Absorptive Capacity, Alliance Portfolios and Innovation Performance: An Analytical Model Based on Bibliographic Research

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Abstract: The objective of this article is to present a model for analysing the role of absorptive capacity in the relationship between strategic alliance portfolios and innovation performance based on the results of bibliographic research on the subject published between 2000 and 2015. The research was carried out in three stages, involving both quantitative - bibliometric and bibliographic coupling - and qualitative content analyses. AP management capabilities were found to have a fundamental moderating role in the AP–IP relationship, and amongst these capabilities AC was highlighted by several authors. However, its role was found to vary according to AP characteristics, notably AP diversity – functional, geographic and institutional, but also centrality, size, stability and volume of resources, alliance and partner types as well as country type: emerging versus developed economies. This research formed the basis for the development of the model and the formulation of some propositions that focused on emerging countries.

Keywords: innovation; strategic alliance portfolios; absorptive capacity; emerging countries; bibliographic coupling; bibliographic research

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Introduction

Globalization and the pressure to launch new products have led to a greater interdependency between firms. This pressure has driven firms to engage not only in dyadic alliances, but, increasingly, in multiple alliances, configuring strategic alliance networks (Ahuja, 2000) or alliance portfolios – APs, so as to leverage innovation performance - IP (Faems et al., 2005; Duysters & Lokshin, 2011) more effectively and thus ensure their competitive advantage.

Cohen and Levinthal (1990) argued that the competency to explore external knowledge, i.e. absorptive capacity – AC, is a critical factor for organizations that intend to innovate. Literature reviews on AC (eg. Zahra & George, 2002) have emphasized this point.

Lane et al. (2006) affirm that AC has become one of the most important concepts in recent organizational research. Between 1990 and 2006, 900 articles were published in scientific journals on the subject.

Moré et al. (2014) conducted a bibliometric study (1990-2012 timeframe) and found 1447 articles published in international journals on AC and innovation.

Several empirical studies investigated the influence of AC in the relationship between R&D alliances and IP. Although some of these found a positive influence (Berchicci, 2013; Cassiman & V eugelers, 2006), others did not (Belussi et al., 2010; Mowery, 1996). In other words, results diverged.

Literature reviews have also been conducted on APs (Wassmer, 2010), knowledge networks, (Phelps et al., 2012), alliance networks and technological development (Stolwijk et al., 2013), and international APs and innovation (Macedo-Soares et al., 2016). But there is a lack of bibliographic research on the role of AC in the relationship, not just between dyadic alliances, but also between AP and IP.

This article attempts to fill this gap by presenting the results of bibliographic research on AC, AP and IP, as well as a model and propositions for analysing the role of AC in the AP-IP relationship based on this research. Considering the increasing participation of emerging countries in global alliances for innovation (Jacob, Belderbos & Gilsing, 2013), the model focussed on APs in emerging economies. Some studies investigate AC, AP and IP in emerging economies, but very few focus specifically on Latin America (García Fernández, Sánchez Limón & Sevilla Morales, 2012; Gomez, Daim, & Robledo, 2014; Oerlemans, Knoben & Pretorius, 2013) and all fail to consider their interaction, as proposed in our model.

Theoretical References

Innovation performance was defined as the implementation of a new or significantly improved product/service or process (OECD, 2005). We also distinguished between radical (new to the market) and incremental (significantly improved) innovation, characterized, respectively, as explorative and exploitative innovation (March, 1991). In emerging countries "reverse innovation" has become important: "innovation (that) is adopted first in poor economies before 'trickling up' to rich countries" (Govindarajan & Ramamurti, 2011, p. 191).

As mentioned above, increasingly fierce competition has driven firms to establish alliance networks or portfolios to enhance IP. Alliances were defined as voluntary arrangements between firms (Gulati, 1998) and classified as linkages according to their intensity (Contractor & Lorange, 1988), running the gamut from joint-ventures (most

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intense) to agreements/contracts (less intense). Based on social network theory (Ahuja, 2000; Baum et al., 2000; Ozcan & Eisenhardt, 2009) AP was defined as an ego-centric network (Knoke, 2001), or ego-net: network formed by the focal firm, its direct ties to partners and ties between partners. AP and ego-net were considered synonyms. Although the focus was on the ego-net, second-tier ties (partners to their partners) were considered when strategically significant for the focal firm. Moreover, the AP was viewed in the scope of the firm´s value net (Brandenburger & Nalebuff, 1996) which includes all strategic actors (partners/non-partners) and their interdependencies. The expression "AP/network" (AP/net) was used to make this point and literature on firms´ alliance networks was included in the review.

Wassmer (2010) investigated three research streams considered central to APs: (a) AP emergence; (b) AP configuration; (c) AP management. His literature review suggested that the way a firm configures its AP affects its AC and "therefore its ability to use knowledge accessed from its alliance partners" (p. 158). Referring to George et al. (2001), he highlighted two AP configuration characteristics: alliance structure and knowledge flows between the AP´s partners.

