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Abstract

Despite our understanding of the importance of external technology sourcing, we know little about what leads firms to become more open to sourcing external technologies. To elucidate this question, we draw upon the behavioral theory of the firm, and propose that sourcing external technologies is sensitive to how managers evaluate organizational performance relative to aspirations. We develop several propositions linking whether a firm is in "harsh times"—i.e. performing below its aspiration level—or in "slack times"—i.e. performing above its aspiration level—to both the intensity and the direction of its search for external technologies. This paper not only sheds light into how performance affects a firm's search for external technologies, but also reveals important boundary conditions that influence how a firm manages its broader set of R&D activities.

Introduction

External technology sourcing, the process by which managers identify and access technologies[1] from beyond a firm's boundaries, is not only increasingly prevalent (e.g Arora & Gambardella, 2009; Hagedoorn, 2002) but is also a critical organizational activity to access external resources (e.g. Granstrand & Sjolander, 1990; Mowery, Oxley, & Silverman, 1996), to add distinct new technologies to a firm's technology pool (e.g. Ahuja, 2000a; Rosenkopf & Almeida, 2003) and to reduce costs and time in innovation cycles (e.g. Hagedoorn, 1993, 2002).

Researchers have paid considerable attention how external technology sourcing depends on the technological characteristics of sourcing firms, (e.g. Cohen & Levinthal, 1990; Lane & Lubatkin, 1998; Rothaermel & Boeker, 2008), how external technology sourcing is dependent upon exogenous opportunities (e.g. Ahuja, 2000b; Gulati, 1999; Klevorick, Levin, Nelson, & Winter, 1995) and how sourcing external technologies can be conducive for firm performance (e.g. Baum, Calabrese, & Silverman, 2000; DeCarolis & Deeds, 1999; Laursen & Salter, 2006).

Yet, despite our understanding of the importance of, and technological motivation for, external technology sourcing, we know little about what leads firms to become more open to sourcing external technologies. Given that firms are dedicating substantial investments and efforts into external technology sourcing[2], we believe it is of the utmost importance to understand what ultimately triggers their search for external technologies, as well as how they allocate their resources to this important organizational activity.

To examine this question, we draw upon the behavioral theory of the firm (Cyert & March, 1992), and propose that sourcing external technologies is sensitive how firms evaluate

[1] Following Tushman and Anderson (1986:440), we define technologies as "those tools, devices and knowledge that mediate between input and outputs (process technology) and/or that create new products or services (product technology)".

[2] For instance, Kale and Singh (2009:45) highlight that nowadays, 20% of firm assets and more than 30% of firm R&D expenditure are dedicated to collaborative external sourcing activities.

organizational performance relative to their aspirations, which are reference points characterizing perceived success or failure[3]. More specifically, we suggest that understanding whether a firm faces "harsh times"—i.e. when it performs below its aspirations—or "slack times" – i.e. when it performs above its aspirations (Cyert & March, 1992; Greve, 2003a; Levinthal & March, 1981:308) has profound implications on the firm's decision to source external technologies. In detail, we suggest that performance aspiration comparisons impact both the intensity and direction of a firm's external technology sourcing activities[4]. We identify that harsh and slack times provide important behavioral cues about the timing of sourcing external technologies, but also help to identify when firms may suffer from resource constraints, which affect their ability to simultaneously allocate resources to internal research and development (R&D) and external technology sourcing.

We make three contributions in this paper. First, we provide a behavioral explanation (Cyert & March, 1992; Levinthal & March, 1981:308) for the triggering mechanism that may explain when and how a firm sources external technologies. In particular, by situating firms in harsh and slack times, we can make direct predictions about the intensity and direction of a firm's external technology sourcing strategy.

In a business environment where an increasing number of firms are adopting an open-innovation approach (Chesbrough, Vanhaverbeke, & West, 2006), this study suggests that both low and high-performing firms may engage in similar open innovation strategies, but for very different reasons. More importantly, this paper has important managerial implications by providing a more nuanced understanding of the recursive relationship between performance and external knowledge sourcing. For instance, managers in firms facing harsh times should

[3] We follow Schneider (1992:1053), and define a firm's aspirations as the minimal performance outcome that would be deemed satisfactory by the decision-maker. Most recent studies have used return on assets or return on sales as primary performance measures (e.g. Audia & Greve, 2006; Chen & Miller, 2007) but research on alternative performance measures (e.g. innovative performance) is sparse.

[4] By intensity we mean the overall effort (e.g. amount of financial investments, number of sourcing events) spent searching for external technologies, whereas by direction we mean firms' search for local or distant technologies in various dimensions (Rosenkopf & Nerkar, 2001).

be aware that some of the higher-performing firms that they are trying to imitate are successful not necessarily because they sourced external technologies, but because by being successful in the first place, they were able to accumulate the slack necessary to subsequently search for external technologies.

