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La gestión de la innovación abierta en las pymes: Retos, tendencias y oportunidades para competir en el mercado

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TESIS DOCTORAL

Programa de Doctorado en Economía y Derecho

La gestión de la innovación abierta en las pymes: Retos, tendencias y oportunidades para competir en el mercado

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Abstract

The purpose of this thesis is to investigate the influence of open innovation practices in the performance of small and medium enterprises (SMEs). Increasingly, SMEs have a more relevant role in the economy. Not surprisingly, both academics and policymakers are devoting time and resources to their study, promoting them as key drivers for economic growth and the consolidation of local and regional economies (Ayandibu & Houghton 2017; Zafar & Mustafa 2017; Ormazabal et al. 2018; Yun et al. 2019; Yun & Liu, 2019). This thesis contributes to this stream of the literature with new evidence by means of three independent, yet interconnected studies.

In a globalised and dynamic world, SMEs strive to survive. They do not only have to compete for a market share with large corporations, but also have to ensure they generate revenues, being financially sustainable (Oke et al., 2007; Bayarçelik et al., 2014). To achive this goal, innovation becomes a must-do strategy. The marketplace is characterized by an offer that is larger than the demand, where the consumer has the final say. Within this context, companies need to focus all their efforts very well and anticipate to customer's needs, offering products and/or services that meet their expectations. Although investments in R&D are typically linked to substantial economic efforts (Battaglia et al. 2018; Booltink y Saka-Helmhout 2018; Colclough et al., 2019), in recent years, the paradigm of open innovation has appeared as an alternative and a more attractive solution.

Open innovation combines the internal knowledge of a company with ideas and opportunities from the outside. The introduction of open innovation practices in a company requires changes in the business model, ensuring a proper alignment at the strategic, operational and organizational levels. Likewise, an active network with other agents of the ecosystem (e.g., other companies, suppliers, research institution, universities, public adminsitration) are necessary in order to exchange information, so that the final result is greater than the sum of the individual parts.

Although the literature on open innovation is extensive, its specific application in SMEs is limited. In fact, most of the principles of open innovation have been studied in large corporations. SMEs have a more flexible structure and their decision-making processes are

shorter (Lee et al., 2010), henceforth, it should be easier for them to adapt and incorporate new practices. Research in this direction is still scarce with existing studies providing inconclusive results (Hossain and Anees-ur-Rehman, 2016; Wikhamn et al., 2016). Accordingly, new studies are necessary to shed new light on how this type of businesses are adopting the principles of open innovation, the benefits it brings to the firms, the impact in their performance and the challenges ahead.

This dissertation addresses the above issues by means of three independent that are highly related but delve into this topic from different perspectives. The first study (article 1) scrutinizes the existing literature on open innovation in SMEs, offering a complete and updated picture of the main contributions of the academic world on this subject. The second study (article 2) builds upon the first article, and investigates how the business model is modified as a result of the introduction of open innovation practices in the company as well as the impact on the performance. A multiple case study is conducted to answer these questions. Finally, the third study (article 3), complements the previous by adopting a causal complexity approach. Specifically, this article examines the combined effect of open innovation practices, the own characteristics of the company and its innovation strategy. The ultimate goal is to unveil the underlying patterns that SMEs can follow to remain competitive in the marketplace.

The thesis ends with the discussion of the main conclusions and implications, which are expected to help SMEs to make better strategic decisions that minimize their potential risks and maximize the use of their resources. Indications for future research avenues are outlined at the end of this dissertation.

Resumen

Esta tesis tiene por objetivo investigar cómo las prácticas de innovación abierta en las pequeñas y medianas empresas (pymes) influyen su rendimiento. Cada vez más, dichas empresas tienen un papel más relevante en la economía. No es de extrañar que tanto académicos como los organismos encargados de definir políticas legales y económicas dediquen recursos y programas a su estudio e impulso para asegurar su presencia y consolidación en el tejido productivo del territorio (Ayandibu y Houghton 2017; Zafar y Mustafa 2017; Ormazabal et al. 2018; Yun et al. 2019; Yun y Liu, 2019). Esta tesis aporta nuevas evidencias a esta realidad a través de tres estudios.

En un contexto cada vez más global y dinámico, las pymes deben también competir para posicionarse en el mercado, pero al mismo tiempo luchar para ser financieramente rentables (Oke et al., 2007; Bayarçelik et al., 2014). En este punto, innovar se convierte en una obligación más que en una opción. Los mercados se caracterizan por una oferta muy amplia, donde el consumidor tiene la última palabra. Por ello, las empresas deben focalizar muy bien sus esfuerzos y poder anticiparse a las necesidades de los clientes, ofreciéndoles productos/servicios que cubran sus expectativas. Si bien la inversión en I+D+i acostumbra a venir acompañada de importantes esfuerzos económicos (Battaglia et al. 2018; Booltink y Saka-Helmhout 2018; Colclough et al., 2019), en los últimos años, la innovación abierta se presenta como una solución más atractiva, que combina el conocimiento interno de la propia empresa con ideas y oportunidades del exterior. Introducir prácticas de innovación abierta requiere de cambios en el modelo de negocio de una empresa, asegurando así un correcto alineamiento a nivel estratégico, operativo y organizativo. Así mismo, se necesita de una red activa con los demás agentes del ecosistema (e.g., otras empresas, proveedores, centros de investigación, universidades, administración pública, etc.) para interaccionar y compartir información, de manera que el resultado final sea mayor que la suma individual de las partes.

Si bien la literatura sobre innovación abierta es extensa, su aplicación concreta en las pymes es limitada. De hecho, la mayoría de los principios de innovación abierta se han estudiado en las grandes empresas. Sin embargo, las pymes tienen una estructura interna más flexible y los procesos de decisión son más cortos (Lee et al., 2010), por lo que teóricamente deberían estar más bien equipadas para adaptarse e incorporar nuevas prácticas. A parte de

incipiente, la literatura no es concluyente en este aspecto (Hossain y Anees-ur-Rehman, 2016; Wikhamn et al., 2016), siendo necesarios nuevos estudios sobre cómo esta tipología de empresas está adoptando los principios de la innovación abierta, los beneficios que les aporta, los retos que les supone y su impacto en el desempeño global de la empresa.

Esta tesis aborda las cuestiones anteriores a través de tres estudios independientes, pero a su vez, altamente relacionadas que ahondan en esta temática desde distintas perspectivas. En un primer estudio (artículo 1), se analiza la literatura existente sobre innovación abierta en pymes, ofreciendo una fotografía completa y actualizada sobre las principales aportaciones del mundo académico sobre esta temática. El segundo estudio (artículo 2), partiendo de la revisión anterior e incidiendo en unas de las líneas de investigación detectadas, se investiga cómo se modifica el modelo de negocio al introducir prácticas de innovación abierta, y su impacto en el desempeño de la empresa. Para ello se realiza un estudio de casos. Por último, el tercer estudio (artículo 3), complementa los dos anteriores, ofreciendo un nuevo punto de vista: el efecto combinado entre las prácticas de innovación abierta, las características de la propia empresa y su estrategia de innovación. El objetivo último es el de determinar distintos patrones que pueden seguir las pymes para mantener un buen desempeño empresarial según sus características.

La tesis finaliza con la discusión de las principales conclusiones e implicaciones, las cuales se espera que ayuden a las pymes a tomar mejores decisiones estratégicas que minimicen sus posibles riesgos y optimicen la utilización de sus recursos. Se añaden al final indicaciones para futuras líneas de investigación en este campo.

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Esta tesis nace con la intención de servir de referente a los empresarios que buscan mejorar día a día a través de la innovación abierta. Con estas líneas deseo servirles de ayuda para iluminarles sus caminos y animarles a continuar este largo pero apasionante reto en la mejora continua de su empresa.

1. Introducción

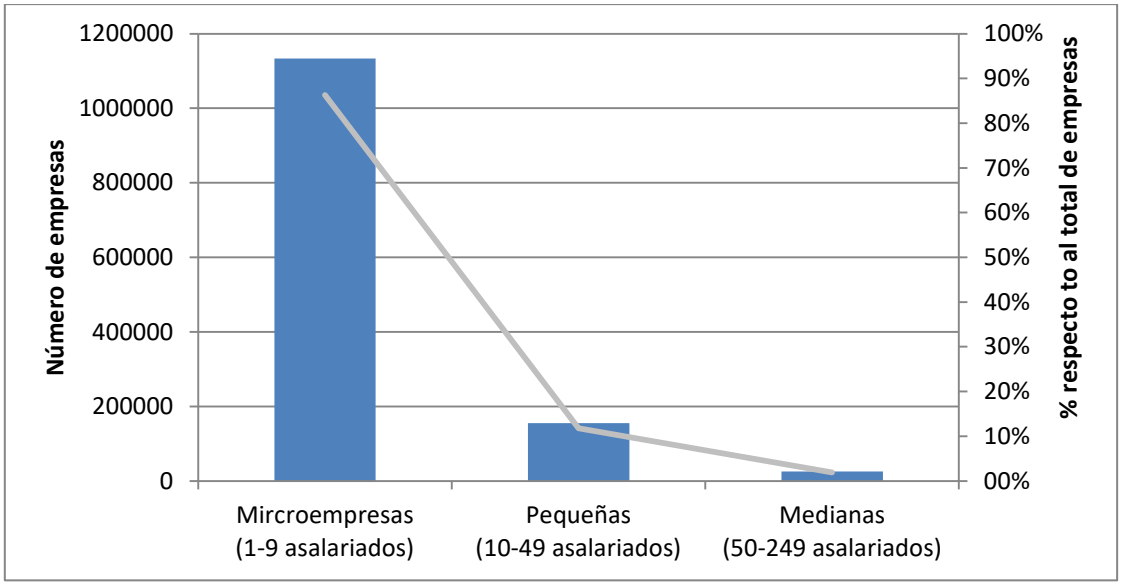
1.1. Problema de investigación

La innovación es el motor principal del desarrollo de una empresa (West y Anderson, 1996; Wong et al., 2008). Innovar implica una transformar la empresa ya sea a través de productos existentes o creando otros nuevos para dar respuesta al mercado o influir en él (Damanpour, 1996). Tradicionalmente, las empresas han gestionado la innovación de forma cerrada, manteniendo en secreto sus procesos internos para evitar posibles copias. Sin embargo, bajo este modelo, la innovación solo puede empezar en el interior de la empresa, y no siempre se dispone ni de las mejores ideas ni de las personas idóneas para ello. La innovación abierta (Chesbrough, 2003) aparece como una alternativa a esta limitación de recursos, dado que las ideas y proyectos pueden originarse tanto dentro como fuera de la empresa, pudiéndose incorporar en cualquier momento en el proceso. La innovación abierta se presenta pues como un paradigma que aporta conocimiento y recursos entre la empresa y las partes interesadas (*stakeholders*) con el objetivo de desarrollar y/o mejorar productos y servicios que contribuyan a incrementar la satisfacción del cliente, y por consiguiente, ayuden a consolidar su cuota de mercado.

La adopción de prácticas de innovación abierta es especialmente relevante para las pequeñas y medianas empresas (en adelante, pymes) (Spithoven et al., 2013; Radziwon y Bogers, 2019). Cuando se reflexiona sobre el nacimiento de las pymes hay que pensar en que una o varias personas dedican todo su esfuerzo en términos laborales, familiares y económicos para poder sacar adelante una idea de negocio. Toda empresa que comienza su andadura en el mundo profesional, mantiene un denominador común, su tamaño. Es decir, la empresa a lo largo de su primera fase de constitución y puesta en funcionamiento es más propensa a ser una micro pyme. Este tamaño condiciona los recursos de los que dispone y, por consiguiente, la posibilidad de generar innovaciones que tengan impacto en el mercado. Apoyados en esta idea, se observa que en España, el tamaño de la empresa medido en número de empleados es inversamente proporcional al número de empresas que existen en cada categoría (micro, pequeña, mediana empresa) a la que pertenecen (Hyder y Lussier, 2016). En otras palabras, la mayoría de empresas en la economía española son de tamaño reducido

(micro). Con el paso del tiempo, en algunos casos crecen hasta estar en otra categoría como pequeña y medianas e incluso grades empresas. En la Figura 1 se representan en términos absolutos y porcentuales, el número de pymes con asalariados[1] que hay en España por número de trabajadores y tamaño.

Figura 1. Volumen de empresas por tamaño
(Fuente: IPYME[2])



A nivel Europeo, las pymes representan el 99% de todos los negocios que existen, creando el 85% de nuevos puestos de trabajo en los últimos 5 años[3]. Dentro de la Organización para la Cooperación y el Desarrollo Económico (OCDE), compuesta por 36 países miembros de todo el mundo, las pymes siguen siendo un pilar fundamental pues representan el 99% sobre el total de empresas y ostentan un papel muy destacado tanto en la creación de empleo como en el PIB, con valores[4] del 40% y el 60%, respectivamente.

Las pymes requieren, hoy más que nunca, de una inversión permanente en innovación con el fin de afianzar su modelo de negocio.. Sin entrar a valorar la supervivencia de las empresas, la Tabla 1 muestra que en España, según datos de IPYME, las micro-pymes se encuentran con una variación interanual negativa. Es decir, en la actualidad, hay menos empresas que responden a esta tipología de pymes que hace un año, mientras que las

[1] Los datos de empresas con asalariados se extraen de la estadística mensual de "*Empresas inscritas en la Seguridad Social*" y están actualizados a finales de diciembre de 2019.
[2] http://www.ipyme.org//Publicaciones/CifrasPYME-enero2020.pdf
[3] https://ec.europa.eu/growth/smes
[4] http://www.oecd.org/cfe/smes/ministerial/SME-Ministerial-Declaration-ENG.pdf

pequeñas y medianas empresas presentan variaciones anuales positivas. Posiblemente, una de las causas tal y como se apuntaba anteriormente, es el esfuerzo (e inversión) inicial en innovación para poder competir en el mercado. El tamaño es proporcional a los recursos disponibles, por lo que disponer de vías alternativas para tener más acceso a recursos es una estrategia relevante a explorar.

Tabla 1. Tasa de variación del número de empresas por tamaño
(Fuente: IPYME[5]).

Empresas por tamaño	**Tasa de variación mensual**	**Tasa de variación anual**
Micro empresas	-1,71	-0,83
Pequeñas empresas	1,43	0.08
Medianas empresas	0,41	2,21
Total pymes con asalariados	-1,66	-0,67

La literatura sobre innovación abierta es considerable; sin embargo, existen pocos estudios que aborden estas prácticas en las pymes (Gassmann et al., 2010; Balios et al., 2015; Ormazabal et al., 2016). De hecho, los principios de la innovación abierta están diseñados para grandes empresas (Chesbrough y Crowther, 2006; Van de Vrande et al., 2009; Ahn et al., 2015; Eftekhari y Bogers, 2015; Usman y Vanhaverbeke, 2017). Sin embargo, dado que las pymes tienen estructuras organizacionales más flexibles y menos formalizadas (Lee et al., 2010), presentan las características idóneas para incorporar prácticas de innovación abierta.

En efecto, en un entorno marcado cada vez más por la internacionalización, los proyectos de innovación abierta pueden ofrecer y ser una solución a muchas pymes para mejorar su competitividad. Varias son las iniciativas que impulsan precisamente la introducción de prácticas de innovación abierta en pymes. Por citar algún ejemplo, la Comunidad de Madrid[6] ofrece un programa de cooperación público-privado en investigación, desarrollo e innovación (I+D+i) para el apoyo a proyectos de innovación tecnológica de efecto tractor elaborados por Núcleos de Innovación Abierta en la Comunidad de Madrid para empresas ("HUBS" de Innovación). Esta iniciativa se enmarca dentro del Programa Operativo FEDER de la Comunidad de Madrid y tiene por objetivo generar sinergias a través de la innovación abierta, creando consorcios compuestos por una gran empresa, tres pymes y un centro investigador o universidad. Pero no sólo las ayudas provienen de entes públicos. El

[5] http://www.ipyme.org//Publicaciones/CifrasPYME-enero2020.pdf
[6] http://www.bocm.es/boletin/CM_Orden_BOCM/2018/07/27/BOCM-20180727-24.PDF

Banco Santander[7] en el año 2019, lanzó un programa de innovación abierta destinado a *startups*, para promover la transformación digital en las pymes a través de la innovación abierta. Por su parte, la compañía eléctrica Endesa[8] cuenta con programas de innovación abierta orientados al fomento de la sostenibilidad.

Según pone de manifiesto el estudio "*Generación Innovar*" de Ricoh Europa[9], el 37% de las pymes europeas temen que su negocio se quede fuera de juego en dos años si no logra innovar. Este dato coincide con los resultados publicado en diciembre de 2019 por el Instituto Nacional de Estadística (INE) sobre empresas innovadoras, en el que se pone de relieve que una de cada cinco empresas en España son innovadoras, reduciéndose a un 13,7% el gasto en innovación en el caso de las pymes. Dicho de otra forma, el gasto en innovación en las empresas españolas[10] tan solo representa el 1% de su cifra de negocio, lo que denota una preocupante falta de inversión en innovación.

Arraigado en este contexto, esta tesis doctoral se presenta como una ocasión única parar contribuir a la literatura existente sobre innovación abierta en pymes, con el objetivo último de dar un conjunto de recomendaciones a este tipo de empresas y proponerles prácticas de innovación que les ayudarán a asegurar su supervivencia y mejorar su posicionamiento en un entorno cada vez más global y competitivo.

1.2. Objetivo de la tesis

Esta tesis doctoral tiene por objetivo **analizar cómo las prácticas de innovación abierta en las pequeñas y medianas empresas (pymes) influyen en el rendimiento de dicha tipología de empresas**. Este objetivo general se puede, a su vez, desglosar en cinco objetivos específicos, tal y como se detalla a continuación:

OB1. Identificar cuáles son los principales artículos, instituciones y autores que han publicado sobre innovación abierta en pymes.

OB2. Determinar qué temas son de interés para la comunidad científica en el estudio de la innovación abierta en pymes.

[7] https://startups.bancosantander.es/
[8] https://www.endesa.com/es/nuestro-compromiso/innovacion/innovacion-abierta
[9] https://www.ricoh-europe.com/news-events/news/failure-to-innovate-threatens-to-put-a-third-of-european-smbs-out-of-business-by-2020.html
[10] https://www.ine.es/prensa/eie_2018.pdf

OB3. Investigar el impacto que tiene la adopción de prácticas de innovación abierta en el modelo de negocio de las pymes.

OB4. Analizar y caracterizar el desempeño de las pymes en función de (i) las prácticas de innovación abierta utilizadas, (ii) la estrategia de innovación, (iii) el desempeño en innovación, y (iv) las propias características de la empresa.

OB5. Medir el desempeño de las pymes que aplican prácticas de innovación abierta para identificar mejores prácticas y proponer recomendaciones.

Para abordar estos objetivos específicos se han planteado tres artículos, de manera que el presente trabajo de investigación se presenta como una tesis por compendio de artículos a través de los cuales es posible dar respuesta a cada uno de los objetivos específicos, y por lo tanto, al objetivo último que suscita esta investigación.

En concreto, se plantea un primer artículo de revisión de la literatura (artículo 1: "*Open innovation in small and medium enterprises: A bibliometric analysis*"), cuyo propósito es el de proporcionar una visión exhaustiva de las aportaciones científicas existentes sobre innovación abierta en las pymes. Para ello, se combina un análisis bibliométrico tradicional con uno de revisión sistemática. Los estudios bibliométricos permiten identificar cuáles son los principales autores, instituciones, países más relevantes en una determinada área de investigación. Así mismo, permiten determinar cuáles son los autores más prolíficos en el área, qué palabras claves están relacionadas con el tema de interés, así como en qué disciplinas tiene impacto (p.ej. economía, marketing empresa, etc.). El punto clave reside en una estrategia de búsqueda suficientemente amplia pero igualmente concreta capaz de recoger las contribuciones científicas relevantes, sin obviar ningún documento importante. Así pues, por medio de este análisis bibliométrico, se da respuesta al primero de los objetivos específicos (**OB1**).

En una segunda fase, dentro de este mismo primer artículo, se prosigue con una revisión sistemática de cada uno de los trabajos que se han identificado en la etapa anterior. Mediante una lectura detallada y pormenorizada de cada uno de los distintos documentos, ha sido posible clasificar la literatura existente en cuatro grandes bloques: (i) estudios que analizan el impacto de la innovación abierta en el desempeño de la empresa y en su estructura organizacional, (ii), estudios que conceptualizan la innovación abierta como mecanismo para acelerar el desarrollo de nuevos productos, (iii) estudios que abordan la dirección (*inbound*:

hacia dentro / *outbound*: hacia fuera) de la innovación abierta, y (iv) estudios que abordan los aspectos legales de los derechos de la propiedad cuando se implementan estrategias de innovación abierta. Esta clasificación da respuesta al segundo de los objetivos específicos (**OB2**) de esta tesis.

Una vez determinados los temas de interés (sobre innovación abierta en pymes) en la literatura académica, se pretende ahondar en dos de las líneas identificadas: el impacto de la innovación abierta en el desempeño así como en la direccionalidad de dicha innovación. En concreto, se diseña un estudio de casos (artículo 2: "*The effect of open innovation strategies on business models. A multiple case study in the automotive sector"*) en el que se analizan cuatro empresas del sector de la automoción. El estudio pone de manifiesto cuáles eran los recursos claves que mantenían estas empresas antes de la crisis de 2008 y como se han reconducido gracias a la introducción de la innovación abierta en su modelo de negocio. Para analizar cómo las empresas han percibido dichos cambios se ha utilizado una metodología de investigación cualitativa, combinando los principios de innovación abierta con instrumentos específicos de estrategia empresarial, como es el *business model canvas* propuesto por Osterwalder y Pigneur (2010).

En concreto, se han identificado los bloques (del *business model canvas*) que son clave para la empresa y cómo se han visto modificados con la adopción del nuevo enfoque de innovación. Los resultados revelan que ante momentos turbulentos del mercado, la innovación abierta se presenta como una estrategia viable que permite, entre otras, abrir nuevas líneas de negocio, reducir los costes, obtener otros ingresos no contemplados originalmente, mejorar la satisfacción del cliente y en definitiva, mejorar la propuesta de valor de la empresa. Este segundo estudio da, por tanto, respuesta al tercero de los objetivos específicos (**OB3**), y aporta nuevas evidencias sobre propuestas *inbound* de innovación abierta y sobre el impacto a nivel estratégico y operativo del negocio. Así mismo, este estudio también da respuesta (de forma parcial), al último de los objetivos (**OB5**), pues de los resultados obtenidos se desprenden varias estrategias que pueden servir de guía para otras pymes con características y/o necesidades de innovación similares.

El compendio de artículos finaliza con un tercer estudio (artículo 3: *"How open are SMEs? Exploring the impact of different open innovation practices"*) en el que se investiga cómo las estrategias de innovación abierta, en combinación con otros factores, condicionan el

desempeño empresarial de una empresa. Este enfoque complementa los estudios existentes que discuten sobre una posible relación directa entre la adopción de prácticas de innovación abierta y el rendimiento de una empresa *vs*. otra más compleja en la que se incluye en la ecuación otros factores (i.e. tipo de innovación, desempeño innovador, características propias de la empresa). En este artículo se defensa la hipótesis de que dependiendo de cómo la empresa percibe su propio desempeño, elige una estrategia de innovación u otra, por lo que resulta necesario investigar si distintos niveles de percepción del desempeño están asociados con diferentes niveles de adopción de prácticas de innovación abierta.

Para contrastar esta hipótesis y responder así al cuarto objetivo específico (**OB4**) se crea una base de datos original de 32 pymes valencianas. Para el análisis empírico se utiliza la metodología del análisis cualitativo comparado (QCA, de las siglas en inglés), la cual busca combinaciones de condiciones antecedentes que explican un resultado (en el caso de este estudio, desempeño en el mercado). Esta metodología presenta la peculiaridad de permitir identificar distintas fórmulas (i.e. combinaciones de factores) que permiten llegar a un mismo resultado, siendo de gran interés para el estudio de las pymes, dado el alto grado de heterogeneidad que presentan. De esta manera, los resultados de este estudio junto con los del artículo 2, dan respuesta al quinto objetivo específico (**OB5**) ofreciendo, desde dos perspectivas distintas, recomendaciones para pymes sobre distintas combinaciones estratégicas (basadas en sus capacidades, visión y características) para lograr un buen posicionamiento en el mercado.

1.3. Estructura de la tesis

El presente documento se estructura en cinco capítulos más el apartado final de referencias. El **Capítulo 1** es la introducción que consta de tres secciones: la contextualización del problema de investigación, la definición del objetivo general de la tesis y su desglose en cinco objetivos específicos, y el presente apartado en el que se resume la estructura del documento.

A este capítulo introductorio le sigue el **Capítulo 2**, con el marco conceptual. Esta sección define y ahonda, con mayor detalle el paradigma de la innovación abierta, y resume sus aplicaciones tanto en grandes corporaciones (la mayor parte de la literatura) como en pequeñas y medianas empresas; si bien en este segundo caso, la literatura es mucho más

escasa. Además en este capítulo se resume el otro marco conceptual de referencia: el de los modelos de negocio.

Una vez planteado el marco teórico, el **Capítulo 3** recoge el diseño de la investigación. En dicho capítulo se explica cómo se ha conceptualizado la actual investigación, el porqué de los tres estudios que lo integran y la conexión entre todos ellos, y la metodología empleada en cada uno. En este sentido, comentar que cada uno de los tres estudios utiliza una metodología de investigación distinta (bibliometría más revisión sistemática en el artículo 1, análisis de casos en el artículo 2, y análisis cualitativo comparado en el artículo 3), por lo que el tema objeto de la tesis (innovación abierta en pymes) queda analizado desde distintas perspectivas, ofreciendo una visión completa.

Seguidamente, el **Capítulo 4** proporciona un resumen detallado de cada uno de los tres documentos que componen la recopilación, y presenta, en primer lugar, información de carácter técnico (título, autores, año de publicación, revista en la que se ha publicado el artículo, índices de impacto de la revista, DOI y enlace web) para luego proseguir con la información más concreta sobre los objetivos, el problema de la investigación, el marco teórico de referencia, la metodología empleada, así como un pequeño resumen de los principales resultados obtenidos.

La tesis concluye con el **Capítulo 5**. En primer lugar se presenta una discusión general, cuyo objetivo es integrar la interpretación de los resultados obtenidos en los tres artículos. Seguidamente se enfatiza cómo la presente investigación contribuye a la literatura existente así como las implicaciones prácticas de la disertación. El capítulo concluye con la identificación de las principales limitaciones que han condicionado la investigación así como pinceladas a posibles futuras líneas de investigación.

Cierra este documento el **Capítulo 6**, con las referencias utilizadas para estos capítulos iniciales y finalmente se incluye en el **Anexo** el texto completo de los tres artículos publicados.

2. Marco conceptual

Este capítulo se divide en dos grandes bloques, los cuales presentan los dos principales cuerpos teóricos en los que se basa la presente tesis: la innovación abierta (sección 2.1) y los modelos de negocio (sección 2.2). A continuación se describe cada uno de ellos.

2.1. Innovación abierta

Las primeras menciones al concepto de innovación abierta los encontramos en el libro "*Open Innovation*" del profesor Henry Chesbrough en el año 2003 ("*Open Innovation*"). En este libro Chesbrough observa que la mayoría de empresas realizan su innovación de forma cerrada. Es decir, las empresas investigan, desarrollan e innovan de puertas adentro, y únicamente cuando el producto y/o servicio está listo para comercializarse, entonces se distribuye, sin cooperación ni colaboración alguna con agentes externos a la empresa. Esta forma de concebir la innovación (cerrada) se basa en buscar nuevas formas de investigar dentro de la propia empresa, para posteriormente, registrar y patentar las ideas de manera que otras empresas no puedan beneficiarse de sus desarrollos. Si bien se trata de un modelo lícito, Chesbrough, por el contrario, aboga por un modelo completamente antagónico, mucho más abierto y colaborativo, con la participación de múltiples actores y con sistemas de retroalimentación para mejorar los posibles nuevos desarrollos. De ahí el nombre de "innovación abierta".

Más allá de entender la innovación abierta como un modelo en el que dos empresas cooperan, se debería ampliar el horizonte a cualquier agente externo que pueda intervenir en el proceso de innovación (p.ej., universidades, gobiernos, clientes, centros de investigación, proveedores, etc.). La innovación abierta parte de la premisa de que las empresas no tienen por qué mantener los mejores recursos humanos, tecnológicos o financieros. Por esa razón, resulta imprescindible colaborar con agentes externos que permitan desarrollar productos y servicios de una forma más eficiente, ya que la combinación del conocimiento interno con el externo genera valor. La innovación abierta también contempla que algunas de las aplicaciones que se desarrollan no deban comercializarse y registrarse con inmediatez (innovación cerrada) sino que puede que sirvan de modelo o punto de partida para negocios o desarrollos futuros.

En la innovación abierta la información puede fluir de dos maneras posibles, de fuera a dentro (*inbound*) o de dentro a fuera (*outbound*). La primera opción es la que más atención ha recibido en el mundo académico y profesional, y consisten en adoptar cualquier tipo de conocimiento o tecnología externa para aplicarlo dentro de la empresa, como por ejemplo utilizar recursos humanos externos que aporten nuevas ideas, incorporar nuevas formas de gestión de activos a nuestra empresa, etc. (ver los artículos de Parida et al. (2012) y Huang et al. (2015) como ejemplos de estudios sobre este tipo de innovación). En cambio, el término *outbound* tiene que ver con desarrollos de productos o servicios que, por alguna razón no se han explotado dentro de la empresa y es entonces cuando se permite que otras empresas o centros de investigación les puedan dar otra utilidad (ver Cagno et al. (2015), Popa et al. (2017) y Usman et al. (2017) como ejemplos de estudios que examinan la innovación *outbound*). En otras palabras, con la innovación abierta nada se desprecia y cualquier desarrollo puede adquirir una nueva dimensión.

El concepto de innovación abierta empezó a expandirse a medida que se popularizaba entre los académicos (Chesbrough, 2003; Laursen and Salter 2006; van de Vrande et al., 2009; Dahlander and Gann, 2010), creando incluso un congreso específico, el *World Open Innovation Conference*, para que académicos y profesionales pudieran exponer sus tesis y debatir sobre este paradigma. A fecha de hoy, la comunidad científica sigue manteniendo un gran interés. Otro ejemplo se encuentra en las revistas académicas, con varios *special issues* que precisamente pretenden ahondar sobre prácticas de innovación abierta en sectores concretos. En el ámbito profesional el interés por la innovación abierta también ha dejado huella, habiendo grandes compañías con capitalización bursátil que en la actualidad cuentan con departamentos y programas específicos de innovación abierta (p.ej., Seat, Acciona, Telefónica, Orange, BBVA).

