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Capturing value from alliance portfolio diversity: The mediating role of R&D human capital in high and low tech industries

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ABSTRACT

Research has demonstrated the value of external linkages to augment in-house R&D efforts; however, very little is known about how managers can operationally leverage the potential benefits of open innovation to create an innovative edge. This paper examines the value of alliance portfolio diversity and whether R&D human capital is the pathway through which alliance portfolio diversity influences innovation novelty. We reason that the absorptive capacity of R&D human capital determines a firm's potential gains from highly diverse alliance portfolios. Using data from the Spanish Technological Innovation Panel (PITEC) for the period 2005–2012, results support the curvilinear (inverted U-shaped) association between alliance portfolio diversity and firm innovation performance reported in studies, suggesting that not only too little, but also too much alliance portfolio diversity may be detrimental to firm innovation performance. Findings emphasise the value of alliance portfolio diversity in high-technology industries to achieve explorative performance objectives, given the technological complexity, market uncertainty and the divergent skill sets required for breakthrough innovations in these sectors. Further, we find evidence that R&D human capital plays an important role in innovation novelty by partially mediating the relationship between alliance partner diversity and firm innovation performance, emphasising the importance of internal capabilities to harness external knowledge assets. This study provides valuable insights to managers aiming to increase the effectiveness of their alliance portfolios.

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1. Introduction

Today's fast paced business environment and shortening product life cycles require firms to consider externally generated scientific knowledge and technology to augment in-house R&D efforts (Dahlander and Gann, 2010). Open innovation research has underscored the value of external sources of knowledge and external collaboration relationships to boost firms' innovative performance and meet new business challenges (Chesbrough, 2012; Enkel et al., 2009; Laursen and Salter, 2006; De Man and Duysters, 2005). Heterogeneity of external partners enables firms to access diverse markets and technological knowledge (Lin, 2014; Zhou and Li, 2012) and facilitates the process of innovation by allowing firms to make new linkages and associations (Cohen and Levinthal, 1990).

However, too much diversity of external sources could

adversely impact firm innovation performance due to increased organisational and managerial complexity (Duysters and Lokshin, 2011; Bader and Enkel, 2014; Foss et al., 2011). Studies report a curvilinear (inverted U-shaped) relationship between R&D alliance portfolio diversity (APD), defined as the distribution of differences in partners' characteristics (Oerlemans et al., 2013), and firm innovation performance, suggesting that an increase in APD will enhance innovativeness only up to a certain limit. Beyond that point, APD may yield few marginal benefits as resources become spread too thin and greater coordination and integration costs are incurred (Chen et al., 2011; Duysters and Lokshin, 2011; De Leeuw et al., 2014). Limited research, however, has focused on a systematic investigation of the underlying mechanisms that explain how APD matters. Particularly, the role exerted by internal capabilities to extract value from APD remains largely under-researched (Foss et al., 2011; Spithoven and Teirlinck, 2015). Absorptive capacity, defined as 'the ability of a firm to recognise the value of new external information, assimilate it and apply it to commercial ends' (Cohen and Levinthal, 1990, p. 128), determines the effectiveness of external knowledge sourcing. A firm's absorptive capacity depends on its existing stock of knowledge,

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much of which is embedded in its products, processes and people (Escribano et al., 2009). Specifically, we contend that R&D human capital, defined as the knowledge, skills and abilities residing and used by individuals (Subramaniam and Youndt, 2005), determines a firm's potential gains from highly diverse alliance portfolios.

Responding to call for more research on how to manage business ecosystem (Biemans and Langerak, 2015), this study draws on the resourced-view (RBV) premise that dynamic capabilities are sources of competitive advantages (Barney, 1991; Barney et al., 2011; Teece et al., 1997) and the theory of human capital (Becker, 1964) to examine the role of R&D human capital to channel the impact of APD on innovation novelty – incremental and radical innovation. Human capital enables firms to expand their technological boundaries and successfully absorb and deploy new and substantially different knowledge domains (Subramaniam and Youndt, 2005; Faems and Subramanian, 2013). Our hypothesising suggests that R&D human capital enables firms to extract value from highly diverse alliance portfolios.

This paper contributes to the literature in two important ways. First, we contribute to innovation management theory by proposing and testing the mediating role of R&D human capital in the effect of APD in firm innovation performance. Open innovation research has largely focused on the environmental context of the firm (e.g., type of industry) (Chesbrough and Crowther, 2006) and organisational factors (e.g., structures, systems and procedures) (Petroni et al., 2011; Ritala et al., 2009); however there is yet little understanding of the intermediate factors that delineate APD's implications for firm's innovativeness. Recent literature suggests the need to consider firm's human capital and training investments that capture the path-dependency nature of absorptive capacity to explain a firm's ability to effectively learn from external sources (Zahra and George, 2002; Lane et al., 2006). Maintaining strong internal R&D capabilities enable firms to retain the knowledge necessary to discern and unfold the tacit knowledge embedded in external knowledge resources (Weigelt, 2009). We posit that R&D human capital becomes the 'means' through which APD benefits innovation outcomes.