Second, we suggest that firm performance imposes important boundary conditions for how firms manage internal and external activities when developing new technologies. We posit that firms in harsh times due to limited resources have to make compensatory tradeoffs between internal research and development (R&D) and external technology sourcing, using them as substitutes for one another. Conversely, firms in slack times have the necessary resources to more thoroughly draw connections between internal R&D and external technology sourcing, leading them to use both activities concomitantly. We believe this distinction of harsh and slack times provides fresh insights into the ongoing debate about whether internal R&D and external technology sourcing are used as substitutes or complements (e.g. Hess & Rothaermel, 2010; Pisano, 1990; Veugelers, 1997).

Finally, we examine the direction of external technology sourcing in harsh and slack times, and distinguish when firms tend to source distant or local external technologies. We posit that firms performing slightly below or slightly above their aspiration levels tend to keep the status quo and prioritize exploitation activities (March, 1991) by sourcing local external technologies. Conversely, firms with performance far below or far above aspirations will search for more distant technologies. Interestingly, however, they do so for very different reasons. Firms in very harsh times (i.e. performing substantially below their aspiration levels) may use exploration as a desperate move to raise their performance. However, firms performing substantially above their aspiration levels engage in exploration as excess resources create an organizational environment with lower scrutiny and control for external sourcing projects. Interestingly, this prior success provides firms in high levels of slack times

with both the incentives to continue refining what they have been doing *and* the resources to experiment with new technologies. In other words, these are the firms that we believe can afford to adopt ambidextrous strategies, when sourcing external technologies (O'Reilly & Tushman, 2008).

The rest of this paper is organized as follows: in the next section, we introduce external technology sourcing as a critical organizational process with important implications to firm performance. We then examine the intensity of a firm's search for external technologies both in harsh and slack times. Next, we analyze how harsh or slack times affect the pursuit of internal R&D and external technology sourcing concomitantly. In the following section, we shift our focus to show how the direction of search for external technologies is likely to vary depending on whether firms are in harsh or slack times. We conclude by summarizing the contributions of this study, anticipating its empirical applications and highlighting its managerial implications.

Background - External Technology Sourcing

Up to the 1980s, researchers and managers alike considered a firm's internal R&D units as the primary sources to develop novel technologies (e.g. Cohen & Levin, 1989; Nelson, 1959; Schumpeter, 1942). However, in the last few decades, firms have considered external technology sourcing as an important—and often complementary—alternative to internal R&D (Cassiman & Veugelers, 2006; Cohen & Levinthal, 1990; Vermeulen & Barkema, 2001). External technology sourcing has increased considerably as demonstrated by the proliferation of external research collaborations and licensing agreements[5] (Arora, Fosfuri, & Gambardella, 2001; Arora & Gambardella, 2009; Chesbrough, 2003; Chesbrough

[5] We take a broad perspective and include major firm technology activities including arm's length transactions (e.g. outright technology sales and licensing), collaborative agreements (e.g. joint ventures or alliances) and alternative interfirm relationships like venture capital investments. We exclude technology sourcing resulting from unplanned spillovers or leakage of private information (Granstrand & Sjolander, 1990).

et al., 2006). Some recent estimates suggest that licensing arrangements have surpassed an annual volume of US$100 billion[6] in 2002 and continue to grow at a considerably higher rate than the average worldwide GDP (Arora & Gambardella, 2009; OECD, 2006; Robbins, 2009). Recent estimates on collaborative research agreements corroborate this exponential growth (Hagedoorn, 2002) and indicate that by the turn of last century, firms allocated over 30% of overall R&D spending to external collaborations (Kale & Singh, 2009:45).

External technology sourcing is not only increasingly prevalent, but is also affects a firm's performance. Extant research shows that external technology sourcing increases both innovative output (e.g. Ahuja, 2000a; Leiponen & Helfat, 2009; Rosenkopf & Almeida, 2003; Rosenkopf & Nerkar, 2001; Rothaermel & Hess, 2007) and economic performance including firm survival (e.g. Baum et al., 2000; Baum & Oliver, 1991; DeCarolis & Deeds, 1999; Hagedoorn & Schakenraad, 1994; Laursen & Salter, 2006; Mitchell & Singh, 1996; Powell, Koput, & Smith-Doerr, 1996; Zaheer & Zaheer, 1997).

However, as much as previous research has advanced our understanding about the effect of external technology sourcing on firm performance, we know less about the inverse relationship: how and why firm performance affects a firm's search for external technologies. This is the focus of this paper. In the next chapter, we will examine this relationship and explain how prior firm performance determines firm aspirations and situates firms in either harsh or slack times, which affects the firm's intensity to source external technologies.

[6] This estimate is extrapolated from US data but only includes licensing of rights to use IP (Intellectual Property), protected as industrial property (Arora & Gambardella, 2009).

The Intensity of Sourcing External Technologies

In Harsh Times

Models of performance[7] feedback (e.g. Greve, 1998; Levinthal & March, 1981) predict that an organization is more likely to engage in search activity when the organization fails to attain its aspirations (i.e. reference points that characterize perceived success or failure). Performance feedback models are powerful lenses through which to study organizational decision-making as they explain a broad range of decisions, including an organization's propensity to make acquisitions (Iyer & Miller, 2008), develop new products (Greve, 2003b) and a firm's overall R&D intensity (Chen & Miller, 2007). We extend this idea and posit that external technology sourcing is an important form of organizational search, which is likely to be guided by performance feedback.

