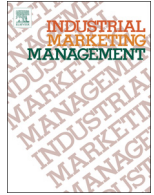




Contents lists available at ScienceDirect

Industrial Marketing Management



Exploring and exploiting network relationships to commercialize technology: A biofuel case[☆]

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ARTICLE INFO

Article history:

Received 6 November 2014

Received in revised form 20 May 2015

Accepted 26 May 2015

Available online xxxx

Keywords:

Adaptation

Ambidexterity

Commercialization

Innovation

Processes

ABSTRACT

We seek to understand how ambidexterity of exploring and exploiting is managed in an innovation context. We contribute to the literature by elaborating exploring and exploiting as three processes shared between actors in a dynamic business network. An innovator firm needs to (1) explore the current business network to find partners and gain access to resources, (2) develop business relationships for exploiting the emerging network, and (3) explore and find a network-technology fit inside a future business network. The final process is essential to innovation and commercialization. Further, the quality of the network-technology fit will affect the speed and success of the other two processes. Our contribution provides an understanding of the way in which managers are exploring and exploiting the business network to adapt and commercialize a breakthrough technology. A longitudinal case study of biofuel development and commercialization exemplifies the conceptual issues. Final sections address managerial and research implications.

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1. Introduction

New technologies find a place and develop in the business network if they supplant and/or complement an existing technology. In either case, other actors invite technology owners into a network position and role. Firms involved in developing a new technology need to build managerial understanding of opportunities and how their innovation fits within the business network (Håkansson, 1987; La Rocca & Snehota, 2014). Seeking a network position relies on exploring to find appropriate relationships with partners at each phase of the technology development (Araujo & Easton, 2005; Johanson & Mattsson, 1992). Developing a network position relies on understanding the network and working with partners to access and exploit the required resources. However, an important and more difficult task is exploring the potentially accessible network to find a future for an innovation.

Exploring the current network for a future, or futures, is an early task in making sense of the opportunities for value creation in positioning a new technology. In contrast, exploring for solutions to current development issues and access to resources is focused in the present business network. This distinction notes the dynamic sense of the business network, as being in the present, and the future, and in relation to the

past (Halinen & Törnroos, 2005). This dynamic perspective of the business network is an area of research that is presently barely studied.

March (1991) introduced the concepts of exploration and exploitation with reference to how an organization learns and adapts. He postulated that firms might fall into either of two traps. Firms effective at exploitation of a technology would become increasingly better in this capability and so fail to adapt to their environment. Firms effective at exploration of new technologies would bring new products to market, but would never fully exploit a set of technologies to build substantial profit. Considerable literature has discussed this paradox and considered whether firms are capable of ambidextrous exploration and exploitation (O'Reilly & Tushman, 2008). However, this literature mainly focuses on the internal capabilities of the firm, rather than on the organization processes between firms in a network setting.

Ritala, Hurmelinna-Laukkanen, and Nätti (2012), in studying network coordination, note that the exploring and exploiting processes are dynamically bound. These authors suggest that there are multiple and overlapping phases of exploring and exploiting. In this paper we develop exploring and exploiting as not only firm learning processes, but also as processes relying on interaction between actors in the context of the network. The changing network and on-going interaction bring into focus the process nature of exploring and exploiting. Our research question is: How are the unfolding processes and phases of exploring and exploiting interlinked in a network of actors developing and commercializing a new technology?

In this paper we extend the innovation literature by applying a dynamic network perspective, in which individuals and their

[☆] Thank you to the two anonymous reviewers for their constructive and helpful comments on this paper.

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understandings play a strong role in re-shaping the business network. Exploring and exploiting processes are based on learning and knowledge development that occurs inside business relationships, and so actors are seen as firms whose activities are managed by individuals. Following a constructivist epistemology (Järvensivu & Törnroos, 2010), we develop a process understanding of how a specific set of actors continuously explores a future network to find other actors who will position and invite entry into the network. Structural change and the positions and roles of actors are implicitly forming a part of the studied process.

The paper is presented in the following manner. First, we scrutinize the literature on firm exploration and exploitation. Next we elaborate and develop a dynamic network perspective as a framework for understanding innovation processes. Third, we explore this framework by reporting a longitudinal case study of technology development concerned with fuel distillation from algae. The processes of network exploration, both future and present, are elaborated, along with the processes involved in the exploitation of technology development, in order to display how the firm and partners are engaged in commercializing a breakthrough technology. Finally, we complete the paper by discussing managerial implications and future research.

2. Exploring and exploiting in a business network

2.1. Ambidexterity or more?

The issue of whether a firm should develop a capability to explore or exploit the environment has vexed researchers since March (1991) indicated that these abilities relied on different capabilities and differing use of resources. Schumpeter (1934) first noted that adaptation requires exploring for new possibilities and exploiting what is known. Richardson (1972, 892) observed that a firm has to “*adapt itself to the need for co-ordination ... between the development of technology and its exploitation.*” But March (1991) saw a particular problem, where a strong exploring firm would have sub-optimal profits if it also attempted to exploit an innovation. On the other hand, strong exploiting firms would go into decline without new opportunities (March, 1991). This seeming paradox has generated considerable research.