Estudios recientes (Lee et al., 2010; Brunswicker y Vanhaverbeke, 2015) demuestran como gracias a la innovación abierta se pueden alcanzar nuevos productos o procesos de una forma versátil y económica. La innovación abierta propone eliminar barreras como la investigación intraempresarial o poner a disposición de otras empresas la propiedad intelectual, además de facilitar el contacto con el mercado de una manera sencilla y sin emplear demasiados recursos.

Las crisis económicas, los cambios legislativos de los gobiernos, la eventual transformación de los modelos de negocio de las empresas (debido a la competencia de costes y a los procesos de *servitización*), la falta de confianza de las entidades bancarias en las empresas, la globalización, y un entorno cada vez más VUCA (i.e., volátil, incierto, complejo y ambiguo) dificultan la supervivencia de las empresas y en especial de las pymes, las cuales suelen disponer de recursos más limitados.

En este contexto, la innovación abierta se presenta como una estrategia clave para paliar estas amenazas y potenciar la proposición de valor sin apenas necesitar grandes inversiones. Esto supone una oportunidad única para las empresas de pequeño y mediano tamaño. Si bien es cierto que las pymes no pueden competir con las grandes corporaciones, la innovación abierta ofrece una vía alternativa para acceder a nuevos recursos y desarrollar una nueva cultura de innovación. Innovar con éxito es unos de los grandes misterios en el mundo empresarial (West, 2001; Fagerberg et al., 2012; Vlados y Katimertzopoulos, 2019). Sin embargo, si partimos de la base de que las mejores ideas no tienen por qué encontrarse dentro de la empresa, la combinación de distintos flujos de información (interna y externa) se posiciona como una práctica altamente atractiva.

En el caso particular de las pymes, existen varios estudios que avalan la tesis de que la capacidad innovadora de las pymes mejora cuando se utilizan prácticas de innovación abierta (Spithoven et al., 2012; Sisodiya et al., 2013; Moretti y Biancardi, 2020). Sin embargo la implementación de estas práctica deben ir acompañadas de un plan de despliegue dentro de la organización, de lo contrario, sería difícil la gestión de los flujos externos de conocimiento y complicaría más que ayudaría el día a día de la empresa. Una buena monitorización de la entrada/salida de conocimiento, la estructura organizativa, los mecanismos de colaboración o la financiación son aspectos claves para que la innovación abierta tenga éxito (Bigliardi y Galati, 2016). El objetivo reside pues en compartir información y herramientas al servicio de la innovación para crear sinergias que den como resultado nuevos productos o procesos con el propósito de, al incorporarlo en el modelo de negocio, añadir valor a la empresa.

2.2. Modelos de negocio

Según Magretta (2002, p.6) "*la gran fortaleza de un modelo de negocio como herramienta de planificación es que centra la atención en cómo todos los elementos del sistema encajan completamente*".

Uno de los grandes errores cometidos por autores, consultoras y empresas reside en la definición del modelo de negocio. En muchos casos se malinterpreta y se confunde con planificación estratégica, generación de recursos y modelo económico (George y Bock 2011; Da Silva y Trkman, 2014). Los orígenes de la palabra "modelo de negocio" se encuentran en el artículo de Bellman et al. (1957), cuando a través del desarrollo de un juego empresarial pretendía ayudar a resolver problemas del ámbito profesional para matemáticos, ingenieros industriales, psicólogos y economistas. La secuencia que utilizaron hasta llegar a la palabra clave es el proceso de toma de decisiones que no sólo reside en máquinas sino en las decisiones que toman los seres humanos, aplicando un modelo matemático y un entorno de simulaciones a las que denomina modelo de negocio. Tres años más tarde, Jones (1960) se planteó que los estudiantes de electrónica no deberían limitarse a estudiar sobre una determinada área sino más bien obtener conocimientos del ámbito profesional en su conjunto, destacando el juego empresarial como una alternativa para conseguir una visión global de conocimientos y así adquirir experiencia de manera transversal. No fue, sin embargo, hasta los años 90 cuando el concepto se extendió, aunque con disparidad en sus definiciones (Porter, 2001; Mäkinen y Seppänen, 2007).

Es difícil encontrar un marco común para caracterizar los modelos de negocio. En un primer momento las definiciones de modelos de negocio iban orientadas mayoritariamente a la planificación estratégica y a la toma de decisiones de los directivos de las empresas (Porter, 1980; Richardson, 2005). Posteriormente pasaron a centrarse más en la propuesta de valor que ofrecían las empresas al mercado (Lindgardt et al., 2009) así como en la creación de valor, incidiendo más que en la adquisición de valor (Zott et al., 2011). Esta secuencia de definiciones se han ido desarrollando y evolucionando hasta nuestros días. Tal y como postulan Mehrizi y Lashkarbolouki (2016), resulta complicado definir qué es un "modelo de negocio" ya que hay otros aspectos de carácter cognitivo (p.ej., visión empresarial) que van más allá de los tangibles e intangibles tradicionales que definen a las empresas (i.e., propuestas de valor, relaciones, financiación, direcciones estratégicas).

A modo de ejemplo, en la Tabla 2 se listan diferentes definiciones de modelos de negocios sostenidas por autores de reconocido prestigio en la materia.

Tabla 2. Definiciones de "modelo de negocio" según varios autores.
(Fuente: Elaboración propia).

Autores	**Definiciones de modelos de negocio**
Hedman y Kalling (2003, p. 49)	El modelo de negocio debe incluir a los clientes y competidores, la oferta, las actividades y la organización, los recursos, los factores del mercado y las interacciones entre ellos.
Seddon, Lewis, Freeman y Shanks (2004, p. 237)	Un modelo de negocio es una representación abstracta de algún aspecto de la estrategia de una empresa.
Morris, Schindehutte y Allen (2005, p.734)	Dispositivo de enfoque para empresarios y empleados, especialmente cuando está respaldado por un conjunto de reglas o pautas que se derivan de decisiones tomadas a nivel particular.
Shafer, Smith y Linder (2005, p. 202)	Un modelo de negocio es la presentación de la lógica central subyacente de una empresa y las opciones estratégicas para crear y capturar valor dentro de una red de valor.
Doganova y Eyquem-Renault (2009, p. 1559)	Dispositivo que permite a los empresarios explorar un mercado y contribuir en la construcción de una red tecno-económica de una innovación.
Storbacka y Nenonen (2011, p.3)	Un modelo de negocio es básicamente un plan de cómo la empresa pretende servir a sus clientes, interactuar con otros actores en la red de mercado y generar beneficios de sus operaciones.
Zott, Amit y Massa (2011, p. 1028)	La lógica central de un modelo de negocio gira en torno a los ingresos de una empresa y costes, su propuesta de valor para el cliente y los mecanismos para capturar el valor.
Teece y Linden (2017, p. 5)	El modelo de negocio es una solución para el cliente que puede soportar un precio lo suficientemente alto como para cubrir todos los costes y obtener beneficios al menos suficientes para apoyar el negocio y su crecimiento.
Belussi, Orsi y Savarese (2019, p. 11)	El modelo de negocio es el conjunto de actividades organizadas para observar el diseño arquitectónico completo, la creación de valor y los mecanismos de entrega y atracción de empleados.

Dentro de la literatura sobre modelos de negocio, hay una línea de investigación de especial interés para el propósito de la presente tesis: la que relaciona el modelo de negocio con la capacidad de innovación de la empresa. En este sentido, resultan interesantes las conclusiones de Nenonen y Storbacka (2010), quienes argumentan que las empresas no generan valor por si solas, sino gracias a sus redes, las cuales proporcionan un valor compartido: la co-creación de valor. Siguiendo esta línea, los autores proponen que los modelos de negocio deben ser abiertos, para aprovechar y utilizar los recursos de otros. Es decir, no tener una visión cerrada, sino más bien emplear un modelo de negocio expansivo en el que se incorporen agentes externos que permitan amplificar la propuesta de valor de la empresa.

No obstante, en los últimos años ha aparecido un nueva tendencia, la de los modelos de negocios innovadores (Foss y Saebi, 2018). Chesbrough (2010) ya apostaba por estos modelos a través de la experimentación, pero siempre cuantificando los datos (para poder tener información objetiva) y siendo conscientes de que los beneficios no serán inmediatos, sino que hay un periodo previo en el que construir las bases de lo que será un modelo de negocio innovador. Siguiendo por esta misma línea, Balocco et al. (2019), dan un paso más y afirman que el modelo de negocio es en sí un elemento disruptivo de innovación que sirve para alcanzar rendimientos superiores, mediando entra la innovación y la creación de valor económico.

Hoy en día, encontramos diversos modelos de negocio que, además, albergan un amplio abanico de características. Un ejemplo de ello son los modelos de negocio sostenibles, que presentan propuestas que, a través de proyectos sostenibles y sociales, persiguen un mayor logro empresarial (Schaltegger, et al., 2012; Boons, y Lüdeke-Freund, 2013; Bocken et al., 2014). Algunas de las características de los modelos de negocio inclusivos y sociales son una amplia red de colaboradores, una oferta de valor flexible (adaptada a los posibles clientes con necesidades especiales), y una alta dosis de confianza entre los distintos *stakholders* (Michelini y Fiorentino, 2012; Alegre y Berbegal-Mirabent, 2016).

Pese a que hay mucha más literatura sobre la disparidad de elementos significativos que deben contener los modelos de negocio, tal y como argumentan Alegre y Berbegal-Mirabent, (2016) más allá de investigar sobre qué características deben tener los modelos de negocio, lo que realmente resulta de interés es la flexibilidad de dichos modelos para readaptarse o reinventarse ante entornos dinámicos. Existen empresas que tienen buenos modelos de negocio pero no saben que lo tienen. Simplemente por experiencia o por repetición han ido incorporando mejoras de forma eventual. Otras, sin embargo, sí tienen bien definido cuáles son sus modelos de negocio y qué estrategias deben modificar para que evolucione positivamente y así continuar generando valor. Ambas tipologías de empresas generan valor en un momento determinado de tiempo y ambas lo harán de forma continuada ya que mantienen modelos de negocio dinámicos y flexibles (Afuah and Tucci, 2001; Osterwalder et al., 2005; Teece, 2010; Zott et al., 2011; Kulins et al., 2016; Saebi et al., 2017).

Son los directivos y gerentes de las empresas los que deben prestar especial interés ante turbulencias del mercado para introducir cambios en los modelos de negocios y recuperar la

rentabilidad de la empresa si esta se viera amenazada. Demil y Lecocq (2010) denominan estos cambios la "consistencia dinámica" de los modelos de negocio. Se trata de acciones orientadas a la experimentación de nuevas oportunidades comerciales, gestión correcta de los recursos de la empresa y una combinación de liderazgo, cultura de empresa y compromiso de los empleados que deben ser capaces de generar valor permanente en el tiempo (Achtenhagen et al., 2013). Precisamente Chesbrough (2017) argumenta que la innovación abierta debe formalizarse y consolidarse a través de un modelo de negocio que permita obtener beneficios a lo largo del tiempo. Es por ello que resulta de especial interés contar con un instrumento (i.e., el modelo de negocio) que controle y supervise las estrategias de innovación abierta para ir perfeccionando e incorporando unidades de conocimiento e información al servicio de la innovación.

3. Diseño de la investigación

3.1. Fases de la investigación

Esta tesis se presenta como un compendio de tres artículos, todos ellos publicados en revistas académicas indexadas (ver el Anexo para el detalle completo de las publicaciones). Tal y como se mencionaba en el capítulo introductorio, el objetivo último de esta investigación es el de ayudar a las pymes a escoger prácticas de innovación abierta sobre las cuales basar su ventaja competitiva, y por consiguiente, ayudarlas a mejorar su desempeño y rendimiento. Para poder dar respuesta a este propósito, esta tesis aborda la temática desde tres perspectivas diferentes que constituyen las tres fases en las que se estructura la investigación.

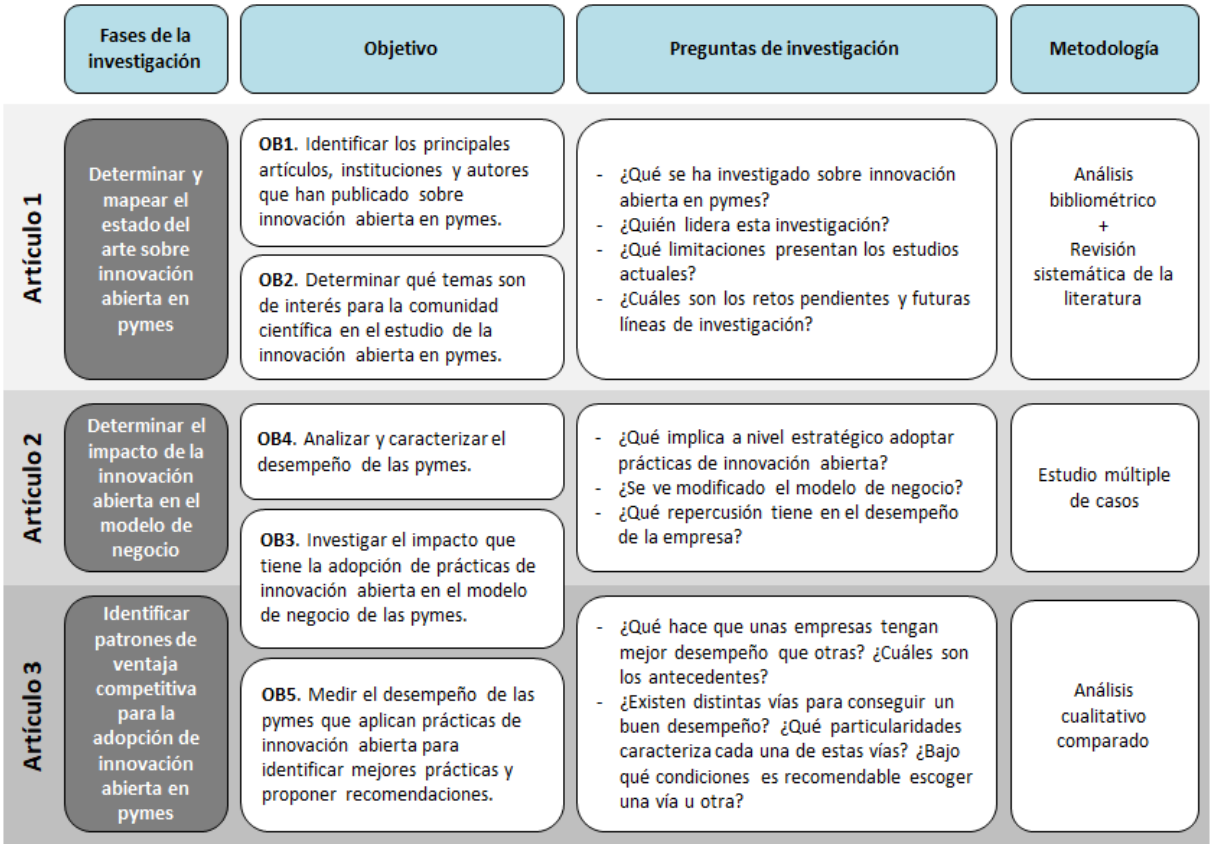
En una primera fase (artículo 1) se traza un mapa sobre el estado del arte de la innovación abierta en pymes, el cual proporciona un marco de referencia (con una visión global pero a la vez exhaustiva) para el resto de la tesis. En concreto este estudio permite identificar qué se ha estudiado hasta la fecha en el área de interés (innovación abierta en pymes) así como las preguntas de investigación (teóricas y empíricas) pendientes por resolver y que, por consiguiente, requieren de nuevas investigaciones. Este propósito se ha logrado por medio de un análisis bibliométrico que se ha complementado con una revisión sistemática de la literatura identificada en el análisis bibliométrico.

Tomando como punto de partida estos vacíos en la literatura, se han diseñado las dos fases posteriores, que corresponden a los artículos 2 y 3, y abordan, desde distintas perspectivas, el impacto que tiene en la empresa la incorporación de prácticas de innovación abierta, bien sea a nivel estratégico mediante el diseño de un modelo de negocio como a nivel de desempeño empresarial. Para tratar estos dos aspectos se ha utilizado una metodología distinta en cada caso, optando por aquella que mejor se ajustaba a los objetivos específicos de cada estudio: el estudio de casos (artículo 2) y el análisis cualitativo comparado (artículo 3).

Para una mejor comprensión de la estructura de la tesis, en la Figura 2 se relacionan las distintas fases de la investigación con los objetivos específicos, las preguntas de investigación y la metodología utilizada. El resultado son tres artículos claramente diferenciados e independientes, pero que en su conjunto (la suma de los tres) arroja nuevo conocimiento sobre

cómo las pymes pueden beneficiarse al introducir estrategias de innovación abierta en sus modelos de negocio.

Figura 2. Estructura de la tesis por compendio de artículos.
(Fuente: Elaboración propia).



Siguiendo con la segunda fase, el artículo 2 persigue determinar el impacto de la innovación abierta en el modelo de negocio de las pymes. Esto implica analizar cómo las empresas introducen la innovación abierta en su día a día y las implicaciones que esto conlleva a nivel estratégico pudiendo, en algunos casos, cambiar la proposición de valor u otras áreas de la empresa (p.ej. relación con los distintos grupos de interés, estructura de costes, fuentes de ingreso, etc.). Para ello, en este estudio se utiliza también literatura procedente del área de la organización y gestión estratégica de empresas (modelos de negocio). La metodología que mejor se ajusta a este tipo de estudio es la de estudio de casos. En concreto, se han seleccionado cuatro empresas del sector de la automoción en la Comunidad Valenciana. Así mismo, y también por medio de una aproximación cualitativa con datos longitudinales se realiza un análisis con carácter retrospectivo en el que se relaciona la estrategia adoptada con indicadores de desempeño.

Por último, el artículo 3 propone identificar patrones de ventaja competitiva para ayudar a las pymes a seleccionar aquella estrategia que más se adecúe a sus recursos disponibles (características intrínsecas), a su posicionamiento estratégico (p.ej. tipo de innovación que se persigue) y cultura organizativa (p.ej. capacidad de absorción de la innovación, canales internos de diseminación de conocimiento, etc.). En este estudio se utiliza una metodología híbrida, el análisis cualitativo comparado, que permite dar una respuesta cuantitativa al objetivo de la tesis.

En su conjunto, los tres artículos que conforman esta tesis ofrecen nueva información y evidencia empírica para comprender mejor cómo las pymes pueden beneficiarse de adoptar estrategias de innovación abierta. No sólo eso, sino que también se arroja nueva luz sobre cómo las pymes deben combinar sus recursos propios con estrategias de innovación para ser más competitivas en el mercado.

Como se desprende de la Figura 2 y de la explicación anterior, si bien la tesis está formada por tres estudios que tienen entidad por si solos, hay coherencia y sinergias en su diseño. Resulta también un valor añadido para esta tesis el hecho de utilizar un enfoque multi-metodológico. En la siguiente sección se resumen las principales características de las tres metodologías utilizadas (análisis bibliométrico, estudio de casos, análisis cualitativo comparado).

3.2. Metodologías de investigación

3.2.1. Análisis bibliométrico

La bibliometría es una ciencia en constante evolución. Recoger el conjunto de citas, libros, artículos, autores, editoriales e instituciones no es tarea fácil. Si bien en la antigüedad este proceso se hacía de forma manual, el avance de las nuevas tecnologías y la digitalización de documentos han dado lugar a una mejora y sofisticación de las técnicas de recogida y de catalogación de la información. Fue en el siglo XX cuando se pudo establecer un marco común aceptado que permitió mantener un orden para divulgadores e investigadores (Buckland, 2011).

La etimología de la palabra bibliografía proviene de la antigua Grecia, en los términos *biblion* que significa libro y *graphein* que significa escribir. Según la RAE se puede definir

como "*la relación de textos procedentes de diversos soportes, utilizados como fuente documental*". En 1922 se utiliza por primera vez el término análisis bibliográfico por el autor Hulme, al comparar dos disciplinas (Pritchard 1969). Sin embargo, no es hasta Pritchard (1969), cuando aparece el neologismo del término bibliometría.

La bibliometría (también a veces referida en inglés como *bibliometrics* o *scientometrics*) es un método aceptado en la sociología de la ciencia (Cole, 2000) que ha sido ampliamente documento en la literatura (p.ej. Garfield, 1972 y 1998; Sengupta, 1992; Noyon et al., 1999; Vinkler, 2001). Aunque existen múltiples definiciones, los autores convergen en referirse a la bibliometría como la ciencia que aplica técnicas procedentes de análisis cuantitativos, cualitativos y estadísticos para una evaluación objetiva de las publicaciones académicas (incluyendo distintos soportes: artículos, libros, comunicaciones, etc.) y las relaciones entre ellos, transformando de esta manera la calidad científica (concepto intangible) en variables medibles.

Los estudios bibliométricos son especialmente útiles para la realización de revisiones de la literatura (Subramanyam, 1983) ya que los investigadores a través de análisis cualitativos pueden reflexionar o caer en una subjetividad excesiva sobre las contribuciones más prolíficas y futuras líneas de investigación que deben desarrollarse. El análisis bibliométrico aporta una nueva perspectiva, tratando de dar mayor objetividad y agrupando e incidiendo en las relaciones que guardan (García-Lillo et al., 2017). Para ello, la bibliometría utiliza un conjunto de indicadores.

Se entiende por indicador bibliométrico aquella medida, índice o estadístico que captura información concreta sobre una comunicación científica (Vinkler, 1988). Los inicios los encontramos en los trabajos de Garfield (1955), quien consideró que las citas recibidas por trabajo eran de gran interés bibliométrico (Garfield, 1994) y fue él quien, por primera vez, subrayó la importancia de crear un sistema de citas universal. El Institute for Scientific Information (ISI) creó las bases de datos Science Citation Index® (SCI), Social Science Citation Index® (SSCI) y Arts & Humanities Citation Index® (A&HCI) (Callon et al., 1995). Otros ejemplos de indicadores bibliométricos son el número de autores por artículo, el número de páginas, las palabras clave, el número de referencias bibliográficas y su año de publicación, el número de citas que ha recibido el artículo y de las referencias citadas, la temática del artículo, etc.

A fecha de hoy, la posibilidad de almacenar y analizar gran cantidad de datos de formas casi automática (p.ej. *big data*, *machine learning*, etc.) ha propiciado el desarrollo de herramientas y softwares informáticos que asisten en la ejecución de análisis bibliométricos, creando sistemas cada vez más complejos y con más prestaciones que responden a las nuevas preguntas que el mundo académico se plantea (Borgman, 1990).

3.2.2. Estudio de casos

El método del caso "*explora un sistema acotado contemporáneo de la vida real (un caso) o múltiples sistemas delimitados (casos) a lo largo del tiempo, a través de una recopilación de datos detallada y profunda que involucra múltiples fuentes de información e informa una descripción del caso y temas del caso*" (Creswell, 2016, p. 97). Expresado en otras palabras: el estudio del caso (o de casos) plantea preguntas del tipo *cómo* y *por qué*. Estas preguntas responden a investigaciones en las que el investigador tiene poco control sobre los eventos y/o cuando el fenómeno de interés a estudiar es contemporáneo dentro de un contexto en la vida real (Yin, 1989).

La técnica del método del caso utiliza la observación como base del estudio, combinado con una subjetividad del propio investigador. Resulta complicado que a través de estos mecanismos descriptivos se aporte conocimiento y, por tanto, aliente a otros autores a investigar sobre ese tema en cuestión (Rowley, 2002), por lo que esta técnica es muchas veces criticada y a menudo de forma injustificada (Meyer 2001). Es por ello que la propuesta de investigación debe ser rigurosa con los datos aportados, con un esquema coherente en el análisis de los mismos, unas conclusiones originales y unas evidencias lógicas que permitan la formulación de futuras líneas de investigación a desarrollar por otros autores (Voss et al., 2002; Vissak, 2010).

El estudio del caso considera el planteamiento del problema, la lógica del diseño, las técnicas para la recolección de datos y los enfoques específicos para el análisis de estos (Yin, 1989). Esta técnica es especialmente interesante cuando se trata de comparar varias organizaciones (p.ej., empresas) para entender las diferencias o similitudes entre ellas (Gustafsson, 2017). En este sentido, cuando se comparan varios casos (i.e., en un estudio de casos múltiples) es posible aportar patrones de relación que los datos cuantitativos pueden obviar, entender relaciones causales y proporcionar un marco de como ha sucedido un hecho (Hillebrand et al., 2001; Eisenhardt y Graebner, 2007; Enkel y Gassmann, 2010). El estudio

de casos permite analizar varias observaciones a lo largo del tiempo de forma que el lector pueda tener un mejor entendimiento sobre lo sucedido (Eisenhardt, 1989; Yin, 2003).

Dentro del estudio del caso, existen tres tipos de estudios, según sea el propósito de la investigación: exploratorio, descriptivo o explicativo. Para el propósito de esta tesis se ha considerado un estudio de carácter exploratorio ya que se pretenden validar una serie de hipótesis que se derivan de la teoría.

3.2.3. Análisis cualitativo comparado

El análisis cualitativo comparado (QCA, de sus siglas en inglés *qualitative comparative analysis*) es una potente herramienta que aplica lógica booleana. Se trata de una metodología que combina los métodos cualitativos con los cuantitativos, relacionando las preguntas de investigación de manera comparativa pero obteniendo resultados analíticos. Sus orígenes se remontan a 1987 durante la búsqueda incesante de Charles Ragin por dar respuesta a métodos cualitativos de forma empírica.

QCA se utiliza para verificar la coherencia en las relaciones entre datos, para probar hipótesis y para desarrollar nuevos argumentos teóricos (Schneider y Wagemann, 2010). QCA va un paso más allá de los métodos tradicionales y asume la no simetría de los datos, por lo que pretende resolver contradicciones incluyendo y excluyendo condiciones necesarias y suficientes hasta que un modelo mantenga una o ninguna contradicción con el objetivo de que el investigador tenga un modelo característico. Las condiciones necesarias son relevantes para que ocurra un determinado resultado y las suficientes son condiciones que por sí solas permiten obtener un resultado determinado (Marx et al., 2014).

Otra característica del QCA es la equifinalidad, es decir, la posibilidad de encontrar diferentes condiciones combinadas (denominadas configuraciones) que llegan a un mismo resultado. Una configuración es una combinación de factores que es mínimamente necesaria y/o suficiente para obtener un resultado específico (Meyer et al., 1993). También la combinación de la ausencia o presencia de determinadas condiciones puede explicar ese mismo resultado (a esta propiedad se le denomina complejidad causal).

Como se mencionaba anteriormente, QCA utiliza lógica booleana, por lo que es necesario transformar tanto las condiciones antecedentes (o factores explicativos) como el *outcome* (resultado esperado) a valores comprendidos entre el 0 y el 1. El valor indicará el

nivel de pertenencia de cada observación al conjunto (1 = inclusión, 0 = no-inclusión). Este proceso de transformación se llama calibración. Según la naturaleza de la variable, la trasformación será de un tipo u otro. Para los factores o *outcomes* con información del estilo dicotómico, se recomienda una transformación en términos *crisp* (csQCA), mientras que cuando se tratan de valores continuos es necesaria una transformación de conjuntos difusos o *fuzzy* (fsQCA) (Ragin, 2009). En este último caso, los valores varían de membresía completa (1) hasta la total exclusión del conjunto (0). El punto de cruce (0.5) indica la máxima indefinición (ni dentro ni fuera del conjunto).

El siguiente paso consiste en construir la tabla de verdad. Se trata de una matriz con 2^k filas, donde *k* es el número de condiciones antecedentes. Cada caso empírico representa a una configuración que depende de las condiciones antecedentes que el caso cumple, mientras que cada columna corresponde a una condición (Fiss, 2011). El último paso en un análisis es la denominada reducción del número de filas de la tabla de la verdad. Utilizando el algoritmo de Quine-McCluskey (Quine, 1952) se obtiene el mínimo número posibles de configuraciones, es decir, cada configuración es mínimamente suficiente para producir el *outcome* de interés. El proceso de reducción de filas se realiza en base a dos criterios (Ragin, 2009): la cobertura (relevancia empírica de una solución) y la consistencia (cuantifica el grado en que los casos que comparten condiciones similares muestran el mismo resultado).

4. Resumen de los artículos

Tal y como se ha mencionado en apartados anteriores, esta tesis se constituye como un compendio de tres artículos. En el presente capítulo se introducen estos tres estudios, y se proporciona información detallada, para cada uno de ellos, sobre su objetivo, pregunta de investigación, marco teórico en el que se sustentan, metodología de investigación y principales resultados.

4.1. Artículo 1

4.1.1. Ficha técnica del artículo

Título	Open innovation in small and medium enterprises: A bibliometric analysis
Autores	Ignacio Odriozola (Universitat Internacional de Catalunya) Jasmina Berbegal-Mirabent (Universitat Internacional de Catalunya) José M. Merigó-Lindhal (Universidad de Chile)
Revista	*Journal of Organizational Change Management*, 32(5), pp. 533-557. Special issue en "*Organizational change in open innovation*" (guest editors Marta Peris-Ortiz, Francisco Liñán).
DOI	10.1108/JOCM-12-2017-0491
Enlace web	https://www.emerald.com/insight/content/doi/10.1108/JOCM-12-2017-0491/full/html
Año publicación	2019
Impacto	Índice de impacto (SCI/SSCI): 0.967 (2019) Cuartil y áreas (SCI/SSCI): Q4 - Management Índice de impacto (SJR): 0.441 (2019) Cuartil y área (SJR): Q2 - Management of Technology and Innovation

4.1.2. Objetivo y pregunta de investigación

De la revisión de la literatura y de la observación directa de la actividad de las pymes se desprende la importancia de investigar cómo la innovación abierta puede ayudar a las pymes a mejorar su rendimiento. Los trabajos revisados evidencian una literatura todavía incipiente, pero bastante rica y prometedora como línea de investigación. Esta literatura ha ido surgiendo de forma orgánica y espontánea, sin existir un referente o marco conceptual que identifique qué se sabe sobre el tema, qué corrientes de investigación existen, quién investiga sobre el tema, etc. En este contexto, el propósito de este primer artículo es el de *proporcionar una visión general, y a la vez exhaustiva, de la investigación existente sobre innovación abierta en*

pymes que, proporcione información útil sobre el estado de la cuestión, indicando no solo los principales contenidos tratados sino cuáles son las instituciones más expertas en esta temática, quiénes son los autores más activos en esta área, los artículos referentes y las revistas más representativas. Así pues, no se trata únicamente de ordenar el conocimiento a través de una clasificación jerárquica (p.ej., ranking de principales autores, instituciones, etc.) sino que ofrece el valor añadido de la asociación o dispersión que hay entre la propia disciplina. En concreto, se plantean las siguientes preguntas de investigación:

- ¿Qué se ha investigado sobre innovación abierta en pymes?
- ¿Quién lidera esta investigación?
- ¿Qué limitaciones presentan los estudios actuales?
- ¿Cuáles son los retos pendientes y futuras líneas de investigación?