The behavioral theory of the firm suggests that firms are goal directed systems that use simple operating procedures and heuristics to adapt their behavior to performance feedback (Cyert & March, 1992; Greve, 1998; March & Simon, 1958). Models of performance feedback are built on the idea that firms develop aspirations, which are path dependent on the firms' prior performance (Lant, 1992; Levinthal & March, 1981). Organizations regularly compare their aspirations with actual achievements leading to

[7] Most recent studies have used financial measures like return on assets, return on equity and return on sales as primary performance measures (e.g. Audia & Greve, 2006; Chen & Miller, 2007). In their original study Cyert and March describe a range of goals, firms can build aspiration levels beyond profitability including production output, inventory, sales and market share (Cyert & March, 1992). Studies in the innovation literature tend to examine the effect of external technology sourcing on innovative performance in form of patent output or patent impact (Hess & Rothaermel, 2010; Rosenkopf & Nerkar, 2001). Our conceptual paper does not distinguish between different performance aspiration points but makes the assumption that they lead to similar consequences with respect to how firms perceive the resources they have available.

favorable (above aspirations) or unfavorable (below aspirations) comparisons (Lant & Montgomery, 1987; Lewin, Dembo, Festinger, & Sears, 1944).

Researchers have predominantly distinguished two types of aspiration levels within firms. Historical aspirations form as firms learn what is reasonable to expect by observing what the firms had achieved in prior periods (Levinthal & March, 1981:310). As organizations rarely operate in isolation, a second form of aspiration level, called social aspiration, is based on how firms assess themselves versus their social context and in particular versus reference groups (Audia & Greve, 2006; Chen, 2008; Cyert & March, 1992; Festinger, 1957). Following this research we consider a firm aspiration (historically or socially evolved) as a "master switch" (Greve, 2003a:76), so that firms performing below their aspirations alter their behavior substantially.

As discussed above, and following Levinthal and March (1981:308), we call situations in which firms fail to achieve their aspirations, "harsh times". We suggest that in firms in "harsh times" engage in problemistic search as their search is targeted to solving a specific problem (Cyert & March, 1992:168). External technology sourcing is an important organizational search process (Rosenkopf & Almeida, 2003; Rosenkopf & Nerkar, 2001), which allows firms to find solution to existing problems by reducing overall R&D costs (Sakakibara, 1997), overcoming technologically inferior positions (Capron & Mitchell, 2009; Hamel, 1991), or accelerating innovation cycles (Hagedoorn, 1993). The importance in using external technology sourcing in harsh times is increased as firms performing below aspirations face short term pressures to raise their performance (Pitelis, 2007) but might not have solutions readily available internally.

Extant research indeed demonstrates that external technologies are increasingly perceived as solutions and that firms have become more open to considering external technologies as technological inputs (Chesbrough et al., 2006; Hagedoorn, 2002). Moreover,

technological supply factors (e.g. an increase in education and scientists and the proliferation of venture capital available for small firms) have made technological solutions readily available so that firms facing performance or complex technological challenges rely at least to some degree on technologies from beyond their boundaries (Chatterji & Manuel, 1993; Veugelers, 1997).

Empirical studies show that firms, which are able to draw on external technologies, experience positive effects on both firm innovation (e.g. Ahuja, 2000a; Leiponen & Helfat, 2009; Rosenkopf & Almeida, 2003; Rosenkopf & Nerkar, 2001) and firm performance (e.g. Baum et al., 2000; DeCarolis & Deeds, 1999; Laursen & Salter, 2006). Naturally, this leads firms to increasingly consider external technologies to remedy performance problems in harsh times. Hence, we expect firms in harsh times to intensify their search for external technologies.

Another factor, increasing a firm's intensity to source external technologies in harsh times, is the fact that external technology sourcing is predominantly project-based. For example, licensing contracts and alliances are not infinite but entail contract terms defining the duration of the sourcing activity. Cyert and March (1992:181) distinguish resource allocation to projects and resource alloaction to organizational subunits and find that the latter is strongly path dependent and persistent over time, whereas the former can be more ad-hoc and flexible (Cyert & March, 1992). Given the increased demand for firms to search in harsh times, we expect that firms perfoming below their aspirations will draw more intensively on external technology sourcing, as resources can be allocated and withdrawn in a timely manner.[8]

[8] Only recently, firms have begun to set up organizational units dedicated to searching for external technologies (Monteiro, 2009) or managing external technology sourcing through institutional functions (Kale, Dyer, & Singh, 2002). However, the current size of such functions is small (Kale et al., 2002) compared with organizational units like internal R&D.

Grounded in the behavioral view, we posit that firms are sensitive to performance feedback in harsh times. As firms performing below their aspirations face short-term pressures to raise performance, we expect firms to intensify their search for external technologies, which can be an important solution to their organizational performance problems. This search will further intensify the more performance falls below aspirations, as more effort will be needed to close the gap[9].

Proposition 1: The further an organization's performance is below its aspirations, the more intense a firm's search for external technologies, all else being equal.