Macedo-Soares´s (2015) Strategic Network Analysis Innovation Framework - SNA–IF, for carrying out analyses of firms that establish APs to leverage innovation, and which was based on Macedo-Soares (2011), proposed four dimensions: 1) AP/Net Structure (AP size; AP density; AP scope; AP position/centrality; embeddedness; structural holes; AP´s configuration of partners/resources in terms of heterogeneity/diversity; 2) AP/Net Composition (focal firm´s identity and status; partners´ identity and status; access to firm´s innovation resources; access to partners´ innovation resources); 3) AP/Net Linkage Modalities (strength; nature – international/local, collaborative/opportunistic, explorative/exploitative); 4) AP/Net Management. The latter included AP Management capabilities, which encompassed AC, as well as multiple alliance experience, dynamic capability, coordination, resource and information sharing, and AP/Net performance assessment. In Macedo-Soares et al.´s (2016) literature review of international APs (IAPs) and innovation, AC was highlighted by some authors as a management capability with a critical role in the IAP-IP relationship. Differences were found between emerging and developed countries. In the former AC could pose a problem, because of AP´s institutional diversity. Since AC was not its focus, this finding prompted us to investigate AC more deeply and pay attention to the case of APs with partners from emerging economies.

AC was defined according to Cohen & Levinthal (1990) as the "ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends" (p. 128). These authors proposed the AC concept, observing that it is "critical to (the firm's) innovative capabilities" (p. 128). "Unlike "learning-by-doing," which allows firms to get better at what they already do, AC allows firms to learn to do something quite different" (Lane et al., 2006, p. 836).

Research Methods

Our study was conducted in three stages. In the first – bibliometric - we collected data on the literature about AC, alliances, APs, networks and innovation between 2000 and 2015. Although studies on AC started in 1990 after Cohen and Levinthal's (1990) seminal article, we found that the publication of articles on AC, alliances and innovation has intensified more recently.

We adopted the ISI Web of Science - WoS that includes most journals with high impact factors (Thomson Reuters, 2012). We limited ourselves to "peer-reviewed" journals, and used the following combination of keywords: "AC" and "alliance" and "innovation"; "AC" and "linkage" and "innovation"; "AC" and "portfolio" and "alliance" and "innovation"; "AC" and "portfolio" and "alliance" and network" and "innovation". These combinations included keywords such as "linkages" because alliances were classified as linkages, and "network" because our definition of AP was in keeping with network theory, and therefore articles on alliance networks could be relevant, as indeed was the case. We thus obtained a sample of 402 articles.

In the second stage the abstracts of our sample were analyzed as well as those of articles cited in pertinent bibliographic studies. The articles identified as most relevant to achieving our objective were analyzed in greater depth.

For stage three, we used bibliographic coupling - BC (Kessler 1963) to identify articles from the most recent theoretical trends in the field to help formulate our propositions and develop the conceptual model. BC shifts the focus from "traditions to trends in the scientific literature" (Vogel & Guttel, 2013, p. 427). Furthermore, it "allows us to draw an overview of how this field of research has developed, eventually recognizing clustered research themes" (Dagnino, Levanti & Picone, 2015, p. 355). Indeed, BC groups recent literature with common references. The frequency of common citations between pairs of articles suggests a thematic similarity between them (Kessler, 1963). To perform the BC, we selected articles from the WoS data base, published between 2011 and 2015, using the same filters as in the first stage. We decided to limit ourselves to the last five years so as to focus on cutting-edge literature. We obtained 41 articles. BibExcel software (Persson et al. 2009) helped carry out the BC. After importing the articles´ metadata and references into the system, we corrected duplicated references.

For the BC we considered articles that had at least ten references in common with the others. We thus considered 33 out of 41 articles. Next, we created a square matrix that featured the co-citations for all pairs of articles. This matrix was converted into another one using the Pearson correlation coefficients calculated for the original matrix (McCain, 1990); the higher the coefficient the greater the thematic proximity between the two articles.

Using the latter matrix, we applied multidimensional scaling - MDS (Hair et al, 2013), to transform metric similarities into spatial distances for the selected articles. To verify the validity of MDS, the stress coefficient was calculated and a value less than 0.15 was considered acceptable (Dugard et al., 2010). The articles were plotted in a two-dimensional space according to the coordinates calculated by the MDS.

Next, we analyzed the articles´ abstracts to separate them into thematically similar clusters, so as to identify those that contributed most to our model and propositions. An in-depth analysis of these articles was conducted as in the second stage.

Results

An important result of the first stage concerned the most productive authors on the subject. G. Duysters was the leading author with 11 articles in our sample, followed by W. Vanhaverbeke (9) and U. Lichtenthaler (8).

Other significant data captured at this stage referred to the countries with most publications on the subject. The US led, followed by several European countries (Spain 2nd; Germany 3rd; The Netherlands 4th; UK 5th). Considering our concern with emerging economies, it was relevant that several leaders came from these, notably from the Far East (China 6th; Taiwan 7th; S. Korea 8th). This reflects the fact that global technological alliances increasingly involve emerging countries (Jacob et al., 2013). Note however that no Latin American country is ranked amongst the first 20.

The last significant result at this stage concerned journals with most articles on the wider subject of alliances, AC and innovation. *Research Policy* (26), *Technovation* (24), *Strategic Management Journal* (23) and *International Journal of Technology Management* (17) were the four leading ones.