La respuesta a estas preguntas permite abordar los objetivos específicos OB1 y OB2 enunciados en el apartado 1.2 de este documento.

4.1.3. Marco teórico

Dado que este primer trabajo es una revisión de la literatura, el marco teórico es el resultado del estudio, si bien se empieza el artículo contextualizando el paradigma de la innovación abierta, sus orígenes y su aplicabilidad a la empresa. En el Capítulo 2 del presente documento de tesis se presentan sus fundamentos, explicando el origen y sus desarrollos y aplicaciones posteriores en el mundo empresarial.

4.1.4. Metodología

Para este estudio se ha combinado el análisis bibliométrico con un análisis sistemático de la literatura. Empezando por el primero, los análisis bibliométricos estudian material bibliográfico de forma cuantitativa, a través de un conjunto de indicadores que ayudan a determinar el estado de la cuestión de una disciplina concreta.

El primer paso en un estudio bibliométrico consiste en la selección de la(s) base(s) de datos de donde se obtendrá el material a analizar (en este caso, los artículos). Para el caso concreto de este estudio se ha seleccionado la Web of Science (WOS), propiedad de la empresa Clarivate Analytics. Se trata de una de las colecciones de bases de datos de referencias bibliográficas y citas de publicaciones periódicas más completas, recogiendo

información desde 1900 en cualquier disciplina del conocimiento, tanto científico como tecnológico, humanístico y sociológico.

Una vez seleccionada la base de datos se determinan un conjunto de palabras clave que sean lo suficientemente relevantes y significativas para devolver inequívocamente los documentos que abordan el tema de interés. Dado que el estudio se realiza en inglés, las palabras clave seleccionadas fueron "*open innovation*" y "*small and medium enterprise**". Dado que para referirse a pymes se pueden utilizar varias formas, se incluyeron también en la estrategia de búsqueda: "*small or medium enterprise**", "*SME**", "*medium-sized enterprise**", "*small-sized enterprise**". El uso del símbolo * permite la inclusión del plural. La búsqueda se realizó en noviembre de 2017 y se restringió el tipo de documento a artículos escritos en inglés. El resultado fueron 246 artículos, si bien después de filtrarlos por *abstract* se obtuvieron 138. A continuación, se revisó cada artículo con detalle para verificar que el foco de interés era la innovación abierta en PYMES, descartando un total de 26 artículos, por lo que la muestra final incluye 112 artículos.

Según Merigó et al. (2017), existe un consenso en el tipo de indicadores que debe contener un estudio bibliométrico: de frecuencia (p.ej. número de artículos, número de citas, palabras clave) y ratios (p.ej. citas por año). Otro indicador a destacar es el *H-index* (índice H), que combina las citas y las publicaciones en un solo índice, relacionando el número de artículos que ha recibido con un número de citas determinado. Para el análisis bibliométrico también se ha utilizado la herramienta VOSviewer, la cual permite analizar índices más elaborados como es la co-citación (cuando dos documentos reciben una cita de un tercer documento), el acoplamiento bibliográfico (dos documentos citan a un tercer documento) y la co-ocurrencia (cuando dos palabras clave aparecen en un mismo documento).

Tras el análisis bibliométrico, este estudio prosigue con un análisis sistemático de los 112 artículos seleccionados. Para recoger información de forma ordenada y homogénea de todos los artículos, se diseñó una plantilla en Excel. Entre otra información de interés, se incluyó una columna en la que se indicaba la temática. Tras varias rondas de revisión, se agruparon las temáticas en cinco grandes categorías, las cuales son después revisadas en profundidad. Este estudio más detallado del contenido se espera que pueda servir no sólo para dar a conocer los temas investigados sino también que sirva como material de soporte para la formulación de políticas relacionadas con la capacidad innovadora de las pymes.

4.1.5. Principales resultados

Del análisis bibliométrico se desprende que el trabajo realizado por van de Vrande et al. (2009) y publicado en la revista *Technovation*, es el que más citas ha recibido, con un total de 112 citas a fecha de Noviembre de 2017. La relevancia de este artículo queda también confirmada con los gráficos obtenidos con el VOSviewer (ver Figuras 2 y 3 en Artículo 1, en los Anexos), donde se ven varias líneas cruzadas entre los autores y revistas, revelando una relación más estrecha entre ellos que con otros autores o revistas.

En cuanto al análisis de revistas, la que ha publicado más estudios sobre innovación abierta en pymes es el *International Journal of Technology Management* con nueve artículos. Sin embargo el que más impacto ostenta (atendiendo a las citas recibidas) es *Technovation*. En referencia a la co-citación, los artículos que más destacan están publicados en las revistas *Research Policy*, *Technovation* y *R&D Management*, revistas con amplio prestigio en investigación sobre tecnología e innovación.

Otra información de interés a resaltar sería el dato del autor con más publicaciones en el tema, Wim Vanhaverbeke, con cuatro artículos que suman un total de 526 citas. La institución educativa con mayor número de publicaciones es Dongguk University (Cora del Sur), y el país con mayor producción de investigaciones académicas sobre innovación abierta en pymes es el Reino Unido. Estos hallazgos, de nuevo, son coherentes con los gráficos generados con el VOSviewer sobre acoplamiento bibliográfico.

En referencia al contenido que tratan los artículos anteriores, a través del análisis sistemático de la literatura, se han identificado cuatro temáticas: (i) el impacto de la innovación abierta en el desempeño de la empresa y en su estructura, (ii) la innovación abierta entendida como mecanismo para el desarrollo de nuevos productos, (iii) la direccionalidad de los flujos de conocimiento (*inbound/outbound*) en las empresas, y (iv) la gestión de la propiedad intelectual en la innovación abierta.

4.2. Artículo 2

4.2.1. Ficha técnica del artículo

Título	The effect of open innovation strategies on business models. A multiple case study in the automotive sector
Autores	Ignacio Odriozola-Fernández (Universitat Internacional de Catalunya) Jasmina Berbegal-Mirabent (Universitat Internacional de Catalunya)
Revista	*International Journal of Intellectual Property Management*
DOI	10.1504/IJIPM.2019.10023987
Enlace web	https://www.inderscience.com/info/ingeneral/forthcoming.php?jcode=ijipm
Año publicación	2020, *en producción*
Impacto	Índice de impacto (SJR): 0.105 (2019) Cuartil y área (SJR): Q4 - Business and International Management

4.2.2. Objetivo y pregunta de investigación

Este segundo artículo está alineado con el estudio planteado por Steen y Vanhaverbeke (2018) sobre cómo la innovación abierta debe incorporarse en el modelo de negocio de las empresas para que haya un retorno de la inversión. Pese a que los autores, con gran agudeza, proponen una herramienta (adaptación del *business model canvas*) que integra los conceptos de innovación abierta, la principal crítica a su propuesta es que se trata de una herramienta estática, mientras que la adopción de prácticas de innovación abierta requiere de una análisis dinámico en el tiempo, por lo que su propuesta dificulta la medición del impacto.

Para dar respuesta a esta limitación, en el presente artículo se opta por un estudio de casos, estudiando en profundidad la evolución de cuatro empresas. Para ello se combina información cualitativa y cuantitativa, obteniendo datos de distintos momentos en el tiempo a lo largo de los últimos 10 años. Así mismo, como base para el análisis se parte de las cuatro estrategias propuestas por Saebi y Foss (2015) de cómo introducir innovación abierta en un negocio, y se utiliza el *business model canvas* para identificar en qué áreas del negocio dichas prácticas han tenido un impacto.

Ateniendo a lo expuesto anteriormente, este estudio da respuesta a los objetivos específicos OB3 y OB5, y responde a las siguientes preguntas de investigación:

- ¿Qué implica a nivel estratégico adoptar prácticas de innovación abierta?
- ¿Se ve modificado el modelo de negocio? ¿En qué aspectos?
- ¿Qué repercusión tiene en el desempeño de la empresa?

De lo expuesto anteriormente se desprende que este estudio está alineado con el trabajo de West et al. (2006), autores que se plantean varias preguntas sobre la agenda de futuro de la innovación abierta. En concreto, dichos autores ponen de manifiesto la necesidad de investigar sobre el grado de adopción de prácticas de innovación abierta en términos graduales con un pre- y post- análisis de las empresas a lo largo del tiempo. Siguiendo estas indicaciones, en el artículo 2 de la presente tesis se realiza un análisis de casos en el tiempo (10 años), lo que permite observar hasta qué punto la innovación abierta transforma los modelos de negocio de las empresas objeto de estudio así como el impacto en su rendimiento.

4.2.3. Marco teórico

Los fundamentos teóricos de este segundo artículo provienen de dos áreas temáticas distintas, aunque relacionadas: la innovación abierta y los modelos de negocio. Si profundizamos en estas dos literaturas se observa que, de forma conjunta, han sido ya objeto de interés en artículos académicos. Por tanto para dar respuesta a las preguntas de investigación que se mencionan en la sección anterior se ha recurrido por un lado, a las prácticas de innovación abierta, y por otro, a los modelos de negocio. Ambos marcos de referencia se han explicado en Capítulo 2 del presente documento. El objetivo último es ver el impacto que puede tener la introducción de prácticas de innovación abierta en el modelo de negocio de las empresas, y por consiguiente, en sus objetivos y desempeño. Resulta pues necesario contar con el soporte teórico de las dos literaturas para encontrar su punto de unión.

Para abordar esta cuestión, el modelo de referencia utilizado es el contemplado por Saebi y Foss (2015), quienes describen cuatro estrategias que las empresas pueden utilizar para introducir estrategias de innovación abiertas: basadas en el mercado (*marketing-based*), basadas en la multitud (*crowd-based*), colaborativas (*collaborative*) y basadas en redes (*network-based*). Estas cuatro estrategias se caracterizan por atender a los *partners*, por ser recursos clave y ejercer un impacto en la propuesta de valor de la empresa. Por otro lado, para determinar cómo se transforma el modelo de negocio de las empresas, se utiliza el *business model canvas* definido por Osterwalder and Pigneur (2010), con sus nueve bloques que representan las partes internas y externas de la empresa.

4.2.4. Metodología

La metodología que mejor sirve para dar respuesta a los objetivos planteados es la de carácter cualitativo, a través de un estudio de casos múltiple. En concreto, se han seleccionado cuatro empresas de un sector de actividad específico, el de la automoción, y en una región concreta, la Comunidad Valenciana, para así homogenizar la muestra y poder establecer comparativas sin riesgo a incluir sesgos debidos a las características específicas del sector o de la región. Dichas empresas tuvieron dificultades durante la última crisis económica y siguieron diferentes estrategias de innovación abierta para sobrevivir o acceder a otros mercados, respondiendo así a las cuatro tipologías definidas por Saebi y Foss (2015).

Durante el periodo de octubre de 2018 a enero de 2019 se mantuvieron un total de 15 entrevistas semiestructuradas con las cuatro empresas. Los encuestados tenían perfiles gerenciales (p.ej., CEO, CFO, gerente de ventas, gerente de proyectos) y poseían conocimiento sobre la estrategia de la empresa. Los temas discutidos durante las entrevistas estaban relacionados con la creación de la empresa, las estrategias de innovación, el día a día de sus operaciones, y el plan estratégico para los próximos tres años (para conocer el posicionamiento al que aspiran en el medio plazo). La información se trianguló con visitas in situ, páginas web de la empresa, informes anuales y otro material disponible en línea. También se obtuvieron datos económicos (balances y resultados financieros) a través de www.informa.es. Para garantizar el anonimato, los nombres de las empresas que figuran en el artículo no son los originales. Posteriormente, hubo un trabajo manual de transcripción de las entrevistas, clasificación de la información y poder así, responder a las preguntas de investigación.

4.2.5. Principales resultados

Del análisis de los cuatro casos se derivan un conjunto de implicaciones. En primer lugar, destacar que, en mayor o menor medida, a través de estrategias de innovación abierta las cuatro empresas alcanzaron buenos niveles de desempeño, mejorando también su propuesta de valor inicial, y por consiguiente, la satisfacción del cliente. Estas estrategias se demuestran como efectivas para afrontar las turbulencias del mercado, si bien es cierto que se observan particularidades y recomendaciones según si la empresa es fabricante o distribuidora. Para las empresas distribuidoras con exclusividad, se recomienda utilizar una estrategia de innovación basada en el mercado para beneficiarse así de la propiedad intelectual del fabricante oficial.

En cambio, para las empresas distribuidoras que no cuentan con exclusividad es mejor apuntar a una estrategia de innovación basada en la colaboración, aprovechando así los contactos y canales de distribución ya existentes que les permitan acceder a un mayor número de clientes. Por lo que a las empresas fabricantes se refiere, se observa que aquellas empresas que concentran sus esfuerzos en mantener un único producto deberían apostar por una estrategia de innovación basada en la multitud, es decir, aquella que incluye como fuentes de innovación a los distintos *stakeholders* (desde los proveedores a los distribuidores, incluyendo también a los clientes) potenciando tanto las prácticas *inbound* como las *outbound* para innovar. Por último, para las empresas fabricantes que desarrollan varios productos y lo hacen en colaboración con otras empresas se recomienda desarrollar una estrategia de innovación basada en la red, con flujos de información bidireccionales y la posibilidad de aplicar innovaciones tanto a productos y procesos relacionados como totalmente desvinculados. Se trata de extraer buenas prácticas y ver cómo aplicarlas en cualquier contexto.

Si bien las recomendaciones anteriores son generales (aunque concretas), las estrategias a implantar deben tener en cuenta las características de la propia empresa (tamaño, capital humano, capacidad de absorción, etc.) pero también las del sector en el que opera (qué hace la competencia, nivel de obsolescencia tecnológica, rotación, etc.). Este estudio también muestra la relevancia de involucrar a todos los *stakeholders* en el proceso de innovación como una estrategia efectiva para mejorar el desempeño de la pyme. En este sentido y siguiendo la idea que hay detrás del *funnel* de la innovación, es importante la cantidad de ideas que llegan más que su calidad, pues de una combinación de varias ideas, a priori irrelevantes o poco factibles, puede surgir una gran oportunidad a explorar.

4.3. Artículo 3

4.3.1. Ficha técnica del artículo

Título	How open are SMEs? Exploring the impact of different open innovation practices
Autores	Ignacio Odriozola-Fernández (Universitat Internacional de Catalunya) Jasmina Berbegal-Mirabent (Universitat Internacional de Catalunya)
Revista	*European Journal of International Management*
DOI	10.1504/EJIM.2020.10026139
Enlace web	https://www.inderscience.com/info/ingeneral/forthcoming.php?jcode=ejim
Año publicación	2020, *en producción*
Impacto	Índice de impacto (SCI/SSCI): 2.145 (2019) Cuartil y área (SCI/SSCI): Q3 - Management Índice de impacto (SJR): 0.753 (2019) Cuartil y área (SJR): Q2 - Business & International Management

Una versión preliminar de este artículo se presentó en el *1st Innovation, Entrepreneurship, Knowledge Academy Conference (INEKA)*, celebrado en Verona (Italia), del 11 al 13 junio de 2019. El artículo fue seleccionado para su posible inclusión en el *special issue* del congreso que publicaría la revista *European Journal of International Management*. Tras varias rondas de revisión, siguiendo el tradicional proceso de revisión ciega a pares, el artículo fue finalmente aceptado para su publicación.

4.3.2. Objetivo y pregunta de investigación

El debate sobre qué prácticas de innovación deben adoptar las empresas para mejorar su desempeño empresarial permanece abierto en varios puntos críticos. Algunos autores relacionan la innovación con el éxito (Freel, 2000; Aragón-Sánchez y Sánchez-Marín, 2005; Bennett y Ramsden, 2007; Raymond and Bergeron, 2008; Zaefarian et al., 2017). Más concretamente, Sisodiya (2013) aboga por unos flujos de conocimiento externo que permitan potenciar la innovación interna de la empresa. Otros autores, son más cautos y si bien afirman esta relación entre innovación y desempeño, indican que ésta está supeditada al tamaño de la empresa y a la experiencia (Majocchi et al., 2005; Raymond and St-Pierre, 2005; Lu et al., 2006; Laforet, 2013). El presente artículo pretende ahondar en esta relación. Concretamente, se plantean una serie de interrogantes:

- ¿Qué hace que unas empresas tengan mejor desempeño (en términos de facturación, rentabilidad, crecimiento de mercado y cuota de mercado) que otras? ¿Cuáles son los antecedentes?
- ¿Existen distintas vías para conseguir un buen desempeño? En caso afirmativo, ¿qué particularidades caracteriza cada una de estas vías? ¿Bajo qué condiciones es recomendable escoger una vía u otra?

Al responder a estas preguntas se abordan los objetivos específicos OB4 y OB5. Dado a que pueden existir varias combinaciones de factores que expliquen el desempeño, este estudio utiliza un enfoque configuracional para explicar que el rendimiento de una empresa en el mercado se debe a interacciones complejas entre varios factores. De la revisión de la literatura, dichos factores son: prácticas de innovación abierta (fuentes e intensidad de uso), desempeño actual en innovación (tipo de innovación—incremental vs radical—, estrategia de innovación y auto-percepción del desempeño innovador de la empresa en el mercado) y las características propias de la empresa (experiencia en el mercado y tamaño). El argumento que sustenta esta aproximación configuracional yace en que, dependiendo de cómo la empresa perciba su propio desempeño en el mercado, elegirá una estrategia de innovación u otra. Así pues, resulta interesante *investigar si distintos tipos de innovación, estrategia y desempeño innovador están asociados a diferentes niveles de participación en prácticas de innovación abierta*.

4.3.3. Marco teórico

El éxito en el desempeño de una empresa depende de muchos factores, existiendo una amplia variedad de estrategias. Si bien algunas empresas pueden centrarse en las áreas, capacidades o recursos que constituyen sus fortalezas para crear una oferta de servicios única que los diferencie de los competidores (Kemayel, 2015), otras empresas deciden reforzar su cultura y organización interna, así como las relaciones con sus *stakedholders* (Rammer et al. al., 2009). Existe todavía una tercera vía, consistente en adaptarse a las demandas del mercado utilizando procesos de trabajo flexibles y ciclos rápidos para entregar nuevo valor lo más pronto posible (Aziz y Samad, 2016). Independientemente de la estrategia, todos estos planes de acción requieren innovación constante (Pratali, 2003; Ramadani et al., 2013; Tse et al., 2016). En otras palabras, la innovación debe concebirse como un hábito en la empresa más que como un

proceso puntual o un fin en sí misma. En este contexto, la innovación abierta es vista como un activo central (Hamdani y Wirawan, 2012).

Para el propósito de este artículo, los fundamentos teóricos se estructuran en tres bloques. En primer lugar, se exponen las prácticas de innovación abierta. A continuación, se revisa la literatura sobre cómo medir el desempeño en innovación. Finalmente, se estudian las características propias de la empresa que pueden condicionar su desempeño.

4.3.4. Metodología

Para evaluar empíricamente qué combinaciones de factores producen un rendimiento superior de la empresa en el mercado, se optó por el caso de pymes ubicadas en la Comunidad Valenciana. Las empresas seleccionadas debían cumplir con los siguientes criterios: i) aparecer en el Registro Público Español de Empresas Innovadoras (Ministerio de Economía y Competitividad de España), ii) aplicar prácticas de innovación abierta, iii) llevar más de cuatro años activas en el mercado.

Para la recogida de información se diseñó un cuestionario, el cual se envió por correo electrónico a los directivos de las empresas que cumplían los requisitos anteriores. Se enviaron un total de 215 encuestas, obteniendo una tasa de respuesta baja (14.8%) pues los encuestados se mostraron reacios a participar en el estudio citando la falta de tiempo y la confidencialidad de los datos por los que se preguntaban. Tras eliminar los casos con datos incompletos, la muestra se redujo a 32 empresas, incluyendo empresas manufactureras que ofrecen productos o servicios. Los datos se recopilaron entre septiembre y noviembre de 2018.

El cuestionario se estructuró en tres partes. En primer lugar, una sección con preguntas para identificar el tipo de innovación (incremental o radical) y el objetivo que existe para aplicar esta innovación (producto, servicio, proceso). La segunda sección contenía preguntas sobre los conceptos de interés. En concreto se utilizó la escala de Ritala (2012) para medir el desempeño en el mercado, la escala desarrollada por Sisodiya et al. (2012) sobre prácticas de innovación abierta, la escala sobre estrategia de innovación de Terziovski (2010) y la escala de Ritala (2012) que mide la auto-percepción del desempeño innovador de la empresa. En total, se incluyeron 26 ítems. Por último, la tercera sección recopiló otros datos clave de la empresa (internacionalización, forma legal, etc.).

En referencia a la metodología de análisis, en primer lugar, y con el objetivo de tener un único indicador para cada uno de los constructos de interés se utilizó un análisis de componentes principales. Una vez calculado, y puesto que la tesis de partida es la co-existencia de distintas configuraciones que dan lugar a un determinado resultado, se seleccionó el análisis cualitativo comparado (QCA) como técnica (Olsen, 2014; Woodside, 2013). Esta técnica tiene además la ventaja adicional de funcionar correctamente con muestras pequeñas, como es el caso del presente estudio (Berg-Schlosser, 2009; Fiss, 2011). El software utilizado fue el fsQCA[11] en su versión 3.0. QCA identifica el número mínimo de combinaciones de condiciones casuales que son suficientes para producir un determinado resultado (en este caso, desempeño de la empresa).

Al trabajar con álgebra Booleana y conjuntos borrosos, el primer paso es la calibración de los datos, es decir, la transformación de los datos numéricos en valores entre 0 y 1. Los factores con valores dicotómicos se transforman en conjuntos nítidos (transformación *crisp*), con 0 indicando la no membresía y 1 la membresía al conjunto. Para el resto de factores, el proceso de calibración es en términos *fuzzy*, siendo necesario indicar para cada factor qué valor está totalmente dentro del conjunto (valor 0.95), totalmente fuera (valor 0.05) y el punto de máxima indefinición (valor 0.5, ni dentro ni fuera). Una vez completada esta etapa, se prosigue con el análisis de necesidad, en el que se verifica si alguna de las condiciones antecedentes (i.e. factores) es necesaria para que ocurra el resultado objeto de estudio. Siguiendo a Schneider y Wagemann (2010), se considera necesaria una condición cuando su porcentaje de consistencia excede el valor umbral de 0.9.

A continuación se construye la tabla de la verdad, que contiene todas las combinaciones posibles de condiciones antecedentes (mostradas en filas). Por lo tanto, la tabla de verdad tiene 2^k filas (es decir, el número de combinaciones de condiciones lógicamente posibles), donde k es el número de condiciones antecedentes en el modelo. Algunas filas pueden no tener evidencia empírica si no hay observación con esa combinación particular de condiciones antecedentes (Beynon et al., 2016). Para identificar las condiciones suficientes para producir el resultado, se reduce el número de filas utilizando el algoritmo de Quine-McCluskey (Quine, 1952). Esta reducción se basa en la relevancia empírica de la solución (cobertura) y en la medida en que los casos que comparten condiciones similares conducen al mismo resultado (consistencia). Las condiciones con cobertura 0 o un nivel de consistencia

[11] Disponible en http://www.socsci.uci.edu/~cragin/fsQCA/software.shtml

subóptimo se deben refinar. El valor predeterminado para el corte de consistencia es 0.8. Cuanto más se acerca este valor a 1, mayor es la consistencia (Ragin, 2009). Finalmente el programa identifica tres posibles soluciones: la compleja, la intermedia y la parsimoniosa. La diferencia entre ellas reside en las suposiciones hechas en el proceso de reducción. Siguiendo a Ragin (2009), para este estudio se reportan únicamente los resultados de la solución intermedia.

4.3.5. Principales resultados

Este estudio contribuye a la literatura de tres maneras. En primer lugar, responde a la llamda de trabajos recientes en los que se anima a investigar cómo las pymes utilizan la innovación abierta (Gassmann et al., 2010; Van de Vrande et al. 2010; Spithoven et al., 2013; Popa et al., 2017). En segundo lugar, investiga cómo las estrategias de innovación abierta, en combinación con otros factores, configuran el desempeño de una empresa. Este enfoque complementa la investigación actual sobre la existencia de un vínculo directo entre la innovación abierta y el desempeño empresarial. En tercer lugar, los resultados de este estudio (i.e. los distintos patrones identificados) proporcionan un punto de partida para las empresas, dibujando un mapa de ruta que les puede ser de ayuda a la hora de definir la estrategia (o combinación de factores) que mejor se adapte a sus características (p.ej., tamaño, tipo de innovación y experiencia en el mercado) y que conduzca a un mejor desempeño de la empresa.

En cuanto a los resultados específicos, del análisis con QCA se obtuvieron seis configuraciones, confirmando la intuición inicial de que hay distintas formas de llegar al resultado. En concreto, los resultados indican distintas estrategias a seguir en función de las características de la empresa. La Tabla 3 que se muestra a continuación presenta una síntesis de esta información.

Tabla 3. Resumen de los principales patrones identificados

Experiencia en el mercado	**Innovación incremental**	**Innovación radical**
Jóvenes	Pymes de reducido tamaño. Optan por consolidar su posición en el mercado con unos pocos productos/servicios que son altamente valorados por los clientes. La innovación se concibe como pequeñas mejoras, fruto de sus recursos limitados y escasa experiencia en el mercado.	Es el caso de las *born global*, es decir, empresas que desde el inicio asignan sus recursos y esfuerzos para encontrar un nicho internacional. La innovación está en su ADN.
		Para pymes pequeñas, formalizar una estrategia es menos relevante, ya que la empresa aún se encuentra en una etapa embrionaria y probablemente todavía está pivotando para reajustarse al mercado.
Consolidadas		Pymes más bien de tamaño mediano-grande que tienen muy formalizada su estrategia de innovación, arraigada por la dirección de la empresa y asumida por los trabajadores, lo que permite obtener un mejor posicionamiento en el mercado en términos de innovación.
Indiferente		Pymes grandes que apuestan por la innovación radical en base a procesos internos de innovación.

Nota: Las celdas en gris indica que con las empresas de la muestra, no se han obtenido configuraciones específicas para empresas que respondan a estas características.

5. Discusión y conclusiones finales

5.1. Discusión y conclusiones

La presente tesis centra su interés en el estudio de la innovación abierta en las pymes. La elección de las pymes no es casual. Son las pymes las que están despertando un mayor interés en gobiernos e instituciones (en detrimento de las grandes empresas) como agentes necesarios para reactivar la economía. Como se desprende del capítulo introductorio, las pymes tienen un peso muy importante en los países europeos, representando el 99% de todos los negocios. No es extraño pues que instituciones y gobiernos quieran reforzar (mediante políticas, incentivos y programas específicos) el impacto que tienen estas micro, pequeñas y medianas empresas en las economías, especialmente, en los países desarrollados. Esta relevancia de las pymes también se ha puesto de manifiesto en la literatura, con un número creciente de estudios dedicados a empresas que responden a este perfil.

Como se ha detallado en los capítulos anteriores, la tesis se ha elaborado bajo el formato de compendio de tres artículos, los cuales siguen una coherencia lógica y secuencial, que da respuesta al objetivo general de esta investigación. En el primer artículo, se presentan los fundamentos del área concreta de investigación, lo que permite obtener una imagen completa de la literatura existente que trata la innovación abierta en pymes. Este estudio se complementa con herramientas bibliométricas que, utilizando indicadores cuantitativos, permiten completar la información acerca del área de estudio e identificar los principales autores, citas, co-citaciones, palabras clave, instituciones, revistas, artículos más relevantes, etc. En un segundo artículo, a través de un estudio cualitativo, se profundiza en las estrategias de innovación abierta y su incorporación a los modelos de negocio para, en última instancia, determinar el impacto en el rendimiento de la empresa. Por último, el tercer artículo ofrece una visión cuantitativa, identificando distintos caminos que pueden seguir las empresas para introducir prácticas de innovación abierta en sus organizaciones y ser competitivas en el mercado, ateniendo a la estrategia de innovación, al desempeño en innovación y a las propias características de la empresa.

Combinando los resultados obtenidos en los tres estudios, se puede concluir que las pymes no mantienen una única fórmula eficaz, sino varias estrategias que pueden conducir al

éxito. Es decir, si bien se pueden generalizar ciertos resultados (i.e., los patrones definidos en los artículos 2 y 3), es relevante reconocer que cada estrategia debe entenderse en su contexto específico. Esto se traduce en que a la hora de decidir qué rumbo tomar, es importante escoger *benchmarks* adecuados (i.e., una estrategia no tiene porqué funcionar igual en todas las empresas), conocer bien la situación interna de la empresa, así como el entorno que la rodea.

Se espera que los resultados obtenidos con esta tesis sean de utilidad tanto para académicos como para empresarios, animando especialmente a éstos últimos a adoptar prácticas de innovación abierta. En concreto, del artículo 2 se observa que la innovación abierta ayuda a transformar (y a actualizar) el modelo de negocio, teniendo en consecuencia, un impacto en los resultados contables de la empresa. Se une así la parte más puramente estratégica y organizativa (p.ej., modelo de negocio) con una parte más pragmática orientada a los resultados. Aplicar estrategias de innovación abierta en las pymes supone un proceso de redimensionamiento de la empresa y contar con "nuevos jugadores" que colaboren para abrir nuevos nichos de mercado, mejorar la productividad de las empresas y aumentar la competitividad. En definitiva, consiste en transformar la gestión tradicional de operar y hacerlo de la mano con los demás grupos de interés, como si de una misma unidad se tratara. Del estudio 2, también se desprende que aplicar prácticas de innovación abierta es una via viable para salir reforzado de una crisis. En el estudio longitudinal, se observa que, a pesar del impacto de la crisis, las empresas estudiadas sobrevivieron con éxito ante coyunturas del mercado, al mismo tiempo que mejoraron sus procesos de innovación. La combinación de ambas, ayuda a mantener un desempeño de la empresa que es competitivo en el mercado. Estos resultados combinados con los hallazgos del artículo 3 permiten concluir que los modelos de negocio deben ser flexibles y que su configuración dependerá de las prácticas o estrategias de innovación abierta que se apliquen, pudiendo cambiar sin necesidad de mermar los recursos de la empresa en demasía, lo que proporciona una total adaptabilidad además de eficiencia. Si los modelos de negocio actuales destacan la propuesta de valor como una de las características esenciales de cualquier empresa, la innovación abierta propone innovar en cualquier aspecto, ya sea dentro o fuera de ella, siempre y cuando haya un retorno superior. El abanico de posibilidades aumenta y flexibiliza a los modelos de negocio de las empresas no sólo en un momento determinado sino que se asemeja a un gran compañero de viaje del que uno no debe desprenderse.

