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When do firms rely on their knowledge spillover recipients for guidance in exploring unfamiliar knowledge?

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ABSTRACT

Knowledge spillover occurs when recipient firms combine the knowledge of an originating firm with other knowledge. When recipient firms combine the originating firm's knowledge with knowledge that is unfamiliar to the originating firm, the recipient firms potentially provide insight to the originating firm on the viability of exploring such knowledge. By mimicking its recipient firms, the originating firm reduces the challenge and uncertainty of exploring unfamiliar knowledge domains. We examine the exploration activities of 87 telecommunications equipment manufacturers over a ten-year time period. We argue that those firms that operate in competitive and dynamic market environments promoting conservative risk-taking behavior will value such uncertainty reduction more highly and thus rely to a greater extent on their recipient firms for guidance on where to explore for new expertise. In contrast, firms in high-growth market environments are more likely to look beyond the activities of recipient firms when exploring new technological domains and rely less on mimicking their recipient firms.

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1. Introduction

Knowledge spillover is thought to be essential for economic growth (Griliches, 1979), urban development (Arrow, 1962; Romer, 1986), and promoting the growth of high technology industries in certain regions (Saxenian, 1994). Knowledge spillover occurs when recipient firms exploit knowledge that has been originally developed by another firm (i.e., originating firm) (Griliches, 1992). These recipient firms may be alliance partners, direct competitors of the originating firm, or firms from other industrial sectors. Whatever the case, when recipient firms exploit the knowledge of the originating firm, they often combine the originating firm's knowledge with other knowledge to create their own unique innovations (Sorenson, Rivkin, and Fleming, 2006). Although many studies have considered how recipient firms absorb and benefit from knowledge spillovers (e.g., Henderson and Cockburn, 1996; Cohen and Levinthal, 1990; Zahra and George, 2002), our understanding of how knowledge spillovers influence originating firms is limited. The conventional wisdom has been that originating firms

always lose when knowledge spills out from their boundaries to be used by others (Lippman and Rumelt, 1982; Kogut and Zander, 1992).

However more recent studies suggest that originating firms may benefit when other firms build on their knowledge. For example, firms can strategically promote the copying of their technology to influence industry standards (Spencer, 2003). Firms can proactively shape the collaborative behavior of other firms in their innovation ecosystem by selectively revealing some of their knowledge (Alexy et al., 2013). Aside from strategically motivated spillover, Yang et al. (2010) conceptualize a *knowledge spillover pool* that emerges when an originating firm's knowledge spills over to recipient firms and is subsequently recombined with other knowledge through the innovative activities of recipient firms. Originating firms can potentially learn vicariously from these *knowledge spillover pools* to enhance their subsequent innovation efforts. Yang et al. (2010) showed that originating firms' overall level of subsequent innovation increased the larger their knowledge spillover pool and the more similar it was to their existing expertise. They argue that the originating firm may learn how to further exploit its expertise by observing how other firms are using the originating firm's knowledge in domains that are *familiar* to the originating firm.

However the long term survival and success of firms depend on them being able to discover and use relevant knowledge that

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is *unfamiliar* (March, 1991; Levinthal, 1997). When might recipient firms play a role in guiding originating firms as they search for knowledge that is distant and unfamiliar relative to their existing knowledge? As opposed to exploring how recipient firm activity influences the originating firm's *rate* of innovation as did Yang et al. (2010), we consider how it can influence the *nature* of the originating firm's innovation, i.e., the pursuit of exploration. We also extend the work of Yang et al. (2010) by limiting the knowledge spillover pool to knowledge that is by definition unfamiliar; that is, we focus on knowledge that (1) has been recombined with the originating firm's knowledge by other firms (i.e., recipient firms), and (2) is in technological domains the originating firm has not previously used in their innovative activities.

We contend that if an originating firm can observe how its recipient firms combine its knowledge with knowledge that is unfamiliar to the originating firm, the originating firm's effort and the associated uncertainty in exploring this knowledge will be reduced. For example, an electronics firm (recipient firm) might use a chemical process in its innovation that was originally developed by a chemical firm (originating firm). In turn, by observing the innovation of the electronics firm, the chemical firm may gain some understanding of viable, albeit relatively unfamiliar, knowledge domains in electronics that are worthy of exploring and integrating with its existing repertoire of expertise.

The extent, to which firms mimic the innovative behavior of their recipient firms in such fashion, we argue, largely depends on the environment in which they find themselves. Those firms that operate in highly competitive and dynamic market environments promoting conservative risk-taking behavior will place greater value on such uncertainty buffering and rely more on recipient firms for guidance about where to explore for new expertise. In contrast, firms in high-growth market environments that promote riskier behavior are more likely to look beyond the activities of recipient firms when exploring new knowledge domains and rely less on mimicking their recipient firms.