In Slack Times

So far our analysis covers firms that are motivated to search for external technologies as performance falls below aspirations. In this section, we examine how organizational slack is an alternative explanation for why firms source technologies from beyond their boundaries.

We have previously argued that firms conduct problemistic searches if performance falls below their aspirations. However, we have not yet examined how the aspiration "switch" works when performance exceeds aspirations. At first glance, one might argue that firms performing above aspirations do not face immediate gaps between performance and aspirations and thus are unlikely to search for external technologies (Cyert & March, 1992). In other words, firms performing above their aspiration levels may have little incentive to search because they are content with the status quo (Levinthal & March, 1981).

Cyert and March (1992) indicate that problemistic search is only one possible explanation for why firms search for novel technologies. Alternatively, slack search is based on the availability of slack, which is composed of excess liquid resources or operational

[9] We are excluding extreme cases of poor performance. It has been shown that firms performing extremely poorly (i.e. verging on bankruptcy) behave differently, as managers shift their attention to survival (and not aspiration), which leads these firms to search less (March & Shapira, 1987; Miller & Chen, 2004).

resources beyond what is needed to operate the firm short term (Cyert & March, 1992; Singh, 1986). When firms are able to accumulate slack resources, we describe them as being in "slack times". This follows Cyert and March's (1992:189) idea that "success tends to breed slack", which means that performance above aspirations and the accumulation of slack are concomitant in the short-run.

Slack supports the search for external technologies in two ways. First, slack directly provides excess resources (Cyert & March, 1992), which a firm can channel into developing technologies. Excess financial, human (e.g. scientists), and technological resources (e.g. laboratories) allow firms to more intensively source external technologies, as additional projects can be initiated. Second, slack affects a firm's decision-making environment by relaxing its internal monitoring and controls (Bourgeois III, 1981). This allows firms to pursue more projects and projects it would otherwise not be able to approve in harsh times (Cyert & March, 1992; Levinthal & March, 1981). Overall, slack provides a cushion in the event of failure so that the scrutiny of organizational decision-making is reduced (Cyert & March, 1992:43).

We argue that the relaxing of firm controls is particularly salient for a firm's project-based external technology sourcing, which will allow the firm to increase its external sourcing intensity in slack times. Following the behavioral theory of the firm we expect firms in slack times to provide excess resources and reduce scrutiny of project selection, which will allow them to increase their intensity of external technology sourcing[10].

Proposition 2: The further an organization's performance is above its aspirations, the more intense a firm's search for external technologies, all else being equal.

[10] We are particularly interested in how firms facing slack times adjust their intensity of external technology sourcing in the short-run. However, we posit that our predictions also hold for long-term slack (i.e. slack accumulated through persistent performance above aspirations).

Figure 1 provides a simplified summary of our predictions for the search intensity for external technologies[11]. The graph shows that we expect firms in both harsh and slack times to increase their intensity in sourcing external technologies. However, their reasons for sourcing external technologies are very different. Whereas firms in harsh times are motivated to search in the short-run for solutions to raise their performance towards aspirations, firms in slack times are able to use excess resources and face a less stringent resource allocation environment. As we discuss in the conclusion section, this has profound managerial implications.

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

Resource Allocation between Internal R&D and External Technology Sourcing

So far, we have examined external technology sourcing in harsh and slack times as an isolated activity. Yet, researchers distinguish that firms can search and develop technologies both through external technology sourcing and internal R&D (Cassiman & Veugelers, 2006; Laursen & Salter, 2006; Veugelers, 1997). Two different positions have been put forward to explain how external technology sourcing unfolds when firms simultaneously invest in internal R&D.

One perspective considers internal R&D and external technology sourcing as substitutes for one another, as both activities produce similar outcomes (Pisano, 1990). Based on transaction cost economics, this perspective examines cost negotiating, contracting, and managing relationships with external partners. These costs determine whether firms should make or buy technologies (Williamson, 1985). Applying this perspective to the R&D domain,

[11] As highlighted before, firms may become be less active in external technology sourcing once they approach bankruptcy (March & Shapira, 1987). Nohria and Gulati (1996) found that slack has a curvilinear effect on innovative performance. As we are only interested in the intensity of search (and less on innovative or performance outcome) we will not consider the negative effect of slack in our analysis.

the decision to source external technologies becomes a "procurement" decision, that is firms need to decide whether to substitute internal R&D (make) and external technology sourcing (buy) (Pisano, 1990:153).

Even though transaction costs play an important role in explaining external technology sourcing, the procurement perspective does not consider potential interactions among internal R&D and external technology sourcing. Researchers have suggested that external technology sourcing and internal R&D can be complementary activities (Veugelers, 1997) for the following reasons. First, firms require a minimum level of technological understanding, so they need to invest in their own R&D to be able to source and assimilate external technologies (Cohen & Levinthal, 1990). External technology sourcing depends critically on "…sufficient expertise …, to utilize the results of externally performed research" Mowery and Rosenberg (1989:page). Second, firms pursuing both activities simultaneously can enjoy innovation benefits if they are able to recombine distinctive new variations of technology derived from internal R&D and external technology sourcing (Fey & Birkinshaw, 2005; Fleming & Sorenson, 2004; Katila & Ahuja, 2002).