Esta tesis complementa los estudios existentes de dos maneras. Por una parte rompe con la tradicional idea que sólo las empresas grandes aplican innovación abierta tal y como postulaban los primeros artículos sobre innovación abierta en empresas. Por otra parte, aborda un tema de especial interés para un colectivo que no sólo ha sufrido la crisis finaciera de 2008, sino que ahora se encuentra en una posición vulnerable a raíz de la pandemia de la COVID-19. Si bien el efecto del coronavirus no ha sido objeto de estudio en esta tesis (los tres estudios se publicaron antes de la llegada de la pandemia), es momento ahora de proponer soluciones alternativas y ayudar a las pymes a encontrar aquellas configuraciones que les ayuden a hacer un uso más eficiente de sus recursos, dar respuesta a las necesidades de los clientes y seguir siendo económicamente rentables. En este contexto, las prácticas de innovación abierta se posicionan como una solución más que atractiva.

Es importante remarcar también que en los tres estudios que forman la tesis se han expuesto a diferentes escenarios, analizando empresas tanto de un mismo sector como de sectores y tamaños diversos. Los resultados son convergentes, lo que refuerza la validez de los argumentos presentados.

En conclusión, se puede argumentar que si bien las primeras referencias al concepto de innovación abierta se remontan a hace casi 20 años, no es hasta recientemente cuando la innovación abierta, y los conceptos relacionados de co-creación y *crowdsourcing*, están adquiriendo mayor relevancia no sólo a nivel académico sino también llegando a otras esferas, como son las microempresas, los emprendedores o las pymes. Escenarios de *coopetition* (cooperar + competir) han demostrado ser efectivos para impulsar las economías. La innovación abierta, es un facilitador. Como se ha visto en el artículo 1 quedan todavía muchas cuestiones por investigar y preguntas por responder. Esta tesis pretende aportar su grano de arena en esta dirección para que los resultados obtenidos ayuden a pymes a mejorar su competitividad.

5.2. Contribución

Esta tesis contribuye tanto al debate académico como al profesional sobre cómo las pymes pueden, mediante la inclusión de prácticas de innovación abierta, mejorar su posicionamiento en el mercado.

5.2.1. Contribución a la literatura

Desde una óptica académica, la contribución es tanto teórica como empírica. Desde un punto de vista teórico, la tesis ofrece una revisión sistemática del estado del arte en innovación abierta en pymes. En este sentido, el primer artículo puede ser de gran valor para investigadores que se inician en el área y quieran conocer dónde están los límites del conocimiento en esta disciplina. Así mismo, también resulta de enorme interés para investigadores ya con un perfil más senior, pues en el estudio se identifican los vacíos y se formulan propuestas para investigaciones futuras. El segundo artículo contribuye a la comunidad académica tanto del ámbito de la estrategia como de la innovación, poniendo sobre la mesa unas estrategias concretas para reorientar el modelo de negocio a base de innovar con un enfoque abierto. Por último, el tercer artículo señala qué configuraciones son las más adecuadas a la hora de introducir prácticas de innovación abierta en las pymes, en función de la tipología de la empresa (fabricante o comercializadora) y demás componentes de su visión estratégica.

Desde un punto de vista empírico, la tesis presenta una combinación original, combinando, para la parte de casos (artículos 2 y 3), el estudio de casos soportado con datos cuantitativos, con el análisis cualitativo comparado (QCA). Aunque son enfoques distintos, ambas metodologías permiten analizar en profundidad y desde perspectivas complementarias, el impacto de introducir prácticas de innovación abierta en las pymes. En concreto, el uso del QCA en este contexto es original, pues a fecha de hoy, son pocos los estudios que han utilizado esta técnica para relacionar las características propias de las empresas con estrategia, innovación y posicionamiento en el mercado.

5.2.1. Contribución e implicaciones prácticas

Esta tesis resulta también de especial interés para empresarios ya que proporciona soluciones alternativas, basadas en la innovación abierta, orientadas a mejorar los resultados económicos de las pymes. Los resultados de los artículos 2 y 3 pueden ser particularmente atractivos para este público, pues las categorías y patrones que se indican podrían servir de guía para empresarios, atrapados en modelos de negocio obsoletos, estructuras pesadas o empresas que necesiten reinventarse para seguir siendo viables. En muchos casos las características de la empresa (tamaño, antigüedad, tipo de innovación que aplican, etc.) condicionarán sus

decisiones, pero precisamente estas variables se han tenido en cuenta en los modelos que se han analizado, pudiéndose utilizar los resultados aquí presentados como *benchmarks*.

Esta tesis también persigue cambiar el tópico de que para innovar se necesitan grandes inversiones. Precisamente, los casos analizados (especialmente en el artículo 2) responden a empresas que se vieron inmersas en dificultades económicas importantes para poder seguir adelante con sus operaciones. La innovación abierta no tiene por qué ser "cara", al contrario, trata de optimizar al máximo todas las interacciones y flujos de información. Además, busca un cambio en la mentalidad del empresario: todos los elementos que toman parte activa en la cadena de valor tienen un peso importante y son clave para dar valor a la empresa. Conseguir un entorno favorable en cada uno de los eslabones ayuda a fomentar la innovación, y por ende los resultados empresariales.

5.3. Limitaciones y futuras líneas de investigación

Aunque en todo momento se ha seguido una metodología rigurosa, esta tesis presenta una serie de limitaciones que a su vez, dibujan oportunidades para trabajos futuros. En primer lugar, una de las limitaciones es que, aunque parezca una obviedad, para que la innovación abierta surja se requiere de una mentalidad abierta para compartir el conocimiento. En este sentido, los casos analizados consideran únicamente empresas con vocación innovadora que, en mayor o menor medida, mostraron una actitud proactiva de mejora, con directivos abiertos a nuevas maneras de dar respuesta a las necesidades de sus clientes, aportando al negocio un aire fresco que se adapte mejor a las tendencias del momento. Esto significa que no se han podido comparar grupos de empresas innovadoras con no-innovadoras, si bien es cierto que sí ha sido posible (en el tercer artículo) categorizar su grado de innovación.

En segundo lugar, tal y como se apuntaba en la sección 5.1, los entornos de coopetición (simultaneidad de competición y cooperación) son de elevado interés, si bien no forman parte del alcance de esta tesis. En el presente estudio, se ha asumido que los empleados realizaban innovación abierta y compartían información, herramientas y tecnología orientadas a colaborar con otras instituciones y empresas en pro de mejorar sus resultados sin tener en cuenta sus limitados recursos. En estas empresas la alta dirección fomentaba el cambio, adaptándose a la intrusión laboral de otros agentes externos, sin valorarlo de forma negativa, sino todo lo contrario. Es decir cooperaban en lugar de competir. Sería interesante, en futuro

estudios, abordar el triángulo coopetición-cooperación-competición en un contexto de innovación abierta.

En tercer lugar, es importante mencionar que para el diseño de esta tesis se ha partido de la base de que gobiernos, universidades y centros de investigación se encuentran abiertos a colaborar con las empresas de manera recurrente, aportando los primeros, leyes y medidas que fomentan este tipo de innovación, y conocimiento y rigurosidad científica los segundos, manteniendo todos ellos conversaciones periódicas para monitorizar los avances obtenidos. Sin embargo se cree que esto no ha sucedido más allá de momentos puntuales. Los gobiernos, en función de sus posibilidades económicas y de su actitud con las empresas fomentan en mayor o menor medida colaboraciones. Las universidades emanan conocimiento. A pesar de ello, la alineación de los intereses de empresas, gobiernos y universidades no siempre es fácil, aunque sea algo deseable por todas las partes. Este hecho condiciona las posibles interacciones y flujos de información entre los distintos agentes, dificultando canales a través de los cuales pueda materializarse la innovación abierta. Los motivos son diversos. Los empresarios y gerentes de empresas, en la mayoría de casos, se encuentran centrados en la facturación, margen de sus productos o servicios y en los beneficios al cierre del ejercicio, sin tener estrategias a largo plazo en cuestiones relacionadas con la innovación, eludiendo colaboraciones con otros organismos que les pueden aportar conocimiento. Si se combinan adecuadamente estos tres agentes y se añaden otras partes interesadas, se podrían obtener importantes avances en innovación. En efecto, implementar prácticas de innovación abierta requiere tiempo y esfuerzo, por lo que la pyme deberá considerarlo como cultura de empresa y registrarlo en su ADN. En la presente tesis se han contemplado empresas que sí han buscado estas interacciones con otros agentes del tejido productivo y socioeconómico, por lo que sería conveniente realizar un estudio sobre el proceso de interiorización de esta nueva cultura, más abierta a miradas y formas distintas, dentro de las empresas.

Otro aspecto a considerar es la relación que se va a generar fruto de la innovación abierta. La innovación abierta es mucho más que desarrollar un producto o mejorar un proceso. Se entiende la innovación abierta como algo que no debería tener una fecha de entrega o de finalización, pues no se trata de un contrato comercial que se empieza y se acaba. La dificultad reside cuando se quiere estudiar su impacto en la empresa, pues hay que determinar no sólo el objetivo que se persigue sino también un periodo de tiempo en el que recoger datos para poder concluir qué ha pasado en la empresa durante este tiempo objeto de

análisis. Además se debería poder tener un control exhaustivo de todas las dimensiones de la empresa para que se pueda observar periódicamente los avances o retrocesos que se están desarrollando. La limitación de la presente tesis ha sido que solo se ha observado el desempeño de la empresa en un momento puntual. Considerar alguna metodología que permita monitorizar los impactos periódicamente sería de gran utilidad.

Por último, el artículo 2 limita su estudio a una industria concreta, mientras que el estudio 3 recoge únicamente datos a nivel regional (Comunidad Valenciana) lo que limita la profundidad del análisis en términos del fenómeno de estudio a mayor escala. También el tamaño de la muestra es otra limitación. Si bien los estudios desarrollados cumplen con los casos mínimos requeridos, por razones de disponibilidad y acceso a datos, no se ha podido ampliar el estudio a una población mayor. Queda pendiente, para futuros estudios, probar si las configuraciones y perfiles identificados son extrapolables a otras regiones e industrias.

6. Referencias

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7. Anexos

En esta sección se incluye el texto completo de los tres artículos que integran la tesis.

Artículo 1:

Odriozola, I., Berbegal-Mirabent, J. and Merigó-Lindhal, J.M. (2019), "Open innovation in small and medium enterprises: A bibliometric analysis", *Journal of Organizational Change Management*, Vol. 32 No. 5, pp. 533-557. DOI: 10.1108/JOCM-12-2017-0491.

Artículo 2:

Odriozola-Fernández, I. and Berbegal-Mirabent, J. (2020, *in press*), "The effect of open innovation strategies on business models. A multiple case study in the automotive sector", *International Journal of Intellectual Property Management*. DOI: 10.1504/IJIPM.2019.10023987.

Artículo 3:

Odriozola-Fernández, I. and Berbegal-Mirabent, J. (2020, *in press*), "How open are SMEs? Exploring the impact of different open innovation practices", *European Journal of International Management*. DOI: 10.1504/EJIM.2020.10026139.

Artículo 1

Open Innovation in Small and Medium Enterprises: A bibliometric analysis

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Abstract

Purpose – The Open Innovation (OI) paradigm suggests that firms should use inflows and outflows of knowledge in order to accelerate innovation and leverage markets. Literature examining how firms are adopting OI practices is rich; notwithstanding, little research has addressed this topic from the perspective of small and medium enterprises (SMEs). Given the relevance of SMEs in worldwide economies, this paper provides a comprehensive overview of research on OI in SMEs.

Design / Methodology / approach – 112 academic articles were selected from the Web of Science database. Following a bibliometric analysis, the most relevant authors, journals, institutions and countries are presented. Additionally, the main areas these articles cover are summarized.

Findings – Results are consistent in that the most prolific authors are affiliated with the universities leading the ranking of institutions. However, it is remarkable that top authors in this field do not possess a large number of publications on OI in SMEs, but combine this research topic with other related ones. At the country level, European countries are on the top together with South Korea.

Research limitations – Despite following a rigorous method, other relevant documents not included in the selected databases might have been ignored.

Practical implications – This paper outlines the main topics of interest within this area: impact of OI on firm performance and on organizations' structure, OI as a mechanism to hasten new product development, the analysis of the inbound/outbound dimensions of OI, and legal issues related to IPR management when OI is implemented.

Originality / value – Combination of bibliometric indicators with a literature review.

Keywords – Open innovation, SMEs, bibliometrics, literature review

Paper type – Literature review

1. Introduction

Small and medium-sized enterprises (SMEs) play a paramount role in the development of current and future economies (Bruque and Moyano, 2007). Contemporary firms are constantly evolving. This requires not only a flexible and adaptable workforce able to quickly respond to customers' changing demands but also technological expertise and financial resources, which, conversely, tend to be limited (Vrgovic et al., 2012). In this context, Open Innovation (OI) is seen as a solution to these challenges, enabling companies to foresee the threats of the market and strengthen their business models (van de Vrande et al., 2009). As Chesbrough (2003) describes, OI represents an innovation paradigm shift from a closed to an open model.

OI seeks to use all external knowledge (Mina et al., 2014) to innovate within the company or use all internal knowledge to innovate outside the company. In other words, different agents (Wu et al., 2013; Felin and Zenger, 2014), whether internal or external to the company (Padilla-Meléndez et al., 2012), are involved in the innovation process. Universities, innovation centers and even governments stand out as external agents, playing an essential role in creating value based on the exchange of information and knowledge to improve companies' assets.

The term OI was first used to express the usage of "*internal and external knowledge to accelerate internal innovation and expand markets for the external use of such innovation*" (Chesbrough, 2003, p.43). The origin of this paradigm shift is clearly explained in a recent publication (Chesbrough, 2016). While collaborating on several projects at the Xerox Research Center (Palo Alto), Chesbrough noted that all projects had a closed innovation

approach; everything within the company was transformed. When the funding for those 35 projects ended, Xerox encouraged its employees to launch the projects in the market. Most of these projects failed to survive but five of them succeeded, and some even had a better market capitalization than Xerox. With a different business model, many of those projects that failed could have succeeded. Registering a patent and disseminating it among suppliers and customers might turn such assets into highly profitable opportunities (Granstrad and Holgersson, 2014; Henkel et al., 2014).

Since then, many articles from all sectors have been published in the most important journals on the international scene (Chesbrough, 2003; Laursen and Salter, 2006; van de Vrande et al., 2009; Dahlander and Gann, 2010). The interest in this topic has rapidly spread. An example of this is the 'World Open Innovation Conference,' held for 4 years, and 2017's edition was held in San Francisco. Other relevant conferences include the 'Open Innovation 2.0: The Platform for Digital Innovation Conference'—aimed at creating infrastructure that drives the ideas generated from citizens—, the 'Global Open Innovation Driven R&D Forum', or the forthcoming 'Open Innovation Summit' that will take place in Boston in 2018.

Also, the academic community has echoed the relevance of OI, mainly its broad perspective. It is, therefore, not surprising that several leading journals in the fields of management and business have fostered conversations among scholars with calls for papers in special issues. In this respect, it is worth mentioning this current special issue in *Organizational Change in Open Innovation*, on how organization, and SMEs in particular, manage and articulate different OI practices; or the recent call for papers in *Technological Forecasting and Social Change*—linked to the SOItmc and CSCOM 2016 conference—, which looked for articles discussing the challenges and opportunities of an open society which is increasingly globalized, with new technologies constantly emerging, and communication channels multiplying exponentially. In this regard, OI also plays a key role, allowing better connection between companies and consumers, which in turn, better respond to customers' needs. As a result, there have been substantial changes in the ways companies operate and in their business models (Chesbrough, 2011). New opportunities have also emerged in the market. SME, partnerships, joint ventures, alliances or capital ventures (Huizingh, 2011; Henkel et al., 2014, Laursen and Salter, 2014, Mina et al., 2014)—whether in an economic or scientific way—, are deploying non-existing technology or knowledge.

This allows them to access completely new markets, suppliers, customers, distribution channels, new products or innovation processes.

Research on OI is considerable; however, there are few studies examining OI in SMEs despite these representing the largest number of companies in an economy (Gassmann et al., 2010; Balios et al., 2015; Ormazabal et al., 2016). Indeed, most of the principles of OI are tailored to large companies. Given that SMEs are less formalized, more flexible, and make decisions faster (Lee et al., 2010), SMEs are particularly well-equipped for adapting and incorporating new ideas.

Rooted in this context, the present study contributes to the existing literature in two main ways. First, in light of the need to promote OI in SMEs, this study provides a comprehensive review of scholarly research on this topic. To do so, a bibliometric analysis is conducted. Covering a time horizon of 11 years (2007-2017), 112 research papers are examined. The Web of Science database is used as the main source. The current state of the art is therefore presented, including the identification of the most cited articles, the key authors, the most relevant journals, the leading institutions as well as the most productive countries investigating this specific topic. According to Merigó and Yang (2017), bibliometric analysis is an attractive field for the scientific community as it allows for the identification, classification and analysis of bibliographies, permitting the generation of summaries of the most outstanding results. Second, based on the accurate review of the selected papers, this paper does not only examine the development of research in this specific domain, but also it is expected to help researchers realize the importance OI has in SMEs by putting forward directions for future research. By adopting this perspective, we believe our paper to complement the recent work of Hossain and Kauranen (2016) which, compared to ours, use a meta-synthesis approach—instead of a bibliometric one—to synthetize the current state of the art of OI in SMEs. To do so and with the help of NVivo program, the authors compare the abstract of 51 papers and classify them into six different themes namely, searching strategies and networking, collaboration, innovation and technology management, performance and challenges.

The remaining of the paper is organized as follows. The next section explains the methods for the bibliometric analysis. Results are then presented and discussed. The paper ends with some concluding remarks. Limitations are also outlined.

2. Methodology

Bibliometric analyses study the bibliographic material quantitatively (Broadus, 1987), providing a general overview of a research field according to a wide range of indicators. By adopting a bibliometric approach in this study we aim not only at determining the most relevant literature in the area and different streams, but also at identifying the main authors, the leading journals, and the institutions that are at the forefront of OI in SMEs. This approach is very useful as a way to get a quick overview of the state of the art of a particular field. Additionally, the main findings can be very valuable for newcomers in the field as well as for developing research policies connected to OI and SMEs.

The first step in a bibliometric study consists in the selection of the database(s) from where the material (in this case, articles) will be gathered. This study selects the Web of Science (WoS) database, which has been widely acknowledged to collect reliable, integrated and multidisciplinary research from multiple sources, on the basis of impact evaluations, fulfilling the highest quality standards (Podsakoff et al., 2008; Yu and Shi, 2015).

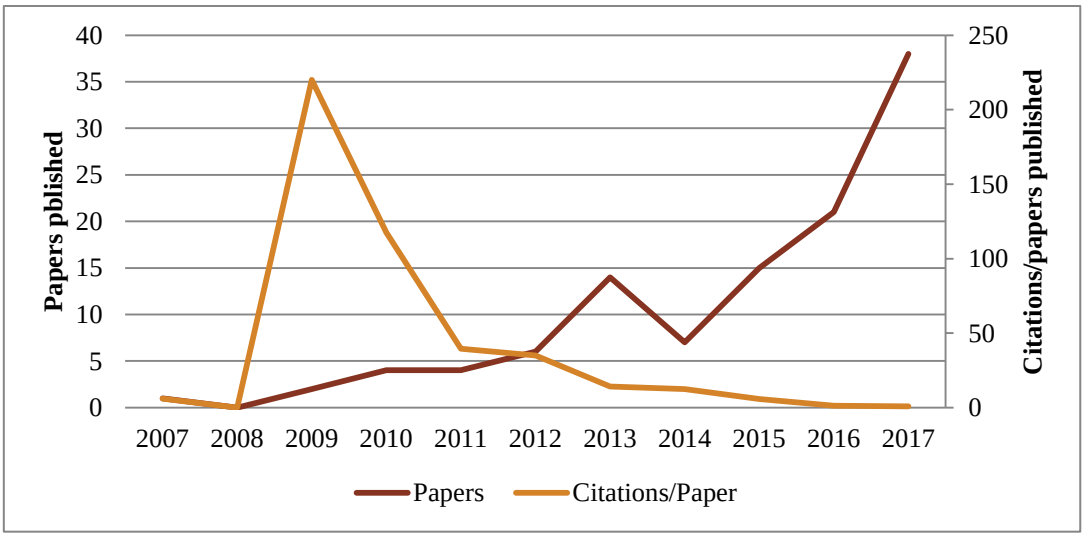
The selection of meaningful keywords that unequivocally return papers that fall in this topic is the next step. Two main keywords were selected "open innovation" and "small and medium enterprise*". Because small and medium enterprises can be written in a variety of forms, the following terms were also used in the search strategy: "small or medium enterprise*", "SME*", "medium-sized enterprise*", "small-sized enterprise*". Note that the symbol * allows for the inclusion of the plural. The search was conducted in November 2017, resulting in 246 documents. With the objective to concentrate on the most illustrative pieces of research, only "journal articles" were selected. As inclusion criterion, articles should be written in English. After filtering, 138 were obtained. Next, each article was reviewed—mainly the abstract, but if necessary the full paper—one by one to check if they addressed OI in SMEs. 26 articles were discarded. 8 of them were about OI but not on SMEs. 11 cover SMEs but OI was not the focus of the research. The remaining 7 were neither focusing on SMEs nor OI. Accordingly, the final sample includes 112 articles.

No restrictions were posed in terms of the time period. This was done on purpose to identify all articles that had covered this topic. As Figure 1 shows, the first article found was published in 2007. The number of publications seems to grow at a fairly steady pace—experiencing some fluctuations—until 2016. However, from 2016 to 2017 the number of

papers has increased by 80%, moving from 21 research articles to 38. The red line indicates the average number of citations per year. It is worth remarking on the peak in 2009, which is due to the pioneer research developed by van de Vrande et al. (2009), with 433 citations, examining the OI practices in the Netherlands SMEs. In this work, these authors demonstrate that OI helps SMEs gain access to market information and technologies, which in turn, create value for their customers.

Bibliometric studies employ a variety of indicators to signal, among others, how relevant the authors, articles, journals, institutions and countries—among others—are in a specific discipline (Van Leeuwen et al., 2003; Merigó et al., 2016). The main challenge is selecting a few but significant metrics able to capture impact, in the form of both productivity and relevance. In this respect, there is common agreement that frequency counts (e.g., number of articles published), citations, as well as ratios (e.g., citations/article) can perform this role well (Merigó et al., 2017).

Figure 1. Evolution of the number of publications on OI in SMEs.



Source: Self-elaborated.

Another metric that can provide additional insights is the H-index (Hirsch, 2005), also employed in previous bibliometric studies (Merigó and Yang, 2017). This index integrates publications and citations into one single measure by connecting the number of papers (*n*) that have received (*n*) citations. In this sense, an author with an H-index of 5 means that s/he has authored 5 papers, with all 5 articles cited, at least, 5 times.

VOS viewer has been widely used to illustrate bibliographic material (Van Eck and Waltman, 2010). This paper also uses this software. Developed by a research group from Leiden University, VOS viewer is freely available and helps to graphically visualize the results (Cancino et al., *2017*) by using co-citation, bibliographic coupling and co-occurrence of keywords. Recall that co-citation occurs when two documents receive a citation from the same third document (Small, 1973). Bibliographic coupling appears when two works cite the same third document (Kessler, 1963). Co-occurrence of keywords identifies the keywords that appear in the same work.

3. Results

The following section is structured in two main parts. First, we describe the results from the bibliometric analysis. Accordingly, the most influential journals, the most cited articles, and the most productive and influential authors are presented. Later information concerning the most relevant institutions, most productive countries and most relevant keywords is summarized. The second part of this section summarizes the main topics covered by the articles obtained through the bibliometric analysis. After carefully reading all articles, they were labelled depending on their focus, identifying four main themes in which to classify the existing literature on OI in SMEs. As such, we distinguish: (1) impact of OI on firm performance and on organizations' structure, (2) OI as a mechanism to hasten new product development, (3) the analysis of the inbound/outbound dimensions of OI, and (4) legal issues related to IPR management when OI is implemented.

3.1. Results of the bibliometric analysis

Most cited articles

Table 1 lists the 50 most cited articles from the 112 in the list. As previously mentioned, the article leading this ranking is the work authored by van de Vrande et al. (2009), published in the journal *Technovation*. There are only 4 additional articles that have received more than 100 citations. Next in the list is the study published in *Research Policy* elaborated by Lee et al. (2010). Specifically, in this work the authors place the concept of open innovation in the context of Korean SMEs and suggest the input of an intermediary in facilitating innovation. Impact of innovation performance in SMEs is another topic that has received attention among scholars. This is the case for Parida et al. (2012). Fourth and fifth in the ranking are the works

elaborated by Spithoven et al. (2011, 2010). Both works, by the same author and published in *Technovation*, explore inbound OI practices.

Other articles that have received a large number of citations—more than 50—are the ones by Bianchi et al. (2010) and Spithoven et al. (2013). While the former examines the use of technology in enabling OI initiatives among SMEs, the later compares OI practices between large corporations and SMEs. Although not leading the list, the study conducted by Brunswicker and Vanhaverbeke (2015) is also remarkable, receiving circa 12 citations each year since its publication.

Most influential journals

The journal with the most publications in OI in SMEs is the *International Journal of Technology Management* with 9 articles, however, the journal that has the greater impact—when considering the citations these papers have received—is *Technovation*, with an average of more than 100 of citations per publication. This result is consistent with the ones displayed in Table 1.

Indeed, some of the most cited articles are published in this journal. Following this, four journals appear, all with four articles. These journals are the *International Small Business Journal*, *Technology Analysis & Strategic Management*, *Business Process Management Journal*, and *Management Decision*; however, none of them score high in terms of the ratio TC/TP. On the contrary, there are two journals—*Journal of Small Business Management*, and *Research Policy*—that despite not leading this ranking have published articles that have acquired significant prevalence among scholars, receiving a significant number of citations. Note that all these journals—except the *Business Process Management Journal*—are well-established in the sense that they enjoy a solid reputation within the academic community. This is not the case for the *Technology Innovation Management Review*, the *European Journal of Innovation Management*, or the *International Journal of Innovation Management*, which have surprisingly entered this ranking. These journals are relatively young and they have probably been created to provide specific space for conversations that specifically deal with innovation—note that the term "innovation" is included in the title of the journal. It would be interesting to follow the evolution of these journals in the forthcoming years.

Table 1. 50 most cited articles.

R	Authors	Article title	Journal	TC	Y	TC/Y
1	van de Vrande, V; de Jong, JPJ; Vanhaverbeke, W; de Rochemont, M	Open innovation in SMEs: Trends, motives and management challenges	Technovation	433	2009	48.11
2	Lee, S; Park, G; Yoon, B; Park, J	Open innovation in SMEs-An intermediated network model	Res Policy	280	2010	35.00
3	Parida, V; Westerberg, M; Frishammar, J	Inbound Open Innovation Activities in High-Tech SMEs: The Impact on Innovation Performance	J Small Bus Manage	117	2012	19.50
4	Spithoven, A; Clarysse, B; Knockaert, M	Building absorptive capacity to organise inbound open innovation in traditional industries	Technovation	114	2011	16.29
5	Spithoven, A; Clarysse, B; Knockaert, M	Building absorptive capacity to organise inbound open innovation in traditional industries	Technovation	100	2010	12.50
6	Bianchi, M; Campodall'Orto, S; Frattini, F; Vercesi, P	Enabling open innovation in small- and medium-sized enterprises: how to find alternative applications for your technologies	R&D Manage	59	2010	7.38
7	Spithoven, A; Vanhaverbeke, W; Roijakkers, N	Open innovation practices in SMEs and large enterprises	Small Bus Econ	56	2013	11.20
8	Brunswicker, S; Vanhaverbeke, W	Open Innovation in Small and Medium-Sized Enterprises (SMEs): External Knowledge Sourcing Strategies and Internal Organizational Facilitators	J Small Bus Manage	37	2015	12.33
9	Teirlinck, P; Spithoven, A	Research collaboration and R&D outsourcing: Different R&D personnel requirements in SMEs	Technovation	36	2013	7.20
10	Caetano, M; Amaral, DC	Roadmapping for technology push and partnership: A contribution for open innovation environments	Technovation	34	2011	4.86
11	Pullen, AJJ; de Weerd-Nederhof, PC; Groen, AJ; Fisscher, OAM	Open Innovation in Practice: Goal Complementarity and Closed NPD Networks to Explain Differences in Innovation Performance for SMEs in the Medical Devices Sector	J Prod Innovat Manag	31	2012	5.17
12	Kim, H; Park, Y	The effects of open innovation activity on performance of SMEs: the case of Korea	Int J Technol Manage	31	2010	3.88
13	Tranekjer, TL; Knudsen, MP	The (Unknown) Providers to Other Firms' New Product Development: What's in It for Them?	J Prod Innovat Manag	22	2012	3.67
14	Bocken, NMP; Farracho, M; Bosworth, R; Kemp, R	The front-end of eco-innovation for eco-innovative small and medium sized companies	J Eng Technol Manage	21	2014	5.25
15	Brown, R; Mason, C	Inside the high-tech black box: A critique of technology entrepreneurship policy	Technovation	20	2014	5.00
16	Wynarczyk, P; Piperopoulos, P; McAdam, M	Open innovation in small and medium-sized enterprises: An overview	Int Small Bus J	19	2013	3.80