As noted earlier, at the second stage of our study, we conducted an in-depth analysis of the articles in our sample and their bibliographic references, with greatest potential to contribute to our study´s objective. Their findings are summarized in Table 1.

Table 1. Summary of selected articles

Reference & Theoretical Lens & Industry	Role of AC	AP/Network Characteristics	Implications for IP	AP/Net Dimensions
George, Zahra, Wheatley & Khan (2001)/AP approach Learning Theory/ Biopharmaceutical firms	-AC mediates AP-IP relationship	- AP structure – horizontal vs vertical alliances -AP knowledge flow patterns – generative (two-way) vs attractive alliances (one way)	-Horizontal alliances give access to multiple knowledge sources. -Vertical alliances to commercialization of innovations -Generative alliances - supply firm with new technology. Attractive alliances give access to new multiple knowledge sources.	-AP/Net Structure -AP/Net Linkage Modalities -AP/Net manage-ment
Gilsing, Nooteboom, Vanhaverbeke, Duysters, van den Oord (2008)/ Network Theory Pharmaceutical, chemical and automotive industries	-AC is one of the main (innovation) exploration tasks	-The elements of alliance network embeddedness are: i) position/centrality; ii) partner technological distance iii) density	-High alliance network centrality requires smaller partner tech. distance to influence positively exploratory innovation. -Low centrality increases exploratory innovation as tech. distance increases. -Intermediate degree of density is effective in central and peripheral networks.	-AP/Net Structure -AP/Net manage-ment
Tsai (2009)/ Network Perspective Knowledge-Based View Evolutionary theory Taiwan Traditional manufacturing sectors	-AC affects positively/ negatively relationship between network partners and IP, depending on partner types and degree of innovation.	-Diversity of partner types/ knowledge sources -Relationship between vertical network partners and IP (incremental/ radical) -Relationship between rival network partners and IP (incremental) -Relationship between research organization partners and IP (radical and incremental).	-AC positively moderates impact of vertical collaboration on IP -AC´s impact varies according to firm size and industry.	-AP/Net Structure -AP/Net Composi-tion

Cui & O´Connor (2012)/ AP approach (but not as ego-net), RBV, TCE. AC/ International perspective/ Selected firms from 60 industries (Fortune ranking)	-Resource and information sharing, -Implicitly AC, AP composition and market factors are moderating factors in the AP resource diversity - IP relationship.	-AP partner resource diversity – degree to which partner resources are different -AP composition - functional heterogeneity and national dispersion -Resource & information sharing, coordination capabilities -Alliance experience -Market factors (uncertainty).	-High partner diversity can be negative for innovation because of high transaction and coordination costs, and reduced AC. -Effective resource and information sharing across functions is necessary to reap benefits of resource diversity.	-AP/Net Structure -AP/Net Composi-tion -AP/Net Manage-ment
Lião & Yu (2013/ OL, AC & IT, not explicit AP approach nor network, merely alliances/linkages International - focus Taiwanese firms in China	-AC has a stronger moderating effect on relationship between local versus international linkages and innovation in emerging countries.	-Diversity: Local alliances (with geographically proximate firms) vs International alliances; Institutional diversity. -Alliance management/learning capabilities	-International (versus local) diversity influences more positively innovation, as it involves informal ties and greater heterogeneity. -Institutional diversity influences differences in levels of AC between developed & emerging countries, related to technology gap.	-AP/Net Structure -AP/Net Composi-tion -AP/Net Linkage Modalities -AP/Net Manage-ment
Yu (2013)/ Recombinatory SearchTheory & Network at Ego-network level/ Taiwanese high-tech firms	-AC moderates the relationship between firm Network Composition and IP	-Network composition precisely Ego-network-level Technological Diversity (different and new technological information and resources) measured in terms of distribution of patents.	-There is an inverted U-shaped relationship between technological diversity of a firm´s network (ego-net) and its IP. -Firm size and industry are important influencing factors.	-AP/Net Composi-tion -AP/Net Manage-ment
Beers & Zand (2014)/OL, AC/TCE, KBV, AP/ R & D alliances Dutch and foreign innovating firms	-AC and learning mechanisms influence significantly IP. -AC enables firms to benefit from multiple partner type experience.	-Diversity: Functional (partners from multiple categories in AP/net) Geographic (partners in different countries in AP/net) -Radical IP vs Incremental IP -Prior experience with multiple partners.	-Both geographic and functional diversity contribute to innovation -The factors explaining functional and geographic diversity are prior partner experience, patenting, and IT infrastructure that helps manage complex and diverse networks.	-AP/Net Structure -AP/Net Composi-tion -AP/Net Linkage Modalities -AP/Net Manage-ment
Leeuw, Lokshin & Duysters (2014)/ AP approach, RBV, TCE/ International perspective/ Dutch innovative firms	-Reference to the AC problem from excessive AP diversity accounting for negative influence of high AP diversity on innovation.	-Diversity Partner types, alliance types (different categories of firms), Geographical (national vs foreign) -Radical vs incremental innovation: exploration vs exploitation -Management capabilities	-There is an inverted U-shaped relationship between AP partner diversity and radical innovation and a positive relationship with incremental innovation. -Exploiting synergies and complementarities in AP can lead to superior IP.	-AP/Net Structure -AP/Net Composi-tion -AP/Net Linkage Modalities -AP/Net Manage-ment
Wuyts & Dutta (2014) AP approach/ Contingency perspective/ AC/ Biopharmaceutical industry	-Management Capabilities have fundamental role in relationship -AP diversity and innovation. -Implicitly AC and experience have a moderating role in this relationship.	-Diversity Technological -Management capabilities to align internal knowledge creation and external knowledge sourcing.	-The relationship between AP technological diversity and superior product innovation is not linear; it is moderated by firm´s past strategies to create new knowledge internally and by management capabilities regarding internal and external knowledge.	-AP/Net Structure -AP/Net Composi-tion -AP/Net Linkage Modalities -AP/Net Manage-ment

