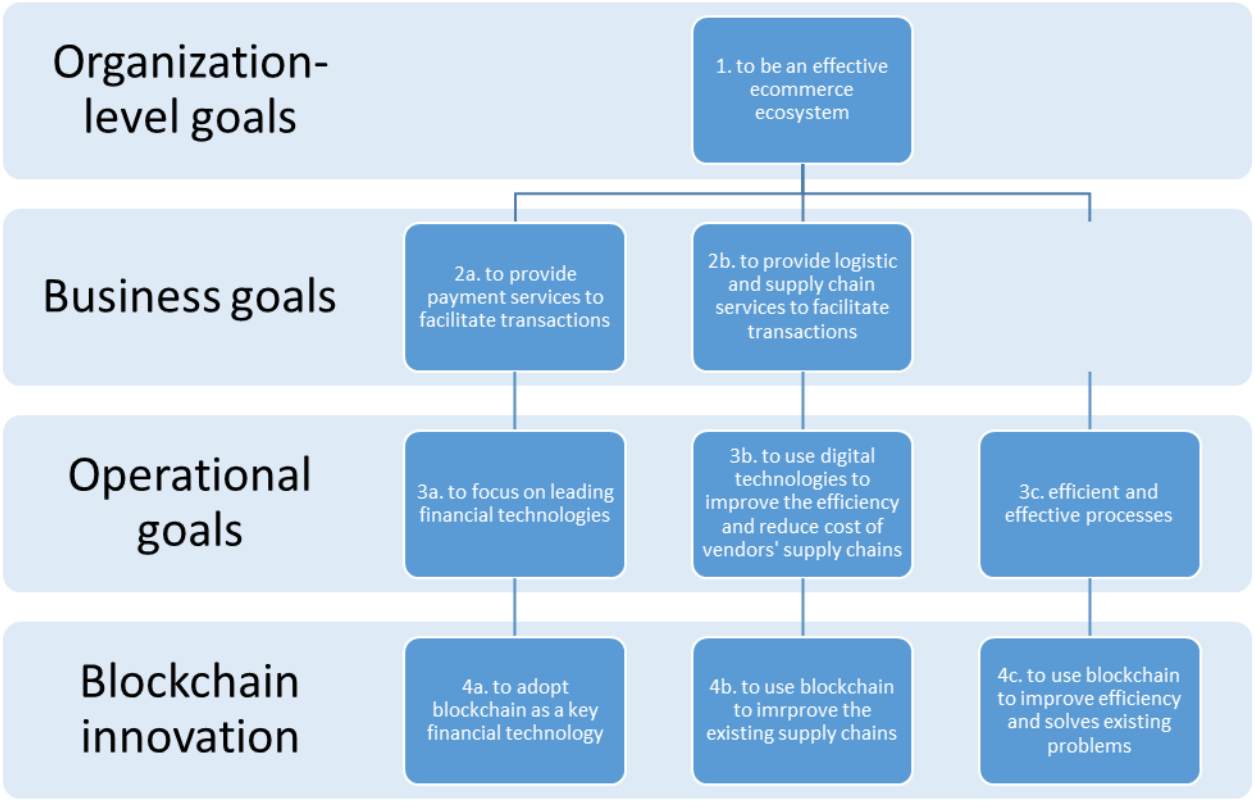
Search and the goal hierarchy: A process of coevolution

Goals motivate search and innovation (e.g. Khanna, Guler, and Nerkar, 2016; Shapira, 2017; Vissa, Greve, and Chen, 2010). This literature supports an implicit assumption that goals provide the impetus for the depth and breadth of search, and the decision to adopt an innovation. The process is sequential – a goal statement, a pattern of search, and learning outcomes.

However, the firm documents and interviews across this set of firms adopting blockchain suggest a more complex relationship between goals and search – that goals and search are iterative activities, and as the goals branch through the organization, the process of branching shapes the search in ways that affect organization learning. While the prevailing literature emphasizes how goals lead to search, in this study, the data describes a process of goal-oriented search that leads to the development of subgoals. First, the patterns fit the existing literature in that that goals, especially discrepancy in expected goal performance, lead firms to search for alternative solutions. In terms of BTOF wisdom: "search is motivated" (Cyert and March, 1963: 169).

Second, as firms search for solutions to reach the goals at the organization level, they do so in multiple steps across the organizational hierarchy – solutions selected at a higher level of hierarchy often become the goals of the lower level, leading to further search. As a result, goals at the corporate level lead to search, which results in the identification of varied business goals to support the higher level organization goals. These business goals lead to further search and definition of various operational tasks, or goals. These operational goals are the necessary tasks to reach the goals at the business and organization level. Overall, I find an iterative process of goal definition and search, through which search extends the goal hierarchy of the firm from the organization level to the business and operational levels (e.g. Figure 4.2: Firm A).

Figure 4.2: A search process that develops subgoals



* Firm A is used as an example in this table.

This description of an iterative, top down process complements the existing literature on how goals motivate search in two important ways. The BTOF established goals as an important concept for understanding organization adaptation. However, the strategy and organization literature has not studied the pattern partitioning of the goals during the search process. Here, while I find that organization goals trigger the initial search process, the sequential steps to interpret the organization goals and define business and operational goals have a material impact on the outcomes of the search. The business and operational goals can be loosely or tightly

connected with the initial organization goals. This emergent process matches an early insight from the BTOF:

> *There is an "elaboration and clarification of goals through day-to-day bargaining."* (1963: 37)

In studies of decision making, the psychology literature provides similar clues regarding the generation of goal hierarchy, albeit of individuals (e.g. Gozli and Dolcini, 2018; Locke, Cartledge, and Knerr, 1970). For example, Gozli and Dolcini (2018) theorized that individuals develop subgoals as process for attending to complex goals. In an early empirical paper, Locke, Cartledge, and Knerr (1970) found that:

> *"When a person has an overall end goal on a task, he will set subgoals according to their judged instrumentality in achieving this end goal… Most men choose subgoals as a means to an end goal. Their focus in choosing a subgoal is not on the immediate pleasure to be gained from it but on its instrumentality in achieving their long-range goals."*

Therefore, my findings here are consistent with both the general wisdom of BTOF and insights from psychology. In tracing the search process from an initial definition of organization goals, I found that the emergent goal hierarchy plays a key role in the form of learning.

Differential attention leads to different operational goals

Much of existing research has theorized the importance of attention in directing organization changes and innovation (e.g. Eggers and Kaplan, 2009; Ocasio, 1997; Rhee and Leonardi, 2018). These studies generally find that attention, the results of various dispositional or experiential factors, directly and indirectly affect organizations' innovation decisions. Organizations with attention on innovative technologies and related problems are more likely to innovate and adopt the new technologies.

The qualitative data of my study show a more nuanced picture of how attention affects innovation decisions – as managers define the specific goals that they want to achieve. As attention shapes organizational decisions and actions (Ocasio, 1997) the attention triggers the search for subgoals in order to achieve the higher-level goals of the organizations. First, I found that business and operational managers varied in where they focused their attention. The choice of focus of attention, in turn, impacted the form of learning. For example, decisions emerged to search in certain industries and sectors. Similarly, the decision makers focused attention on specific customers, services and competitors (Table 4.1). These choices provide boundaries on where the firm would search, and ultimately, what they would learn.

Similarly, the choices at the business level shaped the ensuing attentional process at the operational level (Table 4.2). The operational subgoals, which focused attention on specific customers, competitors, regulators, and etc., linked the organizational wide search to a specific and limited number of uses of blockchain technology. The range of the external uses affected how the firm used the technology, once adopted.

