



# Alliance portfolio diversity, radical and incremental innovation: The moderating role of technology management

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## ABSTRACT

In this paper we test whether the use of a set of technology management tools (TM-tools), a specification of alliance portfolio capability, influences the relationship between alliance portfolio diversity and a firm's innovation outcomes. With this model, we add to the theoretical literature on the performance effects of alliance portfolio diversity and specific contingencies allowing to appropriate benefits from this diversity. Based on a sample of South African firms, we first confirm the inverted U-shaped relation between alliance portfolio diversity and a firm's innovation outcomes found by earlier research. We also show that the shape of this inverted-U differs for incremental and radical innovation outcomes. Subsequently, we test the moderating effect of the use of TM-tools on this relationship, for which find a strong positive moderating effect. In particular, for firms intensively using TM-tools, the negative effect of high levels of alliance portfolio diversity on innovation outcomes turns into a positive effect. This suggests that the use of formal technology management practices is beneficial to manage highly diverse alliance portfolios.

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## 1. Introduction

One of the latest sprouts of the alliance literature focuses on portfolios of alliances (Wassmer, 2010), which are commonly defined as sets of alliances, thus concerning ego-networks including firms' direct inter-organizational ties with alters. It is shown that the prevalence of alliance portfolios is increasing over time (Lavie, 2009) and that the characteristics of portfolios, such as their diversity, impact a firm's innovation outcomes above and beyond what can be expected by the presence of the sum of individual alliances (Faems et al., 2005; Phelps, 2010).

Alliance portfolio diversity is a multi-dimensional construct and can be generally defined as the distribution of differences in partners' characteristics. Previous research has shown that many of the dimensions of alliance portfolio diversity significantly affect various firms' outcomes. Yamakawa et al. (2011), for instance, find that a high proportion of exploitative ties in an alliance portfolio, which is a form of functional diversity, has a negative return on assets effect. Jiang et al. (2010) report that alliance portfolios with greater organizational and functional diversity and lower governance diversity were associated with higher net

profit, whereas partner diversity has a non-linear relationship with this specific firm outcome. Lavie and Miller (2008) present a sigmoid relationship between alliance portfolio diversity in terms of internationalization (including geographical diversity of partners) and financial performance of firms.

This study focuses on the relationship between a specific dimension of alliance portfolio diversity, namely, alliance portfolio partner diversity (hereafter APPD), and firms' innovation outcomes. The latter is defined as the proportion of sales from products or services that were technologically improved versions of existing ones (incremental) or were technologically new to the market (radical). The alliances taken into account are technological collaborations with a wide range of external partners (e.g., buyers, suppliers, universities, research labs) possessing different types of knowledge, which defines the concept of APPD. In these alliances, partner firms actively work together on the development of technologically new or strongly improved products, processes and services.

Recent empirical studies on the relationship between APPD and innovation and other knowledge related outcomes converge to a similar conclusion; there is an inverted U-shaped relationship between the two (Duysters and Lokshin, 2011; Laursen and Salter, 2006; Vasudeva and Anand, 2011). An exception is a study by Wuyts and Dutta (in press), who report that alliance portfolio diversity and superior innovation performance are U-shaped related, which is according to them probably due to the benefits

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of both a focus and a diversity strategy in the particular industry under study (pharmaceuticals). These predominantly focus on innovation outcomes as a single construct, whereas there is reason to assume that the effects of alliance partner diversity on incremental and radical innovation outcomes differ, for example because incremental and radical innovation may require different type, depth and variety of knowledge. The configuration of alliance partner portfolios may thus be more suitable for one of the innovation types, but not for both. In this study, we argue that the performance impact from alliance portfolio partner diversity tends to be higher for incremental innovations in comparison to more radical innovations due to the fact the former innovations are more technological proximate to existing products, predictable and less risky (Yamakawa et al., 2011), which implies that it is relatively easier to be successful in the market with this type of innovations. By addressing these performance differentials we fill a gap in the alliance portfolio literature.