Second, we contend that the heterogeneity of technological intensity in manufacturing sectors creates distinct contexts for knowledge creation and sharing, and thereby benefit from different levels of APD (Denicolai et al., 2014). Our study demonstrates the need for firms to assess and develop R&D human capital strategies based on the type of innovation activity pursued (incremental and radical) as its dimensions of 'general' and 'specific' human capital impact firms' ability to benefit from APD differently.

The paper is structured as follows. Following this introduction, in section two we provide an overview of the relevant literature on APD and R&D human capital and present the research hypotheses. Section three details the research design and methods, and section four presents the results. We discuss our findings in section five together with the theoretical and managerial implications of our findings, and a direction for future research and practice in external collaboration.

2. Theoretical background and hypotheses development

2.1. Alliance portfolio diversity and innovation performance

Increasing global competition, rapid technological advances and shortening product life cycles put firms under unprecedented pressure to introduce new products and services to survive and remain competitive (Teirlinck and Spithoven, 2013; Van Beers and Zand, 2014). Breakthrough innovation requires a wider-knowledge base and organisations increasingly rely on external knowledge assets for the successful realisation of their innovative endeavours

(Garcia Martinez, 2013; Chiaroni et al., 2010). Sustainable superior innovation performance can be attained by combining diverse market and technological knowledge sources in the alliance portfolio (Lin, 2014) and exploiting possible complementarities and synergies (De Leeuw et al., 2014). R&D alliances are an ideal platform for learning as external partners bring diverse knowledge and resources that firms can integrate into new products and services (Doz, 1996; Hamel, 1991; Cohen and Levinthal, 1990; Chen, 2004). As firms develop a more balanced alliance portfolio that incorporates core as well as non-core activities, they gain access to supplementary and complementary knowledge assets and expand their knowledge bases (Jiang et al., 2010). In general, the larger and more diverse the alliance portfolio, the higher the innovation performance of a firm (Caloghirou et al., 2004; Laursen and Salter, 2006).

Acknowledging the increasing importance of strategic alliance to firms' overall performance, scholars have looked at alliance characteristics and impact on innovation outcomes. At the portfolio level, allying with partners along the value chain provides market and knowledge access advantages (Jiang et al., 2010). Vertical alliances enable firms to pool complementary resources and access market information to better target innovation efforts (Miotti and Sachwald, 2003). Cooperation with suppliers is found to enhance efficiency and complement the technological-base of the firm (Belderbos et al., 2004; Un and Asakawa, 2015). Collaboration with universities and research institutes, on the other hand, can provide access to tailor made, cutting edge technologies (Tether and Tajar, 2008; Tsai, 2009); however, it may require firms to collaborate with other actors in order to implement the technology (Berg-Jensen et al., 2007). Horizontal alliances with partners at the same level of the value chain provide access to knowledge in design, prototyping, testing, development and new product introductions (George et al., 2001). Horizontal alliances are more likely to be strategically motivated to improve long-term product technology development whereas vertical alliances tend to be more concerned with cost reduction (Kotabe, 1990). Collaboration with competitors enables firms speedy market penetration (Van Beers and Zand, 2014) and access to technological abilities that can be difficult, time-consuming, and costly to develop alone within their boundaries (Chen et al., 2011).

Increasingly strategies alliances involve partners from diverse geographical locations. Cross-border collaboration can facilitate market access (Glaister and Buckley, 1996), provide complementary capabilities (Lane et al., 2001), and integrate different knowledge bases (Lubatkin et al., 2001). Geographical diversity is found to be important for the adaptation of existing products to different local requirements and preferences (Van Beers and Zand, 2014; Lavie and Miller, 2008). Terjesen et al. (2011) argue that alliances with local, national, and international suppliers enable firms to benefit from location-based variations in resources, market and technologies to deliver consistently high performing products.

Recent research suggests differing effects of APD on innovation novelty (Oerlemans et al., 2013) and reduced utility from alliance variety as firms become more innovative (Egbetokun, 2015). Radical innovation represents a dramatic departure from existing products in terms of technology and generate greater information processing and exposure to a variety of knowledge domains (Wuyts et al., 2004; Leifer et al., 2000). Scholars argue that internally generated knowledge provides low potential for creating radical innovation outputs (Rosenkopf and Nerkar, 2001), limiting firms' ability to remain competitive in dynamic business environments (e.g., Laursen and Salter, 2006; Lichtenthaler, 2009). Not surprisingly, organisations increasingly collaborate with a wide range of external partners to tap into new and non-redundant knowledge bases and competencies enhancing firm

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