To test this premise, we track the search activities of 87 telecommunication equipment firms over a ten-year time frame and found a general relationship between environmental context and discovering unfamiliar knowledge through mimicry. While others have considered factors that influence a firm's general propensity for exploring unfamiliar technological domains (March and Shapira, 1992), or the choice between exploring unfamiliar knowledge and exploiting existing knowledge (Benner and Tushman, 2003; Hill and Rothaermel, 2003), we highlight factors that influence *how* firms discover unfamiliar technological domains, specifically how firms can gain insight from their recipient firms.

Firms face a paradox when searching for useful knowledge in unfamiliar technological domains. New capabilities and expertise are especially valuable during times of uncertainty, when the environment is dynamic, and resources are limited (Sirmon et al., 2007). Yet the discovery of valuable, yet unfamiliar knowledge is both cognitively challenging and inherently uncertain (Fleming, 2001; Levinthal and March, 1981; March, 1991). By conceptualizing search behavior within the realm of managerial risk-taking, we show how firms can search for valuable unfamiliar knowledge in a way that reconciles the tension of taking on additional risk in an already uncertain environment. We thus contribute to the literature on knowledge search by identifying a source of knowledge that firms may more easily explore. Finally, our study differentiates the impact of new knowledge domains introduced by the recipients' recombination of originating firm's knowledge spillovers from the overall knowledge domains in this knowledge spillover recombination process (Yang et al., 2010). Our results identify further benefits for the originating firm that may be gained from knowledge spillover (Spencer, 2003).

2. Theory and hypotheses

2.1. The value of recipient firms for exploration guidance

Innovation occurs when knowledge is integrated and recombined with other knowledge (Fleming, 2001). For example, combining physics technology with molecular technology has led to both new electronic devices and new medicines. Firms tend to depend on their existing expertise for input into their ongoing innovation pursuits. Relying on knowledge that is familiar and already resides within the firm is more cost-effective and has a higher probability of success, compared with searching unfamiliar knowledge domains (Fleming and Sorenson, 2001; March and Simon, 1958; March, 1991).

Although relying on existing expertise may seem easy and relatively efficient, it may not be so effective in practice, especially in cases where market environments have changed to the point where a firm's existing expertise is rendered irrelevant. When firms rely only on their existing expertise, they become trapped within their restricted knowledge domains and risk simply perpetuating their own expertise (March, 1991; Levinthal, 1997). To avoid becoming too insular, firms must explore knowledge available outside of their existing expertise.

Successful exploration occurs when a firm integrates knowledge into its current innovation from beyond the realm of its existing expertise. To do so, firms often need to hire outside experts or acquire firms that are sources of unfamiliar knowledge (Song et al., 2003). Even after taking these actions, lack of experience and the high cost of a trial-and-error process may cast doubt on whether firms can successfully combine disparate areas of knowledge to create a novel technological contribution (March, 1991).

However, there is an alternative to conducting expensive search into unfamiliar domains and bearing the full uncertainty of combining disparate domains of knowledge. That is, firms can search unfamiliar domains more easily and with less uncertainty by learning from recipient firms which have borrowed knowledge originally created by the searching firm. When recipient firms use knowledge that has spilled over from an originating firm, they often integrate that knowledge with other knowledge to create unique value (Sorenson et al., 2006). Some of the knowledge that is integrated with the originating firm's knowledge by the recipient firms will be relatively unfamiliar to the originating firm.

Drawing on the guidance of recipient firms to identify potentially useful yet unfamiliar knowledge represents a middle ground of sorts in terms of the cognitive challenge and uncertainty of innovation. It will require more effort than simply exploiting familiar knowledge domains that lie within the firm. The firm will still need to cognitively process knowledge in domains which are generally unfamiliar to the firm and lie outside of its technological boundaries. However, drawing on the guidance of recipient firms will not be as costly or uncertain as searching for useful yet unfamiliar knowledge 'cold'; that is, searching for unfamiliar knowledge that has not been associated in any way with the firm's existing knowledge by recipient firms. By mimicking recipient firms in terms of using knowledge from new domains that recipient firms have used in conjunction with the knowledge of the originating firm, the originating firm abbreviates the normally challenging and uncertain search process. Because recipient firms have already established the viability of linking an originating firm's knowledge with the technological domains that are relatively unfamiliar to the originating firm, the risk for the originating firm of doing likewise is reduced (Fleming, 2001; Fleming and Sorenson, 2001).

Furthermore, when knowledge created by the originating firm is recombined with unfamiliar knowledge by other recipient firms, the originating firm will have a unique advantage in learning from these recombinations because it will have been the originator of

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