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# Complementary effects of clusters and networks on firm innovation: A conceptual model

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### ABSTRACT

We develop a conceptual model that explains how a firm's cluster and network complement each other in enhancing the firm's likelihood of technological innovations. We identify critical innovation catalysts—awareness and motivation—and innovation barriers—resource constraints, organizational rigidity, and uncertainty. Our conceptual model explains how various factors in the cluster such as competitive intensity, social interaction intensity, and cluster vitality and network factors such as resource potential, acquisition orientation, co-development orientation, and network vitality impact innovation catalysts and barriers and subsequently the firm's likelihood of generating incremental and breakthrough innovations. We discuss several promising avenues for future research.

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## Introduction

Innovation is becoming increasingly critical for survival and growth of firms, but firms often struggle to innovate (Ahuja and Lampert, 2001) partly because their internal resources and capabilities become inadequate to engage in sustained technological explorations and resource recombinations (Fleming, 2001). Firms therefore seek resources from their strategic alliance networks (Ahuja, 2000a; Collins and Hitt, 2006; Phelps, 2010; Srivastava and Gnyawali, 2011) and geographic clusters (Ketelhöhn, 2006; Poudier and St. John, 1996; Whittington et al., 2009) as these are valuable

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reservoirs of external resources (Tallman et al., 2004). Clusters and networks, however, are likely to work differently with respect to the nature and flow of resources, therefore possibly resulting into their differential impact on firm innovation. Further, access to external resources does not necessarily lead to enhanced innovation unless the firm is motivated to pursue innovation opportunities and is able to overcome internal organizational barriers (Ahuja and Lampert, 2001). Our understanding of these important issues is limited as little research has systematically examined the mechanisms through which cluster and network conditions uniquely impact firm innovation. Accordingly, the purpose of this paper is to address the following question: how do a firm's cluster and network conditions influence the firm's likelihood of generating technological innovations?

In addressing the research question, we argue that in order to understand the specific effects of cluster (defined as a set of co-located firms operating in related industries) and network (defined as a set of focal firm and its formalized partners) on innovation, researchers need to first understand factors that may serve as barriers versus catalysts for innovation (Mohr, 1969). We therefore first identify important barriers that inhibit and important catalysts that enhance a firm's likelihood of generating technological innovations before discussing how they would be influenced by cluster and network conditions. We suggest that competition and collaboration serve as underlying forces in both cluster and network, but the ways in which they work and impact firm innovation differ between a cluster and a network. We therefore use competition and collaboration as a basis for our theorizing and for identifying relevant constructs for our conceptual model. We build on prior research that suggests that competition in a cluster provides stimulus for innovation (Porter, 1998), and that opportunities for informal interactions facilitate knowledge flow (Maskell, 2001; Saxenian, 1994; Tallman et al., 2004). In terms of network, we underscore the importance of resources stemming from networks (Ahuja, 2000a; Baum et al., 2000; Powell et al., 1996) and argue that how a firm views its network and resources contained in it has important implications on the firm's leveraging of such resources in pursuit of innovations.

By building on prior literature (Chen et al., 2007; Chen, 1996; Porter, 2000; Saxenian, 1994), we argue that the primary role of a cluster lies in increasing a firm's awareness of technological developments and motivation to engage in innovation, and in reducing uncertainty in innovation. Further, we advance a concept of cluster *vitality*—the extent to which a cluster is imbued with new knowledge resources over time—, and suggest that cluster vitality is very critical for sustained flow of cluster benefits. In terms of network, we suggest that resource potential inside a network is helpful in addressing important innovation barriers, but the extent and nature of network resources a firm gains and leverages depend on the firm's *network orientation*, i.e., how a firm views and utilizes its network and the resources contained in them. We argue that a firm that primarily views its network as a way to acquire resources would derive benefits enhancing the likelihood of, primarily, incremental innovations, whereas a firm that pursues its network for co-development of resources would derive benefits enhancing the likelihood of breakthrough innovations. We further argue that network *vitality*—the extent to which a network is imbued with new knowledge resources over time—plays a critical role in realizing the specific resource benefits from the network.

We contribute to the innovation, cluster, and network literature in important ways. First, our identification and discussion of innovation barriers and catalysts provide insights into why and how firms might struggle in their innovation efforts. An understanding of barriers and catalysts is a critical first step in addressing them. Second, by explicitly developing cluster and network mechanisms and linking them to innovation barriers and catalysts, we provide a theoretically richer base for future research on how these important external conditions impact innovation pursuits and outcomes. Further, our conceptual model explains how cluster primarily strengthens the catalysts of innovation, and network primarily helps in overcoming the innovation barriers, and together how they complement each other in enhancing the likelihood of innovation. Third, the concepts of cluster vitality and network vitality we advance in this paper provide an evolutionary perspective on clusters and networks and underscore the importance of temporal considerations in examining their effects. Finally, our conceptualization of network orientation provides novel insights on why and how firms gain differently from their network resources and lays a very strong foundation for future conceptual and empirical research.

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