Table 4.1: Attention guides in specifying business goals

Attention to:	Leading to business goals	
	Goals	Quotes
Customers	to provide transaction payment services	The company's payment business was started to facilitate transactions between vendors and consumers on its platforms. – A
	to provide logistics services	In order to provide consumers an enjoyable shopping experience, the company has built extensive fulfillment infrastructure and delivery networks. – E Under the smart retailing goal, the company develops a smart supply chain infrastructure that improves the efficiency and performance of traditional supply chains and the ability to provide services to customers. – G

	to provide comprehensive services to meet customer needs	The company uses various channels, including online sales, offline services, and retail stores, to satisfy various demands of customers. – E
Performance	to develop technology capabilities and provide related services	The company's platforms are driven by heavy investments in technologies. This is necessary to support the growth of sales. – E
	to provide logistics services	To support company growth, the company has developed extensive front- and back-end infrastructures and services. It further uses a data approach to improve efficiency to support the infrastructures. – E Under the smart retailing goal, the company develops a smart supply chain infrastructure that improves the efficiency and performance of traditional supply chains and the ability to provide services to customers. – G

Table 4.2: Attention guides in specifying operational goals

Attention to:	Leading to operational goals	
	Goals	Quotes
Customers	to adopt big data approach in operations	The logistics business unit uses various digital technologies to meet customers' and vendors' logistics needs, and to improve the efficiency of the supply chain network. – A The company will use digital technologies to improve personalization and customer experience. – A To better serve the customers, the company is using a data-driven approach to provide authentic products at low cost and with effective services. – E On one hand, it will use data to improve service, and on the other hand, it will rely on data analytics to reduce inventory and improve capital efficiency. The goal is to achieve a highly efficient supply chain operating system. – G
Performance	to adopt big data approach in operations	The logistics business unit uses various digital technologies to meet customers' and vendors' logistics needs, and to improve the efficiency of the supply chain network. – A To support company growth, the company has developed extensive front- and back-end infrastructures and services. It further uses a data approach to improve efficiency to support the infrastructures. – E On one hand, it will use data to improve service, and on the other hand, it will rely on data analytics to reduce inventory and improve capital efficiency. The goal is to achieve a highly efficient supply chain operating system. – G
Competitors	to adopt emerging technologies	"The company is relatively weak in technological capabilities. It wants to learn and adopt new emerging technologies." – E
Resources	to provide financial	"Currently, the most important goal of the (payment business unit) is to become a financial technology business. This is partly due to pressure from external regulations, and also because technology companies are

	technologies services	valued higher than payment companies from a financing perspective." – A
Regulators	to provide financial technologies services	"Currently, the most important goal of the (payment business unit) is to become a financial technology business. This is partly due to pressure from external regulations, and also because technology companies are valued higher than payment companies from a financing perspective." – A

Understanding how the goal hierarchy shapes the form of attention in innovation decisions

An important factor leading to organization innovation decisions is the combination of the effects of top-down goal hierarchy, specifically, how the division of goals shapes organization attention. It is important to recognize that the goal hierarchy shapes attention, and in so doing, also shapes the direction and breadth of innovation decisions. This influence of subordinate goals have important implications for research and managerial practice.

Organization goals, usually clearly specified, are part of formal organizations and their control systems (Cardinal, Sitkin, and Long, 2004). Although they are not always strictly adhered to, due to various internal and external factors, these organization goals are crucial in drawing the attention, and directing the activities, of the whole organization. For example, in the annual reports, most firms in my study clearly announced their organization goals presenting company information. They then follow with further discussions on business and operations, often with a direct connection between stated organization goals and business and operational activities.

In contrast, attention is a less formally specified as a process within the organization. Although influenced by the formal organization and goals, attention is a distinctly different construct than the formal organization. Organization attention tends to be implicit, resulting from the collective experience and learning within the organization or subgroups. Although less

visible than clearly specified goals, the attention process affects the daily activities of organizations (Ocasio, 1997).

I found that as the search develops through the goal hierarchy, differences in attention across levels and individuals shape and constrain the search. The result is that lower-level operational goals can become less connected to organization goals, as firms move to adopt blockchain. Attention is a process that is hinged through the formal organization goals, and at the same time, subject to the vicissitudes of individual attention and experience.

Differential attention and transformational innovation

Research on attention and innovation has often focused on attention as regard to the particular problems organizations face, specific innovative technologies, or various information networks and sources relevant for innovation (e.g. Eggers and Kaplan, 2009; Rhee and Leonardi, 2018; Tripsas and Gavetti, 2000). This research stream, similar to the studies on search and innovation, often finds that broad attention to new technologies and opportunities promote innovations by organizations.

In this study, however, I observed that many firms adopt blockchain innovations despite restricted ranges of attention. As mentioned, all companies in this sample adopted blockchain. In interviews as well as textual documents, attention to customers, regulators, competitors, etc. are often cited as important reasons for blockchain adoption. While the respondents mention attention to the publicity surrounding blockchain at the time of our interviews in 2018, the articulated logic for adoption for these companies referred mainly to customers, regulators, etc.

Christensen made a famous point that attention to existing customers leads to a focus on existing products and markets, and inhibits innovation (Christensen and Bower, 1996). This view

has not been without challenge (e.g. Ketchen, Hult, and Slater, 2007; Slater and Narver, 1998). These opposing studies point out that customer attention is key to understanding customers and markets, hence helping organizations to be more proactive in anticipating customer demands and innovate. However, to date, there is lack of qualitative understanding of this process of innovation spawned by customer attention (see Foss, Laursen, and Pedersen, 2011, for a notable exception).

My data shows that internal attention to performance and external attention to customers, competitors, and regulators can each be an important impetus to developing innovative operational subgoals, which then lead to the adoption of digital technologies such as blockchain (Table 4.2). However, these operational subgoals differ as regard to the potential change on organizations and their processes. When the attention is on customers, organizations try to understand various customer needs, both existing and potential. Also, when firms focus on improving performance, they also drive deep to understand how operations can be improved through use of technologies. Both lead to adoption of innovation, with potential to change organizations and processes to meet customer needs or performance requirements.

On the other hand, in this sample, organizations develop substantially different operational goals, which then impact the way an adopted innovation is used. When their attention is on competitors, regulators, or external investors, the operational goals usually lead to a simple adoption of blockchain for a narrow breadth of innovation. The goal of these companies is to be ahead of competitors in adopting something new, to meet regulatory requirements, or to attract external funding, as a result, the innovation becomes more like a checkbox to be ticked.

In contrast, for some organizations, the adoption of blockchain causes them to use innovation as a means for a major transformation of their company. These firms do not

necessarily have a broader search, but they do have a different search, one which is influenced by the interaction of goal definitions across the hierarchy.

For example, Firm A had an overarching organizational goal to provide an effective e-commerce platform to its customers, and its search predominantly focused on customers (Figure 4.2). To define this firm-level goal, the search focused on how to provide better services to customers by providing payment convenience and delivery solutions. Through further iterations of search, these goals were subdivided into specific business and operational goals. It is important to note that these goals emerged from attention to customer satisfaction. Finally, the process led to operational goals for improving the firm's financial payment infrastructure and supply chain systems, to which blockchain technology proved suitable candidate. These goals hence connected the blockchain technology with the actual processes and structures of the organization and its strategy. As result of this search and goal specification process, the firm-level goal led to an adoption of blockchain technology that had broad impact on the organization's processes and structure.

This is in contrast to Firm E, whose attention on competitors also led to the decision to adopt blockchain technology (Table 4.2). By paying attention to its competitors, Firm E aimed at the specific goal of outperforming its competitors in the technologies that it adopts, for which blockchain was also an ideal candidate. However, as shown in the case of Firm E, this attention on external competitors proved shallow – it does not effectively connect with other internal organizational processes and structures to the technology. As a result, the impact from the adoption is narrower, affecting less of the organization.