Researchers confirm that external technology sourcing is often accompanied by investments in internal R&D and vice versa. For example, Arora and Gambardella (1990, 1994) find that firms, which conduct more R&D, have a larger number of external collaborations. Also, Veugelers (1997) shows that internal R&D and external technology sourcing can stimulate each other for firms with dedicated R&D departments. Conversely, researchers also highlight that external technology sourcing can be a substitute for internal R&D, so that the importance of internal research activities gradually declines as they are replace by networked organizations (Chesbrough et al., 2006). We propose that one reason for these inconclusive findings on the relationship between internal R&D and external

technology sourcing is that researchers so far have been agnostics as to whether a firm searching for technologies is concomitantly in harsh or slack times.

In Harsh Times

We have identified that firms facing harsh times will intensify their search for external technologies. Yet, we propose that firms in harsh times are constrained in their ability to allocate attention and resources to external technology sourcing, if they are simultaneously trying to search through internal R&D.

It is commonly accepted that the search for technologies and, in particular, the search for external technologies, is a costly process requiring a significant amount of financial, technological, organizational, and managerial resources (Gulati, Khanna, & Nohria, 1994; Levinthal, 1998; Levinthal & March, 1981; Parkhe, 1993). In harsh times, the resources available to the firm are limited, as firms perform below their aspirations, leading them to perceive their situations as a loss (Greve, 1998). Firms in harsh times also spend considerable efforts to attend to pressures from internal and external stakeholders (Abrahamson & Park, 1994; Cyert & March, 1992:43; Salancik & Pfeffer, 1978; Useem, 1996)[12], which further constrains the resources available to the firm.

Given the scarcity of resources in harsh times, we argue that firms need to make compensatory tradeoffs in allocating resources between internal R&D and external technology sourcing. This is supported by recent research on firm innovation, which demonstrates that some firms initially attempt to solve their problems through internal R&D and only later attempt to solve their problems through sourcing external technologies (Jeppesen & Lakhani, 2009).

[12] For example Abrahamson and Park (1994) suggest that firms with poor performance are under pressure from agencies like the SEC commission to more substantially disclose their results. Conversely, firms with a higher performance are less under scrutiny.

The idea that organizations need to make tradeoffs in their search for technologies dates back to Cyert and March (1992) and Simon (1997), who early recognized that firms only attend to a few problems and solutions (Ocasio, 1997:190). In terms of resource allocation to R&D this means that a firm in harsh times not necessarily performs an exhaustive scan considering internal R&D and external technology sourcing mutually. Conversely, the decision to invest in one activity substitutes for the decision to invest in the other. Cyert and March (1992:179) further highlight that firms try to allocate scarce resources to minimize conflict and maintain the relative position of the firm's coalitions. For instance, a firm in harsh times might be required to intensify its attention to internal stakeholders like employee representatives, middle management or the internal R&D department, while at the same time avoiding organizational conflict. Process models of organizational resource allocation (Burgelman, 1991; Burgelman, 1996) support that internal R&D can become institutionalized, so that firms are reluctant to reduce the ongoing flow of resources to internal R&D activities in harsh times.

Overall, problems of attention and limited resources in harsh times affect how firms can use internal R&D and external technology simultaneously. Even though complementarities between internal R&D and external technology sourcing may be obtainable, and we will elaborate on this below, firms face important boundary conditions in allocating resources to internal R&D and external technology sourcing. This means that firms performing below their aspiration levels need to make compensatory tradeoffs between searching for technologies through internal R&D or through external technology sourcing. More formally, we propose:

Proposition 3: Firms in harsh times tend to use external technology sourcing and internal R&D as substitutes for one another, so that the intensity of external technology sourcing will be lower the more a firm uses internal R&D.

In Slack Times

We now turn our attention to how external technology sourcing and internal R&D co-exist in slack times. Contrary to harsh times, firms in slack times possess excess managerial and financial resources, which allow these firms to pursue both internal R&D and external technology sourcing simultaneously. Cyert and March (1992:189) emphasize that

> "[one of the] main consequences of slack is a muting of problems of scarcity…. Slack is available for projects that would not necessarily be approved in a tight budget. … [and] provides a source of funds for innovations that would not be approved in the face of scarcity…".

Put differently, firms in slack times face fewer resource constraints, as they are able to tap into excess resources they've accumulated but are not yet consumed or incorporated into organizational processes. Firms performing above aspirations also face less pressure from stakeholders to close performance aspiration gaps, which frees firm resources. Consequently, firms in slack times have less pressure to make compensatory tradeoffs between internal R&D and external technology sourcing. Slack, in particular, mitigates the problem of limited attention, which we identified as a major obstacle to pursuing internal R&D and external technology sourcing simultaneously in harsh times. In particular, firms in slack times will relax the pressure of monitoring and controlling firm projects, which frees up resources and allows firms to consider a broader range of research activities (Cyert & March, 1992). A well-known example of slack search is 3M's policy of allowing scientists to allocate a percentage of their time for their own discretion and experimentation.