The most important gap in the literature regarding APDD and innovative outcomes, however, is the lack of insights into whether managers can influence this relation through conscious and targeted managerial effort. It has been recognized that not all organizations benefit to the same extent from alliance portfolio partner diversity, resulting in several scholars calling for a contingency perspective (Schilke and Goerzen, 2010; Wassmer, 2010). In this regard, a recent literature review on alliance management (Kale and Singh, 2009) concluded that a vast majority of scholarly work has focused on the management of single inter-organizational relationships. The same study observed that alliance portfolios bring new managerial challenges (Hoffman, 2007, 2005). First, an organization needs to assess to what extent the composition of its alliance portfolio is in fit with its strategic needs. Second, while building its portfolio, it has to deal with competition that might grow between individual partners in the portfolio. Third, it has to ensure that the synergetic benefits that accrue from complementary alliances in its portfolio are actually reaped by the firm (Kale and Singh, 2009: 57). In particular, managerial action becomes relevant when an organization collaborates on technological matters with a diverse set of alliance partners. In the light of the above, this study puts forward the notion that the negative performance effects of high diversity levels can be positively influenced by focused managerial effort in the form of technology management. Technology management is defined as the capability to stimulate the effective use of technical knowledge and skills to develop new products and processes, the improvement of existing technology, and the generation of new knowledge and skills, and is a specification of what Sarkar et al. (2009) label as alliance portfolio coordination because it helps in identifying, selecting and combining relevant technologies in the hands of a diverse set of external actors, with whom the focal firm has technological collaborations (Phaal et al., 2001).

Therefore, we put forward the following research question: What is the effect of alliance portfolio partner diversity on a firm's innovation outcomes, and what is the effect of the use of TM-tools on this relationship? Answering this research question will contribute to the literature in several distinct ways. First and foremost, we contribute to alliance portfolio (management) literature by showing that the negative effects of high levels of APPD on innovation outcomes can be counteracted by conscious and focused managerial efforts. Preceding studies predominantly focus on the development of capabilities and management functions aiming for the improvement of the functioning of individual alliances, but say relatively little about which managerial interventions innovating firms put in place to coordinate and profit from externally acquired knowledge and information acquired from a portfolio of inter-organizational ties. Second, we propose,

and empirically find, differing effects of APPD on radical and incremental innovation. Third, we contribute to increasing the generalizability of empirical findings in alliance portfolio diversity literature by studying the performance effects of alliance portfolios of firms in a non-western context, that is, in South Africa for a wide range of industries and size classes.

## 2. Theory and hypotheses

### 2.1. Alliance portfolio partner diversity and the innovation outcomes of firms

There is a small but growing literature on the innovation outcome implications of firms' linkage in diverse alliance partner portfolios. The different partners in these portfolios possess different types of knowledge. Universities and research labs, for example, give access to fundamental knowledge and the possibility of conducting high quality research (Laursen and Salter, 2004; Von Raesfeld et al., 2012). Suppliers possess knowledge related to production processes and input characteristics that could lead to process innovation, cost reduction or product innovation (Sobrero and Roberts, 2002), whereas buyers can be sources of new product ideas (Hernandez-Espallardo et al., 2011; von Hippel, 2007). Collaboration with competitors gives access to industry-specific knowledge and a possibility of sharing, for example, research facilities (Gnyawali and Park, 2011; Kim and Higgins, 2007) and consultants and private research organizations can be valuable sources, for example because they offer engineering capabilities or marketing knowledge helping in commercializing innovations (Tether and Tajar, 2008; Toedtling et al., 2009).

The curvilinear relationship between alliance partner diversity and firm innovation found in previous research (Duysters and Lokshin, 2011; Laursen and Salter, 2006) has been explained by two partly overlapping theories—the extended resource-based view (Lavie, 2006) and organizational economics (e.g., Belderbos et al., 2006). At low levels of APPD, firms are connected to the same kind of partners possessing similar resources. Consequently they have limited access to complementary assets and new knowledge (Faems et al., 2005) and they have limited possibilities of profiting from synergies across a set of dyads. Furthermore, a focal actor has limited possibilities for learning from feedback (Ruef, 2002). As a result, firms' innovation outcomes tend to be relatively low. As the level of APPD increases, risks of knowledge and information redundancies diminish, whereas a wider variety of complementary assets can be accessed. A more diverse set of alliances also act as a sounding board for new innovative ideas of the focal actor and can lead to a decrease of intra-alliance competition costs (Belderbos et al., 2006). At moderate levels of APPD, firms profit the most from diversity of inflowing knowledge, and at the same time they are able to deal with the diversity of the portfolio (Bruyaka and Durand, 2012). As diversity levels further increase, costs of the portfolio may overcome the benefits (Bapuji et al., 2011; Chen et al., 2011). There are several reasons why this may be the case. Higher diversity levels imply the inflow of (too) many ideas, often emerging at the wrong time, and getting too little attention, all of this resulting in an information overflow problem (Koput, 1997). Furthermore, collaborating with a highly diverse set of actors substantially increases the costs of coordination, monitoring and communication, and the probability of opportunism, for example resulting in unintended knowledge spillovers (Combs and Ketchen, 1999).

In sum, as argued in the literature, low alliance diversity levels will be associated with low innovation outcomes; also that increased alliance diversity levels will improve outcomes, but very high alliance diversity levels confront firms with such high

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