A striking finding at this stage was that all but two of the selected articles that explicitly or implicitly address AC´s role in the AP-IP relationship, highlight firm AP/net diversity as a significant AP/network characteristic for IP. The AP/net diversity considered is generally functional (different activities, alliance types, partner types) and geographic (AP/net partners/linkages from foreign countries). It thus relates to all key AP/Net dimensions: i) AP/Net structure, because of the heterogeneity and complexity associated with diversity; ii) AP/Net composition, because of the diverse partner types/resources; iii) AP/Net linkage modalities because of the different alliance types. Note that Wuyts and Dutta (2014), that investigate AP technological diversity, and Lião and Yu (2013), that also examine geographic diversity, stress the importance of institutional diversity of firm´s multiple linkages, especially when these involve emerging countries.

The two articles that do not analyse AP/network diversity are concerned with other AP/net structure characteristics. George et al. (2001), highlights the mediating role of AC in the AP structure - IP relationship, considering vertical versus horizontal alliance type and AP knowledge-flow patterns (one-way versus two-way). Gilsing et al. (2008) investigates three network structure characteristics: position/centrality, partner technological distance and density, and the relationship between these and exploratory innovation. AC is considered one of the two fundamental exploration tasks - novelty creation and efficient absorption of it – that have to be delicately balanced to ensure successful exploratory IP. The authors emphasize the complementary effects of these characteristics on both novelty creation and AC. Although innovation requires non-redundant contacts to access new knowledge, network density is important for integrating diverse knowledge from these contacts. For exploratory innovation an intermediate degree of density would be most effective in both central and peripheral positions. Higher network centrality, that enables greater exposure to different levels of knowledge, requires smaller partner technological distance so as to have the necessary AC to absorb knowledge from all parts of the network and generate innovation. Conversely, low centrality could increase innovation when technological distance increases. Their research finds, however, that firms with high network centrality generally have superior explorative IP.

In Macedo-Soares et al.´s (2016) literature review on international AP/networks and IP, but where the focus was not on AC, diversity was also found to be the most significant AP/network characteristic in terms of influencing IP. This influence differed according to the types of diversity and IP (radical or incremental). Although there was no consensus among authors, a majority found that the AP/network diversity – IP relationship was not linear (see also Wuyts & Dutta, 2014). Several suggested that it was curvilinear, precisely, an inverted U-shaped relationship. After a certain point, increasing diversity would have a negative impact on IP because of the difficulty of managing increasing transaction costs and of absorbing different knowledge; in other words because of an AC problem (Leeuw et al., 2014; Yu, 2013).

This explains why most articles reviewed in Macedo-Soares et al. (2016), and those in the second stage of our study, stress the need for AP/net management capabilities (see also Duysters et al., 2012; Faems et al., 2012), with several highlighting AC, or just referring to it implicitly or explicitly. Note that many also stress prior (multiple) alliance experience together with management capabilities (e.g. Cui & O´Connor, 2012; Beers & Zand, 2014) and/or AC, not only to contend with the challenges associated with high AP/net diversity or heterogeneity, but more generally to derive greater benefit from the AP/net for leveraging IP.

Most of those that highlight AC view it as having a moderating role in the AP/net – IP relationship, but, as we saw they do not all focus on the AP diversity characteristic. George et al. (2001), is a case in point. On the other hand, Tsai (2009), Yu (2013) and Lião and Yu (2013) are all concerned with this characteristic.

Tsai (2009) takes a knowledge-based view of the firm when investigating the mediating role of AC in the relationship between alliance network diversity and product IP. The focus is on the diversity of different partner types whose collaboration "represents…the diversity of knowledge networks" (p. 776). This has to do with the author´s evolutionary theory perspective that "asserts that diverse sources of knowledge allow a firm to create new combinations of knowledge (Nelson & Winter, 1982)" (p. 776). This article is of special interest because it analyses the case of an emerging country. An important finding was that AC has a positive moderating role in the relationship between vertical collaboration, i.e. with supplier and customer partners in the firm´s network, and radical product IP. This is not necessarily the case, however, for incremental product IP. When the alliances in the network are with suppliers, firm size and industry type have a significant influence, and when the alliances are with customers, AC has a negative effect on the alliance network – incremental IP relationship. On the other hand, when the alliances are with competitors in the network, AC has a positive moderating effect in the relationship with incremental IP, in the case of large firms. Tsai (2009) also found that AC has a negative influence on the relationship between research organization partners and radical IP, and a positive one in the case of incremental IP.

