Journal of Business Research 67 (2014) 2860–2866

Contents lists available at ScienceDirect

Journal of Business Research

Appropriating innovation's technical value: Examining the influence of exploration

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ARTICLE INFO

Article history:
Received 3 May 2011
Accepted 3 July 2012
Available online 25 July 2012

Keywords:
Appropriation
Exploration
R&D
Patents

ABSTRACT

In this study we examine how different approaches to exploratory search are used to generate an innovation influence appropriation of its technical value. Technical value is the benefit a firm derives from utilizing the underlying knowledge embedded in an innovation to stimulate and generate further innovations. Based on a sample of 772 patents from the ink jet printing field, we find that exploratory search that spans *technical* domains enhances appropriation of innovations' technical value; conversely, exploratory search spanning *industry* domains diminishes appropriation of innovations' technical value. These effects are further influenced by the age of the knowledge explored. In addition, we find that appropriation of innovations' technical value enhances the market share of the innovators. We discuss the implications of these findings for both future research and for improving business practice.

1. Introduction

Innovations notably influence the competitiveness of organizations in the marketplace. They can, for example, enhance cash flows and profits and make organizations attractive to investors. Indeed, the significance of an innovation's value to organizations is evident from several empirical studies that find innovation irrefutably linked to a wide range of market performance outcomes such as sales growth, market share, profitability, and share price valuations (e.g., Bowen, Rostami, & Steel, 2010; Jimenez-Jimenez & Sanz-Valle, 2011).

Even as market performance is a more apparent value of innovations, a different and not as conspicuous an aspect of its value stems from the new underlying knowledge that innovations embed in themselves. This new knowledge often provides a foundation for ensuing knowledge advancement and a consequent flow of continuing innovations. For example, when *aspirin* was introduced by Bayer as an innovation, it embodied new knowledge of a chemical called acetyl salicylic acid (ACA) that reduced pain and fever (Sneader, 2000). This knowledge of ACA eventually generated a novel understanding of how the blocking of platelets in blood can prevent heart attacks (Julian, Chamberlain, & Pocock, 1996), thereby spawning a subsequent set of innovations and a new class of drugs such as *Plavix* and *Reopro* (Randall & Neil, 2004). We distinguish such value as an innovation's *technical* value.

An innovation's technical value usually takes longer to realize compared to market performance outcomes. Also, while an innovation's market performance related benefits are clearly enjoyed by the innovator, the benefits related to an innovation's technical value can spill over to other organizations and are not always retained by the innovator. After an innovation enters the public domain, its underlying knowledge may become visible and accessible to the world. Consequently, the benefits of its technical value also become potentially available to other interested organizations, which are frequently competitors. These rival organizations can use this underlying knowledge to advance their trajectories in their own way and exploit it to generate their own set of innovations. *Bayer*, for instance, was not the only company to benefit from the new knowledge about ACA embodied in its innovation, *aspirin*. A host of other companies used that knowledge not only to develop alternative mechanisms for reducing pain and fever (such as *Motrin* and *Aleve*) but also to develop a new class of drugs for other medical applications such as to prevent strokes and heart attacks (Randall & Neil, 2004).

Our study attempts to understand the factors that influence how organizations advance *their own* innovation trajectory from the knowledge embedded in their innovations. Put another way, we examine how organizations *appropriate* for themselves the technical value of their innovations. We define technical value *as the extent to which the underlying knowledge embedded in an innovation stimulates subsequent innovations*. We further define the appropriability of an innovation's technical value *as the extent to which the locus of subsequent innovations stimulated by an innovation is retained within the organization initiating that innovation.*

2. Research framework

Most studies on innovation have limited their focus to its more immediate and apparent market value, such as market share or

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0148-2963/$ – see front matter © 2012 Elsevier Inc. All rights reserved.
doi:10.1016/j.jbusres.2012.07.001

profitability (Brown & Eisenhardt, 1995). Little attention has gone into comprehending how an innovation may subsequently spawn further innovations or enhance its technical value. Similarly, research on the appropriation of an innovation's value (e.g., Teece, 1986) also has focused almost exclusively on understanding how to capture the primary commercial value of an innovation, not how to appropriate value from the subsequent trajectory of ensuing innovations or its technical value.

To address these gaps, our study builds on three theoretical domains. First, we use studies on *exploratory search* (e.g., Gupta, 2006; March, 1991) to theorize the antecedents of technical value. Second, we use and extend prior insights on *complementary assets* (e.g., Kostopoulos, Papalexandris, Papachroni, & Ioannou, 2011; Teece, 1986) to conceptualize the special circumstances in which an innovation's technical value can be appropriated. Third, we also use the concept of *situated knowledge* (e.g., Sherwood & Covin, 2008; Tyre & von Hippel, 1997) to understand how firms can influence their complementary assets and impact appropriating their innovations' technical value by directing their exploratory search on situated versus non-situated knowledge.

2.1. Literature review

Search comprises scanning activities aimed at probing through various technological options and improving an organization's prevailing knowledge and technology (Nelson & Winter, 1982). Search is exploratory when scanning activities are broad and probe through multiple new and unfamiliar knowledge or technology domains (March, 1991).