It appears, then, that some firms do suffer the "innovator's dilemma" proposed by Christensen. And, in contrast, some firms do innovate based on searches in the local

neighborhood of current customers. With respect to the blockchain adoption, the adoption after the neighborhood search is often myopic, and extends the firm's legacy strategy. But a few firms do use the new technology to change their legacy strategy. The analysis presented here suggest that the pattern of branching goals can lead to either escalating attention to the exploration of new opportunities, or focused exploitation of legacy strategy.

The classic predictors of innovative strategies include performance discrepancies and broad search. The results here show that though performance discrepancies triggers search, the form of the search is shaped by interpretations as the goal filters through the hierarchy. My observations show that narrow searches can lead to the adoption of a new technology. Further, the adoption of a new technology can have either a limited or broad impact on the firm's overall strategy.

Part of the explanations for the varied forms of adoption can be found in the nested relationships within and across the black boxes of the organizations goal branching activities. The links between performance, search and learning follow many paths.

In the next chapter, I summarize the insights from the three distinct analyses. I discuss the limitations of the research designs and samples. Then I make recommendations for future research.

CHAPTER 5: SYNTHESIS AND FUTURE RESEARCH DIRECTIONS

Summary of Research Goals

My thesis follows a long tradition of strategic research that focuses on the change in large companies. These companies are important to the economy and society, and are crucial subjects for strategy research. For example, the firms that are in the samples of this thesis include General Electric, Caterpillar, and Alibaba. While these large companies have common and different traits, in this thesis, I focus on search within the multilevel and multidivisional structure of these organizations.

I set out to understand the interactions among firm structure, goals, and the search process (see Chapter 1). I drew from the rich literature of the BTOF on search, and connected this literature with other key research streams on multidivisional firms and diversification. I found that the search literature is rarely connected with multidivisional structure that is the main feature of today's large firms. How do multidivisional firms respond to corporate level shortfalls in performance? I focused on the learning process based on the evaluation of performance feedback and the exploration and exploitation tradeoff. I provide insight as to how these firms make the tradeoff decision when they learn from their previous performance, and how the response to performance differs as they become more or less diversified.

The second research goal of my thesis addresses the search process itself. Much of the existing literature has looked at the types and dimensions of search. However, less is known about what happens within the firm during the search process. Posen, Keil, Kim, and Meissner

(2018) describe this as a "black box." I aimed to understand more of this process of search and how the search influences innovation decisions by focusing on three key aspects of search: the divisional structure of firms, how search is distributed in firms, and how search develops across multiple stages. Studies have described the search process variably as distant, local, and frequent, but I focused on how the search evolves (that is, becomes distant or local) once a problem is identified.

Finally, I studied the evolution of firm-level goals during the search process, or, to put it differently, the co-evolution of search and the goal hierarchy. As the corporate search process creates a number of related searches in different parts of the hierarchy, the role of the goal that has initiated the entire search process is an important determinant of the ultimate search outcome. According to the BTOF, goals initiate search. But with search itself being a multiple step process, how do these initial goals affect the search process? Particularly, I provide insight into how firms reshape these initial goals while they search for innovative solutions.

To summarize, my dissertation intends to provide a deeper understanding of search, by focusing on the organizational processes that accompany search. I provide nuanced insight into how the learning process affects that breadth of that innovation following search. In the quantitative analysis of the electrical industry, I use the ratio of the number of exploration decisions to exploitation decisions discussed in firm quarterly announcements to measure the breadth of innovation. In the qualitative field study, some firms use the technology to exploit their legacy strategy, while other firms use the technology to explore new corporate level strategies decisions. So, I use the firm's form of adoption of blockchain technology as the indicator of breadth of adoption.

Summary of Main Findings

I conducted three empirical studies to address patterns of learning from performance when there is a diversified multidivisional structure, the steps within search, and co-evolution of search and goal hierarchies. The first study is a quantitative analysis of the exploration and exploitation tradeoff decisions of electric equipment companies in the U.S. The second and thirst studies present a qualitative analysis of blockchain adoption by several Chinese companies. These studies result in the findings described below.

Performance feedback in the presence of diversification and multidivisional structures

The key insight from this study (Chapter 2) is that corporate diversification and the multidivisional structure alter the feedback learning process, resulting in different patterns of risk taking choices at the firm level of diversified, multidivisional firms. The finding provides support of my analysis of two different theories about the feedback learning process – probability weighting of risky decisions, and risk diversification across multiple lines of businesses in multidivisional firms. Corresponding to the shortfalls in the existing literature as mentioned by Posen, Keil, Kim, and Meissner (2018), my study contributes to our understanding of search and the BTOF by helping to resolve the results in conflicting findings on the effect of performance feedback on risk taking, and by looking at a broad range of exploration and exploitation outcomes.

First, based on prospect theory (Kahneman and Tversky, 1979; Tversky and Kahneman, 1992), I theorized that firm level decisions at varies risk levels – probabilities of success or failure – are weighted differently in the managers' calculations of the value of the decisions. Based on prospect theory, I argue that these probabilities are important considerations in understanding firms' risk taking.

Second, based on probability theory regarding compound probabilities, I theorized that the probabilities of success or failure at the firm level of diversified firms are different from the probabilities of each individual decision at the business units' level. Specifically, for decisions with risk (decisions with small individual probabilities of success or failure), the aggregate probabilities at the firm level, as the perceptions of risk interact across managers with different areas of responsibility, will be higher. In fact, simple probabilities calculations show that a combination of risks across the firm are very different from the risks of the individual components (Appendix 2).

Finally, merging these two insights, I theorized and found that multidivisional firms differ in their risk taking behaviors following performance, when compared to unitary (non-diversified) firms. Specifically, due to diversification of risks, more diversified firms are in general less incentivized to take risks than less diversified firms. In addition, while diversified firms are risk seeking in loss and risk averse in gain, the least diversified firms exhibit the reverse pattern.

Overall, my findings suggest that, in a sense, the organization structure becomes an information filter as the firms and managers search, learn, and make changes. This insight is a crucial complement to the traditional view on the relationship between strategy and structure. In the traditional view, structure affects firm strategies in at least two ways: the strategic decisions of firms, and which strategies are more likely to lead to better performance (Rumelt, 1974). My findings suggest an additional way that structure affects strategy by showing that structure is crucial to the information processing during strategic decisions. It addresses the division of responsibility for decisions across diversified and undiversified firms. It addresses the division of

responsibility for decisions across diversified and undiversified firms and it provides description of organizational designs which facilitate the use of exploratory learning.

The search process

My dissertation provides important descriptive insights about the search process. Based on a qualitative analysis of how Chinese firms adopt blockchain technology, I show how a multi-step process of search sometimes leads firms beyond the constraints of legacy cognition and strategies (Chapter 3). Corresponding to the shortfalls in the existing literature as mentioned by Posen, Keil, Kim, and Meissner (2018), my study contributes to our understanding of search and the BTOF by disentangling the conjoined elements of the search process in the existing literature.

I find that search might be better described as a multiple step process. Consistent with the classic view on search, in my sample firms, search is triggered by the discrepancy between goals and attainment. However, in reaching the decisions to adopt blockchain, the firms usually go through iterative searches. Through a sequence of steps, the solution at each step – an intermediate solution – becomes a derived goal in itself to be fulfilled, leading to further search. These intermediate solutions provide bridges connecting the original goals with the innovation decisions, in a way which influences whether the adoption leads to narrow or broad changes in strategy.

Environmental dynamism is a key factor, in that under conditions of environmental dynamism, the intermediate solutions lead to broader searches and broader uses of the newly adopted technology.