More importantly, the availability of slack resources also allows firms to more thoroughly consider potential beneficial connections between investing in internal R&D and external technology sourcing simultaneously. Firms in slack times do not face short-term pressures to find solutions to existing problems. Rather, they possess excess resources and more room for experimentation. This allows them to consider a more long-term and forward-

looking (Gavetti & Levinthal, 2000) approach to using internal R&D and external technology sourcing simultaneously and complementarily.

Resource constraints being less salient in slack times fundamentally changes the relationship between internal R&D and external technology sourcing. Whereas in harsh times internal R&D imposes a constraint on the intensity of external technology sourcing, it can have a positive effect on external technology sourcing intensity in slack times. First, firms with greater internal R&D are better able to absorb and *"…to recognize the value of new, external knowledge…"* (Cohen & Levinthal, 1990:128). Put differently, internal R&D can facilitate how firms spot opportunities beyond their boundaries (Rothaermel & Boeker, 2008). Second, internal R&D can facilitate the way firms are able to assimilate and use external technologies (Cohen & Levinthal, 1990:128). As slack times enable firms to consider these benefits, we propose that the more firms invest in internal R&D in slack times, the more they will increase their intensity of external technology sourcing.

In other words, we posit that with this long-term perspective, firms in slack times can better connect the benefits of employing external technology sourcing and internal R&D concomitantly. This is consistent with extant research findings that external technology sourcing can add important technologies to a firm's technology pool and that such external technologies can be subsequently recombined with internal R&D (Fey & Birkinshaw, 2005; Fleming & Sorenson, 2004; Katila & Ahuja, 2002). We expect that firms in slack times are more able to understand and dedicate resources to the relations between internal R&D and external technology sourcing, which is why we expect firms in slack times to increase the intensity of both simultaneously.

Proposition 4: Firms in slack times tend to use external technology sourcing and internal R&D as complements for one another, so that the intensity of external technology sourcing will be higher the more a firm uses internal R&D.

Search Direction for External Technologies in Harsh and Slack Times

So far we have identified how firms in harsh and slack times adjust their intensity of external technology sourcing. We now turn our attention to the direction of searches, i.e. if firms search for local or distant external technologies.

The idea of search direction examines what firms search for, from the "pool of technological possibilities" (Levinthal & March, 1981:313). We apply the exploration–exploitation framework of organizational search (March, 1991) to external technology sourcing, so that firms searching for technologies beyond their boundaries can exploit existing capabilities or explore new opportunities (Koza & Lewin, 1998:256).

Extant research (Benner & Tushman, 2002; Katila & Ahuja, 2002; Rosenkopf & Nerkar, 2001)[13] has focused on the technological dimensions of organizational search and has distinguished between the sourcing of local or familiar technologies (exploitation) versus the sourcing of distant technologies (exploration). More recently, alternative exploration/exploitation dimensions have been suggested, including geographical distances among external technology sourcing partners (e.g. Almeida, 1996)[14], the relative position (upstream and downstream) in the value chain of the sourcing partner (e.g. Lavie & Rosenkopf, 2006; Rothaermel & Deeds, 2004)[15] and partnership structure, which refers to forming unfamiliar versus familiar ties (e.g. Baum, Rowley, Shipilov, & Chuang, 2005; Lavie & Rosenkopf, 2006)[16]. Common to all dimensions is the idea that exploration is a riskier and more experimental activity compared to exploitation (March, 1991).

[13] Exploration and exploitation are commonly operationalized through patent data. Distant technologies are those not previously cited by the focal firms, whereas similar technologies have build on patents previously cited by the focal firms (e.g. Rosenkopf & Nerkar, 2001)

[14] Geographic distance also reflects how physically close firms search for technologies (e.g. through local clusters or subsidiaries abroad).

[15] In this literature upstream is defined as exploration and downstream as exploitation.

[16] Exploration refers to the formation of non-local ties (previously unconnected partners), whereas exploitation is repeating a tie with a former sourcing partner.

We follow the above literature and use the term *distant* to describe when firms search for unfamiliar technologies or try to source technologies from unfamiliar partners. Conversely, *local search* will refer to when firms source familiar technologies or source technologies from familiar partners. Next, we will examine the direction of external technology sourcing for firms facing harsh or slack times.

In Harsh Times

There are several reasons to believe that firms in harsh times will favor exploitation and source more local external technologies. First, exploitation entails a lower costs of search, which is the cost of "discovering who it is that one wishes to deal with and informing people that one wishes to deal with" (Coase, 1960:7). Exploitation refers to sourcing local technologies, which are familiar to the firm, and sourcing technologies from familiar partners. Familiarity with a technology will help a firm to more readily make sense of external technologies, which reduces the cost of search (Cohen & Levinthal, 1990; Gulati, 1995; Mowery et al., 1996; Rothaermel & Boeker, 2008). The ease of accessing external technology is particularly relevant for firms in harsh times, which need short-term solutions to remedy their performance problems.

