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A Bibliometric Review of the Innovation Intermediary: Mapping Roles and Setting a Research Agenda

Abstract

The development of innovation management practices toward openness and emerging socio-economic models have changed the roles and supporting activities of innovation intermediaries. This paper aims to review the extant research to explore the role of innovation intermediaries, map the current knowledge and outline a future research agenda. Utilizing the novel quantitative literature review approach of bibliographic coupling, examining 164 journal articles, the paper presents a robust analysis of the intellectual streams and key concepts underpinning innovation intermediaries. This is the first time that a quantitative review method has been used to analyses this research area and it provides an opportunity for new insights to complement previous qualitative reviews. This paper makes a contribution to the on-going debate by proposing a framework that explains the role of innovation intermediaries: knowledge broker, knowledge transfer enabler, orchestrator, and open innovation facilitator, and the functions embedded with the roles at different levels of unit analysis, i.e., firm, industry, and national. The paper concludes by discussing the theoretical and practical implications of the framework and details key areas for future research.

Keywords: innovation intermediary, bibliographic coupling, open innovation, innovation management

Introduction

The pace of innovation intermediary research has accelerated in recent years, spurred on by new socio-economic models, digital technologies, the local and global challenges of population growth and environmental pressure. Research on innovation intermediaries is predicated on the idea that intermediaries act as a catalyst for innovation to address these changes and challenges. Innovation intermediaries are defined as different kinds of agents, such as individuals, organizations and networks or spaces, which link people, organizations, ideas and resources within the innovation process.

Despite the importance of innovation intermediaries, however, there is a substantial lack of research that contributes to the knowledge base regarding the different roles of intermediaries. The development of global challenges and digitization impact how intermediaries may support innovation. For example, Sieg et al. (2010) stated that there are

crucial shifts in intermediaries' roles toward openness. Their roles vary and may include tapping into, sharing and co-creating the knowledge and experience of actors, identifying and selecting new technology options, and forming linkages between external and internal knowledge providers to develop, commercialize and even diffuse new products, technology or even experience in societies. They help organizations and communities in a number of ways, from building inclusive markets for the 'base of the pyramid' (Mair et al., 2012) to developing ecosystems of resources and participants during the innovation process. At this time, the literature lacks cohesion regarding the emergent roles of intermediaries and the current state of the art, necessary in order to clearly understand and conceptualize emergent themes of intermediaries, innovation scholars and practitioners. Not only is it currently difficult to gauge what, exactly, is known in the field and how research may be consolidated, but the field also lacks specific conceptualizations of new developments and an explicit future research agenda that may provide consolidation and push future progress in the domain of innovation intermediary research.

The goal of this article is to have a comprehensive understanding on the role of the innovation intermediary based on prior research and find gaps for future research opportunities. Future research should be embedded within an integrated innovation intermediary framework; we propose one such in this paper. In order to advance conceptual understanding of innovation intermediaries, we interpret the results of the bibliometric analysis using the intermediaries' new catalyst roles in global changes and digitalization. Doing so also helps to provide an agenda for future research.

This article's primary contribution to the literature is recommending ways in which innovation intermediary research may be advanced by different concepts and theories from innovation management at different levels (e.g., firm, industry, system). Different levels of analysis of the structure and content of the field led to the identification of specific research

gaps which these recommendations are designed to address. We used the bibliographic coupling method, a bibliometric analysis method that uses a quantitative approach, in analyzing the innovation intermediary literature. This paper is among the first to use the bibliographic coupling method to identify the intellectual structure of innovation intermediary research. With the support of cluster mapping, we provide a visualization of the state of the art of intermediation in the innovation research field, research development in this area over the years, the integrative framework of the role of the intermediary, and suggest topics for future research development.

Our article is organized in the following sequence. Firstly, we review briefly the development of innovation intermediary research alongside the shift of innovation management research. Secondly, we outline the bibliometric coupling method that was used in collecting, identifying and analyzing the relevant roles of intermediaries in the innovation literature. We then use the bibliographic coupling method to summarize the current understanding of intermediaries' role while also examining the activities of innovation intermediaries in different levels, from firms to the national level, together with divergences in the current interpretation of intermediaries' role in the innovation context. We conclude the review by suggesting directions for future research.

Innovation Intermediary Research

Previous research in innovation has shown how the role of innovation intermediaries has developed in line with changes in innovation management research. Earlier studies on intermediaries in the innovation context captured innovation as a way to find a competitive advantage. It was focused on internal firm resources, such as the R&D department which relies on researchers' capabilities (Dyer and Singh, 1998). At this time, innovation intermediaries assisted the innovation processes of a firm in the form of consultants or

university faculty (Billington and Davidson, 2013). together relevant resources and key actors and intermediary firms act as 'bridging institutions' (Watkins et al., 2015). The role of intermediaries described in earlier publications tends to be very task-focused, e.g., helping firms to transfer technology and generally operating on a hub-on-spoke model. As a hub, intermediaries are expected to help companies to develop innovation/technology management responsibilities, including capabilities development, technology know-how, knowledge development, intellectual property, customer management, regulatory compliance, partnership agreements and so on. On the other hand, a spoke is conceptualized as an implementation actor that can develop business and innovation strategies, locating key sources of new knowledge and so on. Examples of these kinds of intermediaries include specialized government agencies, university technology transfer offices, regional technology centers, and cross-national networks.

Subsequent studies on innovation intermediaries have mainly focused on intermediary institutions as facilitators of knowledge transfer between policy makers and innovators (Kelly, 2003). These papers are focused generally on technology or knowledge transfer aspects, based on the realization that firms have different competencies and capabilities in absorbing and assimilating new inputs of technology. Firms could use consultants as intermediaries to assist and advise them during the knowledge or technology transfer process to compensate for a lack of capability (Bozeman, 2000). These organizations as intermediaries offer technological or networking facilities that organizations may not independently possess, allowing them to generate innovation to solve their problems (Saxenian, 1990).

More recently, studies on innovation intermediaries have started focusing on social network interactions and the associated learning processes (i.e., Mair, Marti and Ventresca, 2012; Watkins et al., 2015). It consists of various types of companies and individuals

embedded in different kinds of networks. The activities of this intermediary facilitate and build new forms of collaborations whilst reinforcing long-term relationships between participants in the innovation ecosystem, bringing people together around common areas of interest. Moreover, there are virtual knowledge brokers or open innovation accelerators (e.g., InnoCentive), which provide virtual environments for an innovating institution to connect effectively with relevant experts, customers, or value chain actors wherever they might reside.

Methodology

Sample Selection

In searching the literature, we restricted the review to include only peer-reviewed journal articles; we excluded books and non-refereed publications. The use of validated knowledge serves to strengthen the robustness of the review. We used a multi-stage process to identify and select relevant articles to be included in the analysis.

First, we selected highly ranked journals in innovation management research. Our selection followed West and Bogers (2014) suggestion and looked for articles that were published in these top 19 journals (Table 1). We then chose articles which were published between January 2003 and March 2017. 2003 was set as the initial data parameter as this was the time when open innovation proliferation had started to develop marked with Chesbrough (2003) phenomenal publication. We then searched the titles and abstracts of journals using combinations of the keywords 'knowledge' AND 'broker' or 'technology' AND 'broker' or 'intermedia*' AND 'innovation'. We intentionally used only those keywords to specify and distinguish the articles whose research domain was only related to innovation intermediaries.

Outputs were further restricted to management-related disciplines only, which resulted in an initial database of 232 journal articles. With the aim of minimizing subjective selection biases, each of the 232 articles' titles and abstracts was read by the authors to ensure

the relevance of the innovation intermediary research. Articles that were not related to innovation intermediaries could then be excluded. 164 articles were finally selected for further evaluation.