Yu (2013) is interesting because it involves an empirical investigation into AC´s role in the inverted U-shaped relationship between ego-network diversity - technological diversity - and innovation in an emerging country, and verifies that AC has an important moderating role in this relationship. AC increases the slope and amplitude of the positive effects of technological diversity on firm IP and reduces its negative effects. Firms that are embedded in technologically diverse ego-networks should invest significantly in increasing their AC so as to derive more benefits in terms of leveraging IP from this diversity.

Lião and Yu (2013) do not take a network or portfolio approach. However, this article contributes to our objective. In the scope of their empirical research into multiple linkage diversity (international and institutional) of Taiwanese manufacturing firms, the authors make evident peculiarities of emerging countries regarding AC´s role in the linkage diversity – IP relationship. Their research shows that AC has a weaker moderating effect in the relationship between international linkages with firms from emerging countries due to the fact that firms in such countries generally have lower levels of AC. Institutional diversity probably accounts to some extent for differences in AC levels between developed and emerging economies.

As for the remaining selected articles that also focus on the AP/network diversity characteristic, none explicitly refer to the moderating or mediating role of AC in the relationship between this characteristic and IP, although all mention the importance of AC. For Cui and O´Connor (2012) alliance management capabilities, notably, resource and information sharing as well as coordination capabilities are highlighted as having this role. Alliance experience is also stressed in that it would help firms overcome the reduced level of AC associated with high AP partner resource diversity.

Beers and Zand (2014) who finds a positive relationship between, on the one hand, functional AP diversity and radical IP and, on the other hand, geographic AP diversity and incremental IP, also emphasizes the importance of prior experience with multiple alliances in this relationship. However, in contrast to Cui and O´Connor (2012), AC is fundamental for deriving benefits from this experience. Thus AC and learning mechanisms, implicitly, have a significant influence on the relationship between AP diversity and IP. The authors recommend investing in R&D, as well as training, because they contribute to the firm´s AC, increasing its ability to assimilate knowledge from diverse external sources which could benefit its innovativeness.

Leeuw et al. (2014) that found an inverted U-shaped relationship between AP diversity and IP, do not explicitly mention AC as having a moderating role in this relationship. AP management capabilities, specifically, combining resources of partners and exploiting synergies and complementarities in the AP, are stressed as contributing to superior IP from the AP. However, AC is implicitly considered critical in this relationship when the authors highlight the fact that excessive diversity can create difficulties to manage too many new ideas because of an AC problem.

Wuyts and Dutta (2014) that also consider the relationship between AP diversity (technological) and product innovation as a non-linear one, emphasizes AP management capabilities. These would be critical for creating new knowledge internally and aligning internal knowledge creation with external knowledge sourcing, thus involving AC. The authors believe that they contribute to the AC literature "by identifying concrete dimensions of internal knowledge creation that enable firms to benefit from external knowledge": "(1) low reliance on existing solutions, (2) attention to the unfamiliar, (3) attention to the nascent, and (4) a broad perspective on the technological field to help them in leveraging the value of extramural knowledge" (p. 1655). They hold that these dimensions have a moderating role in the relationship between portfolio diversity and superior product innovation.

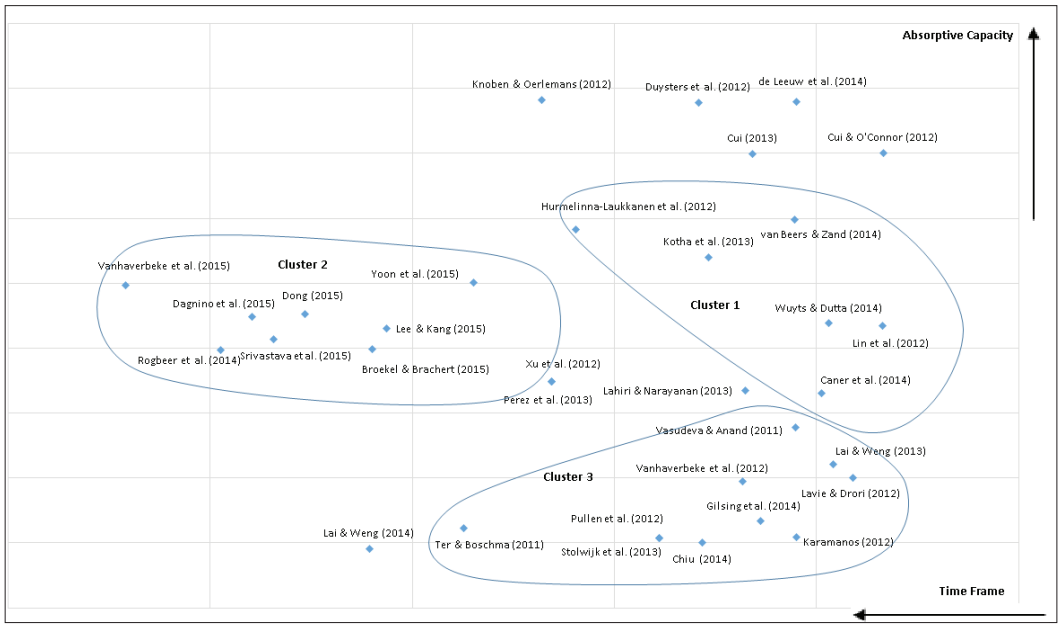
As mentioned earlier, in the third stage, we used BC to analyze the 33 articles that had at least 10 common references. Next, we performed MDS using the Pearson correlation matrixes, generated by the BC, and we created a bi-dimensional map of thematically close articles (Figure 1). The stress index was 0.05618, which was lower than the threshold value that was considered appropriate. All articles were analyzed qualitatively in order to identify the three thematic clusters featured in Figure 1:

