Overcoming the false dichotomy between internal R&D and external knowledge acquisition: Absorptive capacity dynamics over time

Stefano Denicolai [a], Matias Ramirez [b], Joe Tidd [b]

[a] University of Pavia, Italy
[b] SPRU, University of Sussex, UK

ABSTRACT

An important challenge in open innovation is the capability to absorb and exploit external inbound knowledge, and how internal R&D may facilitate or hinder this. Conventionally, internal R&D expenditure is used as a proxy for absorptive capacity, but in the context of open innovation, this can be problematic. Internal R&D may also constrain present and future absorption, and restrict exploitation for a number of reasons, e.g. degree of development, structural, geographical or relevance to existing business units and markets. Conversely, external sources of innovation can be difficult to identify, evaluate and absorb, but may be more codified, as by definition they are available in the market, and more fully-developed to demonstrate commercial potential. Using panel data of 325 firms over five years, we find that contrary to the prescriptions of transaction cost analysis, externally-sourced knowledge takes less time to absorb and exploit than internally-generated knowledge, but that internal knowledge creates higher returns over the longer term. Significantly, the relationship between internal and external knowledge and performance changes over time, while the ideal strategic balance needs to consider decisions taken at different times.

© 2015 Elsevier Inc. All rights reserved.

1. Introduction

The open innovation model emphasizes that firms should acquire valuable resources from other organizations and share internal resources for new product/service development, but the question of under what circumstances and how a firm source external knowledge, share internal knowledge, and – above all – combine these activities with strategic planning in the medium-long run is less clear.

We argue that two key issues may have undermined research and practice. Firstly, in open innovation research and practice, much of the focus has been on how organizations search for potential inbound innovation (Schweitzer et al., 2011; Henttonen and Ritala, 2013; Wang et al., 2015), and the extent to which inbound innovation complements or substitutes for internal R&D (Lazzarotti and Manzini, 2009; Denicolai et al., 2014). However, although internal R&D and technology sourcing may show some complementarities, they remain two inherently different activities.

In particular, some research suggests that internal R&D takes a long time to deliver results, normally years (Kondo, 1999), while earnings from open innovation activities are expected to be quicker (Enkel et al., 2009; West et al., 2014). Plans for the future of organizations should take into account such dynamics.

There has therefore been relatively little research on the subsequent challenges of absorbing and exploiting inbound knowledge (Rosell, 2014), and even fewer have studied this process over time (Salge et al., 2012), which is the focus of this paper. We therefore contribute to a shift in the debate from potentially misleading general prescriptions, and provide conceptual and empirical insights into the challenges of absorbing and exploiting inbound external sources of innovation.

A second issue concerns what is being measured as the dependent variable. The majority of contributions measure the interaction between R&D and externally acquired knowledge in terms of the impact on firm growth or profitability (e.g. Tsai and Wang, 2008). By contrast, we measure the ability of the firm to accumulate knowledge over time as our dependent variable. This is a broader measure of capabilities reflecting the importance of ownership and accumulation of a range of knowledge stocks over time, relevant to a wider range of sectors and types of innovation.

These considerations taken together represent a breakthrough in our understanding of how companies combine 'Internal R&D' and 'Technology sourcing' investments in their strategic planning. Our findings suggest that organizations should pay more attention to finding the right combinations of internal knowledge investment and external sourcing, and less on understanding pros and cons of these two options taken alone.

2. Challenges of exploiting open innovation

The early conceptual and empirical work on open innovation provided many insights and prescriptions, but these suffered from being universal, and often universally positive. More recently there has been

E-mail addresses: Stefano.denicolai@unipv.it (S. Denicolai), Matias.Ramirez@sussex.ac.uk (M. Ramirez), j.tidd@sussex.ac.uk (J. Tidd).

a shift to a more critical approach which attempts to better understand the conditions under which open innovation is most effective (Tidd, 2014). Much of this research has focussed on the strategies for searching and sourcing for external knowledge, but there have been relatively few studies which have examined the subsequent challenges of implementing inbound innovation, and the influences on outcomes and performance over time.

Studies which have examined the implementation of inbound open innovation have focused on the relationships between internal and external knowledge, and whether these are complementary or competing substitutes. Fabrizio (2009) examined the complementary relationships between internal basic research in biotechnology firms and external research from universities. Internal knowledge was critical in identifying problems to solve, but external knowledge was more important to provide knowledge useful in the solution. This resulted in more timely access to relevant knowledge, and faster development.

In contrast, Spithoven et al. (2009) examine how firms with low levels of internal R&D, and therefore low absorptive capacity, use alternative mechanisms to identify and internalize inbound knowledge. Wang (2012) offers a framework for exploring R&D investments with external technological complementarity, which leverages on the relationship among integrated technologies, specific technology fields, and patentees. Lazzarotti and Manzini (2009) consider the different phases of the innovation process that a company opens to external contributions, and rather than a simple open or closed dichotomy, find that different degrees and ways of 'openness' can be implemented successfully.