INSERT TABLE 1 HERE

Bibliometric Coupling

To analyze the structure of innovation intermediary research and identify future research opportunities, this study uses the quantitative approach of meta-analysis and science mapping or bibliometric research methods (Zupic and Carter, 2014).We used the bibliometric coupling method for two main reasons. First, this method represented the best way to map the current research front (Vogel and Guettel, 2013), a good fit for the purposes of this study. This method works by capturing and analyzing recent publications in a particular area of research; the unit of analysis is the identified articles, not the citing references. Second, the result of this approach is more accurate if compared with co-citation and direct citation analysis results (Boyack and Klavans, 2010).

Bibliometric coupling is one type of bibliometric research (Zupic and Carter, 2014). It has been widely utilized by researchers to identify connections between two texts and determine the relationship between them. A larger number of connections between the bibliographies of texts indicates a greater association. The connection is based on the number of the same articles being cited in both documents. If two documents cite the same articles, it can be identified as bibliographic coupling. The frequency of the two articles citing the same articles shows the level of connection. The more frequently they cite the same articles, the stronger the connection. References to several articles can be analyzed and clustered based on their citations. Bibliographic coupling analysis produces a grouped map of connected articles based on similarity in references.

This study used the Bibexcel tool to measure coupling and to find document relationships. Bibexcel is a versatile bibliometric toolbox developed by Persson that helps to do most types of bibliometric analysis (Persson et al., 2009). Generally, in organizational and management studies, the software is utilized for running bibliometric analysis (Zupic and Carter, 2014). Bibliometric data is provided at the beginning of the measurement process and can be downloaded from a database source. Bibexcel helps restructure the data, perform bibliometric calculations and conduct analytical functions to measure the relationship matrices between items (e.g., authors, words). The output of the Bibexcel tool is a file that can be used to visualize articles' cluster mapping as the result of bibliographic coupling. The next step was performed to show a graphical representation of the bibliographic coupling cluster, utilizing the VOS viewer tool. VOS viewer was used for analyzing bibliometric networks, based on the cluster file produced in the previous stage. The tool develops a publication's chart, researchers based on citations, co-citations, or bibliographic coupling networks (Eck and Waltman, 2010).

VOSviewer produced a distance-based map. This map shows the distance between two dots, which indicate the strength of the relationship; a smaller distance reflects a stronger relationship. The dots are often unequally allocated and it helped to show clusters of related items (Eck and Waltman, 2010).

Results of bibliometric coupling

We performed a bibliometric coupling analysis of database of the 164 focal publications on innovation intermediaries to identify patterns between them and examine the current state of the art. Table 2 provides a look at highly cited articles in the innovation intermediary literature. Howells's (2006) article, which gave a brief explanation of the definition and the typology of innovation intermediaries, sits at the top of the list. Two of Chesbrough's articles about open innovation are also included on the list. It shows that open

innovation is used by most researchers as a perspective to investigate the concept of innovation intermediaries. In addition, the absorptive capacity article by Cohen and Levinthal (1990), a book by Burt (1992) about the social structure of competition, and a network learning article by Powell et al. (1996) are also included.

INSERT TABLE 2 HERE

All clusters developed through the bibliographic coupling process are presented in Figure 1. Extracting the shared references from the innovation intermediary literature provides a visualization of a dense network document, clustered according to similarity. First, the two authors read the 164 publications in their entirety and discussed the structure of the results until a consensus on interpretation was achieved. Through a detailed review of the references in each cluster, we distinguished the keys idea and themes that take priority within this field of research. Interpretation of the themes and concepts, along with the reading of samples of text that form them allowed this study to define four areas of research into the role of an innovation intermediary: 1) Facilitating knowledge or technology transfer; 2) A knowledge broker linking institutions in innovation networks and alliances; 3) Orchestrating an innovation network; and 4) The innovation intermediary's role in the open innovation context. Research into the knowledge broker role of an innovation intermediary has received the most attention (cluster 2).

INSERT FIGURE 1 HERE

To interpret the contents of each cluster the keywords, paper titles and articles were reviewed.

Cluster 1: Facilitating knowledge or technology transfer

This cluster contained 29 articles and we labeled it as 'facilitating knowledge or technology transfer'. Articles in this cluster mainly discussed the innovation intermediary as an organization that took on the role of transition management in facilitating the transfer of

technology and knowledge. There are a variety of organizations that act as innovation intermediaries in this cluster: 1) KTTO – knowledge and technology transfer offices (Landry et al., 2013, Alexander and Martin, 2013); 2) Incubator/ service intermediaries (Dutt et al., 2016, Zhang and Li, 2010); and 3) Collective research centers (Knockaert et al., 2014, Spithoven et al., 2010, Spithoven and Knockaert, 2012). These types of innovation intermediaries play the role of bridging organizations (Villani et al., 2017).

Related to their role in knowledge transfer, intermediary innovation in this cluster exists with variety of types and functions. A transfer office is one type of intermediary that transfers knowledge or technology from a university to industry. It is a showcase for new technologies developed by a university that are ready to be amplified and commercialized by industry (Alexander and Martin, 2013, Landry et al., 2013, Yusuf, 2008, Villani et al., 2017). Another innovation intermediary type is a collective research center, an innovation intermediary that is usually initiated by the government, plays role in conducting R&D collaboration and also forms a network with downstream sectors (Lee and Park, 2006, Spithoven and Knockaert, 2012).

Most of the articles discussing the transfer of technology or knowledge from university to industry (Villani et al., 2017, Taheri and van Geenhuizen, 2016, Wurmseher, 2017, Yusuf, 2008) focus on product commercialization or solving new social challenge like environmental issues, urban planning, etc. Innovation intermediaries also take part in the triple helix innovation system model in order to systematically apply foresight to the renewal of products systematic foresight in renewal product (Frykfors and Jonsson, 2010, Mendonca and Heitor, 2016, Raven et al., 2010).

Some of articles shed light on the conditions that support technological transitions or knowledge transfers of connected firms by innovation intermediaries through the triple helix (Frykfors and Jonsson, 2010) in cities where the firms and innovation intermediaries are

located (Mas-Verdu et al., 2016, Hodson and Marvin, 2009). Some articles deal with strategic niche management as a tool to develop instruments for governing technological transitions in socially desirable directions (Raven et al., 2010, Schreuer et al., 2010).

A smaller group of articles in this cluster focus on the impact of innovation intermediaries on organizations: 1) increasing the level of absorptive capacity and innovation performance (Knockaert et al., 2014, Spithoven et al., 2010); and 2) reducing cognitive, organizational, geographical, and social distance (Villani et al., 2017), which completes this cluster. However, to some extent, articles in this cluster are similar in the role of innovation intermediaries in knowledge or technology transfer.

Cluster 2: Knowledge broker linking institutions in innovation networks and alliances

We label this cluster as actors as knowledge brokers linking institutions in innovation networks and alliances. This is the biggest cluster of all; 64 articles that mostly discuss actors or individuals as innovation intermediaries (Aalbers and Dolfsma, 2015, Arora et al., 2014, Bidwell and Fernandez-Mateo, 2010, Boari and Riboldazzi, 2014, Kirkels and Duysters, 2010, Lee, 2010, Lin, 2012, Obstfeld, 2005, Quintane and Carnabuci, 2016, Ryall and Sorenson, 2007). As actors, the intermediaries' role is linking unconnected network members and combining members' respective knowledge and capabilities in new ways (Hakanson et al., 2011, Kim et al., 2010). As individuals, actors in this role may include: lead users (Arora et al., 2014); salespeople (Groza et al., 2016, van den Berg et al., 2014); academic inventors (Lissoni, 2010); skilled return migrants (Wang, 2015); and principal investigators in a transfer office (Kidwell, 2013).

Quintane and Carnabuci (2016) reveal that there are two main discussions of the individual as innovation broker: 1) innovation broker as a structural position – an actor's network of long-term relationships; and 2) innovation broker as an information exchange

process. Moreover, they also explore two different ways brokers can negotiate the exchange of information across a structural hole: 1) the tertiusgaudens strategy, in which the exchange of information is intermediated between the brokered parties by the broker acting as the only passage through which information flows across the hole; and 2) the tertiusiungens strategy in which the broker facilitates the flow of information across the structural hole by enabling a direct exchange between the brokered parties. Transcoding is how an actor, as an innovation intermediary, not only links but also translates and makes complex knowledge meaningful to others.