Search and goals

My findings about the sequential nature of search and the role of search in reshaping goals prompted further study of how the distribution of goals influences the emergent search outcomes. My study finds that the search process, in the serial steps of looking for intermediate solutions, involves a division of responsibility for search based on the firm's goal hierarchy. The relationship between goals and search seems to be co-evolutionary. Corresponding to the shortfalls in the existing literature as mentioned by Posen, Keil, Kim, and Meissner (2018), this study makes further contribution than the previous study by helping to understand the role of attention during search, and by further disentangling the search process to include the role of subordinate goals.

First, when search is triggered by the firm-level goals, the goals tend to be abstract and inclusive. The goals become less abstract as firms search and subdivide the goal through the firms' different businesses arenas. Within the business arena, the search focus narrows to even more specific operational tasks and goals. The firm subdivision process may then further specify these operational goals in greater operational details. Finally, the firm selects the technology to meet operational goals. In this process, search evolves as a response to abstract frim firm-level goals into more specific business and operational goals. In this way, the goal the goal hierarchy influences two key processes of evolution – selection and retention.

Second, I find that the form of specification of goals is affected by the firms' attention. I find that the firms' attention is shaped by a number of factors: performance, customers, competitors, regulators, etc. These different focal points of attention shape the pattern of goal choice.

In turn, the differential attention also leads to different decisions about the form of implementation of blockchain. I find that firms that pay attention to performance and customers

connect the internal organization processes to a broader use of the new technology. This results in a broader impact of blockchain on organization, which I label as "transformational innovation." On the other hand, firms that focus their attention on competitors and regulators adopt narrow uses of blockchain, with less change in their existing processes.

Future Research

This dissertation provides insights for future research. A portion of that research will need to address the limitations that are inherent in the analysis presented here.

Limitations and reconciliations

The limitations in this work include the choices of theoretical perspectives and methods, and the generalizability of findings.

Throughout the previous five chapters, the BTOF and its search perspective dominates my theoretical argument and analysis. With this focus on BTOF and search, I forgo the opportunities offered by other theoretical insight that address innovation, such as the perspectives of evolutionary economics, institutional isomorphism, resource dependence, and cognitive studies. However, I believe that the choice of the BTOF is suitable for the research questions that I am trying to answer. Since my goal is to understand the process of how firm search leads to change, the BTOF is well suited due to its rich tradition linking performance, search, and forms of change.

Risk taking is an important topic in strategy, economics, psychology, and finance. In this study, I demonstrated how advancement from psychology and behavioral economics can provide important insight into performance evaluation and patterns in learning across a set of decisions. Admittedly, in the strategy field, traditional studies on managerial risk taking are usually based on accounting and performance measures of risks (e.g. Bettis and Hall, 1982; March and Shapira,

1987). In the psychology literature on individual risk taking, however, the risks are usually measured as regard to the probabilities of success and failure, and the magnitude of risks. To better utilize the insights from the psychology literature, my study has adopted the probability measures of risk. Future studies can extend my findings by using the accounting measures of risks. Future research can also generalize my findings by looking at broader industries and contexts.

In terms of methods, I have used both qualitative and quantitative methods for my investigations of the research questions. For the quantitative investigation (Chapter 2), I used a large quantitative sample of electric equipment manufacturers publicly listed in the U.S. This sample is bound by several factors, including the industry, the public company status, and the stock listing location. I use the log of a ratio as the dependent variable, which may lessen the reliability of the analysis. All these factors limit the generalizability of the research and findings. However, by focusing on a specific industry, I gained the advantage of being able to identify more suitable controlling variables, thereby improving the fitness of my empirical model. For example, in Chapter 2, the controlling variables include GDP growth that affects electricity generation and the industry, and CEO change.

In Chapter 3 and Chapter 4, I use a qualitative research method for a grounded investigation. Qualitative methods are particularly suitable for theory extension and elaboration when existing theories are lacking. The "black box" nature of search was a strong indicator that theory was lacking. However, due to my small and unique sample of eight Chinese firms, the generalizability of my findings is yet to be established.

In addition, I noted earlier that all eight cases represent adoptions that are embedded in the organizations. That is, these adoption cases reflect specific processes embedded in the

adopting firms. This is likely why these eight firms have pursued a problemistic search that is motivated and driven by real organizational problems. In my future research, I will also look at mimetic adoptions that based on social fashion, in order to understand under what conditions the new technology adoption is mimetic, and under what conditions it is embedded in the organizations.

Another potential limitation related to the qualitative method is that the focus is on adoption, rather than non-adoption. All eight cases are cases of adoption of blockchain technology. As a result, my studies might be limited as regard to the questions such as: why some firms do not adopt blockchain technology, and what the differences are between firms that adopt and the firms that do not adopt. However, since the goal of my studies is to understand the detailed search processes that had led to adoption, this limitation is necessary due to the choice of research questions and focus. As discussed in Eisenhardt (1989):

> *"The cases may be chosen to replicate previous cases or extend emergent theory, or they may be chosen to fill theoretical categories and provide examples of polar types. While the cases may be chosen randomly, random selection is neither necessary, nor even preferable."*

Furthermore, in the two qualitative studies, I have focused only on the decision making and search processes that lead to adoption of new technology. However, as existing studies demonstrate, there can be many post-adoption challenges as there are pre-adoption hurdles (e.g. Bingham and Kahl, 2013; Tripsas and Gavetti, 2000). This limitation is due to two factors – that the focus of my studies is the search process rather than innovation performance, and that due to the recency of these adoptions, there is little data regarding post-adoption performance. While these limitations are necessary due to the study design, it does limit our view as regard to a full picture of search, innovation, and performance outcomes. In my future studies, I plan to follow up with these firms that I have interviewed. I will track their innovation performance after the

adoption of blockchain technology, and try to understand the performance implications of the multi-step search and goal extension.

Implications for future research

Like forms of sequential search in firms, my findings suggest new goals and further search. The findings suggest gaps in existing theories, and show inconsistencies with existing theories. Most significantly, my dissertation and studies contribute to our further understand of the BTOF, and particularly regarding the search perspective of firm change in several aspects.

First, my findings suggest that the current research approach with performance feedback might be oversimplified. In the current approach, the choice of risk taking is triggered by the "master switch" of performance relative to goals (Greve, 2003b). However, by drawing from prospect theory in the psychology literature, I find there is a two-step process in this risk taking choice: performance evaluation and probability weighting. As I pointed out in Chapter 2, the failure to consider the probability weighting process might be a cause for contradictory results in the literature. Future research may help improve our understanding of performance feedback by studying and testing these two steps separately.

Second, my study looks at how precedent structures affect the adoption of blockchain. My findings suggest that in evaluating choices, the organizational structure of multiple divisions distorts the managerial perception of the risks in the choices. In a sense, the organization structure becomes an information filter as the firms and managers search, learn, and make changes. Future research should look further at the learning filtering and information processing functions of the organization structure. This puts the BTOF and search in the complex structural context of organizational processes. My studies hence suggest great opportunities to deepen the

BTOF and search theories by studying search across a variety of organizational contexts related to firm level strategy and organizational design.

Third, I show that there is much to be understood about how search process evolves. Based on my findings, the search process is more than a single step and the organization is much more than a single-minded processor. Instead, the search process can take multiple steps, each may take redirect the firms' search and evaluation in unexpected ways. Search as a central concept of the BTOF requires better understanding, and future research should look into varied patterns of search. I find that initially local search can lead to exploration, while broad search sometimes results in exploitation.

A related implication is that there is a more complicated relationship between goals and search. While we have known that goals initiate search, we are yet to know how goals change during search and how the hierarchy of goals reshapes the search. My dissertation suggests an iterative, co-evolutionary relationship between search and the goal hierarchy. We need to better understand goals as another central concept of the BTOF. The relationship between goals and search could be a valuable topic for future research.