17	Comacchio, A; Bonesso, S; Pizzi, C	Boundary spanning between industry and university: the role of Technology Transfer Centres	J Technol Transfer	18	2012	3.00
18	Colombo, MG; Piva, E; Rossi-Lamastra, C	Open innovation and within-industry diversification in small and medium enterprises: The case of open source software firms	Res Policy	16	2014	4.00
19	Andries, P; Faems, D	Patenting Activities and Firm Performance: Does Firm Size Matter?	J Prod Innovat Manag	15	2013	3.00
20	van Hemert, P; Nijkamp, P; Masurel, E	From innovation to commercialization through networks and agglomerations: analysis of sources of innovation, innovation capabilities and performance of Dutch SMEs	Ann Regional Sci	14	2013	2.80
21	Huang, HC; Lai, MC; Lin, LH; Chen, CT	Overcoming organizational inertia to strengthen business model innovation An open innovation perspective	J Organ Change Manag	13	2013	2.60
22	Suh, Y; Kim, MS	Effects of SME collaboration on R&D in the service sector in open innovation	Innov-Manag Policy P	13	2012	2.17
23	Verbano, C; Crema, M; Venturini, K	The Identification and Characterization of Open Innovation Profiles in Italian Small and Medium-sized Enterprises	J Small Bus Manage	11	2015	3.67
24	Popa, S; Soto-Acosta, P; Martinez-Conesa, I	Antecedents, moderators, and outcomes of innovation climate and open innovation: An empirical study in SMEs	Technol Forecast Soc	9	2017	9.00
25	Cagno, E; Ramirez-Portilla, A; Trianni, A	Linking energy efficiency and innovation practices: Empirical evidence from the foundry sector	Energ Policy	9	2015	3.00
26	Vahter, P; Love, JH; Roper, S	Openness and Innovation Performance: Are Small Firms Different?	Ind Innov	9	2014	2.25
27	Kang, J; Gwon, SH; Kim, S; Cho, K	Determinants of successful technology commercialization: implication for Korean Government-sponsored SMEs	Asian J Technol Inno	9	2013	1.80
28	Eppinger, E; Vladova, G	Intellectual property management practices at small and medium-sized enterprises	Int J Technol Manage	9	2013	1.80
29	Vrgovic, P; Vidicki, P; Glassman, B; Walton, A	Open innovation for SMEs in developing countries - An intermediated communication network model for collaboration beyond obstacles	Innov-Manag Policy P	9	2012	1.50
30	Martinez-Conesa, I; Soto-Acosta, P; Carayannis, EG	On the path towards open innovation: assessing the role of knowledge management capability and environmental dynamism in SMEs	J Knowl Manag	8	2017	8.00
31	Bigliardi, B; Galati, F	Which factors hinder the adoption of open innovation in SMEs?	Technol Anal Strateg	8	2016	4.00
32	Michelino, F; Lamberti, E; Cammarano, A; Caputo, M	Open models for innovation: an accounting-based perspective	Int J Technol Manage	8	2015	2.67
33	McAdam, M; McAdam, R; Dunn, A; McCall, C	Development of small and medium-sized enterprise horizontal innovation networks: UK agri-food sector study	Int Small Bus J	8	2014	2.00
34	Dries, L; Pascucci, S; Torok, A; Toth, J	Keeping Your Secrets Public? Open Versus Closed Innovation Processes in the Hungarian Wine Sector	Int Food Agribus Man	8	2014	2.00
35	Tranekjer, TL; Sondergaard, HA	Sources of innovation, their combinations and strengths - benefits at the NPD project level	Int J Technol Manage	8	2013	1.60

36	Zhao, XY; Zheng, YN	Development of Chinese science and technology intermediaries and their integration into the open innovation paradigm	Technol Anal Strateg	8	2011	1.14
37	Padilla-Melendez, A; Del Aguila-Obra, AR; Lockett, N	Shifting sands: Regional perspectives on the role of social capital in supporting open innovation through knowledge transfer and exchange with small and medium-sized enterprises	Int Small Bus J	7	2013	1.40
38	Lee, YG; Park, SH; Song, YI	Which is Better for a Firm's Financial Performance: An Externally Oriented or Inwardly Oriented Innovation Strategy? An Empirical Study on Korean SMEs	Asian J Technol Inno	7	2009	0.78
39	Vigier, P	Towards a citizen-driven innovation system in Europe - A governance approach for a European innovation agenda	Innovation-Abingdon	6	2007	0.55
40	Ho, YP; Ruan, Y; Hang, CC; Wong, PK	Technology upgrading of Small-and-Medium-sized Enterprises (SMEs) through a manpower secondment strategy A mixed-methods study of Singapore's T-Up program	Technovation	5	2016	2.50
41	Huang, HC; Lai, MC; Huang, WW	Resource complementarity, transformative capacity, and inbound open innovation	J Bus Ind Mark	5	2015	1.67
42	Dodourova, M; Bevis, K	Networking innovation in the European car industry: Does the Open Innovation model fit?	Transport Res A-Pol	5	2014	1.25
43	Ahn, JM; Ju, Y; Moon, TH; Minshall, T; Probert, D; Sohn, SY; Mortara, L	Beyond absorptive capacity in open innovation process: the relationships between openness, capacities and firm performance	Technol Anal Strateg	4	2016	2.00
44	Heger, T; Boman, M	Networked foresight-The case of EIT ICT Labs	Technol Forecast Soc	4	2015	1.33
45	Huang, F; Rice, J; Martin, N	Does open innovation apply to China? Exploring the contingent role of external knowledge sources and internal absorptive capacity in Chinese large firms and SMEs	J Manage Organ	4	2015	1.33
46	Peng, XB; Song, W; Duan, YZ	Framework of open innovation in SMEs in an emerging economy: firm characteristics, network openness, and network information	Int J Technol Manage	4	2013	0.80
47	Ritala, P; Henttonen, K; Salojarvi, H; Sainio, LM; Saarenketo, S	Gone fishing for knowledge? The effect of strategic orientations on the scope of open knowledge search	Balt J Manag	4	2013	0.80
48	Schuurman, D; De Marez, L; Ballon, P	The Impact of Living Lab Methodology on Open Innovation Contributions and Outcomes	Technol Innov Manag	3	2016	1.50
49	Torok, A; Toth, J	Open characters of innovation management in the Hungarian wine industry	Agr Econ-Czech	3	2013	0.60
50	Rehm, SV; Goel, L; Junglas, I	Role of Information Systems in Empowering Innovation Networks	Mis Q Exec	2	2015	0.67

Abbreviations: R, rank; TC, citations; Y, year; TC/Y, total citations per year.
Note: The ranking is developed according to the number of articles (with a minimum of 2). In the case of a tie, the ratio TC/Y is considered.

Table 2. 30 most influential journals in OI in SMEs

R	Journal	TP	TC	TC/TP	H-index	> 300	>200	>100	>50	>25	>10	FYW	IF	IF5
1	International Journal of Technology Management	9	62	6.89	4	0	0	0	0	1	1	1997	1.036	1.106
2	Technovation	7	742	106.00	6	1	2	2	2	3	4	1997	3.265	4.822
3	International Small Business Journal	4	34	8.50	3	0	0	0	0	0	1	2005	3.677	4.651
4	Technology Analysis & Strategic Management	4	21	5.25	3	0	0	0	0	0	0	2005	1.273	1.686
5	Business Process Management Journal	4	4	1.00	1	0	0	0	0	0	0	NA	NA	NA
6	Management Decision	4	0	0.00	0	0	0	0	0	0	0	2009	1.396	2.515
7	Journal of Small Business Management	3	165	55.00	3	0	0	1	1	2	3	1997	2.876	4.342
8	Journal of Product Innovation Management	3	68	22.67	3	0	0	0	0	1	3	1997	3.759	4.358
9	R & D Management	3	60	20.00	1	0	0	0	1	1	1	1997	2.444	2.913
10	Technological Forecasting and Social Change	3	14	4.67	2	0	0	0	0	0	0	1997	2.625	3.226
11	Technology Innovation Management Review	3	4	1.33	1	0	0	0	0	0	0	NA	NA	NA
12	Sustainability	3	1	0.33	1	0	0	0	0	0	0	2013	1.789	1.85
13	European Journal of Innovation Management	3	0	0.00	0	0	0	0	0	0	0	NA	NA	NA
14	International Journal of Innovation Management	3	0	0.00	0	0	0	0	0	0	0	NA	NA	NA
15	Research Policy	2	296	148.00	2	0	1	1	1	1	2	1997	4.495	6.265
16	Innovation-Management Policy & Practice	2	22	11.00	2	0	0	0	0	0	1	2009	0.950	0.994
17	Asian Journal of Technology Innovation	2	16	8.00	2	0	0	0	0	0	0	2010	0.698	0.855
18	Industry and Innovation	2	10	5.00	1	0	0	0	0	0	0	2010	0.791	1.534
19	Journal of Knowledge Management	2	8	4.00	1	0	0	0	0	0	0	2011	2.053	3.293
20	Agricultural Economics-Zemedelska Ekonomika	2	3	1.50	1	0	0	0	0	0	0	2009	0.789	0.751
21	South African Journal of Industrial Engineering	2	1	0.50	1	0	0	0	0	0	0	2009	0.576	0.496
22	Inzinerine Ekonomika-Engineering Economics	2	0	0.00	0	0	0	0	0	0	0	2010	0.726	0.815
23	Small Business Economics	1	56	56.00	1	0	0	0	1	1	1	1997	2.421	3.414
24	Journal of Engineering and Technology Management	1	21	21.00	1	0	0	0	0	0	1	1998	2.419	2.985
25	Journal of Technology Transfer	1	18	18.00	1	0	0	0	0	0	1	2009	2.631	2.777

26	Annals of Regional Science	1	14	14.00	1	0	0	0	0	0	1	1997	0.694	1.037
27	Journal of Organizational Change Management	1	13	13.00	1	0	0	0	0	0	1	1997	0.761	1.192
28	Energy Policy	1	9	9.00	1	0	0	0	0	0	0	1997	4.140	4.599
29	International Food and Agribusiness Management Review	1	8	8.00	1	0	0	0	0	0	0	2011	0.443	0.816
30	Innovation-The European Journal of Social Science Research	1	6	6.00	1	0	0	0	0	0	0	2009	0.811	1.267

Abbreviations: R, rank; TP and TC, total papers and citations dealing with OI in SMEs; TC/TP, total citations divided by total papers; H-index on OI in SMEs; >300, >200, >100, >50, >25, >10, number of papers with more than 500, 200, 100, 50, 25 and 10 citations; FYW, first year in WoS; IF, impact factor 2016; IF5, 5 year impact factor 2016; NA, journals that have recently been included in WoS and still do not have an impact factor.

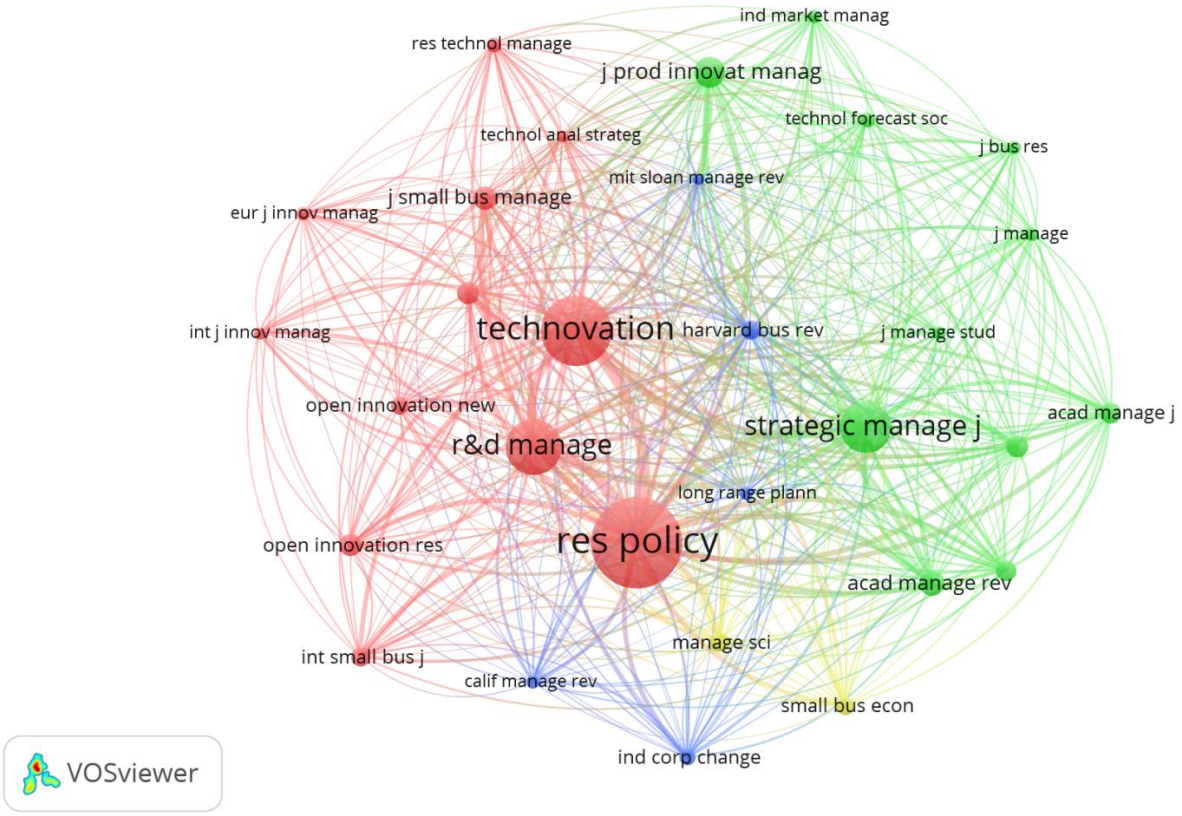
Note: The ranking is developed according to the number of articles. In the case of a tie, the ratio TC/TP is considered.

Most influential journals

The journal with the most publications in OI in SMEs is the *International Journal of Technology Management* with 9 articles, however, the journal that has the greater impact—when considering the citations these papers have received—is *Technovation*, with an average of more than 100 of citations per publication. This result is consistent with the ones displayed in Table 1. Indeed, some of the most cited articles are published in this journal. Following this, four journals appear, all with four articles. These journals are the *International Small Business Journal*, *Technology Analysis & Strategic Management*, *Business Process Management Journal*, and *Management Decision*; however, none of them score high in terms of the ratio TC/TP. On the contrary, there are two journals—*Journal of Small Business Management*, and *Research Policy*—that despite not leading this ranking have published articles that have acquired significant prevalence among scholars, receiving a significant number of citations. Note that all these journals—except the *Business Process Management Journal*—are well-established in the sense that they enjoy a solid reputation within the academic community. This is not the case for the *Technology Innovation Management Review*, the *European Journal of Innovation Management*, or the *International Journal of Innovation Management*, which have surprisingly entered this ranking. These journals are relatively young and they have probably been created to provide specific space for conversations that specifically deal with innovation—note that the term "innovation" is included in the title of the journal. It would be interesting to follow the evolution of these journals in the forthcoming years.

Figure 2 displays the co-citation analysis. That is, the frequency with which two articles are cited together by the same third document. As it can be observed, four types of journals are represented: coloured in green, those journals that refer to management; in red, journals dealing with technology and innovation journals; in yellow, entrepreneurship journals; and finally, in blue, organizational and leadership journals. Three focal journals are located in the centre of the map. The red big circle stands for *Research Policy*, and the other two are *Technovation* and *Research and Development Management*.

Figure 2. Co-citation analysis



Note: The minimum number of citations from each source is 43.
Source: self-elaborated using VOS viewer.

Most productive and influential authors

The most prolific author is Wim Vanhaverbeke, from Hasselt University (Belgium), with four papers that have conjointly received 526 citations. His works mainly focus on the future of OI in SMEs, patterns of OI, access to external sources of information, as well as OI projects that are based on the science or in the market share. Another distinguished author is Andre Spithoven (also from Belgium), with four articles and an average of 76.5 citations per article—note that all four articles are in the top 9 of most cited articles. One of his most salient works is the one where he describes absorption capacity to organize inbound OI. Third and fourth in the ranking—both with four articles—are Byungun Yoon, from Dongguk University in South Korea, and Jozsef Toth from Corvinus University of Budapest (Hungary), with 281 and 11 citations, respectively.

Table 3. Most productive and influential authors in OI in SMEs

R	Author	University	Country	TP	TC	TC/TP
1	Vanhaverbeke, W	Hasselt University	Belgium	4	526	131.5
2	Spithoven, A	Belgian Science Policy Office	Belgium	4	306	76.5
3	Yoon, B	Dongguk University	South Korea	4	281	70.3
4	Toth, J	Corvinus University of Budapest	Hungary	4	11	2.8
5	Del Giudice, M	Sapienza - Università di Roma	Italy	3	1	0.3
6	Scuotto, V	University of the West of Scotland	UK	3	1	0.3
7	Yun, JJ	Daegu Gyeongbuk Institute of Sci and Tech	South Korea	3	0	0.0
8	Lee, S	Ajou University	South Korea	2	281	140.5
9	Clarysse, B	University of Ghent	Belgium	2	214	107.0
10	Knockaert, M	University of Ghent	Belgium	2	214	107.0
11	Teirlinck, P	Katholieke Universiteit Leuven	Belgium	2	37	18.5
12	Tranekjer, TL	University of Southern Denmark	Denmark	2	30	15.0
13	McAdam, M	Queen's University Belfast	North Ireland	2	27	13.5
14	Brown, R	University of St Andrews	UK	2	21	10.5
15	Huang, H-C	National Kaohsiung Univ of App Sci	Taiwan	2	18	9.0
16	Lai, M-C	Tzu Chi College of Technology	Taiwan	2	18	9.0
17	Martinez-Conesa, I	Universidad de Murcia	Spain	2	17	8.5
18	Soto-Acosta, P	Universidad de Murcia	Spain	2	17	8.5
19	Cagno, E	Politecnico di Milano	Italy	2	10	5.0
20	Ramirez-Portilla, A	KTH Royal Institute of Technology	Sweden	2	10	5.0
21	Carayannis, EG	George Washington University	USA	2	9	4.5
22	Vladova, G	University of Potsdam	Germany	2	9	4.5
23	Ahn, JM	Sogang University	South Korea	2	4	2.0
24	Minshall, T	Sogang University	South Korea	2	4	2.0
25	Mortara, L	University of Cambridge	England	2	4	2.0
26	Alfaro Tanco, JA	Universidad de Navarra	Spain	2	2	1.0
27	Agostini, L	Università di Padova	Italy	2	1	0.5
28	Krause, W	Stellenbosch University	South Africa	2	1	0.5
29	Nosella, A	Università di Padova	Italy	2	1	0.5
30	Schutte, CSL	Stellenbosch University	South Africa	2	1	0.5
31	Bresciani, S	University of Turin	Italy	2	0	0.0
32	Ferto, I	Hungarian Academy of Sciences	Hungary	2	0	0.0
33	Henttonen, K	Lappeenranta University of Technology	Finland	2	0	0.0
34	Lee, K	Dongguk University	South Korea	2	0	0.0
35	Park, KB	Sangji University	South Korea	2	0	0.0
36	Yang, J	Daegu Gyeongbuk Institute of Sci and Tech	South Korea	2	0	0.0

Abbreviations: R, rank; TP and TC, total papers and citations dealing with OI in SMEs; TC/TP, total citations divided by total papers;

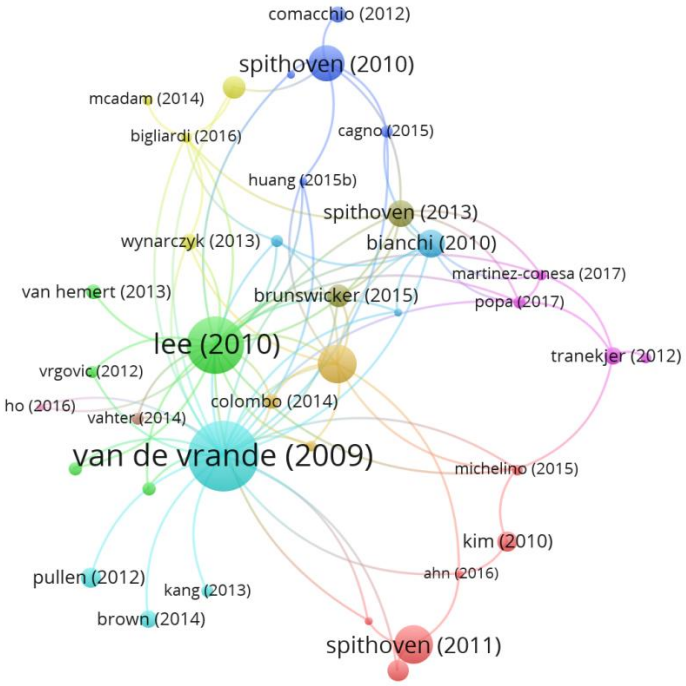
Note: The ranking is developed according to the number of articles (TP) (with a minimum of 2). In the case of a tie, the ratio TC/TP is considered.

As for the authors with 3 articles—Manlio Del Giudice, Veronica Scuotto and JinHyo Joseph Yun—they all share the common feature of having received a low number of citations. Specifically, Del Giudice and Scuotto have co-authored the same three articles, all of them published in 2017; therefore, the low number of citations is not surprising, as the articles have

recently been published. On the other hand, the three articles authored by Yun, date in 2015, 2016 and 2017. Other authors that have a significant impact, despite low production, are Sungjoo Lee from Ajou University in South Korea (2 papers, 281 citations), and the Belgians Bart Clarysse and Mirjam Knockaert, from University of Ghent (co-authors, both with 214 citations from 2 articles).

The analysis in VOS viewer confirms the results reported above. As shown in Figure 3, Van de Vrande is the author whose publications are the most cited ones, followed by Lee and Spithoven. The closer and the more lines between the authors, the more influential and more relationships exist among them.

Figure 3. Most influential authors (based on citations)



Source: Self-elaborated using VOS viewer.

Most relevant institutions

Institutions have been ranked based on the number of publications, and in case of a tie, taking into account the impact of these works—calculated by dividing the total number of publications by the total number of citations these papers have received. Table 4 displays the results.

Table 4. 50 most influential institutions in OI in SMEs

R	University	Country	TP	TC	Impact	Authors	Authors/TP	Impact/Authors	ARWU	QS
1	Hasselt University	Belgium	4	526	131.5	3	0.8	175.3		
2	Dongguk University	South Korea	4	281	70.3	4	1.0	70.3	501-600	471-480
3	Politecnico di Milano	Italy	4	85	21.3	8	2.0	10.6	201-300	170
4	Corvinus University of Budapest	Hungary	4	11	2.8	2	0.5	5.5		801-1000
5	Sungkyunkwan University	South Korea	4	10	2.5	5	1.3	2.0		108
6	Seoul National University	South Korea	3	293	97.7	4	1.3	73.3	101-150	36
7	University of Ghent	Belgium	3	117	39.0	4	1.3	29.3	69	125
8	University of Southern Denmark	Denmark	3	8	2.7	4	1.3	2.0	301-400	384
9	University of Potsdam	Germany	3	4	1.3	4	1.3	1.0	401-500	461-470
10	University of Cambridge	UK	3	4	1.3	5	1.7	0.8	3	5
11	University of the West of Scotland	UK	3	1	0.3	1	0.3	1.0		
12	Università di Padova	Italy	3	1	0.3	5	1.7	0.2	151-200	296
13	Sogang University	South Korea	3	0	0.0	5	1.7	0.0		441-450
14	Daegu Gyeongbuk Institute of Science and Technology	South Korea	3	0	0.0	4	1.3	0.0		
15	Ajou University	South Korea	2	281	140.5	1	0.5	281.0	701-800	6511-700
16	Vlerick Business School	Belgium	2	214	107.0	1	0.5	214.0		
17	Belgian Science Policy Office	Belgium	2	92	46.0	1	0.5	92.0		
18	Purdue University	USA	2	46	23.0	2	1.0	23.0	301-400	105
19	University of Twente	Netherlands	2	32	16.0	5	2.5	6.4	301-400	179
20	Queen's University Belfast	North Ireland	2	27	13.5	2	1.0	13.5	301-400	202
21	University of Wageningen	Netherlands	2	24	12.0	3	1.5	8.0	101-150	124
22	University of St Andrews	UK	2	21	10.5	1	0.5	21.0	301-400	92
23	National Kaohsiung University of Applied Sciences	Taiwan	2	18	9.0	4	2.0	4.5		
24	Universidad de Murcia	Spain	2	17	8.5	2	1.0	8.5	701-800	801-1000
25	Katholieke Universiteit Leuven	Belgium	2	16	8.0	2	1.0	8.0	90	71

26	George Washington University	USA	2	9	4.5	1	0.5	9.0	301-400	352
27	University of Novi Sad	Serbia	2	9	4.5	4	2.0	2.3		
28	University of Science and Technology	South Korea	2	7	3.5	1	0.5	7.0		
29	Korea Institute of Science and Technology	South Korea	2	7	3.5	4	2.0	1.8	201-300	41
30	University of Science and Technology	China	2	4	2.0	3	1.5	1.3	501-600	97
31	Lappeenranta University of Technology	Finland	2	4	2.0	5	2.5	0.8		501-550
32	Universidad de Navarra	Spain	2	2	1.0	2	1.0	1.0		270
33	National Research University	Russia	2	1	0.5	2	1.0	0.5		382
34	Sapienza - Università di Roma	Italy	2	1	0.5	2	1.0	0.5	151-200	215
35	Stellenbosch University	South Africa	2	1	0.5	2	1.0	0.5	401-500	361
36	Hungarian Academy of Sciences	Hungary	2	0	0.0	2	1.0	0.0		
37	Sangji University	South Korea	2	0	0.0	2	1.0	0.0		
38	University of Turin	Italy	2	0	0.0	2	1.0	0.0	201-300	551-600
39	École Polytechnique Fédérale de Lausanne	Switzerland	1	433	433.0	1	1.0	433.0	76	12
40	Eindhoven University of Technology	Netherlands	1	433	433.0	1	1.0	433.0	301-400	104
41	Electronics and Telecommunications Research Institute	South Korea	1	280	280.0	1	1.0	280.0		
42	Luleå University of Technology	Sweden	1	117	117.0	1	1.0	117.0		
43	Sant'Anna School of Advanced Studies	Italy	1	59	59.0	1	1.0	59.0		192
44	University of Bergamo	Italy	1	59	59.0	1	1.0	59.0		
45	Budapest University of Technology and Economics	Hungary	1	56	56.0	1	1.0	56.0	701-800	751-800
46	Hogeschool-Universiteit Brussel	Belgium	1	36	36.0	1	1.0	36.0		
47	Universidade de São Paulo	Brazil	1	34	34.0	2	2.0	17.0	151-200	121
48	University of Auckland	New Zealand	1	21	21.0	1	1.0	21.0	201-300	82
49	Maastricht University	Netherlands	1	21	21.0	2	2.0	10.5	201-300	200
50	University of Glasgow	UK	1	20	20.0	1	1.0	20.0	101-150	65

Abbreviations: R, rank; TP and TC, total papers and citations dealing with OI in SMEs; Impact, TC/TP; Authors, number of authors belonging to this institution (in case of multiple affiliations, the country of the first one given in the paper is considered) that have published on this topic; ARWU, university position in the Academic Ranking of World Universities 2017; QS, university position in the QS World University Rankings® 2017.
Note: The ranking is developed according to the number of articles (TP). In the case of a tie, the Impact is used.

Universities and research centers from South Korea seem to play a relevant role (10 out of 50), with Dongguk University, Sungkyunkwan University and Seoul National University among the top 6. This result is congruent with those in Table 3, where we saw that 8 of the most relevant authors are indeed from this country. Also Belgian institutions are interested in OI practices in SMEs. Specifically, Hasselt University, University of Ghent, Vlerick Business School, the Belgian Science Policy Office, KU Leuven, and Hogeschool-Universiteit Brussel. Politecnico di Milano (Itlay) is third in the ranking, with four publications and 85 citations.

In terms of the number of authors from these institutions, Politecnico di Milano is the one with the highest number of researchers (8) investigating this topic, followed by Sungkyunkwan University and Sogang University (South Korea), University of Cambridge (UK), Università di Padova (Italy), University of Twente (Netherlands), and Lappeenranta University of Technology (Finland), all with 5 researchers.

Calculating the ratio impact/author, there are three institutions—École Polytechnique Fédérale de Lausanne (Switzerland), Eindhoven University of Technology (Netherlands), and the Electronics and Telecommunications Research Institute (South Korea)—that clearly outperform. This is because there is only one author from each of these institutions, and the paper authored by them has achieved a large number of citations. In fact, the first two institutions are the home of V. van de Vrande and M. de Rochemont, two of the authors of the most cited articles. Similarly, G. Park is the author of the second most cited article.

Most productive countries

The 112 articles selected are authored by researchers located in 35 different countries (see Table 5). UK (19 articles), Italy (16), South Korea (12), and Belgium (11) lead the rank in terms of total number of articles published. These countries are also the ones hosting the highest number of researchers investigating OI in SMEs, if we also include China and Spain—with 19 and 18 researchers, respectively—and the number of institutions where this research is carried. European countries seem to dominate this topic, with the exception of South Korea and China, and the modest role played by the USA (6 papers). In terms of impact—citations divided by the number of publications—, the Netherlands ranks first. It is also worth mentioning the role played by Sweden and North Ireland, when analyzing the ratio impact/institutions, meaning that institutions from these two countries have, on average, a

notable proportion of citations per publications. Brazil and Switzerland appear as outliers, with only one publication with a high impact—signaling that the paper has received many citations.

Table 5. Rank of countries publishing research on OI in SMEs

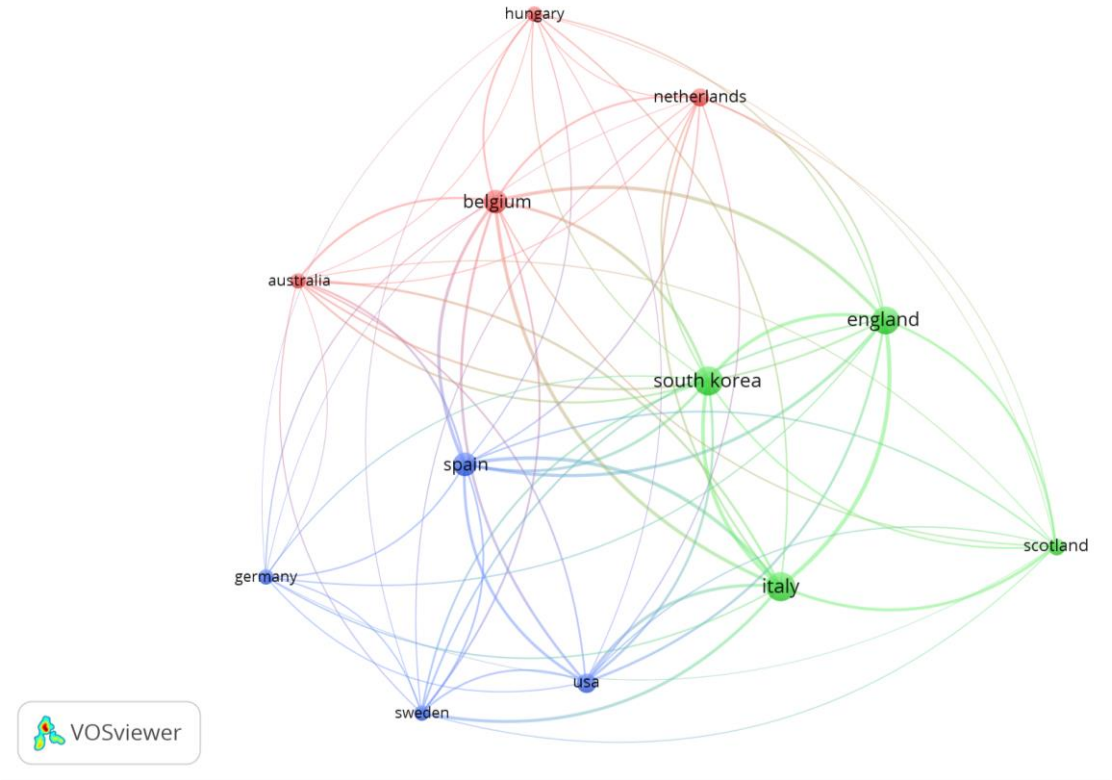
R	Country	TP	TC	Impact	Authors	Impact/Authors	Institutions	Impact/Institutions
1	UK	19	90	25.83	25	1.23	17	2.35
2	Italy	16	133	8.31	38	0.22	17	0.49
3	South Korea	12	310	25.83	21	1.23	11	2.35
4	Belgium	11	801	72.82	14	5.20	8	9.10
5	Netherlands	8	539	67.38	15	4.49	6	11.23
6	Spain	8	29	3.63	18	0.20	10	0.36
7	Hungary	6	68	11.33	6	1.89	4	2.83
8	USA	6	68	11.33	7	1.62	6	1.89
9	China	6	19	3.17	19	0.17	7	0.45
10	Germany	6	16	2.67	7	0.38	4	0.67
11	Sweden	4	122	30.55	6	5.08	4	7.63
12	Finland	4	5	1.25	11	0.11	4	0.31
13	Australia	4	5	1.25	9	0.14	8	0.16
14	Denmark	3	30	10.00	6	1.67	3	3.33
15	Taiwan	3	18	6.00	9	0.67	5	1.20
16	Serbia	3	9	3.00	9	0.33	3	1.00
17	North Ireland	2	27	13.50	5	2.70	2	6.75
18	New Zealand	2	21	10.50	2	5.25	2	5.25
19	U Arab Emirates	2	2	1.00	2	0.50	2	0.50
20	Portugal	2	2	1.00	6	0.17	3	0.33
21	Russia	2	1	0.50	2	0.25	1	0.50
22	South Africa	2	1	0.50	2	0.25	1	0.50
23	France	2	0	0.00	5	0.00	4	0.00
24	Poland	2	0	0.00	3	0.00	2	0.00
25	Switzerland	1	433	433.00	1	433.00	1	433.00
26	Brazil	1	34	34.00	2	17.00	1	34.00
27	Estonia	1	9	9.00	1	9.00	1	9.00
28	Singapore	1	5	5.00	3	1.67	1	5.00
29	Romania	1	2	2.00	5	0.40	2	1.00
30	Canada	1	1	1.00	1	1.00	1	1.00
31	Greece	1	1	1.00	2	0.50	1	1.00
32	Mexico	1	1	1.00	2	0.50	1	1.00
33	Lithuania	1	0	0.00	3	0.00	1	0.00
34	Nigeria	1	0	0.00	2	0.00	1	0.00
35	Slovenia	1	0	0.00	4	0.00	1	0.00

Abbreviations: R, rank; TP and TC, total papers and citations dealing with OI in SMEs; Impact, TC/TP; Authors, number of authors belonging to this country (in case of multiple affiliations, the country of the first one given in the paper is considered) that have published on this topic; Institutions, number of institutions in a given country (in case of multiple affiliations the first one is considered) in which authors that have published on this topic are affiliated at.