Cluster 3: Orchestrating the innovation network

With small number of 12 articles related to similar topics in this cluster, we labeled it as orchestrating the innovation network because most of the articles discussed the role of an innovation intermediary in connecting elements at different levels of activities in an innovation network. The bridging role of innovation intermediaries from earlier publications mainly connected firms with customers, research institutions, suppliers or other partners. In this cluster, the articles expanded the bridging role, instead connecting one-to-one and recent articles focused on innovation intermediaries orchestrating outcomes by develop networks and leading the members to achieve particular purposes. The challenge in orchestrating is to embed all of the members who have different aims and backgrounds. Some articles conclude that the way to do this is understanding the nature and value of activities (Klerkx and Leeuwis, 2009), building trust among members (Lee et al., 2010), balancing multiple interests (Klerkx and Leeuwis, 2008), and/or building innovation intermediaries' dynamic capabilities (Tai and Davids, 2016).

Articles in this cluster also shed light on how the innovation network members could work together in the innovation process. The innovation intermediary in this cluster plays the

role of coordinator, such as in product development partnerships (Chataway et al., 2010, Rong et al., 2013) and commercialization (Vivas, 2016). Some of the articles in this cluster do not specifically explore orchestrating, but focus rather on topics related to innovation networks, including emphasizing the importance of networking for SMEs (Zeng et al., 2010, Vrgovic et al., 2012, Lee et al., 2010) and technology roadmapping (Battistella et al., 2015).

Cluster 4: The innovation intermediary's role in the open innovation context

We choose to label the last cluster as the innovation intermediary's role in the open innovation context because 'open innovation' stands out as the predominant term in most of the publications within this cluster (Bakici et al., 2013, Chesbrough and Brunswicker, 2014, Clausen and Rasmussen, 2011, Nambisan et al., 2012, Sieg et al., 2010, Wang et al., 2012). While some articles do not explicitly mention open innovation, the topics are closely related and include crowdsourcing and using social media for collecting ideas (Colombo et al., 2015, Dong and Pourmohamadi, 2014, Franzoni and Sauermann, 2014, Harland and Nienaber, 2014, Holzmann et al., 2014, Pihl and Sandstrom, 2013). In the context of open innovation, intermediaries break down traditional corporate boundaries and allow the free flow of intellectual property, ideas and people into and out of an organization (Chesbrough and Garman, 2009). In open collaboration, innovators allow their innovation information to be freely accessed, used and diffused by others (Baldwin and von Hippel, 2011). The practice of open collaboration is particularly evident in open source software, which programmers use at various levels, collectively contributing to create and improve software programs (Hutter et al., 2011). Wikis are an example of open collaboration in the context of knowledge creation, where participants voluntarily create and update information on a particular topic. Innovation intermediaries with online platforms, such as InnoCentive, facilitate community forums for contributors who are willing to collaborate with others and cooperate in a group for

innovation problem solving. From the evidence, open collaboration mostly works at the user level of network analysis and at the ideation and development phases of the innovation process.

The articles in this cluster show two different perspectives of open innovation facilitation by intermediaries: inside-out and outside-in innovation. Intermediaries help organizations in *inside-out open innovation* processes, in which a business places some of its assets or projects outside its own walls, through saving a firm time and money, nurturing new supplier and partner relationships, promoting innovative ecosystems and generating high-margin licensing income via IP management (Benassi and Di Minin, 2009, Gredel et al., 2012, Adams et al., 2013, Harland and Nienaber, 2014). The inside-out roles of intermediaries are:1) patent broker, bridging the demand and offer for patents through licensing or reassignment (Benassi and Di Minin, 2009, Harland and Nienaber, 2014, Collinson et al., 2005, Caviggioli and Ughetto, 2013, Steensma et al., 2016); and 2) facilitating the commercialization of technologies at an international scale (Gredel et al., 2012).

Intermediaries also help organizations in o*utside-in open innovation process*, in which outsiders' contributions enable firms to create offerings on a larger scale than could be otherwise achieved through internal capabilities. The role of intermediaries in these processes may include facilitating external knowledge acquisition, but primarily focuses on solidifying the firm's position in a desirable innovation or idea generation network. This confers a strategic advantage for the firm in meeting upcoming knowledge or technology transaction needs, as innovation knowledge trading frequently occurs (Ritter and Walter (2003), Tran et al. (2011), Sandmeier (2009), Dong and Pourmohamadi (2014). Furthermore, few articles discuss the outside-in innovation process involving the crowd as a potential element in the

open innovation process as an idea generator (Franzoni and Sauermann, 2014) or provider of data analysis (Martinez and Walton, 2014).

These publications in this cluster reveal the multi-level position roles of innovation intermediaries. This was mentioned in one of the previous clusters, but this cluster specifically examines this in the open innovation context. Roles supporting product development as an internet-based innovation intermediary, services connection innovation provider and innovation seeker are included at the firm level (Chesbrough and Brunswicker, 2014, Colombo et al., 2015, Dong and Pourmohamadi, 2014, Martinez and Walton, 2014); the role of facilitating inter-firm connections as a coordinator in collaborative projects occurs at the industry level (Franzoni and Sauermann, 2014, Harland and Nienaber, 2014), while the role of policy maker in national innovation systems or cross-industry brokerage takes place at the national level (Wang et al., 2012).

As open innovation mostly happens in large companies, as stated by Chesbrough and Brunswicker (2014), the role of an innovation intermediary is discussed as facilitating technology sharing in corporations or business groups (Skold and Karlsson, 2012, Lin et al., 2016).

Discussion

The previous section has clustered and reviewed all of the publications related to innovation intermediaries. This section will further explore the roles identified and the functions that are embedded within the roles. The roles arrangement was generated based on the cluster's titles, which reflect development in the trends of innovation management research. We have identified the roles of innovation intermediaries as: 1) knowledge/technology broker; 2) knowledge/technology transfer enabler; 3) orchestrator; and 4) open innovation facilitator.

Along with the identified roles of innovation intermediaries, we attempted to present the functions for each role and extended the function exploration into three levels where the innovation intermediary is employed. Informed by Kivimaa (2014) research and multi-level perspectives in open innovation research (West et al., 2014), we identify three levels of engagement of the role of innovation management: system, sector/industry, and firm. These levels of innovation intermediary services utilization compromise systematic intermediaries, as mentioned regarding the establishment of different level actors' arrangements to support innovation transitions.

At the system level, innovation intermediaries connect all elements of nation-specific contexts. Research on this level is related to national system innovation (Wang et al., 2012, Shapiro et al., 2010, Watkins et al., 2015) and the triple helix model (Johnson, 2008), mostly exploring government and related agencies' support of innovation through regulation, standard setting, public-private partnerships and funding of basic research (Dong and Pourmohamadi, 2014). Research at the industry level is more focused on the innovation intermediary's role within industry-specific contexts, such as biotechnology (Chen et al., 2015, Fontes, 2007), manufacture (Adams et al., 2013, Skold and Karlsson, 2012), renewable energy (Loya and Rawani, 2016, Schreuer et al., 2010), and agriculture (Klerkx and Leeuwis, 2009). Lastly, research at the firm level consists of firms which generate commercial innovations through experimentation, R&D, and product improvement (Colombo et al., 2015, Dong and Pourmohamadi, 2014, Harland and Nienaber, 2014, Holzmann et al., 2014).

INSERT TABLE 3 HERE

The role of a knowledge/technology broker for an innovation intermediary is related to third parties and facilitates the ability of firms to seek out potential partners, resources and capabilities to engage in collaboration. At the firm level, the innovation intermediary functions to enable and facilitate joint development projects. The innovation intermediary

links organizations and may coordinate and control the exchange of information and resources within networks. “This engagement allows collaboration between members Mostly occurring in the biotechnology sector, the role of innovation intermediaries at the industry level serves to form alliances and assist in vertical integration.