Another important implication regards attention to customers. Since Christensen, a popular view is that customer focus is a force of inertia that leads to lack of external and internal impetus for change (Christensen and Bower, 1996). However, my work finds that the focus on customers' need leads the firms to change their internal processes. My finding may be due to differences in the economies (U.S. vs China), differences in the strategies of the firm, differences in the stage of product life cycle, and differences in the form of innovation. Due to limits in my data, I can only speculate about these differences. Future research should look into the relationship between customer focus and innovation.

To summarize, I see tremendous opportunities regarding theory development and empirical work to uncover the complex search and learning relationships that occur within organizations as they consider opportunities for change. In the next step of my career, I will continue to improve these three studies that have been presented in this dissertation. In the short term, my goal is to polish and improve these papers for submission and publication in top academic journals. In the long term, I hope to carry on the theme and topics from my dissertation, and make further and deeper inquiry into the questions regarding firm learning and change.

Conclusions

In this thesis, I follow a research tradition that looks at firm level change from the behavioral perspective of the BTOF. Because large organizations form the backbone of modern economy, the topic of how they change (and its analogue, why they fail to change) remains important to both researchers and practitioners. Based on the BTOF on how search and learning leads to change, I develop theoretical arguments regarding the change and evolution of search and goals in multidivisional organizations. Based by my previous industry experience, I took an empirical approach in collecting data and analyzing change in a large, mature industry.

I found that the feedback learning process, a hallmark insight from the BTOF, can be influenced by the multidivisional structure, resulting in different risk taking behaviors in large complex organizations. Given this insight, I then looked into the details of the search process inside large organizations as they adopted a new technology, blockchain. This second study demonstrated that the search process can take multiple steps. This insight led to a related question regarding search and goals: given that search is motivated by goals, how do goals evolve in the search process? In this study, I found an iterative process of search and goals, in

which initial goals motivate search, and those goals evolve as the search filters through the goal hierarchy. Importantly, the filter influences whether the use of the adopted technology explores new options for strategy, or exploits legacy options.

Overall, my thesis contributes to studies on the BTOF and search perspective. First, my thesis extends this classic theory into the context of diversified and multidivisional firms. I show that firms' response to performance attainment discrepancy varies when the firms are more or less diversified. Second, I look into the "black box" of search, and uncover a multiple step process of search that might be more typical in complex corporations. Much of the existing literature has looked at the types and dimensions of search. Posen, Keil, Kim, and Meissner (2018) describe this as a "black box." I contribute to better understanding of this process of search and how the search influences innovation decisions by focusing on three key aspects of search: the divisionalization of firms, how search is distributed in firms, and search and subsequent organizational goals. Studies have described the search process variably as distant, local, and frequent, but I focused on how the search evolves once a problem is identified. In addition, I show the co-evolution between search and goal hierarchy. My thesis also contributes to the large literature on how firms change, and suggest new paths forward on understanding inertial and novel forms of change.

Many questions remain. Throughout my career, I hope to continue this research with the aim of further understanding how organizations can effectively recognize how and when to adapt to changing environments.

APPENDIX 1: THE FUNCTIONAL FORMS AND PARAMETERS ESTIMATION IN PROSPECT THEORY

In their paper, Tversky and Kahneman (1992) proposed the functional forms of value function and probability weighting function and used them to quantify the effects of valuation and weighting. They proposed the value function to be:

$v(x) = x^{\alpha}$ if $x \geq 0$, and

$v(x) = -\lambda(-x)^{ß}$ if $x < 0$;

and the probability weighting function to be:

$w(p) = p^{\gamma} / [p^{\gamma} + (1-p)^{\gamma}]^{1/\gamma}$, with different γ for positive and negative prospects.

By collecting data from repeated experiments, they estimated the parameters to be:

$\alpha = 0.88$, $ß = 0.88$, $\lambda = 2.25$ for the value function;

$\gamma = 0.61$ (positive prospect) and 0.69 (negative prospect) for the weighting function.

After Tversky and Kahneman (1992), more recent work has proposed similar functional forms with qualitatively similar results (e.g. Abdellaoui, 2000; Gonzalez and Wu, 1999). However, a note of caution is that since all functional forms represent researchers' attempts to approximate the true underlying process that is likely to differ from individual to individual, researcher judgement is necessary when using these results. Researchers are advised to use their judgement to ensure applicability and validity in specific situations.

APPENDIX 2: NOTES ON DECISION AGGREGATION

We consider the scenario of a strategy (S) with five decision components (X, Y, Z, S, T), each with probability 50% of success. In the simplest case, we assume the probabilities of each component is independent of the success or failure of others. Note that this independence is between components; the success of the strategy (S) still requires the success of, and is dependent on, each component. In this case, the success probability of the strategy is:

$$P(S) = P(X)\,P(Y)\,P(Z)\,P(S)\,P(T) = (0.5)^5 = 0.03125$$

In real situations, however, the success probabilities of components are likely correlated. When one component is successful, it sometimes helps the others to succeed. We can use the identity:

$$P(XY) = P(X)\,P(Y|X);$$

and assume that, if one component is successful, the next one will have higher probability of success. That is:

$$P(Y|X \text{ successful}) > P(Y).$$

Now, suppose each of these conditional probability is 20%. The success probability of the firm-level strategy is:

$$P(S) = 1 - P(X)\,P(Y|X)\,P(Z|X,Y)\,P(S|X,Y,Z)\,P(T|X,Y,Z,S) = 1 - (0.8)^5 = 67\%$$

This demonstrates that the success probability of the aggregate strategy is generally much bigger than the success probabilities of individual components.

APPENDIX 3: DICTIONARIES

Exploration Words	Exploitation Words
Acquisition, autonomous, create, develop, different, differentiate, discover, distant, distinct, diversify, emerging, entrance, entry, entrepreneur, establish, experiment, explore, first-mover, flexible, forefront, global, initiate, innovate, introduction, launch, new, novel, opportunity, partner, pioneer, play, portfolio, potential, radical, revolution, risk-taking, search, synergy, transform, variation, venture	Choice, choose, competency, consistent, continuity, control, core, cost management, cut, decrease, discipline, discontinue, dispose, divest, efficient, execution, existing, exit, expansion, exploit, focus, imitate, implement, improve, incremental, lean, leverage, low-cost, maintain, organic, perfect, predictable, procedure, production, productive, rationalize, reduce, refinement, reliability, repetitive, replicate, responsive, restructuring, routine, saving, scale, scaling, select, simplify, specialize, spinoff, stability, standardize, streamline, target

APPENDIX 4: INTERVIEW PROTOCOL FOR COMPANIES

Date and time:

Location:

Interviewer:

Interviewee name:

Interviewee job/title:

How long has the interviewee been in the organization and industry?

Company/organization name:

Type of organization (SOE, public listed, private):

Organization location:

Notes to interviewee:

Thank you for participation.

Confidentiality is guaranteed.

As necessary: approximate time/ number of questions / purpose of research

Question 1: strategic background

- Describe your organization in general. What are the goals and purposes? Who are the important constituencies?
- Evaluate your organization's financial performance and performance in general. Are there specific problems? What actions/decisions have been taken for the problems?
- Are there recent or current strategic initiatives/decisions in your organization?

Question 2: organizations

- Describe your organization's business and processes in details (e.g. industry, business areas, how is business done, business partners, suppliers, customers)
- What are the main risks and uncertainty in your business (e.g. uncertainty about the market and business partners)
- How are important decisions made in your organization? Is the process formal/informal? Centralized, decentralized, or hybrid?

Question 3: organizational resources

- What resources does your organization relie on for business and continued existence (e.g. financial, political resources)?
- Where/how does your organizations get these financial and non-financial resources?
- How reliable are these sources of resources? What conditions are necessary to obtain resources?