i) Cluster 1 (6 articles) – addresses AP, AC and IP jointly. These articles were considered the most important ones for developing our model. Two of these coincided with a couple of those selected at the second stage;

ii) Cluster 2 (9 articles) – composed of the most recent articles (all except one published in 2015), two of which were considered highly relevant;

iii) Cluster 3 (8 articles) – none explicitly address both AC and IP. None of these were considered relevant.

Figure 1. BC´s Two-dimensional Plot



As frequently occurs in BC, a few articles in the clusters were included because they have similar bibliographic references to those of the other articles in the cluster, although they are not perfectly aligned with the cluster´s main theme. Note, moreover, that ten articles were not included in any of the clusters, due to a lack of similarity regarding both themes and bibliographic references.

Our analysis enabled the identification of two critical dimensions: AC (vertical axis) and Time Frame (horizontal axis). The vertical axis indicates that most articles that explicitly address AC are found in the upper part of the figure, while the lower one shows those that hardly address AC. The Time Frame axis points to the left indicating that a concentration of the most recent articles is found on the left side. Indeed, all those published in 2015 are on that side (see Figure 1).
In sum, of the 33 articles analysed, seven were selected as contributing most to the development of our conceptual model, two of which had already been identified at the end of the second stage: Beers & Zand (2014) and Wuyts & Dutta (2014) (see Table 1). In Table 2 we summarize the most important findings of our in-depth analysis of the five other articles.

Table 2. Summary of findings – Stage 3

Reference & Theoretical Lens/ Industry	Role of AC	AP/Network Characteristics	Implications for IP	AP/Net Dimensions
Caner, Sun & Prescott (2014) Alliance Network approach /AC/ Bio-pharmaceutical industry	-Inward knowledge transfer (amount of knowledge transfer from other firms to the focal firm), synonymous of the acquisition dimension of AC, has positive impact upon IP measured by invention output).	-Centrality – i.e. number. of direct ties in the firm's early stage R&D alliance (ego) network	-Centrality of R&D alliance network has positive implications for IP in the case of inward knowledge transfer (AC) and negative implications (risks associated with "invention dissipation effect") in the case of outward knowledge transfer. However, the latter when coupled with inward knowledge transfer enhances IP. The coordination of inward and outward knowledge transfer processes "has the potential to create a virtuous invention cycle" (p.206).	-AP/Net Structure -AP/Net Manage-ment
Lin, Wu, Chang, Wang and Lee (2012) AP approach / AC/ Biotechnology industry	-AC emphasized as fundamental for achieving innovation via AP/ networks. Emphasizes importance of R&D alliances in AP. AC´s positive impact depends on the % of R&D alliances in the AP, technological distance, and R&D intensity.	-Percentage of R&D alliances in the AP -Technological distance (partner diversity in terms of differences in technology classes of partners´ patents) -R&D intensity -Interaction of these three factors.	-AC has a positive impact on IP especially when high % of R&D alliances in AP. -AC has a critical moderating role between AP and IP when technological distance between partners is high. -R&D intensity positively moderates effect of AP on IP. -Inverted U-shaped relationship between technological distance and IP. -The higher the proportion of R&D alliances in AP, the greater the positive impact of technological distance (technological diversity among R&D partners) on alliance IP.	-AP/Net composi-tion -AP/Net Manage-ment

Hurmelinna-Laukkanen, Olander, Blomqvist & Panfilii V (2012) Alliance network approach /AC/ Finnish R&D intensive firms	-AC is positively related to IP. -AC is one of the 3 components of R&D alliance network "orchestration"	-Alliance network stability -Innovation appropriability -Network (partner) diversity -Network "orchestration" style as opposed to top down management.	-Innovation appropriability is relevant to a positive IP -Net stability did not influence IP according to the empirical findings. -Network diversity is positively related to performance. These three factors influence R&D network orchestration.	-AP/Net Structure -AP/Net Manage-ment
Vanhaverbeke, Belderbos, Duysters & Beerkens (2015) AP approach / AC/ integrated circuit industry	-AC reinforces IP for firms with both high technological and high alliance capital in early stages of the technology life-cycle	-Technological capital (focal firm´s number of patents weighted by citations) -Alliance capital (no. of existing technology alliances)	-Alliance capital has an inverse U-shaped relationship with IP -AP/net management capabilities are needed for recombining external and internal technology	-AP/Net size -AP/Net composi-tion -AP/Net Manage-ment
Srivastava, Gnyawali, Hatfield (2015) AP approach / AC/ US semiconductor industry	-Moderating role of AC in realizing innovation benefits from the alliance network technological resources	-AC measured according to 2 dimensions: technological effort and technological capability. -Network size -Level of technological resources of the network	-The two dimensions of AC have opposing moderating effects on IP. The higher the firm´s technological capability, the lower the impact of the network´s technological resources on its IP. The higher the firm´s technological effort, the higher the impact of the alliance network´s technological resources on its IP. -Network size influences positively IP.	-AP/Net structure -AP/Net composi-tion