Vertical integration involves relatively distinct sets of activities, such as a biotechnology firm conducting research and development, then transferring the output to a pharmaceutical company for further development or marketing the product (Stuart et al., 2007). In some cases, the innovation intermediary also engages in university and industry linkages through science and technology parks (Diez-Vial and Montoro-Sanchez, 2016) or industry associations (Watkins et al., 2015). Similar to an innovation capitalist, an innovation intermediary may also facilitate IP-related issues, including licensing and reassignment. Moving up to the network level, the innovation intermediary has a function in network development. At the national level, the innovation intermediary’s role in alliance and transaction formation is to facilitate innovation diffusion enabled by policy makers or governments. The innovation outcome should have an economic and social impact; the government can incentivize innovation intermediaries that construct alliances and facilitate these outcomes via the production of supportive policies.

The innovation intermediary’s second role is a knowledge and technology transfer proponent. This role is related to activities combining knowledge and technologies. At the firm level, the innovation intermediary’s function is to facilitate inter-firm knowledge/technology transfers. The knowledge transfer office plays this role by transferring a university’s research results / products to industry for further development or commercialization. Technological innovation thus induces social innovation and vice versa (Raven et al., 2010). At the industry level, the innovation intermediary functions strategically in understanding and predicting social and technological regimes that govern across

institutions. This function serves to anticipate the social changes that will occur when a new technology is released on the market. The result is related to the innovation intermediary's function at the national level in planning sustainability transition in accordance with new socio-technological (the intersection of society and technology) visions.

The third role we have identified is that of innovation orchestrator. This role is related to the management of elements of innovation networks. Nambisan and Sawhney (2011) stated that the innovation intermediary's role as an orchestrator is included in network-centric innovation. In our view, this orchestrator role comprises all previously explained roles: matchmaking, alliance formation, and knowledge integration. It aligns with Klerkx and Aarts (2013) definition of orchestrator activities as demand articulation, network composition (matchmaking and alliances), and innovation process management (integration and management).

At the firm level, the innovation intermediary's function is to build social capital. Social capital at the firm level is related to the accumulation of resources connected to external parties. Some of the authors have used term 'relational asset' as another way to express these valuable external relationships (Kim et al., 2010, Caiazza and Volpe, 2017). At the industry level, the innovation intermediary's role [in the government?] is to create institutional arrangements or policies to facilitate network formation and establish platforms to achieve strong collaboration, mutual relationships, and a market for network actors. We prefer to label these activities as ecosystem building. At the national level, the innovation intermediary's role as an orchestrator functions to build a collaboration model that arranges various combinations of actors, their roles and the ties between them. The biggest innovation intermediary at the national level is the government, creating policies to develop and facilitate a culture of collaboration.

Lastly, the role of innovation intermediary is related to open innovation practices. From an open innovation perspective, the innovation process is distributed internally and externally. This makes it important to find the right partner to share in collaborative work. Innovation intermediaries with an internet platform, like InnoCentive's, have a network of innovators. This type of intermediary does not perform any technical work; instead, they connect innovation seekers and innovation providers (Dong and Pourmohamadi, 2014).

The innovation intermediary at the firm level in the open innovation context supports external knowledge seeking and matching. Creating a supply-demand network in a particular industry to facilitate the transfer of knowledge, technology and resources could assist in the development of an innovation market and support innovation processes for members. To support matchmaking at the national level, the innovation intermediary has the role of building the national IT infrastructure. With IT-based connections, current knowledge may be stored and used for future innovation.

Directions for future research

Innovation intermediaries' roles have changed in response to global challenges and the proliferation of technology. Based on the current innovation intermediary's roles that were explored in the previous section, we have identified four research gaps for every innovation intermediary's role and potential for further research development. Along with each gap, we purpose research questions and the corresponding theoretical background.

INSERT TABLE 4 HERE

Develop a more comprehensive understanding of linking different levels of innovation implementation.

The source of organizations' innovation has shifted from internal initiatives to dyadic external collaboration, and now relies on network–centric innovation (Nambisan and Sawhney, 2011, Billington and Davidson, 2013).

The role of the innovation intermediary as a knowledge broker emphasizes the linking functions, detecting unexplored structural holes and attempting to build new bridges (Quintane and Carnabuci, 2016). As innovation management has evolved toward openness, the innovation intermediary has recently tended to play more of a role in networks than in one-to-one relationships. However, only a few studies have focused on the role of the innovation intermediary in linking different levels of networks.

Innovation intermediaries play a critical role in helping organizations, particularly SMEs, to overcome difficulties in creating innovation in the face of resource and competency constraints. Transitioning from a closed business model to an open business model makes it all the more imperative for SMEs to address their potential for innovation within the context of the overall innovation ecosystem, which consists of micro-innovation systems, ecologies of innovation and social technologies. The roles of the innovation intermediary within this ecosystem are to link organizations and serve as integrators and brokers (Chataway et al., 2010). At the national level, the innovation intermediary's role is related to facilitating institutional arrangements that increase the public wealth.

The trend in innovation management research toward openness and the proliferation of internet technology create research opportunities to understand the relationships among players, including policy makers, SMEs, corporations, financial institutions, incubators or accelerators. It is also important to investigate the physical and non-physical infrastructure of a country to develop a national institutional arrangement that allows innovation activity from various types of innovation intermediaries.

Enhance focus on the roles of innovation intermediaries in transition management as part of knowledge/technology transfer

With the proliferation of internet technology, a firm can connect with various entities and link into networks around the world. As a part of these networks, firms exchange experiences, information and knowledge with other network members and initiate collaboration for innovation purposes. However to find and get access to the right partner within a network, firms need an intermediary that acts as a bridge, knowledge/technology broker or consultant to achieve effective performance of innovation collaboration.

Although scholars have begun to identify future research areas related to how intermediaries can facilitate and build fruitful collaborative networks during joint innovation processes (Huggins, 2010), the literature is still in its infancy about how this happens. How can collaborative networks and knowledge flows be developed and managed by innovation intermediaries? As such, future studies on innovation intermediaries within the network level should be more focused on how knowledge flows and new collaborations emerge over time. Such research might explore initial ideas, how knowledge is shared and evolves within collaborative networks in response to innovation challenges, how these changes generate new directions for organizations and how organizations in networks collaborate and react to idea generation. One line for future research is the study of the role of the innovation intermediary as a social network builder or collaborative network developer by showing how the transfer of knowledge occurs within and across firms.

Related to knowledge transfer roles, recent research in the transition management role of innovation intermediaries has been growing. Innovation intermediaries' role as part of transition management mainly focus on strategic niche management, a strategy to develop instruments for governing transitions in socially desirable directions (Raven et al., 2010, Schreuer et al., 2010). Strategic niche management refers to the creation and nurturing of

protected spaces for promising technology to facilitate ongoing interactive learning of participating actors (Schreuer et al., 2010). It is still unclear what the innovation intermediary's role is during this transition process; more empirical research will contribute to greater understanding of the process and developing a toolkit to support it. Moreover, ensuring a multi-level view of this research topic will facilitate a more comprehensive understanding of transition management.

Along with transition management, it is necessary to consider the importance of the business model intermediary and the role of knowledge brokerage role of knowledge brokerage in the context of business model heterogeneity (Nair et al., 2012, Frykfors and Jonsson, 2010). This kind of research is best performed at the national level. The parties involved in transition management have different goals, yet need a strategy for collaboration and a good implementation plan in order for everyone to gain maximal value. Future research may address business models geared toward increasing the value created for all parties, increasing the social impact of new technology implementation, and increasing the wealth of a nation.