One solution is that firms develop an ambidextrous capability, where the firm is successful at both exploration and exploitation (O'Reilly & Tushman, 2004, 2008). An empirical study by Li and Huang (2012) supports this concept of ambidexterity. According to Gibson and Birkinshaw (2004) contextual ambidexterity means managers are able to stretch, display discipline, support and trust other managers while pursuing multiple goals. Similarly, ambidextrous behavior is possible by differentiation and integration within a firm, with, for example, different business units or departments responsible for exploration or exploitation (Gupta, Smith, & Shalley, 2006; Raisch, Birkinshaw, Probst, & Tushman, 2009). The empirical study of Jansen, Tempelaar, Van Den Bosch, and Volberda (2009) supports ambidexterity by both integration and differentiation. Managing both exploration and exploitation is possible in a larger and differentiated firm. However, many R&D firms are small and not well resourced.

Other researchers have elaborated a deeper understanding of the context for exploration and exploitation (Gupta et al., 2006; Raisch et al., 2009). Gupta et al. (2006) address the dimensionality of the two concepts and question whether exploration and exploitation might be orthogonal. In the case of a single dimension the paradox is evident; but the second conceptualization opens the way to ambidextrous firm behavior. However, when resources are limited, the issue of whether to spend energy on exploration or exploitation will arise.

While calling for studies with a multi-level and longitudinal perspective, Raisch et al. (2009) question whether the processes of exploring and exploiting might be partially external to the firm. Thus, these authors suggest that the key areas to research are a firm's

absorptive capacity for knowledge and access to external knowledge through social networks. Supporting this approach is evidence from Im and Rai (2008) that combined explorative and exploitative knowledge sharing affects relationship performance in long-term supplier-customer exchanges. However, none of the research noted investigates the learning processes involved in exploring and exploiting in a business network, although learning processes are important in networks (Håkansson & Johanson, 2001) and innovative business development (Lundvall, 1993). Rather, what is evident for success of innovating firms is the question of the way in which they and their partners mutually undertake successful exploration and exploitation.

Interestingly March (1991) highlights that choosing between firm exploration and exploitation is complicated, because judgments and risk preferences “*embody intertemporal, interinstitutional, and interpersonal comparisons*” (March, 1991, 71). This suggests the need for studying the temporal, network and individual actor perspectives of activity allocation toward exploring and exploiting the firm environment. March (1991) also characterized exploration and exploitation as nouns, with exploration including “*search, variation, risk taking, experimentation, play, flexibility, discovery, [and] innovation.*” But exploring and exploiting are learning processes and so are better associated with activities (Engeström, 1987; Langley, 2009; Lundvall, 1993) and better described by using verbs (Langley, 2007). Exploring includes the activities of *searching, seeking, risking, experimenting, playing, being flexible, discovering and innovating*; while exploiting includes the activities of *refining, choosing, selecting, implementing and executing* and so producing efficiently. We consider therefore an activity focus as more suitable for studying the inter-temporal nature of exploring and exploiting.

Gupta et al. (2006) and Raisch et al. (2009) note an underlying time dimension; where exploration and exploitation occur iteratively in a punctuated equilibria context or ambidextrous behavior is synchronously undertaken. A punctuated equilibrium has been conceptualized as a way to apprehend change in a network (Halinen, Salmi, & Havila, 1999). Recently, Halinen, Medlin, and Törnroos (2012) have elaborated a more complex understanding of time as dynamic periods, sequenced periods, and flowing time. This explicitly dynamic characterization of constructed times can provide researchers with tools to understand inter-firm exploring and exploiting processes within the dynamics of the emerging business network.

2.2. Dynamic network framework

Firm learning through innovation and relational processes occurs through and inside time. This suggests that an elongated conceptualization of the business environment is required as a framework for understanding change and technology development. In this section we develop the concept of an elongated network.

Consider the bounded and subjective view of the network drawn by managers when examined under research conditions (Henneberg, Mouzas, & Naudé, 2006). No two managers have the same mental understanding of the network, and each has different network horizons (Holmen & Pedersen, 2003). These divergent human-based cognitive network pictures are simple representations. Managers know and appreciate that the network is forever changing, and that their mental network maps are simplifications of the continuously dynamic activities within and between firms. Theoretically, around the manager are all of the resource ties, activity links and actor bonds that comprise the business network at that point in time. Also, extending into the past are those ties, links and bonds as well as changing actor forms as firms are sold, merged, bought and closed. Viewed from the present, the activities connecting resources in the past provide the perspective of the structured network (Håkansson & Snehota, 1995) flowing into the present, along with the associated technological trajectories

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