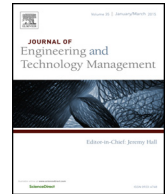


Contents lists available at [ScienceDirect](#)

Journal of Engineering and Technology Management

journal homepage: www.elsevier.com/locate/jengtecman

Converting inventions into breakthrough innovations: The role of exploitation and alliance network knowledge heterogeneity

Susan K. Cohen^{1,a}, Turanay Caner^{1,b,*}^a Katz Graduate School of Business, University of Pittsburgh, 252 Mervis Hall, Roberto Clemente Drive, Pittsburgh, PA 15260, United States^b The Peter J. Tobin College of Business, St. John's University (NY), 406 Bent Hall, 8000 Utopia Parkway, Queens, NY 11439, United States

ARTICLE INFO

Article history:

Received 8 April 2015

Received in revised form 23 February 2016

Accepted 31 March 2016

Available online 23 April 2016

Keywords:

Exploration
Exploitation
Invention
Innovation
Network

ABSTRACT

We investigate how firms' exploratory and exploitative invention can lead to breakthrough innovations, and how heterogeneous knowledge available to firms through their R&D alliance network moderates this relationship. Using panel data of U.S. biopharmaceutical firms, we find that emphasis on exploitative invention has a stronger positive effect on breakthrough innovation than does a firm's emphasis on exploratory invention. Furthermore, heterogeneous knowledge available in firms' R&D alliance network increases the number of breakthrough innovations, up to a point, and then it begins to exert a negative effect. Interestingly, engaging alliance partners with heterogeneous knowledge strengthens the positive effect of exploitative invention on a firm's production of breakthrough innovations.

© 2016 Elsevier B.V. All rights reserved.

1. Introduction

Management research suggests that breakthrough innovations are essential to sustaining and renewing opportunities for corporate growth and profitability (Ahuja and Lampert, 2001; Zhou and Li, 2012). Breakthrough innovations advance the state of the technology or create new to the world products (Sorescu et al., 2003; Zhou and Li, 2012). These can replace extant solutions by offering higher performance, disrupt established competitors by offering a novel mix of features, or create entirely new markets by solving a problem that no one else has (Christensen, 1997; Hargadon, 2003; Maine et al., 2014). Given their central role in the growth and transformation of markets and organizations, it is important for scholars and managers to understand what enables firms to produce breakthrough product innovations (O'Connor, 2008; O'Reilly and Tushman, 2008).

A predominant theme in the literature is that breakthroughs occur when inventors recombine knowledge elements from disparate fields (Hargadon and Sutton, 1997; Arthur, 2007), but there is debate regarding whether the inspiration derives primarily from exploratory invention or exploitative invention (Schoenmakers and Duysters, 2010; Nemet and Johnson, 2012; Kaplan and Vakili, 2014). Moreover, research has not produced a clear answer to the question of how much emphasis firms should place on exploratory versus exploitative invention, despite the fact that the question is pivotal to understanding how organizations remain viable (March, 1991; Levinthal and March, 1993). We suggest that progress toward understanding

* Corresponding author.

E-mail addresses: suecohen@katz.pitt.edu (S.K. Cohen), turanaycaner@gmail.com, canert@stjohns.edu (T. Caner).¹ Both authors contributed equally.

how much exploration and exploitation firms should engage in can be made by distinguishing the challenges that exploration and exploitation pose during invention from those that surface during later stages of the innovation and by considering the role of external knowledge.

Balancing exploration and exploitation during invention is challenging because the two processes present firms with distinctive sets of trade-offs, making it difficult to evaluate the costs and benefits of one versus the other (March, 1991). Exploration is risky and the returns are distant and diffuse, but too much exploitation may produce convergent ideas and increasingly incremental extensions of prior innovations. The degree to which a tension exists between exploration and exploitation is linked to the resource commitment each requires (Gupta et al., 2006). Firms commit fewer resources during invention, for instance, as compared to the resources they invest to develop new products (Rosenberg, 1994). As a result, the trade-off between exploration and exploitation should be less severe during invention, and firms would resist exploration to a greater degree as they move from invention to innovation (i.e. developing and commercializing new products). Further, exploration is beneficial because it introduces variation into the way members of an organization look at problems and expands the possibilities for solving them. Yet, the same benefits can be obtained through immersion in social contexts, such as alliances, that expose members of the firm to a wide variety of ideas (Phelps, 2010; Felin and Zenger, 2014).