Leverage the understanding on the role of the corporation as an innovation intermediary orchestrator

Research in inter-firms relations and alliances based on social network analysis has acknowledged the role of hub-firms at the center of many networks in the formation, growth and success of the network. Our analysis indicates that while interest in the orchestration role of intermediaries seems have increased, few scholars are working to connect innovation research with the various elements of the orchestration role of innovation intermediaries, indicating that this orchestrating role is not fully considered an innovation intermediary role. Orchestration encompasses 'knowledge mobility, innovation appropriability, and network

stability' (p. 659, Dhanaraj and Parke, 2006). Informed by Dhanaraj and Parke (2006), we see the role of orchestration as the group of deliberate, purposeful actions of the innovation intermediary seeking to create and expand value from the network, both expanding and extracting more of the available 'pie'.

Playing the role of an orchestrator, the hub firm could be an integrator or a platform leader with different functions (Nambisan and Sawhney, 2011). In this situation, a hub firm is a corporation that tries to build an ecosystem to coordinate, influence and/or direct other firms in the innovation network. As an innovation integrator, the established firm owns the core technology, then invites the network's members to develop and innovate different components for technology product development. The theories underpinning this role are related to product architecture, engineering design, and manufacturing (Gawer, 2014). Meanwhile as a platform leader, an established firm offers the basic technology architecture, which then becomes a platform for other network members to build and develop products of their own innovation. The theory foundation of this concept is economic (Gawer, 2014) and social network theory (Nambisan and Sawhney, 2011). The corporation that plays the role of a hub firm is an innovation intermediary for the other network members and for the firm itself. However it is still unclear how the established firm plays its role as an innovation intermediary.

Some research has focused on how the orchestrator provides benefits to its members (Laten, 2013, Klerkx, 2013), however the outcome of the orchestration role in innovation networks for all members is still unclear. For guidance, the creation concept can be used to understand how the innovation intermediary creates value by orchestrating an innovation network for its members.

At this time, research utilizing social network analysis to determine how the structural position of a firm in a network is related to its impact on innovation outcomes has been

increasing. Networking is believed to leverage a firms ties, whether they are strong or weak. Studies regarding a firm's presence in an innovation network and its impact on innovation performance have had mixed results; outcomes appear to depend on network partners. More research is needed in order to understand the innovation intermediary's role of orchestration in innovation appropriability and network stability at the industry and organizational level.

Another area for future research is in exploring the orchestration role of intermediaries as part of innovation systems. Innovation intermediaries can be private or public where the government supports their existence (Bakici et al., 2013). Public innovation intermediaries have additional roles compared to private firms. The differences are mainly with regard to its focus on orchestration to support the development of start-up companies or actors in rural areas (Dutrenit et al., 2012) where one of their tasks is facilitating the funding of solutions for their clients (Inkinen and Suorsa, 2010). In contrast, the private innovation intermediary's main job is finding solutions for clients. Public innovation intermediaries contribute to building and activating ecosystems, in addition to providing structure and governance of the ecosystem (Bakici et al., 2013). Additionally, the public innovation intermediary's role is to know 'what works' regarding instruments for designing interventions. Therefore, such intermediaries' orchestration role is to know about future technology initiatives in order for innovation to flourish in particular systems. It is still unclear what capabilities a public innovation intermediary must have in terms of the orchestration role in order to face all of the challenges within innovation systems.

Direct increased attention to the role of innovation intermediaries towards facilitating openness

The review of earlier work suggests that new types of innovation intermediaries will continually emerge in the context of open innovation. When a firm involves the user in its

innovation process, the innovation intermediary supports the communication process to understand the user requirements for a product (Hauge and Power, 2013). On the other hand, the innovation intermediary also facilitates managing projects and communicates with users or clients in a variety of ways (Chen and Tseng, 2010, Chen, 2011, Myoken, 2010). Work by Boon et al. (2011) indicates three challenges for intermediaries. The first challenge is positioning; the innovation intermediary should decide the position it wants to take, considering that it will relate to many actors and balance the interests of the organization. It may take a neutral, impartial, coordinating or more activist role. Secondly, there is the issue of representation. The innovation intermediary must have the capability to speak on behalf of their members and present their demands in representative ways. Thirdly, with regard to the level of proactivity, the innovation intermediary's role depends on its ability to be familiar with different situations and contexts. It should proactively clarify what clients expect and assume in relation to the innovation intermediary's roles. Theoretically, researchers have analyzed the benefits of intermediaries that can accumulate from involvement with various kinds of users to address these challenges. The open innovation and intermediary literature has integrated these ideas, resulting in growing interest from innovation scholars and users as well as policy makers. However, it is not clear how these three challenges influence the role of the innovation intermediary.

Furthermore, the analysis reveals that the discussion of the role of innovation intermediaries in open innovation is largely limited to firm level implementation that focuses on searching for ideas for innovation; most of the research is related to crowdsourcing (Colombo et al., 2015, Dong and Pourmohamadi, 2014, Harland and Nienaber, 2014, Holzmann et al., 2014, Katzy et al., 2013, Lin et al., 2016, Martinez and Walton, 2014, Matsuno et al., 2014, Montelisciani et al., 2014), with only a few studies focusing on wider concerns in how implementation of those external externally sourced innovations align with a

firm's internal process (Colombo, 2014). Research in aligning open innovation results to a firm's business model, as suggested by Chesbrough (2010), has just been started to be explored. To address this gap, more research is needed to develop an understanding on the role of an innovation intermediary to support business model alignment with open innovation implementation.

Some research has extended open innovation implementation to a higher level, such as industry, sector and national systems. In these levels, the government plays an important role in producing policies facilitating innovation at every level of implementation (Wang et al., 2012). The proliferation of information technology can facilitate government efforts to reach a wider network size (Tsekouras et al., 2013, Bakici et al., 2013). However, this has been the subject of only limited research focus. Therefore, research that explores how the government play a role in encouraging firms to work together in multi-partner innovation collaborations using information technology has the opportunity to more developed in the future.

Research regarding collaboration has identified communities as an important element of innovation. According to (Bakici, 2013), it is a challenge to connect and engage communities in an innovation ecosystem. Public open innovation intermediaries can play a role, but less research has focused on how the structure and governance of ecosystems in communities may be involved in the innovation process.

The more that users/ online participants succeed in developing innovative ideas, the more challenging it is for firms to keep track of authorship. In this situation, the role of innovation intermediaries becomes crucial in facilitating open innovation processes and ensuring proper management of intellectual property issues. For example, who owns the authorship of submitted ideas that were developed over time through co-creation processes with online solvers and the focal firm? When and how is it appropriate to share or protect

users' ideas is a timely and important research question in this regard. In summary, the impact of the open innovation model on the innovation-related roles of innovation intermediaries is to ensure the transparency of IP-related issues, the success of innovation and governance structures, as well as assisting cooperative behavior, which are far from being clear and require further research.

Conclusions and limitations

This study reviews the literature on innovation intermediary research, showing the growing relevance of this academic field and identifies opportunities for future research. By conducting a literature review using bibliographic coupling to synthesize the literature, this review complements and further develops insights from previous reviews conducted with a more qualitative approach.

This study shows that literature published in this research area can be clustered into four topic groups that represent the role of innovation intermediaries: 1) knowledge broker; 2) knowledge transfer enabler; 3) orchestrator; and 4) open innovation facilitator. From those clusters, we built a framework to understand the widening role of innovation intermediaries corresponding with innovation management research development. The framework also shows the functions that are embedded with the roles of innovation intermediaries in multilevel positions where innovation management is employed. From this, we have identify various opportunities for future research activities.

The focus of previous studies has largely been on the knowledge broker role of the innovation intermediary, investigating innovation networks and alliances from the firm's perspective. In order to gain a more holistic view of the knowledge broker role of innovation intermediaries, research must incorporate system and industry perspectives in addition to the firm's perspective. Other areas to direct attention include investigating the orchestrating role

of intermediaries and the associated value capture and understanding innovation intermediaries in the context of open innovation through emphasis on business model development, innovation ecosystem development and conceptualizing 'open business model innovation'.