Question 4: environment

- Describe the broader environment of your organization. The environment includes social, economic, technological and regulatory environment.
- How fast/slow is the environment changing? Does your organization perceive opportunity or risk in this changing environment?
- Describe your competitors (number of competitors, turnover of competitors, competitiveness).

Question 5: the blockchain initiative

- Who initiated the blockchain project in your organization? How was it initiated?
- Describe your organization's blockchain strategy. How is the project funded? How is it run and managed? Who is responsible? Which part of your business/process does it affect?
- How is the project perceived by your organization in general? Is it seen as successful? Will it continue to production?

Closure:

Thank you to interviewee

Reassure confidentiality

Ask permission to follow-up

APPENDIX 5: INTERVIEW PROTOCOL FOR INDUSTRY EXPERTS

Date and time:

Location:

Interviewer:

Interviewee name:

Interviewee job/title:

How long has the interviewee been in the organization and industry?

Expertise area:

Company/organization name:

Type of organization (SOE, public listed, private):

Organization location:

Notes to interviewee:

Thank you for participation.

Confidentiality is guaranteed unless given.

As necessary: approximate time/ number of questions / purpose of research

Question 1: blockchain definition

- How do you define blockchain? What are the key characteristics of blockchain?
- How would you describe enterprise blockchain? What are the defining characteristics of enterprise blockchain?

Question 2: business use of blockchain

- In your opinion, how can blockchain help companies and business transactions?
- What is the current status of blockchain adoption and use in companies?
- How would you evaluate the current enterprise uses of blockchain? Are they suitable for the purpose for which the blockchain technology is developed?

Question 3: future outlook

- What risks are associated with the blockchain technology as related to market and regulations?
- In general, how would you evaluate the future outlook of blockchain in companies, organizations, and society?

Closure:

Thank you to interviewee

Ask if possible to use expert name and other information

Ask permission to follow-up

REFERENCES

Abdellaoui, M., 2000. Parameter-free elicitation of utility and probability weighting functions. *Management Science*, 46(11): 1497-1512.

Abrahamson, E., 1991. Managerial fads and fashions: The diffusion and rejection of innovations. *Academy of Management Review*, 16(3): 586-612.

Ahuja, G. and Novelli, E., 2017. Redirecting research efforts on the diversification–performance linkage: The search for synergy. *Academy of Management Annals*, 11(1): 342-390.

Andriani, P., Ali, A. and Mastrogiorgio, M., 2017. Measuring exaptation and its impact on innovation, search, and problem solving. *Organization Science*, 28(2): 320-338.

Andriopoulos, C. and Lewis, M.W., 2009. Exploitation-exploration tensions and organizational ambidexterity: Managing paradoxes of innovation. *Organization Science*, 20(4): 696-717.

Argyres, N.S. and Silverman, B.S., 2004. R&D, organization structure, and the development of corporate technological knowledge. *Strategic Management Journal*, 25(8-9): 929-958.

Barberis, N., 2012. A model of casino gambling. *Management Science*, 58(1): 35-51.

Barberis, N.C., 2013. Thirty years of prospect theory in economics: A review and assessment. *The Journal of Economic Perspectives*, 27(1): 173-195.

Barr, P.S., Stimpert, J.L. and Huff, A.S., 1992. Cognitive change, strategic action, and organizational renewal. *Strategic Management Journal*, 13(S1): 15-36.

Baum, J.A. and Dahlin, K.B., 2007. Aspiration performance and railroads' patterns of learning from train wrecks and crashes. *Organization Science*, 18(3): 368-385.

Baum, J.A., Li, S.X. and Usher, J.M., 2000. Making the next move: How experiential and vicarious learning shape the locations of chains' acquisitions. *Administrative Science Quarterly*, 45(4): 766-801.

Baum, J.A. and Shipilov, A.V., 2006. 1.2 Ecological approaches to organizations. *The Sage Handbook of Organization Studies*, 55.

Beckman, C.M., 2006. The influence of founding team company affiliations on firm behavior. *Academy of Management Journal*, 49(4): 741-758.

Benner, M.J. and Tripsas, M., 2012. The influence of prior industry affiliation on framing in nascent industries: The evolution of digital cameras. *Strategic Management Journal*, 33(3): 277-302.

Benner, M.J. and Tushman, M.L., 2003. Exploitation, exploration, and process management: The productivity dilemma revisited. *Academy of Management Review*, 28(2): 238-256.

Berry, H., 2018. The influence of multiple knowledge networks on innovation in foreign operations. *Organization Science*, 29(5): 855-872.

Bettis, R.A., 2017. Organizationally intractable decision problems and the intellectual virtues of heuristics. *Journal of Management*, 43(8): 2620-2637.

Bettis, R.A. and Hall, W.K., 1982. Diversification strategy, accounting determined risk, and accounting determined return. *Academy of Management journal*, 25(2): 254-264.

Bingham, C.B. and Kahl, S.J., 2013. The process of schema emergence: Assimilation, deconstruction, unitization and the plurality of analogies. *Academy of Management Journal*, 56(1): 14-34.

Bruhin, A., Fehr-Duda, H. and Epper, T., 2010. Risk and rationality: Uncovering heterogeneity in probability distortion. *Econometrica*, 78(4): 1375-1412.

Burgelman, R.A., 1983. A process model of internal corporate venturing in the diversified major firm. *Administrative Science Quarterly*: 223-244.

Burns, T. and Stalker, G.M., 1981. The Management of Innovation, Tavistock, London, 1961.

Cameron, A.C. and Trivedi, P.K., 2010. *Microeconometrics using Stata* (Vol. 2). College Station, TX: Stata press.

Cardinal, L.B., 2001. Technological innovation in the pharmaceutical industry: The use of organizational control in managing research and development. *Organization Science*, 12(1): 19-36.

Cardinal, L.B., Sitkin, S.B. and Long, C.P., 2004. Balancing and rebalancing in the creation and evolution of organizational control. *Organization Science*, 15(4): 411-431.

Castellion, G. and Markham, S.K., 2013. Perspective: new product failure rates: influence of argumentum ad populum and self-interest. *Journal of Product Innovation Management*, 30(5): 976-979.

Chen, J., & Nadkarni, S., 2017. It's about time! CEOs' temporal dispositions, temporal leadership, and corporate entrepreneurship. *Administrative Science Quarterly*, 62(1): 31-66.

Christensen, C.M. and Bower, J.L., 1996. Customer power, strategic investment, and the failure of leading firms. *Strategic Management Journal*, 17(3): 197-218.

Cohen, S.L. and Tripsas, M., 2018. Managing technological transitions by building bridges. *Academy of Management Journal*, 61(6): 2319-2342.

Csaszar, F.A., 2013. An efficient frontier in organization design: Organizational structure as a determinant of exploration and exploitation. *Organization Science*, 24(4): 1083-1101.

Cyert, R.M. and March, J.G., 1963. *A behavioral theory of the firm.* Englewood Cliffs, NJ.

Denrell, J., 2008. Organizational risk taking: adaptation versus variable risk preferences. *Industrial and Corporate Change*, 17(3): 427-466.

Deloitte, 2019. https://www2.deloitte.com/insights/us/en/focus/tech-trends.html. Accessed 30 January 2019.

Doz, Y. and Wilson, K., 2017. *Ringtone: Exploring the Rise and Fall of Nokia in Mobile Phones*. Oxford University Press.

Eberhart, R.N., Eesley, C.E. and Eisenhardt, K.M., 2017. Failure is an option: Institutional change, entrepreneurial risk, and new firm growth. *Organization Science*, 28(1): 93-112.