We propose that a firm's emphasis on exploitation during invention contributes more to the firm's production of breakthrough innovations than does its emphasis on exploration. This is, in part, because new product ideas that leverage familiar knowledge are easier for the firm to evaluate, increasing the chances that they will be selected for development. Furthermore, we propose that a firm's access to heterogeneous knowledge through its R&D alliance network will augment the contribution of exploitative invention to the firm's production of breakthrough innovations.

Connecting exploration, exploitation, and alliance network research, our findings contribute three new insights. First, we find that exploitative invention makes a stronger contribution to breakthrough innovation than exploratory invention. This finding supports the 'vulnerability of exploration' (March, 1991, 73) within organizations. That is, returns from exploration are less certain compared to returns from exploitation. Exploitative invention produces novel ideas that survive the selection and development stage of innovation at a higher rate than do ideas largely shaped by exploratory invention. Second, we find that network knowledge heterogeneity (NKH hereafter) available to firms through their R&D alliance networks can increase the number of breakthrough innovations up to a point after which it starts to exert a negative effect. According to this finding we can conclude that while NKH can help firms screen inventive ideas there may be a point where these benefits will no longer occur due to firms' absorptive capacity (Lane and Lubatkin, 1998). Finally, R&D alliance network comprised of partners with diverse expertise amplifies the positive contribution of exploitative invention to breakthrough innovation. Alliance partners with heterogeneous knowledge can help a firm identify novel ways to leverage a familiar technology, to address market needs the firm might not have attended to.

This article is organized as follows. First, drawing on exploration and exploitation stream of organizational learning theory we discuss the differential effect of exploratory and exploitative inventions on breakthrough innovations. Then, integrating exploration and exploitation research with network theory we hypothesize for the direct and moderating effects of knowledge heterogeneity in firms' R&D-alliance ego network on breakthrough innovation. Following this, we present our empirical setting and methodology, discuss the results, and conclude with implications.

2. Theoretical background and hypotheses

Organizational learning theory suggests that exploration and exploitation are parts of organizational learning process through which firms create new knowledge and expertise to develop innovations (Argote, 1999; March, 1991). According to March (1991, 85) exploration includes 'experimentation with new alternatives' while exploitation is 'the refinement and extension of existing competencies, technologies, and paradigms.' The need for both exploration and exploitation within organizations is well established in the organizational research (e.g., Benner and Tushman, 2003; He and Wong, 2004; Katila and Ahuja, 2002; Levinthal and March, 1993). As Levinthal and March (1993, 105) noted "The basic problem confronting an organization is to engage in sufficient exploitation to ensure its current viability and, at the same time, to devote enough energy to exploration to ensure its future viability." Hence, organizations should engage in both exploration and exploitation to develop innovations.

While firms should pursue both exploration and exploitation, how a balance between the two is maintained may differ (Gupta et al., 2006). Firms can simultaneously pursue exploration and exploitation or, they can follow a sequential approach in which long periods of exploitation are followed by short bursts of exploration (He and Wong, 2004; Levinthal and March, 1993). However, the existing organizational literature does not provide a clear picture whether simultaneous or sequential pursuit of exploration and exploitation are equally viable (Gupta et al., 2006).

Although March (1991) acknowledges that organizations must excel at both exploration and exploitation he also suggests that there is a tradeoff between the two because exploration and exploitation can compete for scarce organizational resources. Building on these ideas by March (1991), Gupta et al. (2006) revisited some of the assumptions behind the tradeoff between exploration and exploitation. They suggest that the tradeoff between exploration and exploitation is based on the assumption that all resources are scarce. However, resources are not subject to equal scarcity. For example, knowledge can be used without diminishing its supply (Shapiro and Varian, 1998), whereas the attention and cognitive resources required to create or apply knowledge to new ends are finite. Nonetheless, firms allocate fewer resources to invention than they commit to the downstream development activities, suggesting the trade-offs between

Download English Version:

<https://daneshyari.com/en/article/1006244>

Download Persian Version:

<https://daneshyari.com/article/1006244>

[Daneshyari.com](https://daneshyari.com)