

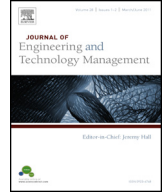


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When a firm's centrality in R&D alliance network is (not) the answer for invention: The interaction of centrality, inward and outward knowledge transfer



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ABSTRACT

Bridging three research domains, centrality in R&D alliance networks, knowledge transfer, and the determinants of firm invention output, we develop an interaction model explaining how the centrality–invention output relationship is contingent on the levels of firm inward and outward knowledge transfer. A positive interaction between inward and outward knowledge transfer enhances invention output. However, an *invention dissipation effect* occurs when central firms have low levels of inward and high levels of outward knowledge transfer. Our findings and implications for managing tensions between inward and outward knowledge transfer are based on an 18-year panel data set including 287 biopharmaceutical firms.

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Introduction

In knowledge intensive industries, how to leverage a central position in a research and development (R&D) alliance network to enhance invention output is a question at the nexus of network and knowledge transfer research. Alliance networks provide access to knowledge that can be transferred within and across organizational boundaries (Phelps et al., 2012; Owen-Smith and Powell, 2004) while the level of transferred knowledge impacts the invention outcomes a firm realizes from its central position (Tsai, 2001). Two types of knowledge transfer associated with invention output are inward and outward knowledge (Cohen and Levinthal, 1990; Argote and Miron-Spektor, 2011). In spite of growing consensus that a central network position enhances invention output there is considerably less clarity of how the transfer of a firm's inward and outward knowledge interact with a firm's central position to influence invention outcomes. Researchers have called for understanding these interactions because conducting both inward and outward knowledge transfer create potential tensions associated with the diversion of managerial attention across the two transfer activities, firm resource constraints, and the likelihood of competitor imitation (Argote and Miron-Spektor, 2011). Since firms are heterogeneous with respect to the levels of inward and outward knowledge transfer, they are likely to moderate the centrality–invention relationship (Ahuja, 2000). We begin to explore the existence of tensions by studying how the set of interactions between centrality in a R&D alliance network, inward and outward knowledge transfer influence invention output in the knowledge intensive biopharmaceutical industry.

Drawing on network and knowledge transfer research, we propose that while the inward transfer of knowledge strengthens the relationship between a central position in a R&D alliance network and invention output, outward knowledge transfer attenuates this relationship. We then hypothesize that a complementary interaction between inward and outward knowledge transfer enhances invention output. Finally, a three-way interaction hypothesizes that when central firms in a R&D alliance network have low levels of inward knowledge transfer and high levels of outward knowledge transfer their level of invention decreases. Our predictions are supported using a two-stage instrumental variable regression analysis on a panel data set consisting of 2209 firm-year observations for 287 biopharmaceutical firms over 18 years.

Connecting the R&D alliance network with the inward and outward transfer of knowledge streams of research our findings contribute two new insights that have multiple implications. First, invention output is enhanced when firms have high levels of both inward and outward knowledge transfer (panel C, Fig. 1). This finding suggests that firms are able to manage the tensions (Argote and Miron-Spektor, 2011) between inward and outward knowledge transfer to achieve complementary benefits in terms of enhanced invention output. Second, central firms in an R&D alliance network experience an *invention dissipation effect* when they have low levels of inward and high levels of outward knowledge transfer (panel D, Fig. 1). In other words, a central firm in an R&D alliance network focusing on exploiting its outward transfer of knowledge while de-emphasizing its inward knowledge transfer has levels of invention output comparable to or less than low centrality firms. We discuss the implications of our findings linking them to the structural positioning and transfer of knowledge in R&D networks (Koka and Prescott, 2008; Phelps et al., 2012), the role of inward and outward transfer of knowledge (Argote and Miron-Spektor, 2011), the dark side of networks (Soda and Usai, 1999) and how the coordination of dedicated inward and outward knowledge functions can lead to virtuous cycles of enhanced invention output (Enkel et al., 2009).

In the following sections, drawing on the network structure and knowledge transfer research, we develop hypotheses for how the set of interactions among centrality, inward and outward knowledge transfer influence invention output. We then present our empirical analysis, results, theoretical and managerial implications and suggest directions for future research.

Theoretical background and hypotheses

According to network theory both the structural aspects of networks and the knowledge transferred by actors in these networks influence firm invention output as reflected by their patenting (Oerlemans and Knobens, 2010; Phelps, 2010). The relationship between network structure,

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