Eggers, J.P. and Kaplan, S., 2009. Cognition and renewal: Comparing CEO and organizational effects on incumbent adaptation to technical change. *Organization Science*, 20(2): 461-477.

Eggers, J.P. and Park, K.F., 2018. Incumbent Adaptation to Technological Change: The Past, Present, and Future of Research on Heterogeneous Incumbent Response. *Academy of Management Annals*, 12(1): 357-389.

Eisenhardt, K.M., 1989. Building theories from case study research. *Academy of Management Review*, 14(4): 532-550.

Eisenmann, T.R., 2002. The effects of CEO equity ownership and firm diversification on risk taking. *Strategic Management Journal*, 23(6): 513-534.

Ellis, S., Aharonson, B.S., Drori, I. and Shapira, Z., 2017. Imprinting through inheritance: A multi-genealogical study of entrepreneurial proclivity. *Academy of Management Journal*, 60(2): 500-522.

Foss, N.J., Laursen, K. and Pedersen, T., 2011. Linking customer interaction and innovation: The mediating role of new organizational practices. *Organization Science*, 22(4): 980-999.

Gaba, V. and Joseph, J., 2013. Corporate structure and performance feedback: Aspirations and adaptation in M-form firms. *Organization Science*, 24(4): 1102-1119.

Gioia, D.A., Corley, K.G. and Hamilton, A.L., 2013. Seeking qualitative rigor in inductive research: Notes on the Gioia methodology. *Organizational Research Methods*, 16(1): 15-31.

Gibson, C.B. and Birkinshaw, J., 2004. The antecedents, consequences, and mediating role of organizational ambidexterity. *Academy of Management Journal*, 47(2): 209-226.

Glaser, B. and Strauss, A., 1967. *The Discovery of Grounded Theory*. London: Weidenfeld and Nicholson, 24(25): 288-304.

Gonzalez, R. and Wu, G., 1999. On the shape of the probability weighting function. *Cognitive Psychology*, 38(1): 129-166.

Greve, H.R., 1998. Performance, aspirations, and risky organizational change. *Administrative Science Quarterly*: 58-86.

Greve, H.R., 2003a. A behavioral theory of R&D expenditures and innovations: Evidence from shipbuilding. *Academy of Management Journal*, 46(6): 685-702.

Greve, H.R., 2003b. *Organizational learning from performance feedback: A behavioral perspective on innovation and change*. Cambridge University Press.

Greve, H.R., 2007. Exploration and exploitation in product innovation. *Industrial and Corporate Change*, 16(5): 945-975.

Greve, H.R., 2008. A behavioral theory of firm growth: Sequential attention to size and performance goals. *Academy of Management Journal*, 51(3): 476-494.

Gozli, D.G. and Dolcini, N., 2018. Reaching into the unknown: Actions, goal hierarchies, and explorative agency. *Frontiers in Psychology*, 9: 266.

Haleblian, J.J., Kim, J.Y.J. and Rajagopalan, N., 2006. The influence of acquisition experience and performance on acquisition behavior: Evidence from the US commercial banking industry. *Academy of Management Journal*, 49(2): 357-370.

Hambrick, D.C. and Mason, P.A., 1984. Upper echelons: The organization as a reflection of its top managers. *Academy of Management Review*, 9(2): 193-206.

Hannan, M.T. and Freeman, J., 1984. Structural inertia and organizational change. *American Sociological Review*, 49(2): 149-164.

Hardisty, D.J. and Pfeffer, J., 2017. Intertemporal uncertainty avoidance: When the future is uncertain, people prefer the present, and when the present is uncertain, people prefer the future. *Management Science*, 63(2): 519-527.

Haug, J.P., Pidun, U. and zu Knyphausen-Aufseß, D., 2018. Cui bono? An empirical investigation into risk benefits of corporate diversification. *Strategic Organization*, 16(4): 429-450.

He, Z.L. and Wong, P.K., 2004. Exploration vs. exploitation: An empirical test of the ambidexterity hypothesis. *Organization Science*, 15(4): 481-494.

Henderson, R.M. and Clark, K.B., 1990. Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms. *Administrative Science Quarterly*, 35(1): 9-30.

Hill, C.W., Hitt, M.A. and Hoskisson, R.E., 1992. Cooperative versus competitive structures in related and unrelated diversified firms. *Organization Science*, 3(4): 501-521.

Hoskisson, R.E., Hitt, M.A. and Hill, C.W., 1991. Managerial risk taking in diversified firms: An evolutionary perspective. *Organization Science*, 2(3): 296-314.

Hu, S. and Bettis, R.A., 2018. Multiple organization goals with feedback from shared technological task environments. *Organization Science*, 29(5): 873-889.

Iyer, D.N. and Miller, K.D., 2008. Performance feedback, slack, and the timing of acquisitions. *Academy of Management Journal*, 51(4): 808-822.

Jansen, J.J., Tempelaar, M.P., Van den Bosch, F.A. and Volberda, H.W., 2009. Structural differentiation and ambidexterity: The mediating role of integration mechanisms. *Organization Science*, 20(4): 797-811.

Johnson, D.R. and Hoopes, D.G., 2003. Managerial cognition, sunk costs, and the evolution of industry structure. *Strategic Management Journal*, 24(10): 1057-1068.

Joseph, J. and Gaba, V., 2020. Organizational Structure, Information Processing, and Decision-Making: A Retrospective and Road Map for Research. *Academy of Management Annals*, 14(1): 267-302.

Jung, H.J. and Lee, J.J., 2016. The quest for originality: A new typology of knowledge search and breakthrough inventions. *Academy of Management Journal*, 59(5): 1725-1753.

Kacperczyk, A., Beckman, C.M. and Moliterno, T.P., 2015. Disentangling risk and change: Internal and external social comparison in the mutual fund industry. *Administrative Science Quarterly*, 60(2): 228-262.

Kahneman, D. and Tversky, A., 1979. Prospect theory: An analysis of decisions under risk. *Econometrica*, 47, 278.

Kang, J., Kang, R. and Kim, S.J., 2017. An empirical examination of vacillation theory. *Strategic Management Journal*, 38(6): 1356-1370.

Kaplan, S. and Vakili, K., 2015. The double-edged sword of recombination in breakthrough innovation. *Strategic Management Journal*, 36(10): 1435-1457.

Katila, R. and Ahuja, G., 2002. Something old, something new: A longitudinal study of search behavior and new product introduction. *Academy of Management Journal*, 45(6): 1183-1194.

Katila, R. and Chen, E.L., 2008. Effects of search timing on innovation: The value of not being in sync with rivals. *Administrative Science Quarterly*, 53(4): 593-625.

Ketchen Jr, D.J., Hult, G.T.M. and Slater, S.F., 2007. Toward greater understanding of market orientation and the resource-based view. *Strategic Management Journal*, 28(9): 961-964.

Khanna, R., Guler, I. and Nerkar, A., 2016. Fail often, fail big, and fail fast? Learning from small failures and R&D performance in the pharmaceutical industry. *Academy of Management Journal*, 59(2): 436-459.

Klein, H.J., 1989. An integrated control theory model of work motivation. *Academy of Management Review*, 14(2): 150-172.

Lavie, D. and Rosenkopf, L., 2006. Balancing exploration and exploitation in alliance formation. *Academy of Management Journal*, 49(4): 797-818.

Lavie, D., Stettner, U. and Tushman, M.L., 2010. Exploration and exploitation within and across organizations. *Academy of Management Annals*, 4(1): 109-155.

Levinthal, D.A., 1997. Adaptation on rugged landscapes. *Management Science*, 43(7): 934-950.

Levinthal, D.A. and March, J.G., 1993. The myopia of learning. *Strategic Management Journal*, 14(S2): 95-112.