Our study supports Gobbo and Olsson's (2010) research stating that innovation intermediaries play a role at different levels of analysis facilitate vertical and horizontal cooperation (Zeng et al., 2010). It also confirms that the ways intermediaries support a firm's innovation develop [change] along with innovation management practices, moving from firm-centric to network-centric and systemic to ecosystem-focused.

Implications for managerial practice

Understanding the role of innovation intermediaries is critical to understand innovation. Firms involving intermediaries in their innovation processes are required to carefully consider the organizational factors that will enable effective intermediation in order to enhance innovation outcomes. Prior to engaging with innovation intermediaries and identifying the most appropriate one(s), it will be important for managers to define the specific requirements of the intermediary based on which stage of the innovation process they are at and the network level that they want to engage with. Firms may create lists of the needs, priorities and working styles that take account of both their circumstances and the innovation intermediaries' services. This will allow them to engage with intermediaries possessing the appropriate resources and capabilities to address their specific organizational challenges.

Innovation intermediary organizations need to be aware of the different types of networks they might be creating (e.g. professional network, supply chain network, or network of communities) and, depending on the expertise and capabilities of both the intermediary

and other institutions linked within the network, define the appropriate position for intermediary itself within different networks. This will enhance their ability to influence network activities and enhance the outcomes of the innovation initiatives they intermediate.

The lack of understanding of the innovation intermediaries' capabilities, business models and working styles make it difficult for firms to either strategically invest or measure returns from their connection with innovation intermediaries. The findings from this paper provide an initial platform towards tackling these challenges.

References

AALBERS, H. L. & DOLFSMA, W. 2015. Bridging firm-internal boundaries for innovation: Directed communication orientation and brokering roles. *Journal of Engineering and Technology Management,* 36**,** 97-115.

ADAMS, P., FONTANA, R. & MALERBA, F. 2013. The magnitude of innovation by demand in a sectoral system: The role of industrial users in semiconductors. *Research Policy,* 42**,** 1-14.

ALEXANDER, A. T. & MARTIN, D. P. 2013. Intermediaries for open innovation: A competence-based comparison of knowledge transfer offices practices. *Technological Forecasting and Social Change,* 80**,** 38-49.

ARORA, S. K., FOLEY, R. W., YOUTIE, J., SHAPIRA, P. & WIEK, A. 2014. Drivers of technology adoption - the case of nanomaterials in building construction. *Technological Forecasting and Social Change,* 87**,** 232-244.

BAKICI, T., ALMIRALL, E. & WAREHAM, J. 2013. The role of public open innovation intermediaries in local government and the public sector. *Technology Analysis & Strategic Management,* 25**,** 311-327.

BALDWIN, C. & VON HIPPEL, E. 2011. Modeling a Paradigm Shift: From Producer Innovation to User and Open Collaborative Innovation. *Organization Science,* 22**,** 1399-1417.

BATTISTELLA, C., DE TONI, A. F. & PILLON, R. 2015. The Extended Map methodology: Technology roadmapping for SMES clusters. *Journal of Engineering and Technology Management,* 38**,** 1-23.

BENASSI, M. & DI MININ, A. 2009. Playing in between: patent brokers in markets for technology. *R & D Management,* 39**,** 68-86.

BIDWELL, M. & FERNANDEZ-MATEO, I. 2010. Relationship Duration and Returns to Brokerage in the Staffing Sector. *Organization Science,* 21**,** 1141-1158.

BILLINGTON, C. & DAVIDSON, R. 2013. Leveraging Open Innovation Using Intermediary Networks. *Production and Operations Management,* 22**,** 1464-1477.

BOARI, C. & RIBOLDAZZI, F. 2014. How knowledge brokers emerge and evolve: The role of actors' behaviour. *Research Policy,* 43**,** 683-695.

BOON, W. P. C., MOORS, E. H. M., KUHLMANN, S. & SMITS, R. E. H. M. 2011. Demand articulation in emerging technologies: Intermediary user organisations as co-producers? *Research Policy,* 40**,** 242-252.

BOYACK, K. W. & KLAVANS, R. 2010. Co-citation analysis, bibliographic coupling, and direct citation: Which citation approach represents the research front most accurately? *Journal of the American Society for Information Science and Technology,* 61**,** 2389-2404.

BURT, R. S. 1992. *THE SOCIAL-STRUCTURE OF COMPETITION,* Boston, Harvard Business School Press.

CAIAZZA, R. & VOLPE, T. 2017. Innovation and its diffusion: process, actors and actions. *Technology Analysis & Strategic Management,* 29**,** 181-189.

CAVIGGIOLI, F. & UGHETTO, E. 2013. The drivers of patent transactions: corporate views on the market for patents. *R & D Management,* 43**,** 318-332.
CHATAWAY, J., HANLIN, R., MUGWAGWA, J. & MURAGURI, L. 2010. Global health social technologies Reflections on evolving theories and landscapes. *Research Policy,* 39**,** 1277-1288.
CHEN, C.-Y. 2011. Managing projects from a client perspective: The concept of the meetings-flow approach. *International Journal of Project Management,* 29**,** 671-686.
CHEN, S. & TSENG, M. M. 2010. A Negotiation-Credit-Auction mechanism for procuring customized products. *International Journal of Production Economics,* 127**,** 203-210.
CHEN, S. H., EGBETOKUN, A. A. & CHEN, D. K. 2015. Brokering knowledge in networks: institutional intermediaries in the Taiwanese biopharmaceutical innovation system. *International Journal of Technology Management,* 69**,** 189-209.
CHESBROUGH, H. 2003. The Era of Open Innovation. *MIT Sloan Management Review*.
CHESBROUGH, H. 2010. Business Model Innovation: Opportunities and Barriers. *Long Range Planning,* 43**,** 354-363.
CHESBROUGH, H. & BRUNSWICKER, S. 2014. A Fad or a Phenomenon? The Adoption of Open Innovation Practices in Large Firms. *Research-Technology Management,* 57**,** 16-25.
CLAUSEN, T. & RASMUSSEN, E. 2011. Open innovation policy through intermediaries: the industry incubator programme in Norway. *Technology Analysis & Strategic Management,* 23**,** 75-85.
COHEN, W. M. & LEVINTHAL, D. A. 1990. ABSORPTIVE-CAPACITY - A NEW PERSPECTIVE ON LEARNING AND INNOVATION. *Administrative Science Quarterly,* 35**,** 128-152.
COLLINSON, S., KATO, H. & YOSHIHARA, H. 2005. Technology strategy revealed: patterns and influences of patent-licensing behaviour in Japanese firms. *International Journal of Technology Management,* 30**,** 327-350.
COLOMBO, G., DELL'ERA, C. & FRATTINI, F. 2015. Exploring the contribution of innovation intermediaries to the new product development (NPD) process: a typology and an empirical study. *R & D Management,* 45**,** 126-146.
DIEZ-VIAL, I. & MONTORO-SANCHEZ, A. 2016. How knowledge links with universities may foster innovation: The case of a science park. *Technovation,* 50-51**,** 41-52.
DONG, A. & POURMOHAMADI, M. 2014. Knowledge matching in the technology outsourcing context of online innovation intermediaries. *Technology Analysis & Strategic Management,* 26**,** 655-668.
DUTRENIT, G., ROCHA-LACKIZ, A. & VERA-CRUZ, A. O. 2012. Functions of the Intermediary Organizations for Agricultural Innovation in Mexico: The Chiapas Produce Foundation. *Review of Policy Research,* 29**,** 693-712.
DUTT, N., HAWN, O., VIDAL, E., CHATTERJI, A., MCGAHAN, A. & MITCHELL, W. 2016. HOW OPEN SYSTEM INTERMEDIARIES ADDRESS INSTITUTIONAL FAILURES: THE CASE OF BUSINESS INCUBATORS IN EMERGING-MARKET COUNTRIES. *Academy of Management Journal,* 59**,** 818-840.
ECK, N. J. V. & WALTMAN, L. 2010. Software Survey: VOSviewer, A Computer Program for Bibliometric Mapping. *Scientometrics***,** 523-538.
FONTES, M. 2007. Technological entrepreneurship and capability building in biotechnology. *Technology Analysis & Strategic Management,* 19**,** 351-367.
FRANZONI, C. & SAUERMANN, H. 2014. Crowd science: The organization of scientific research in open collaborative projects. *Research Policy,* 43**,** 1-20.
FRYKFORS, C. O. & JONSSON, H. 2010. Reframing the multilevel triple helix in a regional innovation system: a case of systemic foresight and regimes in renewal of Skane's food industry. *Technology Analysis & Strategic Management,* 22**,** 819-829.
GAWER, A. 2014. Bridging differing perspectives on technological platforms: Toward an integrative framework. *Research Policy,* 43**,** 1239-1249.