Note: The ranking is developed according to the number of articles (TP). In the case of a tie, the Impact is used.

Going a step further in the analysis, Figure 4 shows the bibliographic coupling of the papers in the sample. Bibliographic coupling among countries occurs when two or more countries cite a third document from another country. As shown in the figure, countries can be grouped in three main groups, being those colored in green the ones with the have received the largest number of citations.

Figure 4. Bibliographic coupling by countries



Source: Self-elaborated using VOS viewer.

Most relevant keywords

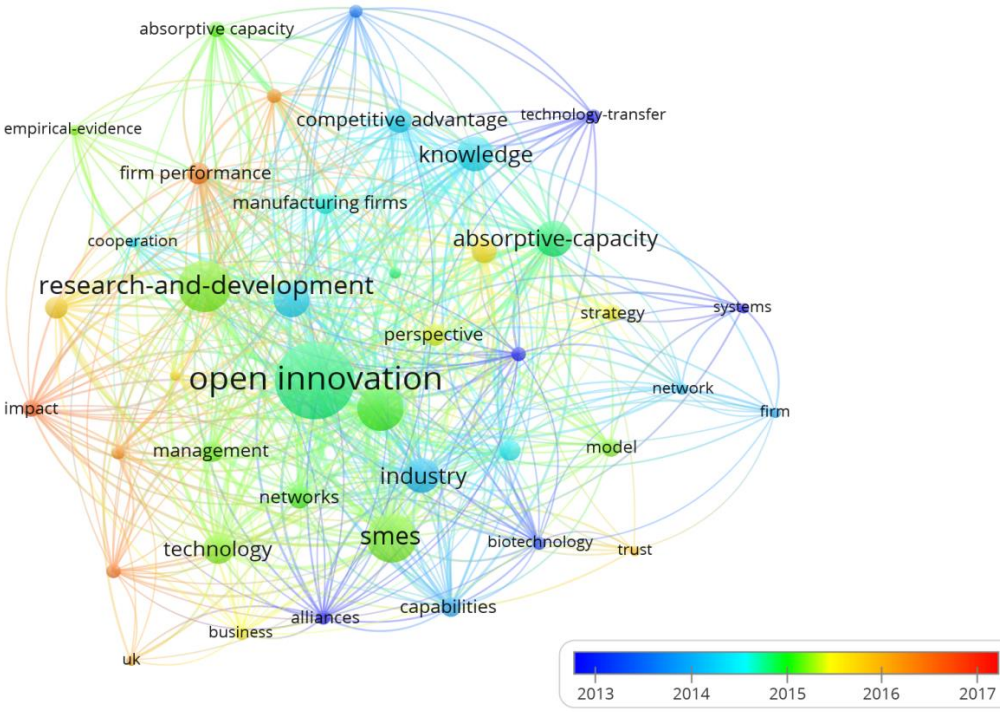
Taking into account the keywords suggested by the authors in their articles, this paper finds that, unsurprisingly, the most common keyword is "open innovation" (used 63 times), followed by SMEs (49 times). Figure 5 graphically illustrates the most common keywords in the form of a cloud: the bigger the size, the more frequent a keyword is. Lagging far behind OI and SMEs, other relevant key terms are "knowledge" (frequency count: 19), technology (15), innovation (11) and absorptive capacity (10). Below the threshold of 10, the other words refer to "R&D management" (9), "collaboration" and "networks" (8), "IP management" (7), "case study" (5), and "external knowledge" and "new product development" (4). All these words give us an idea of the research topics covered in the papers reviewed.

Figure 5. Top keywords employed in OI in SMEs articles

Source: Self-elaborated.

The most relevant keywords can also be mapped (Figure 6). This way it is possible to observe how they are interconnected among different documents. In addition, Figure 6 also takes into account the relevance of the different keywords by year of publication (from 2007 to 2017).

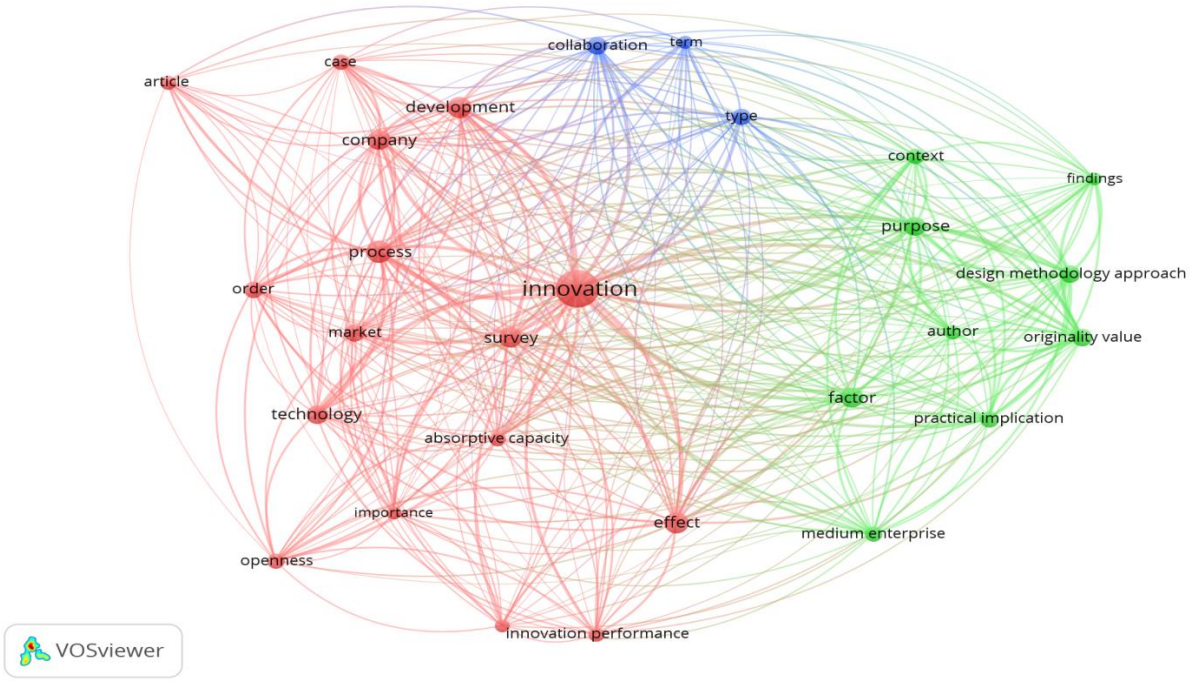
Figure 6. Co-citation analysis of keywords



Source: Self-elaborated using VOS viewer.

Similar to keyword analysis, the software VOS viewer allows for mapping the most relevant terms used in the papers reviewed, not only those terms appearing as keywords, but also considering the terms employed in the titles and abstracts. Figure 7 shows the results. Each circle represents a term for one or more publications. The more occurrences of certain terms in the publications, the closer they are represented. For illustrative purposes, a threshold of at least 12 occurrences has been established. It is also relevant to note that the term "medium-sized enterprises" has been excluded since it was already included as "medium enterprise".

Figure 7. Map of most relevant terms



Source: Self-elaborated using VOS viewer.

The remainder of the as paper is organized follows. The next section briefly outlines what OI is and how SMEs can benefit from adopting such an approach, by summarizing the main findings from the papers reviewed.

3.2. Content analysis: Open Innovation in SMEs

SMEs need to constantly embrace innovation in order to achieve a better position in the market. However, the process of implementing innovation can be arduous and therefore, jeopardize the chances of survival, particularly when resources are scarce (Olander et al., 2009). Rigidity in the legislation is another barrier. Governments generate the most

bureaucratic difficulties by preventing knowledge from being easily shared (Padilla-Meléndez et al., 2012). However, recent studies reveal that despite SMEs facing many challenges, when it comes to generating new ideas/knowledge, the adoption of OI practices can help in eliminating barriers, maintaining contact with the market in a simpler manner and without compromising too many resources (Lee et al., 2010; Brunswicker and Vanhaverbeke, 2015).

Certainly, SMEs are very different from large business. They typically have limited cash and resources, which create a vicious circle that prevents them from quick growth. R&D departments, if any, do not usually spend as much as big companies do (Narula, 2004). Similarly, SMEs lack a formal process for developing new products/services. This implies that SMEs cannot afford the cost of having employees fully dedicated to new product development (Woy and Qing, 2007) and have a limited ability to conduct in-depth customer research on their own (Vrgovic et al., 2012).

Given these particularities, SMEs should innovate using a lower-cost method. In this context, building networks with other companies, research facilities, customers and suppliers are an attractive alternative. This partnership concept allows distinct organizations to collaborate to achieve mutual goals, exchange experiences and eliminate the waiting time involved in creating everything from scratch (Bullinger et al., 2004). At the same time, this strategy reduces costs and insecurity arising from development and use of new technologies. Networking is thus a way in which OI can materialize and SMEs can take advantage of this.

The articles that constitute the basis of this bibliometric analysis are diverse, covering a wide range of facets of OI in SMEs. Yet, this paper outlines five general major categories. One group of studies examines the relationship between the adoption of OI practices and **firm performance**. For instance, Presenza et al. (2017) examine the impact of OI practices on the innovation activity of 191 Italian winemakers that use different external knowledge sources. The ability of these SMEs to acquire and integrate external knowledge into their organizational boundaries is also assessed. Focusing on other metrics of firm performance, Lee et al. (2009) investigate how a concrete measure of financial performance—in this case, operating profit—is related to the variables of openness and closeness in innovation strategy. Also, this group includes those works that aim at identifying factors that hinder the adoption of OI in SMEs. In this respect, Bigliardi and Galati (2016), surveying 157 Italian SMEs, identify four main barriers—knowledge, collaboration, organizational, and financial and

strategic—which impede an effective adoption of the OI paradigm. Another example can be found in Pervan et al. (2015), who administered a survey to 200 senior managers in the emerging Dubai market in the United Arab Emirates; they found that several environmental determinants—namely, government supported developments and market dynamics—have a direct impact in supporting OI in SMEs.

A second group of studies are those dealing with the opportunities that OI brings to improve **organizations' management**. Knowledge is difficult to acquire. OI allows SMEs to take advantage of the competitors by implementing a new way to delegate, motivate, and simplify administrative tasks. From the papers reviewed, there are four critical aspects that need to be considered when implementing OI. First, it is necessary to create a network with universities, stakeholders, and governments, and have a trustworthy relationship with all of them (Vigier, 2007; van Hemert et al., 2013; Dodourova and Bevis, 2014; Anderson and Hardwick, 2017). Second, the structure of the SMEs needs to be re-organized, which means to create work-teams to support the inside-out ideas and receive/develop the outside-in ideas (Ritala et al., 2013; Ullrich and Vladova, 2016). Poorly defined objectives, cultural and administrative problems or the absence of clear guidelines on how to lead teams might diminish the benefits that otherwise could be obtained (Bengtsson et al., 2015; Verbano et al., 2015). Third, OI should consciously integrate external knowledge with firm capabilities and resources. Studies on how SMEs can develop absorptive capacity are examined in Spithoven et al. (2011), Huang et al. (2015b), Ahn et al. (2016), De Zubielqui et al. (2016), and Valentim et al. (2016). Fourth, it is important to put someone in charge of evaluating the procedures: paths, tasks and management of decisions in order to achieve innovation benefits (Ahn et al., 2017; Battistella et al., 2017).

Another set of studies examines how OI networks help in developing **new products/services development (NPD)**. For example, Vorkapić et al. (2017), using a sample of micro and small enterprises in the manufacturing sector in Serbia, found sound evidence that market pull—close collaboration with the customer—was the prevalent strategy for new product development. Other sources for new ideas for NPD can be obtained from innovation contests, as described in Rodriguez Ferradas et al. (2017). Information systems might also play a significant role in empowering NPD in collaborative networks. This is the setting presented in Rehm et al. (2015), where the authors scrutinize which functionalities information systems should possess in order to facilitate innovation flows in the medical

device industry. Going a step further, in Hronszky and Kovács (2013), Living Labs are presented as co-creative spaces where collaborations among consumers, users and producers are quickly developed. These spaces bridge the role between market pull and technology push innovation accelerating new product/service development.

Other studies focus on the two intertwined dimensions of OI (Chesbrough and Crowther, 2006): **inbound**—leveraging others' technologies by accessing their knowledge (e.g., in-licensing, equity investment, acquisition, R&D contract)—and **outbound**—transferring firms' technologies to external organizations for commercial exploitation (e.g., out-licensing, sale of an innovation project, new venture spin-out, joint venture) OI. Concerning the first approach, it is worth mentioning the work of Huang et al. (2015a) which examines the potential impact of external complementary resources on inbound OI and whether transformative capacity acts as a mediator in the process, or the research conducted by Parida et al. (2012) where the research gap covered deals with the effects of a set of different inbound OI activities on innovation performance of SMEs. Although less examined, outbound OI has also been explored. One example is the work of Tranekjer et al. (2012), in the Danish context. Some examples of studies comparing both types of OI can be found in Cagno et al. (2015), Popa et al. (2017) and Usman et al. (2017).

The last group of articles opens the black box of **intellectual property rights (IPRs)** in relation to OI in SMEs. Using data from 2,873 Spanish firms, Brem et al. (2017) investigate the relationship between OI and the use of different forms of IPR—patents, industrial designs, trademarks, and copyrights. Their results suggest that SMEs do not benefit from OI or from patenting in the same way as larger firms do, and point out that industrial designs are currently the most efficient mechanisms for SMEs. In a similar vein, Maldonado-Guzmán et al. (2016) explore the relationship between knowledge management and creation of intellectual property within the context of SMEs in Aguascalientes—a region of Mexico. SMEs contribute to innovation and economic growth, despite their resource shortages and lack of professional intellectual property (IP) management practices. Evidence on this topic is also reported from the pharmaceutical sector. Specifically, Eppinger and Vladova (2013) discuss different IP strategies and managing practices placing special emphasis on how these are embedded in the firms' organizational structures.

4. Discussion

The global economy requires companies to quickly implement innovation and anticipate customers' demands. Compared to large companies, SMEs have the additional challenge of facing these demands with, typically, fewer resources. In this context, OI seems to be a suitable alternative for SMEs to create value, as it allows firms to bring ideas from the outside, permits access to new markets, expands the network, and contributes to improve internal processes. All these activities can be performed at a much lower cost than that of developing the idea internally. Given the relevance of OI in helping SMEs develop, this paper aims at providing a comprehensive overview of the existing literature on this topic, and the identification of the main authors, journals, institutions and countries interested in it.

This paper used a bibliometric analysis to synthesize the main topics discussed in the works that have been published. Several concluding remarks can be drawn. Results show that publications addressing this double issue (OI in SMEs) started appearing in 2007. It is also worth noting there are only four articles that have been cited more than 100 times. The other papers have received less attention. The reason for this might be twofold. On the one hand, the researchers that have authored these articles are also those that have an active role in investigating this topic, meaning that they are works that are becoming seminal articles. On the other hand, the timespan between publication and citation needs to be considered, meaning that probably, in the next couple of years, the number of papers surpassing the threshold of 100 citations might increase. At the country level, European countries—and particularly UK, Italy and Belgium—seem to be leading investigations in this topic; however, it is worth noting the interest of South Korean institutions taking part in this conversation. The supremacy of these countries is also found when looking at the most prolific authors. As for the typical outlet for research on OI in SMEs, the analysis reveals that both traditional journals—such as *International Journal of Technology Management* or *Technovation*—and journals that have entered more recently on the JCR list—*International Small Business Journal, Technology Analysis & Strategic Management, Business Process Management Journal, Management Decision*—are interested in publishing works dealing with this topic.

From the accurate content analysis of the 112 articles selected, it can be concluded that successful practices of OI in SMEs are highly tied to the cultural, financial, and technological aspects that need to be discussed when implementing an OI strategy. The ultimate goal of OI

is to ease the flow of information, resources and expertise from one company to another; however, it is not enough to "open" the firm, but agree on the terms and make sure all parts involved can benefit from this transaction. While in the past most companies relied on closed innovation approaches, current investigations reveal the importance of combining closed and open approaches (Enkel et al., 2009). Too much openness might result in a loss of control and being extremely devoted to external sources can also be harmful in terms of costs (Felin and Zenger, 2014). Likewise, being too closed might imply loss of sight—an inadequate rhythm of innovation—due to the lack of information flows from the market. In such a scenario, the resulting innovation is achieved by means of the technology, tools and knowledge available only within the company. Although a business model based on closed innovation is accepted—when complexity and divergence goals are constant (Almirall and Casadesus-Masanell, 2010)—a proper balance between both approaches seems to report better results.

In the light of the works published, it is possible to delineate some research avenues for future studies. First, studies investigating the effect of OI on firm performance have claimed the need to consider a longitudinal dimension, as the results of R&D investments and OI strategies are not immediately observable (Lee et al., 2009). Similarly, absorption capacity needs some time to be developed (Presenza et al., 2017) and its effect on firm performance are still inconclusive (Spithoven et al., 2011). Thus, future investigations should consider performing longitudinal analysis rather than cross-sectional ones. A second issue that emerges from the review is that it is difficult to find appropriate metrics to measure the degree of collaboration between the different agents involved—clients, suppliers, universities, governments—in collaboration agreements (Greco et al., 2017). Consequently, in order to better understanding the role played by each agent, future studies should develop new measures able to capture not only the depth and breadth of the collaboration but also the openness and closeness. Third, although several studies highlight the importance of providing an adequate climate for innovation to emerge (Popa et al., 2017), little is known about the factors at the strategic and leadership levels that boost such a fertile setting. Fourth, SMEs have limited capabilities and resources that prevent the companies from being open and sharing external knowledge. In this context, trust among partners stands as a critical factor for archiving success when adopting OI practices. More empirical evidence is therefore needed in order to shed new light on the barriers of entry and the nature of the company that allow for a free flow of information among partners. On a related topic and from the works reviewed, it

can be inferred that literature on IPR and OI in SMEs is rich, yet, it mainly focuses on trade secrets and patents, while trademarks are hardly scrutinized (Eppinger et al., 2013). Lastly, published works exploring OI initiatives for NPD have typically avoided highly regulated sectors, such as the high-tech. Another area of research that remains under investigated is the development of networks for NPD (Rodriguez Ferradas et al., 2017) and its impact on firm performance.

5. Concluding remarks

The ultimate purpose of this article has been to provide a comprehensive and critical review of scholarly research on OI in SMEs. To do this, we have reviewed 112 academic articles published between 2007 and 2017. We have analysed the articles from different perspectives, providing some general information such as the most prolific authors, the journals that publish this type of research, the most popular countries among others. We have then grouped these articles according to four thematic areas, and we have outlined several avenues for future research.

Although a rigorous methodology was followed, some limitations are worth mentioning. The first limitation relates to the limited sample—112 articles. Further studies might consider expanding the search in other databases in a search for additional relevant contributions, including works in the form of book chapters, conference proceedings among others. Second, this study adopts a quantitative approach—by quantifying the number of papers, journals, authors, etc.—but has some limitations in translating these results into qualitative ones. Despite the metrics employed having been widely acknowledged to be adequate for bibliometric studies—e.g., citations, impact factor of journals—their ability to reflect quality might be doubtful.

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Artículo 2

The effect of open innovation strategies on business models.

A multiple case study in the automotive sector

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Abstract

Open innovation allows information to be obtained by a company from outside in, and vice versa, in order to achieve improved relationships and better innovation performance in all parties involved in the business environment. This study explores how the adoption of an open innovation strategy changes the business model, specifically, in the case of small and medium enterprises (SMEs). Previous studies have mainly addressed this topic theoretically, and the original contribution of the approach in the present study stems from providing evidence from real cases. A multiple case study examines four cases in the automotive sector. A number of open innovation strategies are analysed, paying special attention to how they have shaped the company's business model and, ultimately, their impact on company performance. The overreaching conclusion is that the implementation of open innovation strategies helps companies to focus on its strengths and boosts them. This leads to a redefinition of the business model, so that they are better adapted not only to the essence of the companies but also to the demands of the market.

Keywords: open innovation, business models, SMEs, case study

1. Introduction

In recent decades, companies and markets have evolved considerably because of their ability to organise and transfer knowledge, regarding it as a competitive advantage (Van Wijk et al.,

2008). Distribution channels, customer behaviour, supplier reliability, and the disruption of new technologies are altering the traditional way in which companies operate. This argument holds particularly true for small and medium enterprises (SMEs) which typically seek collaboration and cooperation with other companies in order to remain innovative and sustainable in the long term (Argote and Ingram, 2000; Díaz-Díaz and de Saá, 2014). The importance of open innovation in SMEs is based on sharing the information and tools placed at the service of innovation, in order to create either synergies or new processes and products. SMEs have limited resources that need to be supplemented with collaboration between companies and economic agents in order to innovate and offer a value proposition to the client.

Despite acknowledging the importance and weight of SMEs in today's society, there are, however, few studies on open innovation and the way it affects business models (Laursen and Salter, 2006). The rationale behind the use of open business models is to "open" the business for the purpose of joining forces in all aspects. Some critical voices, however, refuse to see the advantage in cooperation between SMEs. These articles claim that knowledge and information sharing between companies can be a risk if they have different objectives, which is why they would fail in their cooperation (Lichtenthaler, 2008; Almirall and Casadesus-Masanell, 2010).

The objective of this paper is to study the impact that the implementation of open innovation strategies has on a company's business model, and consequently, on its performance. This study contributes to the existing literature in two main ways. First, the traditional limitation of current studies is overcome. Such studies conceptualise the adoption of open innovation strategies but do not use real examples to test their applicability. In this sense, a multiple case study was conducted on four companies that, due to the economic crisis, were struggling to survive because of redundancies, outstanding bills and promissory notes, and delays in payments between companies. Once these companies implemented open innovation practices, they were able to adjust their business models and to survive. The reference framework in this study is that used by Saebi and Foss (2015) who distinguished four means which companies might use to introduce open innovation strategies: market-based, crowd-based, collaborative and network-based. These four strategies rely on the identification of partners and company key resources that foster the company's value proposition, either through a main partner or several collaborators, thus obtaining information

from outside the company or boosting intellectual property. Second, how the implementation of these four open innovation strategies changed the business model and their final impact on company performance was also examined. The business model canvas defined by Osterwalder and Pigneur (2010) was used, examining which of the nine building blocks were modified.

The context of the study is the automotive industry in Spain. This sector was chosen because of its importance and influence in the Spanish economy, for four fundamental reasons. First, Spain is the second largest vehicle manufacturer in Europe, and the first in industrial vehicles. Second, this sector generates a high degree of employability, both directly and indirectly. Third, the automotive sector contributes approximately 10% of GDP to the Spanish economy. Finally, manufacturers continue to invest in innovation in order to manufacture more efficient vehicles that use cleaner energy and autonomous driving (driverless cars).

This study is aligned with the recent work of Chesbrough (2017) and Steen and Vanhaverbeke (2018, Chapter 14). Chesbrough (2017) points out the importance of promoting open innovation to transform business models. New opportunities can be found through knowledge sharing, and new business models can consequently be drawn. Steen and Vanhaverbeke (2018) carried out a theoretical study and developed a tool for SMEs that combines open innovation and the business model canvas. Although the approach is valid, this tool is based on static models, whereas open innovation is characterised by using dynamic strategies, and consequently the model is too rigid. In this respect, we posit that new research needs to be conducted that allows for the creation of flexible models.

Innovation is not only one of the main ways for companies to remain competitive in markets but it also helps society to progress. Researching which processes and factors obtain the best possible return with minimum resources is of special interest, and that is why this research is interesting for both professionals and academics. From an academic point of view, this work combines two different bodies of literature, one related to open innovation and one to business models. The case studies allow us to go one step beyond theory and analyse the effect of these models on real companies. On a practical level, the study provides recommendations about how SMEs can improve their performance. Specifically, similarly sized companies in the automotive sector are found to use open innovation strategies when

facing difficulties in the market. By doing so they have obtained a higher turnover or client portfolio, reduced unnecessary costs, expanded to more profitable areas and interacted with strategic partners, not only in order to survive but also as a way to improve their position in the market. We believe the cases described can serve as a guide for companies in the same or similar sectors.

The rest of this paper is organised as follows: Section 2 discusses the theoretical foundations that support the work. Next, Section 3 describes the research design. Results are reported in Section 4 and the paper ends with the discussion and concluding remarks (Section 5).

2. Theoretical underpinnings

2.1. The need to innovate in the business model

Business models began to expand in the 1990s and promised a great revolution in the business system (especially in internet companies). The etymology of this term clearly reveals its meaning. The word 'model' comes from the Latin word *modello* from the Italian Renaissance in the 16th century, and 'business' comes from the Latin *negotium*, a word formed by 'nec' and 'otium', meaning 'what is not leisure'. Initially, the combination of both words was primarily used to describe a tool that helped low-performing companies to identify their strengths and design a corrective strategy (Magretta, 2002). The business model is currently widely used in both academia and practice, and it is increasingly gaining importance as a business and management concept (Jonshon et al., 2008; Baden-Fuller and Haefliger, 2013).

As defined by Osterwalder et al. (2005: 17-18), a business model can be understood as '*a conceptual tool that contains a set of elements and their relationships and allows expressing the business logic of a specific company. It is a description of the value a company offers to one or several segments of customers and of the architecture of the company and its network of partners for creating, marketing, and delivering this value and relationship capital, to generate profitable and sustainable revenue streams*'. It is worth noting, however, that there is no generally accepted definition of a business model (Wirtz et al., 2016). In this respect, Da Silva et al. (2014) make an interesting critical comment about the inappropriate use of the term 'business model', which has often been confused with terms such as 'strategic

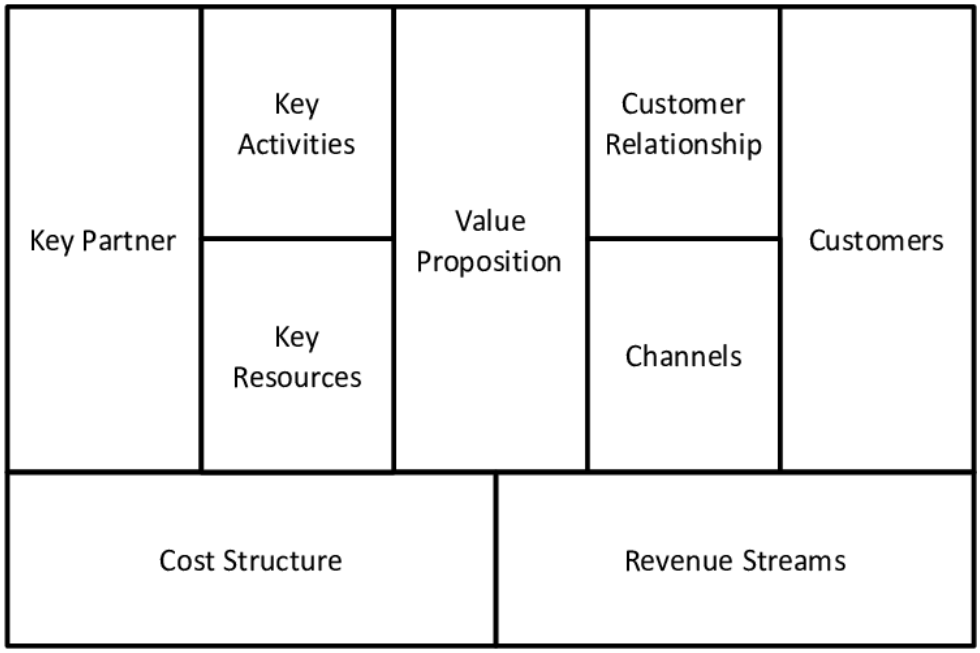
plan', 'resource generation', 'economic model' or 'process model'. Magretta (2002) also distinguishes between business models and strategy and adds another variable with which to define the performance of a company: competitiveness. Wirtz et al. (2016) point out that the definition of a business model is usually standardised in several disciplines to help academics and practitioners avoid misinterpretation and vagueness of the definition. The overreaching conclusion is that, regardless of the fact that some authors disagree over the definition, there is a widespread consensus on its usefulness in order to outline where a company stands, where it should head and how it should get to that desired stage (Amit and Zott, 2012; Foss and Saebi, 2017). It is therefore not surprising that companies, instead of exclusively investing time and money in a new product or process, also invest in business model design (Amit and Zott, 2012).