Second, exploitation not only reduces search costs for technologies but also requires fewer resources to assimilate and integrate those technologies into the organization. For example, familiarity with a sourcing partner can have important advantages, as firms are better able to establish mutual communication paths (Dyer & Singh, 1998; Li, Eden, Hitt, & Ireland, 2008). This facilitates the transfer of technologies (Nooteboom, Berger, & Noorderhaven, 1997). Put differently, exploitation facilitates the absorption of a partner's technology into the organization (Cohen & Levinthal, 1990; Lane & Lubatkin, 1998). Conversely, exploration of unfamiliar external technologies requires firms to make

substantial investments to understand and integrate the technology into the organization (Cohen & Levinthal, 1990). Given the resource constraints of firms in harsh times, we expect such firms to prefer exploitation to exploration, as firms are likely unwilling to commit such substantial resources so that firms "emphasize relatively immediate refinements in existing technology, greater efficiency and discoveries in the near neighborhood of the present activities" (Levinthal & March, 1981:309).

Exploitation can also be an important way to initiate subtle changes without facing the risk of organizational resistance. Case study evidence suggests that local search is often preferred within firms (Tripsas & Gavetti, 2000), and that organizations often develop competencies to search for incremental solutions (Nelson & Winter, 1982; Rosenkopf & Nerkar, 2001). Conversely, organizations often face strong resistance to radical change (Hannan & Freeman, 1977) and face severe penalties from stakeholders when trying to introduce distant technologies (Benner, 2007; Christensen & Bower, 1996). As we have identified that firms in harsh times already face severe pressure from stakeholders, we expect that firms will try to avoid further conflict (Cyert & March, 1992) and will search for local external technologies.

The prevalence of exploitation in harsh times notwithstanding, there is reason to believe that as performance falls far below aspirations, firms switch to sourcing more distant technologies. In particular, the further performance falls below aspirations, the more firms should be willing to take risks to raise performance (Singh, 1986). On an individual level, Kahneman and Tversky (1979) identified that decision makers who face harsh times (the domain of losses), more readily take risks, which has been corroborated on an organization level (Bolton, 1993; Greve, 2003b; Singh, 1986).

The tendency to explore is particularly salient for firms performing significantly below their aspirations. Such firms can benefit disproportionally from exploratory external

technology sourcing decisions (March & Shapira, 1987; Singh, 1986). This is why we expect them to make more risky decisions. Put differently, once managers consider their situation in highly unfavorable terms, they might be more willing to give up established beliefs and start searching for more distant external technologies.

Joining these two arguments we make two propositions. Overall, we expect firms in harsh times to focus on searching for more local external technologies when they are not far below aspirations. However, once firms are situated substantially below their aspirations, we expect them to switch to exploration and take high-risk bets as they become increasingly more desperate to raise their performance level[17].

Proposition 5a: Firms in harsh times search for local technologies, when they perform slightly to moderately below aspirations.

Proposition 5b: Firms in harsh times will search for more distant technologies, when they perform substantially below their aspirations.

In slack times

We have claimed that external knowledge sourcing is influenced by performance feedback. Positive feedback induces firms to repeat behavior (Cyert & March, 1992; Kelly & Amburgey, 1991; March & Simon, 1958; Nelson & Winter, 1982). This suggests that firms in slack times due to previous successes will choose to search local.

Searching for familiar external technologies enables firms to create incremental innovations and become more specialized in their existing domains. Rosenkopf and Nerkar (2001:288) call this type of exploitation "first-order competence". In the short-run, this can generate a competitive advantage[18]. We argue that the effects for pure exploitation in slack

[17] Once more, our propositions are framed under the assumption that the firm is not facing an extreme crisis (e.g. threat to bankruptcy), which can alter its propensity for taking organizational risk (March & Shapira, 1987).
[18] We note that first order competences may lead firms in the long run to develop "core rigidities" (Leonard-Barton, 1992) or to fall into "competency traps" (Levitt & March, 1988).

times are particularly salient when firms perform just above their aspirations. In such cases, the effects of relaxed monitoring and project scrutiny are still low while the positive performance feedback reinforces the firm to continue investing in local external sourcing.

Even though firms in slack times will have a tendency to reinforce their existing competences through local external technology sourcing, we need to also consider their capacity for to accumulate excess resources. These resources are not used to solve immediate performance problems but conversely allow firms to take a long-term approach to sourcing external technologies (Levinthal & March, 1981). Additionally, slack acts as a buffer to "bad" decisions, and this allows firms to be more lenient in allocating resources to external sourcing projects.

Given that firms reduce their scrutiny in approving projects in slack times, the effect of slack on external technology sourcing should be particularly salient for those riskier projects sourcing distant technologies (March, 1991). We posit that the more performance is above aspirations, the more firms are endowed with excess resources, and the more firms are willing to relax project controls. This allows firms to search for both local and distant external technologies.

The arguments above taken together, we predict that:

Proposition 6a: Firms in slack times search for local technologies when they perform slightly to moderately above their aspirations.

Proposition 6b: Firms in slack times search for both local and distant technologies when they perform substantially above their aspirations.

Table 1 summarizes our predictions for the direction of search for external technologies.