GREDEL, D., KRAMER, M. & BEND, B. 2012. Patent-based investment funds as innovation intermediaries for SMEs: In-depth analysis of reciprocal interactions, motives and fallacies. *Technovation,* 32**,** 536-549.
GROZA, M. D., LOCANDER, D. A. & HOWLETT, C. H. 2016. Linking thinking styles to sales performance: The importance of creativity and subjective knowledge. *Journal of Business Research,* 69**,** 4185-4193.
HAKANSON, L., CAESSENS, P. & MACAULAY, S. 2011. InnovationXchange: A case study in innovation intermediation. *Innovation-Management Policy & Practice,* 13**,** 261-274.
HARLAND, P. E. & NIENABER, A. M. 2014. Solving the matchmaking dilemma between companies and external idea contributors. *Technology Analysis & Strategic Management,* 26**,** 639-653.
HAUGE, A. & POWER, D. 2013. Quality, difference and regional advantage: The case of the winter sports industry. *European Urban and Regional Studies,* 20**,** 385-400.
HODSON, M. & MARVIN, S. 2009. Cities mediating technological transitions: understanding visions, intermediation and consequences. *Technology Analysis & Strategic Management,* 21**,** 515-534.
HOLZMANN, T., SAILER, K. & KATZY, B. R. 2014. Matchmaking as multi-sided market for open innovation. *Technology Analysis & Strategic Management,* 26**,** 601-615.
HOWELLS, J. 2006. Intermediation and the role of intermediaries in innovation. *Research Policy,* 35**,** 715-728.
HUGGINS, R. 2010. Forms of Network Resource: Knowledge Access and the Role of Inter-Firm Networks. *International Journal of Management Reviews,* 12**,** 335-352.
HUTTER, K., HAUTZ, J., FULLER, J., MUELLER, J. & MATZLER, K. 2011. Communitition: The Tension between Competition and Collaboration in Community-Based Design Contests. *Creativity and Innovation Management,* 20**,** 3-21.
INKINEN, T. & SUORSA, K. 2010. Intermediaries in Regional Innovation Systems: High-Technology Enterprise Survey from Northern Finland. *European Planning Studies,* 18**,** 169-187.
JOHNSON, W. H. A. 2008. Roles, resources and benefits of intermediate organizations supporting triple helix collaborative R&D: The case of Precarn. *Technovation,* 28**,** 495-505.
KATZY, B., TURGUT, E., HOLZMANN, T. & SAILER, K. 2013. Innovation intermediaries: a process view on open innovation coordination. *Technology Analysis & Strategic Management,* 25**,** 295-309.
KIDWELL, D. K. 2013. Principal investigators as knowledge brokers: A multiple case study of the creative actions of PIs in entrepreneurial science. *Technological Forecasting and Social Change,* 80**,** 212-220.
KIM, K., CHOI, Y., CHOI, C. Y. & KIM, H. J. 2010. The role of intermediaries on technological risk management and business development performance in Korea. *Technological Forecasting and Social Change,* 77**,** 870-880.
KIRKELS, Y. & DUYSTERS, G. 2010. Brokerage in SME networks. *Research Policy,* 39**,** 375-385.
KIVIMAA, P. 2014. Government-affiliated intermediary organisations as actors in system-level transitions. *Research Policy,* 43**,** 1370-1380.
KLERKX, L. & AARTS, N. 2013. The interaction of multiple champions in orchestrating innovation networks: Conflicts and complementarities. *Technovation,* 33**,** 193-210.
KLERKX, L. & LEEUWIS, C. 2008. Balancing multiple interests: Embedding innovation intermediation in the agricultural knowledge infrastructure. *Technovation,* 28**,** 364-378.
KLERKX, L. & LEEUWIS, C. 2009. Establishment and embedding of innovation brokers at different innovation system levels: Insights from the Dutch agricultural sector. *Technological Forecasting and Social Change,* 76**,** 849-860.
KNOCKAERT, M., SPITHOVEN, A. & CLARYSSE, B. 2014. The impact of technology intermediaries on firm cognitive capacity additionality. *Technological Forecasting and Social Change,* 81**,** 376-387.

LANDRY, R., AMARA, N., CLOUTIER, J. S. & HALILEM, N. 2013. Technology transfer organizations: Services and business models. *Technovation,* 33**,** 431-449.
LEE, J. 2010. Heterogeneity, Brokerage, and Innovative Performance: Endogenous Formation of Collaborative Inventor Networks. *Organization Science,* 21**,** 804-822.
LEE, J. D. & PARK, C. 2006. Research and development linkages in a national innovation system: Factors affecting success and failure in Korea. *Technovation,* 26**,** 1045-1054.
LEE, S., PARK, G., YOON, B. & PARK, J. 2010. Open innovation in SMEs-An intermediated network model. *Research Policy,* 39**,** 290-300.
LIN, H., ZENG, S. X., LIU, H. J. & LI, C. 2016. How do intermediaries drive corporate innovation? A moderated mediating examination. *Journal of Business Research,* 69**,** 4831-4836.
LIN, Y. H. 2012. Knowledge brokering for transference to the pilot's safety behavior. *Management Decision,* 50**,** 1326-1338.
LISSONI, F. 2010. Academic inventors as brokers. *Research Policy,* 39**,** 843-857.
LOYA, M. I. M. & RAWANI, A. M. 2016. Strategic framework for commercialisation of fly ash innovations. *Technology Analysis & Strategic Management,* 28**,** 555-567.
MAIR, J., MARTI, I. & VENTRESCA, M. J. 2012. BUILDING INCLUSIVE MARKETS IN RURAL BANGLADESH: HOW INTERMEDIARIES WORK INSTITUTIONAL VOIDS. *Academy of Management Journal,* 55**,** 819-850.
MARTINEZ, M. G. & WALTON, B. 2014. The wisdom of crowds: The potential of online communities as a tool for data analysis. *Technovation,* 34**,** 203-214.
MAS-VERDU, F., ORTIZ-MIRANDA, D. & GARCIA-ALVAREZ-COQUE, J. M. 2016. Examining organizational innovations in different regional settings. *Journal of Business Research,* 69**,** 5324-5329.
MATSUNO, K., ZHU, Z. & RICE, M. P. 2014. Innovation Process and Outcomes for Large Japanese Firms: Roles of Entrepreneurial Proclivity and Customer Equity. *Journal of Product Innovation Management,* 31**,** 1106-1124.
MENDONCA, J. & HEITOR, M. 2016. The changing patterns of industrial production: How does it play for the Iberian Peninsula? *Technological Forecasting and Social Change,* 113**,** 293-307.
MONTELISCIANI, G., GABELLONI, D., TAZZINI, G. & FANTONI, G. 2014. Skills and wills: the keys to identify the right team in collaborative innovation platforms. *Technology Analysis & Strategic Management,* 26**,** 687-702.
MYOKEN, Y. 2010. Demand-orientated policy on leading-edge industry and technology: public procurement for innovation. *International Journal of Technology Management,* 49**,** 196-219.
NAIR, S., NISAR, A., PALACIOS, M. & RUIZ, F. 2012. Impact of knowledge brokering on performance heterogeneity among business models. *Management Decision,* 50**,** 1649-1660.
NAMBISAN, S., BACON, J. & THROCKMORTON, J. 2012. The Role of the Innovation Capitalist in Open Innovation A Case Study and Key Lessons Learned. *Research-Technology Management,* 55**,** 49-57.
NAMBISAN, S. & SAWHNEY, M. 2011. Orchestration Processes in Network-Centric Innovation: Evidence From the Field. *Academy of Management Perspectives,* 25**,** 40-57.
OBSTFELD, D. 2005. Social networks, the Tertius lungens and orientation involvement in innovation. *Administrative Science Quarterly,* 50**,** 100-130.
PERSSON, O., DANELL, R. & SCHNEIDER, J. W. 2009. How to use Bibexcel for various types of bibliometric analysis. *In:* ASTROM, F., DANELL, R., LARSEN, B. & SCHNEIDER, J. W. (eds.) *Celebrating Scholarly Communication Studies.* International society for scientometrics and informetrics.
PIHL, C. & SANDSTROM, C. 2013. Value creation and appropriation in social media - the case of fashion bloggers in Sweden. *International Journal of Technology Management,* 61**,** 309-323.
POWELL, W. W., KOPUT, K. W. & SMITHDOERR, L. 1996. Interorganizational collaboration and the locus of innovation: Networks of learning in biotechnology. *Administrative Science Quarterly,* 41**,** 116-145.

