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Matching technology strategy with knowledge structure: Impact on firm's Tobin's *q* in the semiconductor industry☆

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ABSTRACT

This study tests whether alignment between a firm's technology strategy and its knowledge structure impacts firm performance. We examine how the internal and external R&D strategies align with the depth and diversity of a firm's technology portfolio. The results show that long-term performance of a firm with high technological depth deteriorates when the firm enhances its internal R&D intensity, but enhances when the firm increases its external R&D alliance intensity. But in contrast, performance of a firm with high technological diversity enhances when it increases its internal R&D intensity, but deteriorates when it increases its external R&D alliance intensity.

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Introduction

We are concerned herein with the acquisition of new technological knowledge and its development into valuable organization-specific assets that a firm can possess and manage (Grant, 1996). In search of new technological knowledge, firms often tap internal and external sources of knowledge (Gnyawali and Srivastava, 2013). Increasingly, the issue of organizational boundary

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spanning has assumed a more central role in the technology strategy literature (Rosenkopf and Nerkar, 2001; Rothaermel and Alexandre, 2009; Vermeulen and Barkema, 2001). Understanding when to emphasize on a more internally focused search strategy, by tapping into internal sources of knowledge, and when to switch emphasis to an externally focused search strategy, by tapping into external sources of knowledge (e.g., alliance partners), is of fundamental importance in developing a sound technology strategy, as these strategies involve trade-offs in terms of the value creation and value capturing opportunities they offer (Cruz-Cázares et al., 2013; Miller et al., 2007; Rothaermel and Alexandre, 2009).

One of the fundamental premises of strategy-making is that of matching firm capabilities with opportunities by using appropriate strategies. Recent research suggests that firms vary in their knowledge structures (Galunic and Rodan, 1998; George et al., 2008; Yayavaram and Ahuja, 2008). The characteristics of the knowledge structure of a firm, such as its depth and breadth or diversity (Prencipe, 2000), indicate the nature of the firm's underlying capabilities (Carnabuci and Operti, 2013), and more importantly, the nature of recombinatory opportunities (Galunic and Rodan, 1998) embedded in the firm's knowledge base. This would suggest that the appropriateness of the technology strategy of a firm, as reflected in its long-term firm performance, might be contingent upon the characteristics of a firm's knowledge base.

Despite the importance of the structure of a firm's knowledge base for potentially addressing the issue of organizational boundary spanning, only a few studies have attempted to address this issue while considering the characteristics of a firm's knowledge base (Lin and Wu, 2010; Wu and Shanley, 2009). However, not only have these studies only partially addressed this issue, more importantly, they have not been able to explain some of their important empirical findings using their theoretical frameworks. For instance, adopting an absorptive capacity framework, Lin and Wu (2010) hypothesize that firms with greater knowledge depth would benefit more from their internal R&D intensity, however, contrary to their hypothesis, they find that increasing R&D intensity in the presence of high knowledge depth leads to lower firm performance measured in terms of firm sales growth rate and return on assets. Similarly, adopting the absorptive capacity framework, Wu and Shanley (2009) hypothesize that increasing exploration intensity will have a positive interaction with both the knowledge depth and knowledge breadth of a firm, but contrary to their hypothesis they find that high intensity of exploration in the presence of greater knowledge breadth lowered firm innovation performance.

These mixed and unexpected findings call for a comprehensive further research and closer attention to underlying theoretical mechanisms. They may also warrant adopting alternative theoretical approaches that can answer these questions. With repeated deployment, firms can deplete the recombinant potential of their current knowledge elements (Fleming, 2001). Building upon the recombinant theory (Fleming, 2001; Fleming and Sorenson, 2001; Galunic and Rodan, 1998; Katila and Ahuja, 2002), we argue that depth and diversity – two important dimensions of a firm's knowledge base (Bierly et al., 2009; George et al., 2008; Lin et al., 2006; Miller, 2006) – encapsulate two different types of recombinant potentials, which we call divergent and convergent recombinant potentials.

Convergent recombinant potential lies within a firm's boundaries and captures the valuable recombinations that can be generated by recombining a firm's existing knowledge components. Divergent recombinant potential captures value that can be generated by recombining a firm's existing knowledge components with knowledge components lying outside the firm's boundaries. In order to maximize long-term performance, a firm needs to create highly valuable innovations, and at the same time be able to appropriate value from those innovations (Wang and Chen, 2010). Our central argument is that in order to simultaneously create and capture value using its knowledge-based resources, a firm needs to match capabilities embedded in its knowledge base through its R&D strategy with the nature of recombinant potential embedded in its knowledge base (Carnabuci and Operti, 2013). Using this logic, we expect superior long-term performance when the internal and external R&D strategies of a firm are appropriately matched with the recombinant potentials of the firm's knowledge base.

We test our hypotheses using a panel of 208 public firms from the U.S.-based semiconductor industry during 1988–2006. The results show that the depth and diversity of a firm's technology