It is interesting to compare Caner et al.'s (2014) findings with those of Gilsing et al. (2008) (second stage). Both articles emphasize the AP/network centrality characteristic. Caner et al. (2014) finds that high alliance network centrality has positive implications for IP by increasing the positive moderating effect of the acquisition component of AC in the alliance ego-net –IP relationship. Gilsing et al. (2008) also found that, generally, firms with high centrality have higher exploratory IP. However, it highlights the importance of considering centrality in the light of both network density and technological distance. Contrary to Gilsing et al. (2008) Caner et al. (2014) is not explicitly concerned with the AP/network diversity factor. On the other hand, alliance network management capabilities, precisely, coordination of inward (AC) and outward knowledge transfer processes, are stressed as critical.

Lin et al. (2012) converges with Gilsing et al. (2008), with respect to technological distance and partner diversity, when emphasizing the importance for IP of not having too great a technological distance between AP´s partners, and the role of AC as a moderator of the negative effects of significant technological distance on IP. It contributes by underlining the importance of the proportion of R&D alliances in the AP and AC´s significant role when this proportion is particularly high. However, the article stresses the need for a certain degree of technological distance (diversity) between the R&D alliances as being fundamental for enabling innovation.

Hurmelinna-Laukkanen et al. (2012) that focusses on firms´ R&D alliance networks, also finds that AC has a positive influence upon the network´s and firm´s IP. However, AC should be considered as one of the three central components of R&D alliance network "orchestration". The other components are network stability and innovation appropriability. It contributes by highlighting the need for an orchestration style of AP/net management and by investigating the innovation appropriability factor within the network. A certain level of network stability enhances AC and innovation appropriability; while dynamism and change are important to ensure the necessary variety for innovation. In fact, network diversity (different types of partners), although only briefly addressed in the article, was found to be positively related to performance.

Vanhaverbeke et al.´s (2015) main contribution lies in finding that AC reinforces IP for firms with both high technological capital and high alliance capital in their APs, only in the early stages of the technology life-cycle. This work converges with most of the other selected articles when it stresses the need for AP management "capabilities to recombine knowledge from external technology sourcing and internal technology development" (p. 560) so as to draw benefit from the AP/net.

Srivastava et al.´s (2015) main contribution is to have deepened the analysis of AC´s moderating role of AC in the relationship between alliance networks, precisely, their technological resources, by contemplating two dimensions of AC – technological effort and technological capability - and verifying empirically that they have opposing moderating effects on IP. The former was found to have a positive moderating effect.

Discussion, Propositions and Conceptual Model

Our findings strongly suggest that AC is one of the critical moderating factors in the AP-IP relationship. Indeed, it is "AP/net management capabilities" that is generally viewed as having this moderating role. Amongst these, some researchers who investigated this relationship have highlighted capabilities for "orchestration" style AP/net management, and/or for resource and information sharing, for exploiting synergies and complementarities, for recombining knowledge from external technology sourcing and internal technology development, and/or for coordination of inward (AC) and outward knowledge transfer processes. However, practically all of these also consider AC as being an important factor, even if not having a moderating role in the relationship. We saw that this

role varies depending on the type of AP characteristic investigated as well as the type of IP at issue - radical/explorative or incremental/exploitative. Firm characteristics (size and age), and industry type, were also viewed as significant intervening factors. In the second stage of our study, AP/net diversity stood out as the most significant AP or alliance network characteristic but depending on the type of diversity, for e.g. partner type, AC affected the AP/net–IP relationship differently. The research in Tsai (2009) is a clear example of this.

In the third stage, while AP/net diversity was not explicitly addressed in most articles, other AP/net characteristics, such as centrality, size, stability and volume of resources were highlighted. AP/net management capabilities were stressed in all articles except one.

The finding that we viewed as particularly important concerned the AC level problem in emerging countries and the differences in these countries regarding AC´s moderating role in the AP–IP relationship. Below we formulate a few propositions for analysing the role of AC in the relationship at issue with the help of our conceptual model (Figure 2) focussing emerging countries.