For a business model to last over time, it must adopt correction strategies, acknowledge the limitations of the company and generate value so as to face the turbulence of the market (Teece et al., 2010; Achtenhagen et al., 2013). According to Chesbrough (2010), experimentation in business models – meaning exploring opportunities and barriers – is of paramount importance in order to remain competitive in the marketplace and consolidate results. In other words, business models do not improve or worsen, but they evolve and are in constant movement. The mission of a company is not only to detect opportunities in the market, but also to generate value through permanent innovation, which should be perceived by both consumers and their environment. A business model is easy to adopt from the point of view of a researcher, however, but not from that of a practitioner. SME managers have little time to adopt these measures, because they focus more on sales, and they do not have a global vision as technological, human and financial resources prevent them from thoroughly monitoring the activities carried out in these areas (Owens, 2007). Business models therefore need to be more open and flexible to allow companies to successfully compete in the market.

The business model canvas began to spread in 2010 when Osterwalder and Pigneur created the nine building blocks that are currently studied in business schools and universities, in one of the most commonly cited books by academics (Osterwalder and Pigneur, 2010). This model has become a simple diagnosis tool for companies and entrepreneurs when analysing company strengths and weaknesses, competence, distribution channels, and how they relate to stakeholders. The resulting picture shows how a company creates value for customers.

The business model canvas is divided into three main parts. The left involves performance, both internal (production and strategic partners) and external (costs), while the right side focuses on income (e.g., sales and distribution channels). Generally, the blocks covering income and the expenses structure are analysed empirically. In contrast, the other blocks involve impressions, management decisions or perceptions, from a psychological point of view. The value proposition is found at the centre, and is the core offering of the company. These three main parts are, in turn, subdivided, creating the nine building blocks with which the canvas is structured. Figure 1 shows the canvas and Table 1 provides a short description of each block.

Figure 1. Business Model Canvas



Source: Adapted from Osterwalder and Pigneur (2010)

Table 1. Description of the building blocks of the business model canvas (based on Osterwalder and Pigneur, 2010).

Building block	**Description**
Customer segment	Defines the markets or niches a company pretend to direct their products or if those markets are segmented.
Value propositions	The purpose of the client is to identify interesting the products offered by a firm, whether it is more innovative, a better design, low cost or allows for customize.
Customer channels	Explains how customers reach value proposition of a product or service since they contact for the first time to the after-sales service.
Customer relationships	Represents what type of relationship the company expects to obtain once it has contacted the customer (personalized, self-service or automated services).
Revenue streams	Describes the way through which a company generates incomes once the client wishes to acquire a service or product (traditional sale, payment for use, subscription).
Key resources	Describes the main assets of the company used to develop the business model (physical, intellectual, human or financial).
Key activities	It consists in identifying which are the basic areas of the business so that the value proposition can be articulated (marketing, production, quality, logistics).
Key partnerships	Represents the key agents to develop the business model (optimization of resources, alliances, outsource services, etc.).
Cost structure	It describes all the costs that the company supports as a consequence of developing its activity (fixed or variable costs) and according to its nature.

2.2. Towards open business models

SMEs have limited resources to implement new processes and products as they tend to lack financial, human resources and technological expertise (Vrgovic et al., 2012). They only have their own resources with which to face the market, and do not always have the best ideas for development into a value proposition on the market (Schneider and Spieth, 2013). Open innovation is therefore presented as a possibility for business models in SMEs. This was suggested in Chesbrough (2006) Chapter 1 'Why business models need to open up?' He noted that in order to remain competitive and save costs, many companies chose to move to India or China. While this strategy might be profitable in the short term, if a company does not innovate, it will not be sustainable in the long term. Using only a short-term strategy is not enough. Companies can take a different approach, accelerating innovation by fostering collaboration not only between departments, but also with key strategic partners outside the company pertaining to the supply chain. Instead of working alone, they started working together more closely, looking for win-win relationships.

Open innovation strategies in SMEs might fail if the strategy is not coherent with the business model (West and Gallagher 2006). Following Saebi and Foss (2015), it is certainly important to ensure the correct association between open innovation strategies and business models, and these authors created a framework containing four main innovation strategies, dependent on the structure of the company and its capacity for absorbing external information. The four strategies (market-based, crowd-based, collaborative and network-based) are divided into four quartiles, representing the degree of depth and scope in the search for knowledge. A market-based strategy is oriented towards the selection of a specific and homogeneous supplier or partner (quality), while a crowd-based strategy supports the selection of many and heterogeneous partners (quantity). In a collaborative innovation strategy, collaboration is closer and several external agents intervene, such as universities, governments, companies and partners. Finally, the network-based innovation strategy involves an innovation platform where customers, suppliers and companies interact in a common framework to develop a project together.

Steen and Vanhaverbeke (2018) went a step further and proposed the 'Open innovation canvas', which combines the principles of open innovation and the business model canvas. This approach, however, clashes with the essence of open innovation activities. An open innovation canvas involves an internal analysis of the company and does not consider other companies and stakeholders as part of the company. In other words, open innovation involves many agents providing new market opportunities, using and making the partners' resources available in order to innovate, exploit intellectual property, and so on. Another difference lies in the business model, where the emphasis is on the value proposition (Osterwalder et al., 2014). The business model canvas is more static and does not reflect the dynamism of open innovation. The idea of creating an open business canvas is interesting, but a clearly open approach must be taken into consideration in order to combine the two ideas. As this study is based on open innovation strategies, its results are different to those of previous studies and are demonstrated through their impact on some of the nine blocks of the business model canvas, with a special focus on value proposition.

Van der Meer (2007) studied Dutch companies, and concluded that they apply the principles of open innovation depending on the culture and organizational structure of SMEs, which shapes the resulting business model. Lee et al. (2010) stressed the relevance of business models in open innovation by SMEs, in both the exploration (R&D) and exploitation phase

(commercialisation). This study is useful because it is based on concepts such as strategic alliance, collaboration, cooperation and networking, elements that are necessary for open innovation to emerge amid all parties involved in the innovation process, and that can affect the company's business model.

3. Research design

3.1. Research approach

This paper focuses on the role of SMEs in the implementation of open innovation strategies in business models, as a way of sustaining and encouraging innovation and company survival. This study explores this process using a qualitative approach, which is considered as the most suitable for topics related to innovation activities and business models (Rajala et al., 2012; Frankenberger et al., 2014; Alves Aranha et al., 2015). This paper is based on the theoretical framework developed by Saebi and Foss (2015) and it proposes a multiple case study in the automotive sector. Many studies confirm the utility of qualitative analysis to study innovative processes (Nord and Tucker, 1987; Nutt, 1986; Schnabl, 1995; Repenning and Sterman, 2002; Klein and Knight, 2005; Wiles et al., 2011).

3.2. Background

At the background of this study are SMEs in the Spanish region of the Valencian Community, composed of the provinces of Castellón, Valencia and Alicante. According to the National Institute of Statistics (INE; www.ine.es), there were 164,638 SMEs in 2018. The sector share of GDP takes into consideration all the other sectors related to the automotive industry (distribution, insurance, finance, etc.), the total contribution to GDP being around 10% in 2017 (the Spanish Association of Manufacturers of Automobiles and Trucks, ANFAC).

The automotive industry involves more than 100,000 million euros in Spain, and Spain is not only the country with the second highest production of motor vehicles, but also manufacturers the most industrial cars in Europe (www.sernauto.es), and the eighth most worldwide. Another important point is that Spain has 1,000 companies that manufacture equipment and components for the automotive sector. According to the ANFAC report in 2017, there are 17 factories in Spain that manufacture motor vehicles, totalling an annual production of 2,819,565 units in 2018, of which 2,215,599 units are passenger cars/sedans and 603,966 are industrial vehicles, with 84.44% being exported. The main manufacturers are

Volkswagen, Citroen, Ford, Iveco, Mercedes, Seat and Renault. The Ford factory in Almussafes, Valencia, is a focus in the region, as many SMEs in the area work directly or indirectly for this company. Specifically, 15% of companies that supply components to Ford or other automotive industries are concentrated in Valencia, 10%-15% in Castellón and only 5% in Alicante (ANFAC).

3.3. Facts

Data was collected from October 2018 to January 2019 through interviews. The interviews were semi-structured and aimed at examining the way the companies implemented open innovation strategies, and their impact on the business model and, ultimately, on company performance. A total of 15 interviews were conducted in four companies. Respondents had managerial profiles (CEO, CFO, sales manager, project manager and operators depending on the size of the company) and were knowledgeable about the strategy of the company. The topics discussed during the interviews were related to the origin of the company, how the company manages its strategies to achieve its annual objectives and the strategic plan for the next three years (in order to see the company's positioning forecast in the medium term). Information was triangulated with in-site visits, the company webpages, annual reports and other material available online. Finally, additional data was also obtained from www.informa.es. This platform provides commercial, financial, sectoral and marketing information about companies and entrepreneurs, and analyses their recent balance sheets and income statements.

Table 2 shows the main characteristics of the companies studied. The names of the companies have been changed to guarantee anonymity.

The data displayed allows a comparison between companies in the same sector based on their year of creation, activity, size (employees and turnover), gross benefits (before interest, taxes, amortization and depreciation), net profit, management of cash flow and returns. Although other ratios could be considered, the rationale behind those shown is that they have been widely used to evaluate the financial health of companies.

Table 2. Firms' main descriptives

Characteristics	**Nezbanur**	**Vesvihk**	**Trondis**	**RLC**
Founding year	1979	1998	1983	1994
Business activity	Car dealership	Automotive components	Distribution	Electromechanical actuators
2017				
Number employees	6	250	18	70
Turnover (€)	1.323.349	16.861.871	3.690.580	5.795.415
Profit (€)	15.278	2.287.300	30.985	185.696
EBITDA	19.276	3.578.506	98.250	895.334
Average payment period*	62	57	74	86
Average benefit period*	27	27	118	39
ROA (%)	0,76	37,35	1,62	7,78
ROE (%)	3,44	60,71	2,67	5,78
2007				
Number employees	4	135	25	94
Turnover (€)	1.552.478	6.217.417	6.634.319	10.808.075
Profit (€)	6.534	44.524	150.696	216.726
EBITDA	11.235	420.667	385.425	625.773
Average payment period*	55	38	32	81
Average benefit period*	35	29	149	47
ROA (%)	0,5	8,82	2,27	14,45
ROE (%)	2,91	5,67	1,23	18,43

Note: ROA = Return on Assets. ROE = Return on Equity.

* Expressed in days.

According to Tables 2 and 3, there are differences in the 10-year comparison (2007-2017). Turnover in Nezbanur's – first recovering and then stable at levels similar to those in 2007 – and especially Vesihk, has improved considerably, as both companies have increased their operating results and EBITDA. The turnovers of Trondis and RLC have fallen drastically. The profit and ratios of Trondis have decreased, however it should be noted that its profitability is greater in terms of turnover, and that cash flow has also improved. RLC has adjusted its turnover level, but both its EBITDA and turnover profit have improved considerably. Financial and economic profitability ratios do not seem to have improved much. The analysis of the companies in 2017 suggests that they are in good financial health and have positive EBITDAs, which means that the businesses are running properly. The average payment periods of the four companies exceed those of the average collection. In other words, they maintain adequate management of their capital, except in the case of Trondis, which shows a difference of 44 days – probably due to the type of business that the company runs, in which case adjustments are made via bank financing or contributions from partners. Finally, it should be noted that Nezbanur, Vesvihk and Trondis show a positive financial leverage, not verified in the case of RLC though. Maintaining negative leverage means that the average

cost of debt is lower than the economic cost, which could only be compensated for by selling products or services at higher prices – creating greater profit margins or managing company assets more efficiently. The return on assets (ROA) in Vesvihk and RLC is positive, over 5% in both cases.

4. Results

This section illustrates the different categories of open innovation strategies suggested by Saebi and Foss' (2015). Each category is exemplified by a case study which demonstrates the experience of the company in the automotive sector in the Spanish region of Valencia. This part also explains each company's origin, any problems they faced, how open innovation was introduced and its impact on the business model. The last part connects this to the nine building blocks as defined in Osterwalder and Pigneur's (2010) business model canvas.

4.1. Designing a business model for market-based innovation strategy

Origins

Nezbanur is a family business created in 1992 in Valencia that sells Opel vehicles in Spain as an official dealer. It has a second line of business in purchasing and selling used vehicles.

Challenge

The company employed 15 workers in 2007, but had to dismiss half of them to curb fixed expenses (mainly salaries). Sales dropped year after year from 1,500,000 euros in 2007, to 850,000 euros in 2009 as a result of the economic downturn and clients taking longer to buy a car. The company then focused their efforts on the main office workshop. The few savings they had left were used to reform their facilities, streamlining the workshop to make it more efficient. The workshop was old and lacked proper logistics for the reception of vehicles due to a lack of adequate facilities, which is why vehicle repairs could not be done at the lowest cost and in the shortest time possible. The company knew that the official repairer would increase their charges for spare parts and repairs. Customers took longer to change their vehicle and had their cars fixed more often, which lead to the Opel brand becoming an official repairer. Another source of income was selling multi-brand second-hand cars. They also offered a competitive price, and could obtain a good profit margin if the purchase was done correctly.

Strategy

The strategy used by this company is based on choosing a partner and going hand in hand. This allows the company to take advantage of all the latest management and technological innovations and increase customer satisfaction. The company buys the improvements registered by the Opel brand; in other words, it acquires the intellectual property of the head office. This has a double objective: on the one hand, the benefits of standardisation, regulation and automation of the brand processes implemented in the business; and, on the other hand, the intellectual property that applies has an almost guaranteed success rate since it is tested and applied in the company's official workshops in different countries, and is also highly valued by the end customer. In short, given that, in this case, the main partner is a multinational company with economic, human and technological resources available for a minority, SMEs take advantage of this situation by improving competitiveness, becoming leaders in the market and being less prone to turbulence (Hamel and Välikangas, 2003).

Impact on the business model

This open innovation strategy affects the business model canvas, encouraging company revenues in particular, as new sources of income are promoted by investing in the workshop (key activity). All this is supported by the strategic partner that attracts consumers of the own brand (Opel) and serves as a locomotive strategy for other potential customers (key partnerships). Another aspect that produces a significant impact is frequent contact with the customer. The replacement of parts and regular service produce a more continuous contact with customers by fostering customer loyalty and a customer-centric approach. Nezbanur's value proposition lies in the idea of understanding customers and recognising what they need, and thus income is perceived not only in cars sales but also in subscriptions by offering customers a fee per year which covers all the car parts except the labour employed (revenue streams).

In the figures displayed in Table 2, we can see that although Nezbanur's turnover has decreased by 15% compared to 2007, the operating result has improved by 35%, and the company is more profitable now that 10 years ago. Their average payment periods have improved by seven days and their collection periods by eight days. This is mainly due to the fact that the open innovation strategy they applied has been based on selecting a single partner (OPEL), boosting their own brand workshop and improving sales from the workshop

(recurring income) and to a lesser extent from car sales. Another indicator that reveals the success of the strategy is EBITDA, which improved considerably.

4.2. Designing the business model for crowd-based innovation strategy

Origins

Vesvihk specialises in designing, developing and producing components and services for the automotive industry. Founded in 1998 as a service provider company, it currently has more than 150 employees and a turnover of 20 million euros, and is a highly diversified company in the automotive sector. Their products range from the design and manufacture of metallic structures, and the technical and acoustic insulation of vehicles, to specialisation in the assembly sequence of submodules through the implementation of containment actions and applied engineering.

Issues

Problems arose during the economic crisis in September 2008. Vesvihk contributed a high percentage to the national turnover with only two lines of business. While this specialisation was successful before the economic downturn, once the stagnation of the markets started, the company was subject to the evolution of the national market characterised by little product diversification. As sales started to decrease, so did turnover, and the company was forced to downsize. As manufacturers, their structural costs were also too high and constantly endangered the company's viability, without any possibility of making changes in the short term, thus forcing the company to resort to external financial (banks) and dismiss several employees.

Strategy

To overcome this situation, the company started looking for external sources of innovation (research groups, universities, suppliers, customers, competitors) through a chain of information flowing between agents with the aim of innovating within the company. In its beginnings, Vesvihk was a company that acted only as a service provider with a marked business unit. During the crisis, therefore, the company redirected its efforts to three main objectives: to broaden its business lines, to develop new patents that could be sold in other markets/sectors, and to expand its presence abroad with the clear objective of diversifying its

sales nationally and internationally. Vesvihk adopted an open innovation strategy so that the information flow from inside out and vice versa all took place in the most profitable areas of the company. An open innovation strategy relies on many parties being involved, which is the key to success. The more stakeholders intervene, the better the innovation achieved. Quantity prevails (the many) over quality (the few), and will lead to more innovation due to the joint forces of communities and platforms in the company.

Vesvihk has grown into one of the most important companies in the sector, with six lines of business (metal frames, technical foams, module assembly and sequencing, applied engineering solutions, logistics services, automotive components design) and exports comprising 20% of its turnover, thus increasing sales in foreign markets every year. This enabled the company to obtain the Q1 quality award in 2016, a certificate awarded by Ford and considered the most prestigious recognition of excellence in quality in the automotive sector.

Vesvihk is currently developing a European project of data processing for decision-making. This project aims, on the one hand, to improve innovation processes through a business intelligence tool and, on the other, to upload all information to the company's cloud, together with other applications that implement the internal and external collaborative information workflow. The objective is to use tools that improve interoperability, and to have functionalities that should enable information sharing or collaborative work. In this project, in order to obtain the maximum amount of information, the company works together with other stakeholders such as governments, same-sector companies and universities (Project Imdiga/2017/123).

Impact on the business model

The idea of business diversification is at the core of Vesvihk's change. The company opens new markets with strategic stakeholders by developing new products (key partnership). These new products, developed by employees and partners, enable Vesvihk to operate in national and international markets and expand its presence (customer segment). The company's strategy leads to a reduction in operating costs (structural cost) and its value proposition resides in product innovation, as Vesvihk's products are in high demand by customers due to their quality and competitive price. As a result, sales have grown exponentially year after year, to exceed 16 million euros in 2017. This open innovation strategy has been very

efficient, and this is perhaps the most remarkable case, as the company has managed to innovate in other sectors, supported by stakeholders who have provided knowledge in order to open new lines of business in new markets. This strategy of open innovation has clearly improved the company's business model, not only from a qualitative point of view – due to reduction of structural costs, target segments, key partners and value proposition recognised by customers – but also from a quantitative one, as corroborated by ROA, ROE, EBITDA and benefit rates.

4.3. Designing a business model for collaborative innovation strategy

Origins

Trondis was created in 1983 and emerged to serve the supply chain of locomotive companies, such as Ford or IBM in the Valencian Community. This company offers supply solutions and the servicing of electronic components, instruments for testing, measurement and analysis, and industrial and consumer computing. They have worked since the beginning with major manufacturers to ensure product quality. Its business lines are electronic and communications instruments, electronic components and computer systems for the industrial automotive sector.

Issues

Trondis obtained its greatest benefit in 2007, however, in 2009 their orders halved, resulting in 50% of the turnover of the previous year, and incurring losses for the first time in their history. Suppliers wanted to be paid almost immediately, the quality of their products was unacceptable and, in addition, customers were late in paying, creating an overly lengthy payment period. Financing was insufficient to ensure cash flow. This was a clear case of a solvent company with an enormous lack of liquidity that had to change its strategy in order to face crisis.

Strategy

The success of Trondis lay in working closely with trusted laboratories and suppliers in a collaboration framework so that they could calibrate their equipment properly. The companies all gather optimal environmental and technological characteristics to ensure that calibration processes were carried out in appropriate and traceable conditions (Dodgson et al., 2006). The

trust in both collaborating parties allows the company to offer a differentiated service to its customers. Trondis started in the automotive and computer world. Through the R&D department and in collaboration with its strategic partners, the company has been able to diversify its products for other sectors, such as communications, health, teaching and renewable energies, and also to research in other areas. This has built trust between partners and has allowed the company to expand its range of services by offering comprehensive solutions, highly valued by end customers. To obtain these results, Trondis maintains a direct information channel between the collaborating companies, which is why the company responds better and faster to customer orders and solves problems without involving intermediaries. In summary, the cooperation between suppliers and partners allows them to guarantee a quality product due to their similar technological levels.

Impact on the business model

The company transformed its business model through open innovation by carrying out very specific work for its clients. This sort of business in the industrial and medical sector addresses a technical segment which is hard to attain because of the severe entry barriers. Policy makers and customers require high quality and legal standards for their products (key segment). Trondis uses very specific resources (measurement devices) to carry out measurement (key resources). This strategic collaboration with laboratories lead its customers to value the products for measurement reliability and promptness in product delivery. The success of Trondis was based on an open and reliable collaboration. Nevertheless, service quality is not everything, as customers are also willing to pay for delivery time. Having ensured better quality and knowing that the company was perceived as a quality supplier due to its response time, Tondis negotiated terms of payment to avoid delays, thus balancing cash flow. In addition, the company changed its method of payment. Revenues ensure steady income to a payment modality service operator that performs on-site checks periodically, but also lends their equipment to other companies (key revenues). In consequence, the company´s value proposition resides in the quality of its products. Equipment ensures accuracy in the markets in which the company operates, experience, and permanent innovation, while collaboration with suppliers and partners allows the customer to select Trondis as their first option.

Despite having reduced its income by almost 50%, the company has managed to adapt to the market in which it operates, obtaining a return of 8% in 2017, compared to 2% in 2007.

The great advantage of Trondis has been its use of an open innovation strategy based on collaboration, which has improved its cash flow up to 44 days (the difference between payments and collections). That is to say, Trondis has managed to considerably improve its rate of collection and payment management, which stood at 117 days in 2007, jeopardising the company's viability. Company ROA stays positive despite its decrease, but ROE increases. The company's business model has been a success, as Trondis is currently solvent and liquid. In 2007, it was solvent but lacked liquidity, which also jeopardised the company's viability.

4.4. Designing a business model for a network-based innovation strategy: RLC

Origin

RCL is a company founded 40 years ago, which manufactures precision gear and components adaptable to small places, operating in the automotive, vending and electromechanical sectors.

Issues

During the crisis in 2009, RCL was a company with a significant turnover of 10,000,000 euros and benefits of 200,000 euros. This company's situation has changed in the last decade. RCL invoiced less, until it reached the current turnover of 5,000,000 euros, but maintained the same amount of benefits when earning half of its turnover in 2009 as compared to its peak years, thus becoming much more profitable. This means that RCL selects only the most profitable projects, using half the resources. In other words, the company has adjusted its departments by employing the minimum number of staff required and by selling non-strategic assets, such as machinery, for cost saving purposes.

Strategy

This company bases its strategy on market diversity. RCL collaborates with a network of partners that belong to different sectors, such as electro-mechanical, vending, automotive, differential and switch gear, air conditioning, security and hospitality. The partners participate in the research and development activities of the company. At present, this company belongs to AVIA, an automotive cluster that is formed of SMEs, multinationals, technological institutes and public administrations. These sort of clusters benefits not only from new ideas or projects, but also foster training, possible alliances, productivity and communication

between companies. In addition, AVIA constantly provides contacts and benefits from other projects due to the close collaboration between SMEs.

Impact on the business model

RCL only focuses on the businesses that are most profitable, discarding those with high billing because it does not represent a guarantee of payment collection and risks company profitability (key activities). Being in touch with the innovation clusters, the company receives projects from the automotive sector (key activities). This cluster acts as an open innovation platform where several companies carry out joint projects, contributing the resources of the company (intellectual, human and financial) for the benefit of the project they develop. Each project started by RCL is used to meet new clients, which usually increases the number of clients for new projects (customer relationships). Lastly, the company reduced structural costs such as salaries depending on the turnover and adapting their resources to the needs of the company.

RCL is in a completely different position than it was 10 years ago. The company has decreased its sales by 50% compared to 2007, but its profits have remained practically the same. In other words, the company is much more profitable because it uses fewer resources than a decade ago. This is mainly because the company's strategy is based on maintaining a network that allows access to the most profitable projects. RCL had to move large amounts of money to obtain a profit near 2%. Currently, its margin is 3.2%, EBITDA has improved considerably and the average payment and collection periods have stayed constant. In short, the business model has changed in terms of the company´s relationship with its customers, its value proposition, and the structural costs reduction and selection of key activities to be carried out.

Table 3 summarises the strategies followed by the different companies and the main effects observed in the business model canvas.

Table 3. Firms' strategic choices and main impacts

Firms	Open innovation strategy	Main impacts on the business model canvas
Nezbanur	Market-based innovation strategy	Key activities, key partnerships, revenue streams, value proposition
Vesvihk	Crow-based innovation strategy	Key partnerships, customer segments, structural cost, value proposition
Trondis	Collaborative innovation strategy	Key segments, key resources, revenue streams, value proposition
RLC	Network-based innovation strategy	Key activities, customer relationships, structural costs, value proposition

5. Discussion and concluding remarks

Four companies in the automotive sector were examined in this study. These companies faced difficulties during the economic crisis and followed different strategies of open innovation to survive or to access other markets, thus expanding their possibilities. Analysis of the different cases suggests several implications.

First, this work complements the existing literature by showing that the use of open innovation strategies helps companies to transform their business models, and ultimately offer new value to customers. These strategies are the basis for helping companies to face market turbulence, distinguishing between product distribution companies or intermediaries and product manufacturers. For example, it would be convenient for 'distributor-centric' companies to use two types of strategies in their business models. Intermediary companies should use the business model for collaborative innovation strategy as a tool for product innovation, distribution channels, suppliers and governments backed by them, to reach as many customers as possible. Companies that have the exclusive distribution of a certain manufacturer should use a business model for a market-based innovation strategy because they benefit from the intellectual property developed by the manufacturer. However, manufacturing companies should apply two open innovation strategies. Companies that manufacture a specific product should use the business model for crowd-based innovation strategy with the clear objective that all agents and stakeholders should be part of the process of product innovation and development, from material purchasing to commercialization. Manufacturing companies that develop products in collaboration with other companies should use the model for network-based innovation strategy, because they benefit from receiving information from other companies, helping them to develop not only their products, through

innovation with applicability to other products in their own company, but also new projects that may arise as a result of former successful collaborations.

Second, previous studies (Narula 2004; Rahman et al., 2010; Lasagni 2012; Parida et al., 2012; Suh et al., 2012; Vrgovic et al., 2012; Eppinger et al. 2013; Hochleitner et al., 2017) confirm the effect of inbound strategies, collaboration strategies and IP strategies in the performance of SMEs, but only a few studies show the relevance of engaging stakeholders as an effective strategy to improve company performance. Sometimes suppliers are involved in company innovation (inbound/outbound activities), but sometimes they are not, as in the case of outsourcing, where they do not participate in any process beyond providing the specific service or product. Even if it is not essential, however, SMEs cannot develop their business without the participation of third companies that indirectly intervene in product marketing (for example, in the case of outsourcing logistics to a transport company to take the product to the client). The present study pointed out that stakeholders are important when innovating, and emphasised quantity rather than quality. It is observed, therefore, that, whether directly or indirectly, stakeholders intervene in SME business and consequently, take part in innovation.

Third, it seems that, when turnover decreased and the fourth company was not profitable, the first step it adopted was to reduce costs or selling non-strategic assets and/or dismiss employees. Companies then look at stakeholders, appeal to collaboration/information or IP in order to increase their own business model. These four strategies have been at the base of the transformation of their business and have affected several parts of the blocks in the canvas model, allowing SMEs to both focus on the key segments that earn the most revenue and to exploit their strategic assets in order to offer a product that customers perceive as having more benefits. The four open innovation strategies will depend on business activity, size, and assets, and also on the company's absorptive capacity, degree of collaboration, technology, and intellectual property developed or acquired.

Fourth, companies in the automotive sector have succeeded not only through the control of expenses, but also by looking for other business opportunities through innovation and by being appealing to large multinationals in the Spanish automotive sector. This is because the Spanish minimum salary is not as high as that in France or Germany, but employees are as highly qualified as in other European countries. Spain is also logistically well situated, with easy access by land, sea and air.

Finally, and importantly, this study has some limitations, which in turn represent opportunities for future studies. The main focus has been on inbound open innovation activities, rather than on outbound ones. Future research should explore open innovation strategies in this other direction. Another limitation involves the approach used. A qualitative analysis was performed, and quantitative studies are necessary to complete this research. In addition, it would be interesting to include other items in the analysis, such as management decisions and the capacity of knowledge absorption. New studies should also be encouraged to broaden the scope of this work and research other sectors and regions.

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Artículo 3

How open are SMEs?

Exploring the impact of different open innovation practices

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Abstract

Small and medium-sized enterprises (SMEs) tend to collaborate with many economic agents to develop new ideas and build a solid network. Firms collaborate in this way to increase their profitability and sales and expand their share of the market. This paper sheds light on this phenomenon by examining the combined effect of open innovation practices, innovation performance, innovation strategy and the company characteristics that have been found to shape firms' performance. Given the heterogeneity of SMEs, we expect to find that firms follow different patterns depending on their capabilities, vision and characteristics. The empirical study is based on a sample of 32 SMEs located in the Spanish region of Valencia. The analysis is based on qualitative comparative analysis, which has been found to be a suitable approach under assumptions of causal complexity. The results show different strategies that firms might follow. These strategies are discussed in detail.

Keywords: SMEs, open innovation, qualitative comparative analysis, strategic choices

1. Introduction

Under the open innovation (OI) paradigm, companies adopt external and internal resources (e.g. knowledge, technology and infrastructures) to innovate. As Chesbrough (2006) concludes, to accelerate innovation, firms might benefit from the use of both knowledge inflows and knowledge outflows. The rationale behind this conclusion is that firms,

particularly small and medium-sized enterprises (SMEs), have limited internal resources, a narrow client base, low bargaining power and a tendency to act with unclear strategic planning (Smallbone et al., 2012; Marcelino-Sadaba, et al., 2014; Branicki et al., 2018). Consequently, they seek a combination of internal and external sources to compete more effectively in an increasingly dynamic and globalised market. In other words, SMEs are likely to welcome and cooperate with different stakeholders (e.g. suppliers, clients, policymakers and other companies) to capture new ideas and reach the forefront of innovation (Karno and Purwanto, 2017).

The literature on the adoption of OI by large companies is rich, yet recent studies have shown that OI practices are better adopted by SMEs than large firms (Lee et al., 2010; Popa et al., 2017). As Spithoven et al. (2013) suggest, a plausible explanation for this finding is that SMEs are less rigid than large corporations. Therefore, they have more freedom to implement new strategic practices (in this case, the adoption of OI practices) and are more effective at introducing new products in the market.