----Insert Table 1 about here----

Conclusion

Scholars have long emphasized that external technology sourcing has increased considerably over the past ten to fifteen years (e.g. Arora et al., 2001; Arora & Gambardella, 2009) and that firms sourcing external technologies have seen a number of performance benefits (Eisenhardt & Santos, 2002; Henderson & Cockburn, 1994; Rosenkopf & Nerkar, 2001). Surprisingly though there has been much less scholarly attention on the reverse relationship—i.e. how firm performance affects its external technology sourcing activities.

This relationship between performance relative to aspirations and external technology sourcing was the focus in this paper. We separate firms into two major types according to their performance: those in "harsh times" and those in "slack times" and present three sets of propositions.

First, we provide a behavioral explanation (Cyert & March, 1992; Levinthal & March, 1981:308) for the triggering mechanism that may explain with what intensity firms source external technologies. We suggest that firms in both harsh and slack times increase their intensity of sourcing external technologies. Interestingly though, the search for external technologies occurs for different reasons, and through different search processes. While in harsh times, firms engage in a problemistic search for external technologies to solve a specific problem, in slack times firms use excess resources to search for external technologies but not necessarily target specific problems. It is also interesting to note a third category of firms: those located in between harsh and slack times, with performance right near their aspiration levels. A natural extension of our propositions would be to predict that these firms will have neither the pressure nor the short-term slack resources to source external

technologies, and therefore will be the category of firms with less intense external knowledge sourcing strategies (see Figure 1).

Second, we examine how firms allocate resources towards internal R&D and external technology sourcing, and whether or not firms consider them as substitutes or complements (e.g. Hess & Rothaermel, 2010; Pisano, 1990; Veugelers, 1997). We suggest that if firms are in harsh or slack times imposes important boundary conditions as to how firms manage their internal and external activities to develop new technologies. In particular, whereas firms in harsh times, due to limited resources, have to make compensatory tradeoffs between internal R&D and external technology sourcing, firms in slack times can use both activities concomitantly.

Finally, we posit that firm performance not only affects the intensity of search for external technologies but also the direction of such search. We identify that firms performing close to their aspirations will opt to source technologies local to the firm. Conversely, firms performing far below or above aspirations will engage in more distant search, but for different reasons. Whereas firms in harsh times take risky bets to raise their performance above aspirations, firms in slack times engage in exploration as excess resources create an organizational environment with lower scrutiny and control for external sourcing projects.

Its conceptual nature notwithstanding, we believe our propositions can be tested empirically in industries where firms regularly engage in external technology sourcing would be particularly appropriate. For instance, as we are interested in delineating resource allocation decisions between internal R&D and external technology sourcing, the pharmaceutical industry, where we find trails of both internal R&D projects (i.e. drug compounds) as well as the sourcing of external technologies through licensing and collaborative arrangements (e.g Rothaermel & Boeker, 2008) would be particularly appropriate.

In a business environment where an increasing number of firms are adopting an open-innovation approach, this study has important managerial implications. For managers in high performing firms, our propositions may explain why they not only see their high-performing peers actively engaged in external knowledge sourcing, but also a number of low performing players being equally active in that search for external technologies, but both for different reasons.

For those managers in firms facing harsh times, our propositions should provide them with a more nuanced understanding of the recursive relationship between performance and external knowledge sourcing. Those managers should be aware that some of the high performing firms that they are trying to imitate are successful not necessarily because they sourced external technologies, but because by being successful in the first place they were able to accumulate the slack necessary to subsequently search for external technologies.

Figure 1: Model of external technology sourcing as a response to harsh and slack times

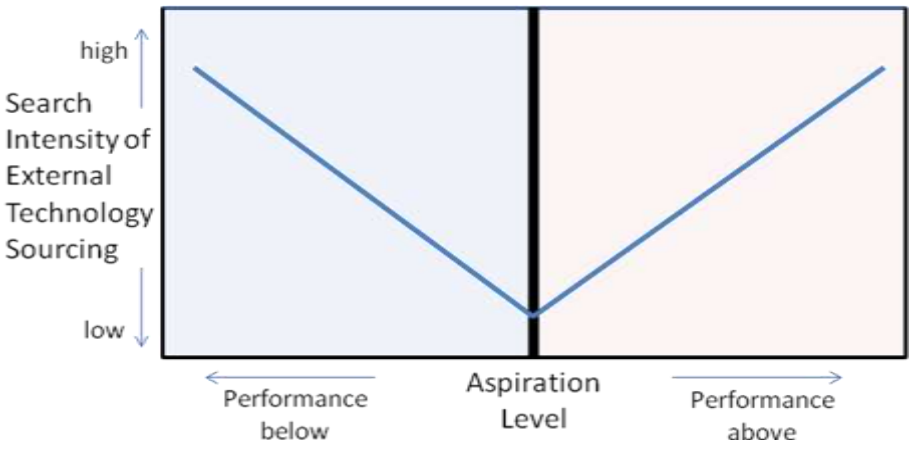

Table 1: Firms facing harsh and slack times with different performance-aspirations gaps

Performance close to aspirations?	**Harsh Times**	**Slack Times**
Yes	Exploit	Exploit
No	Explore	Exploit + Explore

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