Lim, E.N. and McCann, B.T., 2013. Performance feedback and firm risk taking: The moderating effects of CEO and outside director stock options. *Organization Science*, 25(1): 262-282.

Locke, E.A., Cartledge, N. and Knerr, C.S., 1970. Studies of the relationship between satisfaction, goal-setting, and performance. *Organizational Behavior and Human Performance*, 5(2): 135-158.

Lubatkin, M. and O'Neill, H.M., 1987. Merger strategies and capital market risk. *Academy of Management Journal*, 30(4): 665-684.

March, J.G., 1991. Exploration and exploitation in organizational learning. *Organization Science*, 2(1): 71-87.

March, J.G., 2006. Rationality, foolishness, and adaptive intelligence. *Strategic Management Journal*, 27(3): 201-214.

March, J.G. and Shapira, Z., 1987. Managerial perspectives on risk and risk taking. *Management Science*, 33(11): 1404-1418.

Martignoni, D., Menon, A. and Siggelkow, N., 2016. Consequences of misspecified mental models: Contrasting effects and the role of cognitive fit. *Strategic Management Journal*, 37(13): 2545-2568.

McKenny, A.F., Aguinis, H., Short, J.C. and Anglin, A.H., 2016. What doesn't get measured does exist: Improving the accuracy of computer-aided text analysis. *Journal of Management*, 2909-2933.

McKensey, 2018. Blockchain explained: What it is and isn't, and why it matters. Available at: https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/blockchain-explained-what-it-is-and-isnt-and-why-it-matters. Accessed 30 January 2019.

Mintzberg, H., Raisinghani, D. and Theoret, A., 1976. The structure of" unstructured" decision processes. *Administrative Science Quarterly*: 246-275.

Montgomery, C.A. and Singh, H., 1984. Diversification strategy and systematic risk. *Strategic Management Journal*, 5(2): 181-191.

Nakamoto, S., 2008. A peer-to-peer electronic cash system. *Bitcoin.–URL: https://bitcoin. org/bitcoin. pdf*.

Nelson, R.R. and Winter, S.G., 1985. *An evolutionary theory of economic change*. Harvard University Press.

Nohria, N. and Gulati, R., 1996. Is slack good or bad for innovation? *Academy of Management Journal*, 39(5): 1245-1264.

Ocasio, W., 1997. Towards an attention-based view of the firm. *Strategic Management Journal*, 18(S1): 187-206.

Park, K.M., 2007. Antecedents of convergence and divergence in strategic positioning: The effects of performance and aspiration on the direction of strategic change. *Organization Science*, 18(3): 386-402.

Payne, J.W., Laughhunn, D.J. and Crum, R., 1984. Multiattribute risky choice behavior: The editing of complex prospects. *Management Science*, 30(11): 1350-1361.

Perretti, F. and Negro, G., 2006. Filling empty seats: How status and organizational hierarchies affect exploration versus exploitation in team design. *Academy of Management Journal*, 49(4): 759-777.

Posen, H.E., Keil, T., Kim, S. and Meissner, F.D., 2018. Renewing research on problemistic search—A review and research agenda. *Academy of Management Annals*, 12(1): 208-251.

Prahalad, C.K. and Bettis, R.A., 1986. The dominant logic: A new linkage between diversity and performance. *Strategic Management Journal*, 7(6): 485-501.

Prahalad, C.K. and, Hamel, G. 1993. Strategy as stretch and leverage. *Harvard Business Review*, 71(2): 75-84.

Raisch, S. and Birkinshaw, J., 2008. Organizational ambidexterity: Antecedents, outcomes, and moderators. *Journal of Management*, 34(3): 375-409.

Rhee, L. and Leonardi, P.M., 2018. Which pathway to good ideas? An attention-based view of innovation in social networks. *Strategic Management Journal*, 39(4): 1188-1215.

Rivkin, J.W., 2000. Imitation of complex strategies. *Management Science*, 46(6): 824-844.

Rottenstreich, Y. and Hsee, C.K., 2001. Money, kisses, and electric shocks: On the affective psychology of risk. *Psychological Science*, 12(3): 185-190.

Roy, R. and Sarkar, M.B., 2016. Knowledge, firm boundaries, and innovation: Mitigating the incumbent's curse during radical technological change. *Strategic Management Journal*, 37(5): 835-854.

Rumelt, R.P., 1974. *Strategy, Structure, and Economic Performance*. Harvard University Press.

Shapira, Z., 2017. Entering new markets: The effect of performance feedback near aspiration and well below and above it. *Strategic Management Journal*, 38(7): 1416-1434.

Short, J.C., Broberg, J.C., Cogliser, C.C. and Brigham, K.H., 2010. Construct validation using computer-aided text analysis (CATA) an illustration using entrepreneurial orientation. *Organizational Research Methods*, 13(2): 320-347.

Sidhu, J.S., Commandeur, H.R. and Volberda, H.W., 2007. The multifaceted nature of exploration and exploitation: Value of supply, demand, and spatial search for innovation. *Organization Science*, 18(1): 20-38.

Siggelkow, N., 2002. Evolution toward fit. *Administrative Science Quarterly*, 47(1): 125-159.

Siggelkow, N. and Levinthal, D.A., 2003. Temporarily divide to conquer: Centralized, decentralized, and reintegrated organizational approaches to exploration and adaptation. *Organization Science*, 14(6): 650-669.

Simons, R., 1994. *Levers of control: how managers use innovative control systems to drive strategic renewal*. Harvard Business Press.

Slater, S.F. and Narver, J.C., 1998. Customer-led and market-oriented: let's not confuse the two. *Strategic Management Journal*, 19(10): 1001-1006.

Sørensen, J.B. and Stuart, T.E., 2000. Aging, obsolescence, and organizational innovation. *Administrative Science Quarterly*, 45(1): 81-112.

Sosa, M.L., 2014. Corporate structure, indirect bankruptcy costs, and the advantage of de novo firms: The case of gene therapy research. *Organization Science*, 25(3): 850-867.

Suddaby, R. 2006. What grounded theory is not. *Academy of Management Journal*, 49: 633-642.

Surroca, J., Prior, D. and Tribo Gine, J.A., 2016. Using panel data dea to measure CEOs' focus of attention: An application to the study of cognitive group membership and performance. *Strategic Management Journal*, 37(2): 370-388.

Taylor, A. and Helfat, C.E., 2009. Organizational linkages for surviving technological change: Complementary assets, middle management, and ambidexterity. *Organization Science*, 20(4): 718-739.

Tripsas, M. and Gavetti, G., 2000. Capabilities, cognition, and inertia: Evidence from digital imaging. *Strategic Management Journal*, 21(10-11): 1147-1161.

Tversky, A. and Kahneman, D., 1992. Advances in prospect theory: Cumulative representation of uncertainty. *Journal of Risk and Uncertainty*, 5(4): 297-323.

Unsworth, K., Yeo, G. and Beck, J., 2014. Multiple goals: A review and derivation of general principles. *Journal of Organizational Behavior*, 35(8): 1064-1078.

Uotila, J., Maula, M., Keil, T. and Zahra, S.A., 2009. Exploration, exploitation, and financial performance: analysis of S&P 500 corporations. *Strategic Management Journal*, 30(2): 221-231.

Van Mieghem, J.A., 2007. Risk mitigation in newsvendor networks: Resource diversification, flexibility, sharing, and hedging. *Management Science*, 53(8): 1269-1288.

Vidal, E. and Mitchell, W., 2015. Adding by subtracting: The relationship between performance feedback and resource reconfiguration through divestitures. *Organization Science*, 26(4): 1101-1118.

Vissa, B., Greve, H.R. and Chen, W.R., 2010. Business group affiliation and firm search behavior in India: Responsiveness and focus of attention. *Organization Science*, 21(3): 696-712.