Robertson et al. (2012) argue that the literatures on open innovation and absorptive capacity have failed to take sufficient account of the challenges in applying external knowledge. They propose three capacities beyond knowledge management: Excessive Capacity, to collect, sort and analyze knowledge from both internal and external sources; Adaptive Capacity, to ensure that new technology is suitable for the organization's own purposes even though they may have been originally developed for other uses; and Integrative Capacity, to ensure external technology can be applied in existing processes and products with minimum disruption and cost.

Similarly, Enkel and Heil (2014) examine cross-industry innovation, and make the important distinction between ability to identify and value distant knowledge (i.e. recognition), strengthen a firm's knowledge base (i.e. assimilation), and knowledge communication and storage (i.e. maintenance).

More recent research has begun to explore the influences of inbound open innovation on outcomes and performance. Schweitzer et al. (2011) found that open innovation in general to have a positive influence on performance in dynamic settings, and that customers are central when market dynamics are high, but suppliers are more important in technologically challenging environments. Significantly, inbound knowledge from other industries was found to be effective irrespective of the setting, which is consistent with the notion of complementary assets. Further, Mention and Asikainen (2012) found that co-operation and exploiting external sources of knowledge reduces innovation expenditures, while positively affecting sales of new products.

However, Huang and Rice (2012) found that openness to external information sources may, after a time, lead to decreasing marginal returns, as measured by innovation performance. They found complementarities between internal and external knowledge sources as precursors to the introduction of new products and services, and that investment in absorptive capacity has a declining marginal effect on the innovation performance of new processes, but not on the introduction of new products and services.

This raises an intriguing issue since it suggests that these kinds of complementary assets may interact differently over time. Salge et al. (2012) develop and test a firm-level contingency model of inbound open innovation to explain the substantial disparities in open innovation payoff that exist between firms. Drawing on longitudinal data from 1170 firms, econometric analyses reveal that returns from open innovation are greatest when firms maintain their internal research capacity, and advocate strong cross-functional collaboration.

Similarly, based on survey data of 248 high-technology manufacturing firms, Cruz-González et al. (2014) found that search breadth was positively associated with performance in more mature sectors, but harms performance in technologically dynamic environments. This evidence highlights that interaction between internal and external knowledge is closely associated with the dynamic capabilities of the firm, meaning also with its ability to accumulate and renew knowledge over time (Lichtenthaler and Lichtenthaler, 2009; Teece et al., 1997).

We can conclude from this brief review of recent relevant research that the simple dichotomy between open and closed approaches is unhelpful and not realistic. In particular, we need to better understand the interactions between internal and external knowledge, and how these influence performance under different conditions, including the time patterns by which companies engage in internal and/or external R&D strategies. This provides an opportunity to combine contemporary interests in open innovation with the classic notion of absorptive capacity, to investigate how organizations can better manage to absorb and exploit inbound external sources of innovation.

3. Absorption of internal and external knowledge

Conventionally internal R&D expenditure is used as a proxy for absorptive capacity. However, in the context of open innovation this is problematic because there is a high degree of uncertainty regarding how the benefits from the acquisition of external knowledge change over time. An important question is the relative ease of absorption and exploitation of internal versus external sources of innovation. The literature from the area organizational capabilities and innovation studies has most commonly framed this through Cohen and Levinthal's (1990) absorptive capacity, which emphasizes that successfully recognizing the value of external information, assimilating this and applying it for commercial ends requires investment in specific capabilities.

One strand of literature argues that acquisition of external assets can rapidly help establish dynamic capabilities (Teece et al., 1997), and is especially useful in turbulent environments (Escribano et al., 2009). Other work cautions that external acquisition is a complex phenomenon and comprehension in some areas can only take place when there is a reduction in the amount of information coming in other areas (Levitt and March, 1988). Technological effort – including ex-ante investments – and behavioral variables have been also shown as relevant factors in determining the absorptive capacity of the firm (Srivastava et al., 2015).

In terms of empirical evidence, much of the research on absorptive capacity focuses on whether greater levels of investment in R&D spending facilitates the effective use of external knowledge, for example in terms of alliances (Arora and Gambardella, 1994) or ties with the scientific community (Cockburn and Henderson, 1998). Denicolai et al. (2014) showed that organizations with low levels of knowledge intensity benefit most from an 'optimal' investment in externally generated knowledge, while knowledge-intensive firms are relatively freer in defining their knowledge sourcing strategy. Similarly, Srivastava et al. (2015) studied the moderating role of absorptive capacity in realizing benefits from external technological resources. They show that as technological capabilities of firms increase, earnings from the alliance network resources come at a lower rate.

However, what is missing from the above studies and the literature more generally is empirical evidence of how R&D expenditure and absorptive capacity impact the effectiveness of external acquisitions over time. We are left to derive this from conceptual studies. Short and long term absorptive capacity is discussed by Zahra and George (2002) who distinguish between a firm's potential and realized capacity and suggest that while the latter provides a short term benefit, reflecting exploitation of existing knowledge, potential capacity is associated to a dynamic capability and may therefore be more useful at