Propositions:

P1: In emerging countries, AC positively moderates the relationship between AP/Net functional diversity and radical/explorative IP

P2: In emerging countries, AC positively moderates the relationship between AP/Net functional diversity and incremental/exploitative IP

P3: In emerging countries, AC positively moderates the relationship between AP/Net geographic diversity and radical/explorative IP

P4: In emerging countries, AC positively moderates the relationship between AP/Net geographic diversity and incremental/exploitative IP

P5: In emerging countries, AC positively moderates the relationship between AP/Net technological diversity and radical/explorative IP
P6: In emerging countries, AC positively moderates the relationship between AP/Net technological diversity and incremental/exploitative IP

P7: In emerging countries, AC positively moderates the relationship between AP/Net institutional diversity and radical/explorative IP

P8: In emerging countries, AC positively moderates the relationship between AP/Net institutional diversity and incremental/exploitative IP

P9: In emerging countries, the level - high/low - of AC influences positively/negatively AC´s moderating role in the relationship between AP/net diversity and IP

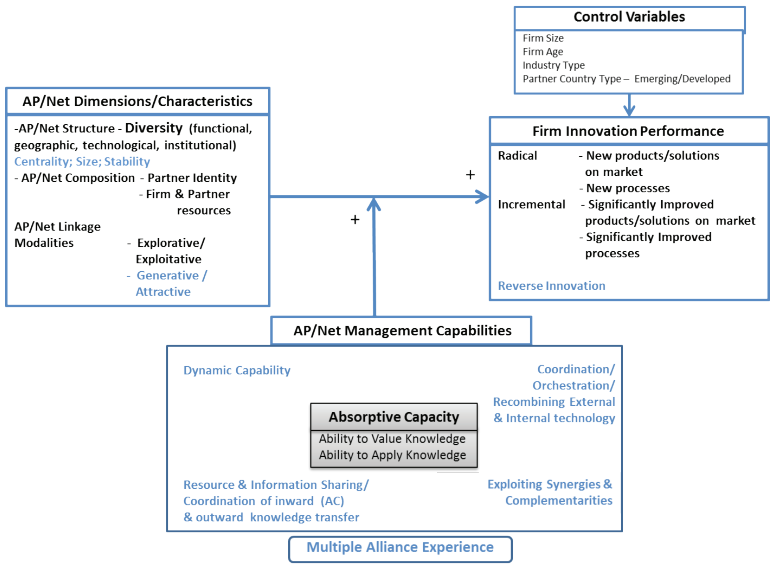
P10: In emerging countries, firm characteristics (size and age) influence AC´s moderating role in the relationship between AP/net diversity and IP

P11: In emerging countries, industry type influences AC´s moderating role in the relationship between AP/net diversity and IP

P12: In emerging countries, partner country type - emerging versus developed - influences AC´s moderating role in the relationship between AP/net diversity and IP.

In Figure 2 we present our conceptual model, highlighting in bold black the variables in the different dimensions to be focussed on first, in keeping with our propositions. These variables are AC in the AP/Net Management Capabilities dimension, AP/net diversity in the AP/net structure dimension, and Radical and Incremental Innovation in the firm IP dimension, as well as the control variables: firm size, firm age, industry type and partner country type - emerging versus developed country. Since AP/Net diversity relates to AP/Net composition and AP/Net linkage modalities, these two dimensions are also in black.

Figure 2. Conceptual Model for Analysing AC in the AP–IP relationship in emerging country focal firms



Managerial Implications, Limitations and Future Research

We believe that our research has important managerial implications especially for firms in emerging countries. Compared with those from developed countries the latter generally have greater difficulty innovating because of their lower degree of technological capacity and development. Therefore, they should increasingly participate in fairly, but not excessively, diverse APs, in order to have access to a greater variety of knowledge. However, to transform this knowledge into effective innovation, it is fundamental that they also leverage their AC that, as we saw, is usually much lower in emerging economies, together with other AP management capabilities, notably, resource and information sharing, coordination, orchestration and recombining of internal and external technology. The development of the necessary AC implies investing in learning how to assess and apply knowledge through personnel training, contracting of qualified professionals, reverse engineering and internal R&D.

Our study had some limitations, including, specifically, a methodological one: the fact that we only used one data base – Web of Science, albeit one of the most comprehensive ones. The second stage that involved qualitative analysis of not only the articles in our sample but also those referenced in this sample as well as in other literature reviews related to our subject aimed at overcoming this limitation. However, the use of several other data bases would be highly recommended in a follow-up study.

Where future research is concerned, we suggest that it consider the variables in blue in our model together with the ones highlighted, in keeping with a systemic holistic approach and to appreciate their complementary effects on both AC´s mediating role, when applicable, and different types of IP, as has been argued, among others, by Gilsing et al. (2008). In addition, we recommend that future research into emerging countries also consider the -reverse innovation- performance type (Govindarajan & Ramamurti, 2011).

Moreover, we believe that a comparison between AP characteristics, notably diversity (functional, geographic, technological and institutional), and their relationship with IP, respectively, radical and incremental, involving both emerging and developing countries and APs could reveal new very relevant insights.

As we noted, the Asian emerging countries are the most productive among the emerging economies in terms of number of publications on the topic at issue. Only four articles in our sample were from Latin American countries. Considering the increasing importance of APs and networks for leveraging innovation of firms in emerging countries (Jacob et al. 2013), we recommend that future research focus on Latin America and conduct comparisons with results from emerging countries in Asia.

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