As exploratory search emphasizes experimenting with a variety of new technological options and incorporating fresh combinations of knowledge, it more likely results in radical breakthroughs in products and technologies (Miner, Bassoff, & Moorman, 2001). Furthermore, the new knowledge embedded in such innovations is also likely to make substantial departures from prevailing knowledge (Subramaniam & Youndt, 2005). Greater intrinsic novelty among innovations based upon exploratory search consequently can provide more fertile ground for further extensions of its trajectory and subsequent innovations. For example, in developing new *stents* (devices that artificially keep arteries dilated to facilitate blood flow without clots), *Medtronics* (a manufacturer of medical devices) scanned and searched across multiple knowledge domains, including those of material science, fluid dynamics, physiology, biochemistry, and pharmacology. Inputs from some of these domains—particularly those from biochemistry and pharmacology—subsequently served as a platform for a new set of innovations featuring stents with therapeutic properties, helping in thinning blood over and above mechanically keeping the arteries dilated.

While these arguments based on exploratory search help us understand how firms can generate greater technical value, they tell us little about how such value can be appropriated by an innovator. Even when an organization's exploratory search efforts generate technically valuable innovations that spark subsequent innovations, it does not necessarily follow that this same organization is alone in generating those subsequent innovations. They may well be generated by other organizations. In fact, exploratory search may even present a potential problem for organizations, as by generating more technical value it could further expose its own new creation of knowledge to outsiders and attract greater competitive attention (Ndofor & Levitas, 2004).

To overcome these limitations and to understand how firms can ensure that the locus of subsequent innovations from the underlying knowledge remains with the innovator, we consider studies on complementary assets. *Complementary assets* are assets that complement the more primary capabilities of innovation (Teece, 1986). Examples include prowess and capacities for marketing, manufacturing, and after-sales support, which are known to complement more fundamental aspects of innovation such as technical/science know-how, and thereby enhance the ability of a firm to appropriate market returns from an innovation (Parmigiani & Mitchell, 2009). While most studies on complementary assets focus on physical assets that are more suited to appropriate, more immediate commercial value of an innovation, our interest is in a different dimension—namely, *complementary knowledge assets* (Teece, 1998).

Complementary knowledge assets allow organizations to identify, filter, and frame relevant information to extend an innovation's underlying knowledge into other potential domains (Thomas, Sussman, & Henderson, 2001). More specifically, it is expertise in those potential domains that provides avenues for an innovation's underlying knowledge to be extended for subsequent innovations (Dougherty & Borrelli, 2000). In other words, complementary knowledge assets provide a firm with greater absorptive capacity to extend an innovation into new opportunity trajectories (Cohen & Levinthal, 1990). For example, identifying the therapeutic opportunities embedded within mechanical stents becomes easier for *Medtronics* if it also has expertise in pharmacology and biochemistry, not just material science. If it does not have that expertise, it may either not notice those extension possibilities or be preempted by a competitor that does (e.g., *Johnson & Johnson*). Thus, expertise in the domains explored for an innovation can become the requisite complementary knowledge assets enabling innovators subsequently to identify and make sense of the new opportunities embedded in their innovations, and thus help appropriate them.

However, organizations do not necessarily explore in domains in which they have *a priori* expertise. In fact, by exploring only in domains where the innovator has prior expertise may unnecessarily constrain the breadth of their search, restrict the seeds of knowledge sowed in their innovations, and thereby limit their potential technical value (Holmqvist, 2004). Thus, to increase the potential technical value in their innovations, innovators may stray into domains in which they do not have expertise. An important question stemming from this quandary is, are there aspects of exploratory search that could embed a wide range of knowledge kernels yet also help an innovator subsequently interpret and make sense of the opportunities implanted in those kernels for future innovations? That is, can innovators direct their exploratory search such that it increases their chances of possessing requisite complementary knowledge assets to better appropriate the technical value of their innovations?

One such aspect of exploratory search entails the degree to which innovators explore domains with *situated* as opposed to *non-situated* knowledge. Situated knowledge, as Tyre and von Hippel (1997, p. 71) put it, "is not absolute, but rather can only be defined in relation to a specific situation or context." As a consequence, absorbing situated knowledge and further extending it by interpreting and making sense of its ensuing opportunities requires not just an understanding of the relevant technological knowledge in an isolated form but also the context from which the knowledge originates (Lam, 1997). This contextual understanding is generally more difficult to obtain. In comparison, absorbing, interpreting, and making sense of innovation extension opportunities offered by non-situated knowledge do not require such added contextual knowledge. Hence, when unfamiliar domains explored for a focal innovation comprise non-situated knowledge, an innovator may subsequently find it easier to extend that knowledge into new opportunities. That is, innovators may find it easier to possess requisite complementary knowledge assets in domains with non-situated, isolated strands of know-how as opposed to domains with situated know-how embedded within idiosyncratic contexts. Put another way, innovators are more likely to possess a greater absorptive capacity (Cohen & Levinthal, 1990) to discern and perceive new innovation ideas when a focal innovation