QUINTANE, E. & CARNABUCI, G. 2016. How Do Brokers Broker? Tertius Gaudens, Tertius Iungens, and the Temporality of Structural Holes. *Organization Science,* 27**,** 1343-1360.
RAVEN, R., VAN DEN BOSCH, S. & WETERINGS, R. 2010. Transitions and strategic niche management: towards a competence kit for practitioners. *International Journal of Technology Management,* 51**,** 57-74.
RITTER, T. & WALTER, A. 2003. Relationship-specific antecedents of customer involvement in new product development. *International Journal of Technology Management,* 26**,** 482-501.
RONG, K., HU, G. Y., HOU, J., MA, R. F. & SHI, Y. J. 2013. Business ecosystem extension: facilitating the technology substitution. *International Journal of Technology Management,* 63**,** 268-294.
RYALL, M. D. & SORENSON, O. 2007. Brokers and competitive advantage. *Management Science,* 53**,** 566-583.
SANDMEIER, P. 2009. Customer integration strategies for innovation projects: anticipation and brokering. *International Journal of Technology Management,* 48**,** 1-23.
SCHREUER, A., ORNETZEDER, M. & ROHRACHER, H. 2010. Negotiating the local embedding of socio-technical experiments: a case study in fuel cell technology. *Technology Analysis & Strategic Management,* 22**,** 729-743.
SHAPIRO, M. A., SO, M. & PARK, H. 2010. Quantifying the national innovation system: inter-regional collaboration networks in South Korea. *Technology Analysis & Strategic Management,* 22**,** 845-857.
SIEG, J. H., WALLIN, M. W. & VON KROGH, G. 2010. Managerial challenges in open innovation: a study of innovation intermediation in the chemical industry. *R & D Management,* 40**,** 281-291.
SKOLD, M. & KARLSSON, C. 2012. Technology Sharing in Manufacturing Business Groups. *Journal of Product Innovation Management,* 29**,** 113-124.
SPITHOVEN, A., CLARYSSE, B. & KNOCKAERT, M. 2010. Building absorptive capacity to organise inbound open innovation in traditional industries. *Technovation,* 30**,** 130-141.
SPITHOVEN, A. & KNOCKAERT, M. 2012. Technology intermediaries in low tech sectors: The case of collective research centres in Belgium. *Innovation-Management Policy & Practice,* 14**,** 375-387.
STEENSMA, H. K., CHARI, M. & HEIDL, R. 2016. A Comparative Analysis of Patent Assertion Entities in Markets for Intellectual Property Rights. *Organization Science,* 27**,** 2-17.
STUART, T. E., OZDEMIR, S. Z. & DING, W. W. 2007. Vertical alliance networks: The case of university-biotechnology-pharmaceutical alliance chains. *Research Policy,* 36**,** 477-498.
TAHERI, M. & VAN GEENHUIZEN, M. 2016. Teams' boundary-spanning capacity at university: Performance of technology projects in commercialization. *Technological Forecasting and Social Change,* 111**,** 31-43.
TAI, S. & DAVIDS, M. 2016. Evolving roles and dynamic capabilities of an innovation agency: the Dutch Rijksnijverheidsdienst, 1910-1940. *Technology Analysis & Strategic Management,* 28**,** 614-626.
TRAN, Y., HSUAN, J. & MAHNKE, V. 2011. How do innovation intermediaries add value? Insight from new product development in fashion markets. *R & D Management,* 41**,** 80-91.
TSEKOURAS, G., KANELLOU, D. & RAI, N. 2013. Redefining learning networks through ICT capabilities: representations, behaviours and intermediation strategies. *Technology Analysis & Strategic Management,* 25**,** 257-279.
VAN DEN BERG, W. E., VERBEKE, W., BAGOZZI, R. P., WORM, L., DE JONG, A. & NIJSSEN, E. 2014. Salespersons as Internal Knowledge Brokers and New Products Selling: Discovering the Link to Genetic Makeup. *Journal of Product Innovation Management,* 31**,** 695-709.
VILLANI, E., RASMUSSEN, E. & GRIMALDI, R. 2017. How intermediary organizations facilitate university-industry technology transfer: A proximity approach. *Technological Forecasting and Social Change,* 114**,** 86-102.

VIVAS, C. 2016. Commercializing technological research and skills: drivers from European technology institutes. *Innovation-Management Policy & Practice,* 18**,** 389-410.
VOGEL, R. & GUETTEL, W. H. 2013. The Dynamic Capability View in Strategic Management: A Bibliometric Review. *International Journal of Management Reviews,* 15**,** 426-446.
VRGOVIC, P., VIDICKI, P., GLASSMAN, B. & WALTON, A. 2012. Open innovation for SMEs in developing countries - An intermediated communication network model for collaboration beyond obstacles. *Innovation-Management Policy & Practice,* 14**,** 290-302.
WANG, D. 2015. Activating Cross-border Brokerage: Interorganizational Knowledge Transfer through Skilled Return Migration. *Administrative Science Quarterly,* 60**,** 133-176.
WANG, Y., VANHAVERBEKE, W. & ROIJAKKERS, N. 2012. Exploring the impact of open innovation on national systems of innovation - A theoretical analysis. *Technological Forecasting and Social Change,* 79**,** 419-428.
WATKINS, A., PAPAIOANNOU, T., MUGWAGWA, J. & KALE, D. 2015. National innovation systems and the intermediary role of industry associations in building institutional capacities for innovation in developing countries: A critical review of the literature. *Research Policy,* 44**,** 1407-1418.
WEST, J., SALTER, A., VANHAVERBEKE, W. & CHESBROUGH, H. 2014. Open innovation: The next decade. *Research Policy,* 43**,** 805-811.
WURMSEHER, M. 2017. To each his own: Matching different entrepreneurial models to the academic scientist's individual needs. *Technovation,* 59**,** 1-17.
YUSUF, S. 2008. Intermediating knowledge exchange between universities and businesses. *Research Policy,* 37**,** 1167-1174.
ZENG, S. X., XIE, X. M. & TAM, C. M. 2010. Relationship between cooperation networks and innovation performance of SMEs. *Technovation,* 30**,** 181-194.
ZHANG, Y. & LI, H. Y. 2010. INNOVATION SEARCH OF NEW VENTURES IN A TECHNOLOGY CLUSTER: THE ROLE OF TIES WITH SERVICE INTERMEDIARIES. *Strategic Management Journal,* 31**,** 88-109.
ZUPIC, I. & CARTER, T. 2014. Bibliometric Methods in Management and Organization. *Organizational Research Methods*.