Evidence of how SMEs incorporate OI practices is still scarce. Only a few studies have empirically examined the impact of OI on firm performance (Odriozola-Fernández et al., 2019). Recent calls for papers in leading management and business journals seem to have encouraged new dialogue in this domain. For instance, using a sample of 156 Korean SMEs, Ahn et al. (2015) found a positive and significant relationship between OI and firm performance, emphasising the importance of close collaboration with partners. In a related study of Polish SMEs, Mazur and Zaburek (2016) found that an organisational culture based on the fundamentals of OI improves firm performance. Analogously, Ahn et al. (2016) investigated the relationships between openness, capacities, firm performance (measured in terms of sales, profits, exports and technology) and lower operational costs.

Because there might be complex combinations of different factors, this study uses a configurational approach. Accordingly, a firm's performance in the market is assumed to be driven by complex interactions between OI practices (sources and intensity of use), the innovation performance of the firm (innovation type, innovation strategy and innovation performance in the market) and the inherent characteristics of the firm (experience in the market and size). Qualitative comparative analysis (QCA) was used for the analysis. This technique enables the identification of different patterns of factors that are associated with an outcome (in our case, firm performance). This method is particularly appropriate for the study

of complex causal relationships and multiple interactions (Fiss, 2011). This technique has recently received greater attention from scholars, and previous studies of innovation and management have supported its use in this specific domain (Roig-Tierno et al., 2017; Kraus et al. 2018).

We apply QCA to a sample of 32 SMEs that are located in the Spanish region of Valencia and that already use OI practices. Four selection criteria were used. First, all sampled companies were located in the same region (Valencia) to reduce potential biases due to differences in exogenous variables (e.g. political, legal, socioeconomic, environmental and technological aspects). Second, sampled firms shared the same framework of tax aid, subsidies and tax obligations. Third, firms were required to be innovative (i.e. they were included in the Spanish Public Registry of Innovative Businesses). Fourth, companies were required to be classified as SMEs.

This study contributes to the literature in three ways. First, as previously discussed, literature on OI in large companies is exhaustive, yet research on how SMEs implement OI is limited. Our study is aligned with calls for new studies to shed light on how SMEs use OI (Gassmann et al., 2010; Van de Vrande et al. 2010; Spithoven et al., 2013; Popa et al., 2017). Second, this study investigates how OI strategies, in combination with other factors, shape a firm's market performance. This approach complements current research on the existence of a straightforward link between OI strategy and innovation performance. We argue that depending on how the company perceives its own performance in the market, it will choose a different innovation strategy. Therefore, it is worthwhile investigating whether different levels of innovation performance are associated with different levels of engagement in OI practices and innovation strategies. Ultimately, we expect to observe specific patterns that lead to superior firm performance. Third, the empirical study is based on a sample of SMEs that use OI practices. Using this sample, we investigate different degrees of adoption of OI and the effect that this varying degree of adoption has on firm performance.

Therefore, this article has valuable implications for both academics and practitioners. Academically speaking, this study provides a new framework for the study of OI practices and their links to innovation performance, innovation strategy and firm performance. The results (i.e. the different patterns) provide a starting point for future research, particularly on the strategic management of innovative firms. From a practitioners' perspective, this study can help companies choose the strategy (or combination of factors) that best suits their

characteristics (e.g. size, innovation type, and market experience) and that leads to superior firm performance.

The remainder of the paper is organised as follows. The next section outlines the theoretical underpinnings. Section 3 explains the method. Results are presented in section 4. The discussion and conclusions are presented in section 5.

2. Theoretical underpinnings

A firm's success depends on many factors, and companies may follow a wide variety of strategies in pursuit of this objective. Whilst some companies might focus on the areas, capabilities or resources that constitute their strengths to create a unique service offering that differentiates them from competitors (Kemayel, 2015), others might update their internal organisational strategy and their communications and relations with partners (Rammer et al., 2009). However, there is a third alternative. Firms might also adapt quickly to market demand, using flexible working processes and rapid cycles to deliver new value as soon as the market requests it (Aziz and Samad, 2016). Regardless of the strategy, all of these action plans require constant innovation. Success is strongly tied to innovation (Pratali, 2003; Ramadani et al., 2013; Tse et al., 2016). In other words, innovation should be conceived as a habit rather than an end in itself.

Under this premise that innovation is imperative, it is natural to conclude that developing more ideas (i.e. the raw material for innovation) makes it more likely to find the ideas that best suit the firm's purpose, whilst better responding to market demands. In this context, OI is seen as a core asset (Hamdani and Wirawan, 2012).

The following sections discuss the theoretical framework for our study. First, we elaborate on OI practices. Next, we focus on innovation performance. Finally, we describe how firm characteristics might also play a role in explaining firm performance.

2.1. Open innovation practices

Competition is a fundamental concern for all organisations, particularly in today's dynamic and globalised world (Narula, 2004). SMEs might struggle more than large corporations to survive in this international and aggressive landscape because they do not always possess all the resources they need to effectively face market demands. Looking beyond the boundaries

of the firm therefore becomes imperative (Chesbrough, 2003). Doing so might help firms gather new ideas that can improve products, services and processes, thereby allowing them to compete more effectively in the market (Brunswicker and Vanhaverbeke, 2015; Chesbrough et al., 2006). In this paper, we focus on inbound OI practices. Inbound OI practices refer to scanning the external environment in search of new ideas and expertise from outside the organisation to internalise and exploit these ideas and expertise within the organisation.

The strategy literature suggests that new product development (NPD) is central for ensuring a firm's viability and sustainable advantage over time (Liu et al., 2005; Ahn et al., 2016). Accordingly, this inbound orientation of OI is worthy of further examination. In Sisodiya's et al. (2013, p. 837) words, OI is 'the sustained and systematic practice of engaging in the search for and then integrating new product inputs from sources that cross firm boundaries and, often, technology boundaries'. The literature reveals three main ways through which new knowledge, ideas and resources might flow and be articulated: technology, collaboration with partners and the acquisition of intellectual property (IP).

In relation to technology, Van de Vrande et al. (2009) discussed the concept of 'technology exploration', which consists of adapting external flows of information to improve current technological developments inside the company. Lichtenthaler (2008) further confirmed the relevance of absorbing external technology to compete more effectively in the marketplace. Similarly, Vanhaverbeke and Cloodt (2006), Faems et al. (2010) and Neyens et al. (2010) confirmed the importance of incorporating outbound technology, which positively influences innovation and, in turn, firm performance.

Another channel for knowledge inflows is networks. As Bullinger et al. (2004) report, the traditional linear model of innovation has evolved into a networked model, in which multiple partners are brought together to develop and integrate complementary competencies. Yet, as Wincent and Örtqvist (2010) suggest, involvement in different networks might influence the type of innovation (radical or incremental). However, recent studies support the idea that collaboration emerging from networks has one of the biggest impacts on innovation performance (Zeng et al., 2010; Sisodiya et al., 2013; Holtgrave et al., 2019). Accordingly, we argue that OI might be converted into enhanced firm performance if it occurs in a rich industry network because such a network provides access to knowledge, ideas and technologies through spillovers. In other words, the relational capability of the firm is a key factor. Nevertheless, as Fang et al. (2011) note, this attribute might not be sufficient if the

firm is not responsive, agile or flexible enough to take advantage of these opportunities. On a related topic, social networks also play a key role in connecting different patterns and fostering knowledge flows. Palacios-Marqués et al. (2017) showed how users and companies cooperate through social networks to develop new products and services whilst consolidating the relevance of this distribution channel.

Finally, a third way of achieving knowledge inflows is through the acquisition of IP as a means of acquiring technology or patents to innovate within the company (Chesbrough 2006; Daneshgar et al., 2013; Maldonado-Guzmán et al., 2016). OI casts a wider net for the development of new product advances. As the number of inputs increases, so does the amount of IP and the number ideas identified in external searches. This greater stock of IP and ideas in turn accelerates development cycles, helps resolve problems more effectively and enables faster achievement of the implementation phase. The natural consequence is superior firm performance. Yet, as Brem et al. (2017) stress, although OI has been found to exert a significant influence on firm performance, this influence only occurs if properly combined with IP rights. Thus, a balanced combination of external and existing IP is imperative to boost a firm's effectiveness and diminish the cost of internal research and development (R&D) programmes to generate new products (Chesbrough, 2003; Sisodya et al., 2013).

To conclude, access to external sources helps firms stay at the forefront of innovation. This pioneering position in turn translates into better market performance (Chesbrough and Crowther, 2006; Huang and Rice, 2009; Flatten, 2011; Huizingh, 2011; Sisodiya et al., 2013, Michelino et al., 2014).

2.2. Innovation performance

In this paper, we characterise a company's innovation strategy in terms of three aspects. The first is how well developed and to what extent the innovation strategy is part of the company's daily activities. The second is the type of innovation pursued (incremental vs. radical). The third is the self-perception about the company's position in the market in terms of innovation.

With respect to the extent to which innovation strategy is part of everyday business, the literature consistently reports that organisations with formal strategies tend to perform better than those without formal strategies (Falshaw et al., 2006; Leitner and Güldenberg 2010). In 400 BC, a Chinese general (Sun Tzu) laid the foundations of strategy when planning for battles by applying knowledge, wisdom and resistance to confrontational and competitive

situations. McNeilly et al. (2012) translated these strategies to the business world. Today's globalised business world is characterised by fierce competition (Karaev et al., 2007; Simpson et al., 2004). Therefore, firms that aim to succeed must develop and articulate their own strategy. A strategy is necessary to define where to focus efforts and resources to take full advantage of them, counteracting internal weakness and external threats. Because innovation is linked to firm success (Zaefarian et al., 2017), a specific innovation strategy is crucial to achieve business success (Freel, 2000; Aragón-Sánchez and Sánchez-Marín, 2005; Bennett and Ramsden, 2007; Raymond and Bergeron, 2008).

In the specific context of SMEs, Hudson et al. (2001) reports that SMEs tend to be more informal in their articulation of specific innovation strategies. This informality owes to SMEs' more fast-moving and flexible structure than that of large companies (Lee et al., 2010). In addition, government policy can also stimulate innovation action plans amongst companies, encouraging them to be more competitive in a global market (Madrid-Guijarro et al., 2009).

Using innovation to improve performance in SMEs is a common approach (Hajar, 2015). Although this use of innovation might seem evident, the way in which it should be implemented is not so straightforward. Applying innovation practices requires using previous knowledge as a mechanism for interaction between innovation and firm performance (Darroch, 2005). This knowledge must be disseminated through company channels, from the CEO to the last employee. If exploited correctly, knowledge positively affects firm performance (Gunday et al., 2011). Innovation can also be integrated into the company from an operational point of view, affecting not only products but also processes (Rosli and Sidek 2013; Karabulut, 2015). Muhamad et al. (2014) studied 150 Malaysian companies and observed that high levels of innovation are linked to improved firm performance measured in terms of the economic, environmental and social dimensions.

Therefore SMEs play an important role in the modern economy, not only from an economic point of view but also from a social and cultural perspective (Baumol, 2002; Veugelers, 2008). SMEs are forced to invest in innovation that allows them to compete in the market. The higher a company's innovation levels, the better its operational results will be. In other words, greater innovation is associated with better performance (Keizer et al., 2002; Shefer and Frenkel, 2005; Yeh-Yun Lin., 2007; Terziovski, 2010).

2.3. Company characteristics

As the literature suggests, different company sizes and levels of market experience lead to different innovation and performance outcomes (Majocchi et al., 2005; Raymond and St-Pierre, 2005; Lu et al., 2006; Laforet, 2013). Experience (or seniority) is important not only to improve internal products or processes but also to understand competitors (Yu et al., 2016). Similarly, from a company's perspective, experience helps solve internal problems more easily through the design of competitive strategies (Kock et al., 2008) because of accumulated knowledge. However, no element is common to all companies that endure over time. Bianchi et al. (2010) studied Italian SMEs and found that firms with more experience simply adapt better to the competition. Therefore, their ability to survive to changes in the market makes them last over time.

Rosenbusch et al. (2011) expressed their agreement and noted that the characteristics of SMEs that influence innovation performance are age, cultural context and type of innovation. Similarly, Coad et al. (2014) observed that younger companies with higher levels of growth are those with higher R&D investment rates. In addition, the level of R&D rigour is higher in young companies than in more established ones.

3. Data and methods

3.1. Sample

To empirically test which combinations of factors yield superior firm performance, we used a sample of SMEs (defined as per Article 2, Regulation Commission Regulation EU No 651/2014 of 17 June 2014) from the Spanish region of Valencia (comprising the provinces of Castellón, Alicante and Valencia). Innovative firms that use OI were selected. The firms were selected from the list kept by the Spanish Public Registry of Innovative Businesses (Spanish Ministry of Economy and Competitiveness).[12] For an SME to be considered innovative, one of the following three conditions must hold: i) the SME has received public funding in the last three years, ii) the SME's activity is of an innovative character or iii) the SME's innovative capacity is certified by certifications or standards (AENOR EA0043, AENOR EA0047 or UNE 166.002). The questionnaire included the second requirement to identify SMEs that apply OI. The study also considered companies that had been operating for more than four years to

[12] http://www.ciencia.gob.es

gather data only from companies that had survived their early years (Headd, 2003; Cader and Leatherman, 2011; Gieure and Buendía-Martínez, 2016).

A questionnaire was designed and used to collect the data. This questionnaire was sent by email to executives of the companies that met the selection requirements. A total of 215 surveys were sent. The response rate was low (14.8%) because respondents were reluctant to participate in the study, citing a lack of time. After refining the results and eliminating cases with missing data, the sample was reduced to 32 companies. The sample includes manufacturing companies that provide products or services. Data were collected from September to November 2018 after the companies had filed their 2017 corporate tax returns (July 2018). The authors thus accessed official data on business turnover, profits, and assets and liabilities.

The questionnaire had three main parts. The first section identified the primary type of innovation in the business (incremental or radical) to determine the aim of this innovation: either an existing product or service (Arnold, 2011) or something new (Kanter, 1985; Oduro et al., 2018). The second section contained questions on the constructs of interest: OI practices, innovation strategy, innovation performance, size, experience and firm performance. In total, 26 items were included using the scales described in section 3.2. Lastly, the third section collected further data on the respondent's profile and position within the business, as well as other key company data (degree of internationalisation, legal form, etc.).

3.2. Measures

Firm performance

Firm performance is the outcome of interest in this study. This construct was measured using the scale developed by Ritala (2012). This scale consists of four items for which respondents must evaluate the company's performance in the last three years compared to competitors in terms of sales growth, profitability, market performance and market share.

Although we could have used financial metrics (e.g. ROA or ROE) to capture company performance, this scale was used because many companies are reluctant to share this information. Asking respondents to rate company performance in comparison to the closest competitors means that firm size and industry effects are automatically controlled for (Love et al., 2002; Eddleston and Kellermanns, 2007). Answers were recorded on a 7-point Likert

scale ranging from 1 (*much worse*) to 7 (*much better*). Reliability of this performance measure was borderline (Cronbach's $\alpha = 0.6623$), although this value is still consistent with the literature, according to which a value of between 0.6 and 0.8 is considered appropriate (George and Mallery, 2003).

Open innovation practices

To measure the variety and intensity of OI practices, we employed the construct used by Sisodiya et al. (2012) to capture external sources of innovation. This scale is based on the extant literature and is complemented by qualified experts (including practitioners and academics) in the field, who provided accurate feedback on the items. Using a 7-point Likert scale, respondents indicated their degree of agreement (intensity) with a series of items that quantify the diversity of the external sources that the company uses to gather new ideas. Confirmatory factor analysis verified internal validity amongst the items. The Cronbach's alpha score was above the recommended threshold of 0.7 ($\alpha = 0.8104$).

Innovation strategy

To measure innovation strategy, we employed the nine-item scale used by Terziovski (2010). The scale covers the strategic vision from both an organisational point of view (mission, company vision and strategic objectives) and the perspective of administrative tasks. The items also capture employees' skills, the way cooperation takes place and the commitment to developing new ideas. Finally, the external strategic vision (customers) is also included. Like for the previous construct, the value of Cronbach's alpha is acceptable (0.8801), confirming the validity of our approach.

Innovation performance in the market

This construct was measured using Ritala's (2012) scale, which is based on early scales developed by Alegre et al. (2006) and Alegre and Chiva (2008). Respondents were asked to compare the success of their firm in various innovation activities (e.g. replacement and extension of products or services, development of environmentally friendly products or services, and opening new markets or target groups) against the success of rivals. This scale has seven statements, and it uses a 7-point Likert scale ranging from 1 (*very poorly*) to 7 (*very well*). Cronbach's alpha for this factor was 0.7343.

Company characteristics

SMEs vary greatly, so we controlled for size and experience. Both factors were expected to shape the performance of the firm. We used the threshold of 10 employees to categorise firms by size. According to the European Union's definition of SMEs, micro-enterprises have fewer than 10 employees, whereas SMEs have 10 or more employees. This cut-off was used because micro-enterprises tend to have an average turnover and a total assets of less than 2 million Euros

Like in other studies (Dahlqvist et al., 2000; Baptista and Karaöz, 2006; Rafiki et al., 2014), we controlled for experience in the marketplace. We expected to find different patterns for young and senior firms. Our prediction was that young companies might have been created under the new paradigm of OI, having instilled a more open mentality from the outset and having been created under the approach of cooperation and collaboration. In contrast, old companies might be more reluctant to apply OI strategies and might be less flexible in implementing OI. We thus introduced this factor in our analysis to examine different patterns based on size and experience. Table 1 shows the full list of items for each construct.

Table 1. Items included in the scales used to operationalise the constructs of interest

Market performance (Ritala (2012)	
MP1	Sales growth
MP2	Profitability
MP3	Market share
MP4	Market growth
Open innovation practices (Sisodiya et al., 2012)	
S1	Constantly scan the external environment for inputs such as technology, information, ideas and knowledge.
S2	Actively seek external sources (e.g. research groups, universities, suppliers, customers, competitors, etc.) of knowledge and technology when developing new products.
S3	Believe it is good to use external sources (e.g. research groups, universities, suppliers, customers, competitors, etc.) to complement our own R&D.
S4	Often bring in externally developed knowledge and technology to use in conjunction with our own R&D.
S5	Seek out technologies and patents from other firms, research groups or universities.
S6	Purchase external intellectual property to use in our own R&D.

Innovation strategy (Terziovski, 2010)	
PI1	The organisation's vision or mission includes a reference to innovation.
PI2	Innovation strategy has helped the organisation achieve its strategic goals.
PI3	Increasing our production volume is an important measure of our process innovation.
PI4	Improving administrative routines is seen as part of our innovation strategy.
PI5	Internal cooperation is an important part of innovation strategy implementation.
PI6	Customer satisfaction is part of our innovation strategy.
PI7	Improving product or service quality is one of our key objectives of innovation strategy.
PI8	Formulating innovation strategy increases employee skills.
PI9	Improving employee commitment, morale or both is part of our innovation strategy monitoring.
Self-perception of innovation performance (Ritala, 2012)	
IP1	Replacement of products being phased out.
IP2	Replacement of services being phased out.
IP3	Extension of product or service range within the main market.
IP4	Extension of product or service range outside the main market.
IP5	Development of environmentally friendly products or services.
IP6	Opening of new market abroad.
IP7	Opening of new domestic target groups.

3.3. Method

The goal of this study was to provide useful guidelines to SMEs to help them improve their performance according to their innovation strategy, OI policy and firm characteristics. QCA was used to do so. The QCA technique identifies which combination or combinations of a given set of antecedent conditions leads to a specific outcome (Olsen, 2014; Woodside, 2013). QCA was chosen instead of alternative techniques because of the small sample of observations. Numerous studies have shown that QCA is well suited to a small number of cases (Berg-Schlosser, 2009; Fiss, 2011). Fuzzy-set qualitative comparative analysis (fsQCA) software version 3.0 was used.

QCA assumes complex causality and focuses on asymmetric relationships. Configurations consist of conditions or factors that can be positive, negative or absent. This method calculates commonalities amongst the configurations that best lead to the outcome. QCA identifies the minimum set of combinations of casual conditions that are sufficient to produce the outcome.

The first step is to calibrate or transform the raw data into fuzzy or crisp sets. Variables with dichotomous values are transformed into crisp sets, with 0 denoting full non-membership and 1 full membership. For continuous variables or those with different levels, fuzzy sets are recommended.

Once the data set has been calibrated, necessity analysis must be performed to check whether any antecedent condition is necessary for the outcome to occur. Following Schneider and Wagemann (2010), a condition is deemed necessary when its consistency score exceeds the threshold value of 0.9.

In the next step, the truth table is constructed. The truth table contains all possible combinations of antecedent conditions (displayed in rows). Thus, the truth table has 2^k rows (i.e. the number of logically possible combinations of conditions), where *k* is the number of antecedent conditions in the model. Some rows might not have empirical evidence if there is no observation with that particular combination of antecedent conditions (Beynon et al., 2016). To identify the sufficient conditions to produce the outcome, the number of rows is reduced using the Quine–McCluskey algorithm (Quine, 1952). This reduction is based on the empirical relevance of the solution (coverage) and the extent to which cases sharing similar conditions lead to the same outcome (consistency). Conditions with 0 coverage or a sub-optimal level of consistency must be refined. The default value for the consistency cut-off is 0.8. The closer this value gets to 1, the greater the consistency is (Ragin, 2009).

Depending on the simplifications that are used, one of three solutions is given. For the complex solution, only configurations for which there is empirical evidence enter the minimisation process. The parsimonious solution explains the presence and absence of cases that are observed and those that are not observed. Finally, the intermediate solution is a combination of the other two solutions that is given by considering that some of the conditions that are absent will still lead to a successful outcome.

4. Results

Six antecedent conditions were considered to shape SME performance: sources of innovation, innovation strategy, innovation performance in the market (self-reflective construct), innovation type, size and experience. All conditions except innovation type and size were transformed into fuzzy sets. The same is true of the outcome. The cut-off points were the

values of the 10th and 90th percentiles (to denote full non-membership and full membership, respectively). The crossover point (i.e. the point of maximum ambiguity or 0.5) was defined using the median. The two remaining antecedent conditions were transformed using a crisp-set approach. As explained above, companies with fewer than 10 employees were considered to lie outside the set (full non-membership), and companies with 10 or more employees were considered to lie in the set (i.e. full membership). For innovation type, a value of 1 denoted radical innovation, whereas 0 denoted incremental innovation. Table 2 shows how the variables were transformed into fuzzy-set conditions. Specifically, for each condition and the outcome (firm performance), the table indicates the cut-off points, as discussed before.

Table 2. Variable definition and calibration values

Condition*	Membership threshold values		
	Full non-membership (0.05)	Crossover point (0.5)	Full membership (0.95)
Performance	1.11	0.00	-0.81
OI practices	1.13	-0.01	-1.13
Innovation strategy	1.13	0.21	-1.00
Innovation performance	1.34	0.12	-1.30
Years	30.1	14.9	5.1

Notes: * Observations above the 90th percentile were considered to reflect full set membership; the 10th percentile was the threshold for full non-membership; the crossover point was approximated using the median; values have been rounded.

Once all values had been calibrated, we evaluated whether any antecedent condition is, in isolation, necessary to explain either the presence or the absence of the outcome (Meyer et al., 1993). Table 3 displays the results of this analysis. No condition exceeded or equalled the threshold of 0.9 (Schneider and Wagemann, 2010), so we concluded that there are no necessary conditions in our model.

Next, Table 4 shows the sufficient configurations of antecedent conditions for superior firm performance. Following Ragin's (2009) recommendations, we report the intermediate solution. The notation used in the table of solutions is as follows: black circles (●) indicate the presence of a condition; white circles (⊗) denote the absence of a condition; ambiguous conditions are left blank.

Table 3. Analysis of necessary conditions

Condition*	Market performance		~Market performance	
	Consistency	Coverage	Consistency	Coverage
OI practices	0.5991	0.5484	0.5780	0.6042
~OI practices	0.5676	0.5408	0.5680	0.6180
Innovation strategy	0.7021	0.6759	0.4678	0.5142
~Innovation strategy	0.4953	0.4490	0.7052	0.7300
Innovation performance	0.7035	0.6716	0.4789	0.5220
~Innovation performance	0.4993	0.4563	0.6987	0.7291
Innovation type	0.4471	0.7422	0.1360	0.2578
~Innovation type	0.5529	0.3591	0.8640	0.6409
Size	0.5221	0.4105	0.6565	0.5895
~Size	0.4779	0.5492	0.3435	0.4508
Market experience	0.5214	0.4495	0.6911	0.6803
~Market experience	0.6292	0.6408	0.4408	0.5126

*Note: * The symbol (~) represents the absence of the condition.*

Table 4 shows the six combinations of antecedent conditions that produce the outcome, confirming our initial intuition that there is no unique recipe to explain market performance. Thus, the results indicate that different types of SMEs follow different pathways and that all of these pathways are equally conducive to performing well in the market. The solution coverage is 0.612, and the solution consistency is 0.870. Raw coverage ranges from 0.08 to 0.202. All these indices reveal good fit.

Table 4. Sufficient configurations of antecedent conditions for performance

Configuration no.	Antecedent conditions						Coverage		Consistency
	OI practices	Innovation strategy	Innovation performance	Innovation type	Size	Market experience	Raw	Unique	
1	⊗	⊗		⊗	⊗	⊗	0.202	0.112	0.786
2	●		●	⊗	⊗	⊗	0.201	0.112	0.858
3	●	●	●	●		●	0.141	0.109	1.000
4	●	⊗	⊗	●	●	⊗	0.081	0.051	1.000
5	⊗	●	●	●	●	⊗	0.106	0.057	0.975
6	⊗	●	⊗	●	●	●	0.077	0.029	0.991
Solution coverage = 0.612; solution consistency = 0.870 Frequency threshold = 1; consistency threshold = 0.824									

Of the six configurations in the solution, the first two (#1 and #2) correspond to companies that use incremental innovation, whereas the last four correspond to companies

that prioritise radical innovation. Regarding OI practices, half of the configurations show high values for this factor, whilst the other half could be characterised as companies that have less activity in the use of such practices (in either intensity or breadth of sources). Regarding innovation strategy, three configurations reflect companies that formalise and internalise the innovation strategy (#3, #5 and #6), whereas two configurations reflect companies that act more spontaneously and in a less-structured fashion (#1 and #4). Similar behaviour is observed in terms of self-perceptions of innovation performance. This relevant factor is present in three configurations (#2, #3 and #5) but absent in configurations #4 and #6. Regarding experience in the market, the solutions indicate that there are certain patterns for young companies (#1, #2, #4 and #5) and for more consolidated companies (#3 and #6). Therefore, the results suggest that there are strategies for all types of companies. The same applies to size, with different solutions depending on the size of the company. Finally, regarding strategy, three configurations show a tendency towards changing obsolete products and looking to other markets, whereas two configurations do not show a change of products (despite obsolescence) and reveal a tendency towards staying in the same market. Type of innovation is present in four out of the six configurations, implying that the use of innovation positively affects market performance.

We present the results by separating companies according to innovation type. We then discuss the results by size and market experience. Focusing first on companies that rely on incremental innovation reveals that three of the four configurations refer to large companies (#4, #5 and #6) and that size is indifferent in only one configuration (#3).

For large companies that are new to the market, two patterns are observed (#4 and #5). Configuration #4 corresponds to companies that rely on external sources, that have not internalised innovation from a strategic point of view and that perceive themselves as less innovative than competitors. In contrast, configuration #5 corresponds to companies with the opposite behaviour: low diversity or intensity of innovation sources, a strategy of formalised innovation and a high self-perception of innovation performance.

There is also a configuration (#6) for small companies that have been in the market for some time. These companies are characterised by a formalised innovation strategy, although they have few communication flows with external ideas and are perceived as less innovative than competitors.

Finally, configuration #3 applies to both big and small SMEs that are characterised by having market experience. These SMEs tend to create new products in the market, rely on external sources, and have strategic involvement in innovation that extends to employees (Gatarik, 2019), the management and company processes.

For companies that primarily use incremental innovation, there are two patterns that lead to superior market performance. Only one applies to micro-enterprises with little experience in the market. Specifically, configuration #1 indicates that these companies have low levels of OI and lack definition in their innovation strategy. Configuration #2 presents a slightly different behaviour, reflecting companies that are very active in OI and that perceive themselves as more innovative than competitors.

5. Discussion and conclusions

This study explores how the combined effect of OI practices and innovation strategies affects firms' market performance. Although the literature on OI in large corporations is extensive, there has been little discussion, particularly of an empirical nature, of OI in SMEs (Love and Roper, 2015; Hossain and Kauranen, 2016). This study contributes to the literature on OI in SMEs from a new perspective, namely that of configurational analysis. Using a sample of firms located in the Spanish region of Valencia, we perform QCA to explore which combinations of antecedents conditions yield superior firm performance. SMEs can exploit the results presented herein to improve their performance by mirroring the different configurations. Specifically, our results reveal six configurations that are sufficient for the outcome to occur.

We argue that, under the right conditions, OI should provide substantial advantages and should result in superior firm performance. Our findings reveal that for inflows of external resources (ideas, knowledge, technology, etc.) to be effective, they must be accompanied by appropriate strategies. Specifically, for mature companies focusing on radical innovation, formalising an innovation strategy is crucial. Doing so in turn helps the company obtain a better market position in terms of innovation. Alternatively, for large, relatively new SMEs that use radical innovation, a formalised innovation strategy is not essential. Further descriptive analysis reveals that companies that follow this latter pattern share the characteristics of born global firms. From the outset, these firms allocate their resources and efforts to finding an international niche.

For SMEs that use OI but are not innovation intensive, an innovation strategy is important if they are large and focus on radical innovation. The logic behind this pattern is that these firms tend to have a more closed innovation culture. Therefore, although they use external sources, their main innovation strategy is in-house innovation, which has led to the creation of new products that have been well received by the market. However, when SMEs are small and relatively new to the market, the role of strategy is less prominent. This finding might owe to the fact that the firm is still at an embryonic stage and is probably still pivoting and iterating to readjust to the market and better satisfy customers' demands.

Additional conclusions can be drawn from the results. First, small firms that perform well seem to prefer to adopt incremental innovation and tend to be younger. This behaviour is representative of companies that seemingly opt to consolidate their position in the market with a few core products or services that are highly valued by customers rather than with a broad and diversified product portfolio. To remain competitive, these companies innovate by making small improvements or upgrades. This strategy is probably a direct consequence of their limited resources (i.e. small firms) or their scarce experience in the market (i.e. young firms). This pattern is consistent with the pattern reported by Oke et al. (2007) for a sample of SMEs in the UK. Second, large companies seem to be geared towards radical innovation. Radical innovations are aimed at destroying current products, services or practices and striving to create new markets. A plausible explanation of why large firms (versus small firms) might prefer this type of innovation is that radical innovation goes further and involves risk. Thus, not all organisations are ready to drastically change their offer or way of operating. Disrupting the market typically entails profound changes, large investments and long-term returns. Large companies can exploit their size, and, in the presence of a creative and innovation-friendly climate supported and exemplified by the top management, are more likely to become involved in radical innovation strategies. Third, firms with a consolidated market experience seem to have internalised an organisational culture of innovation that spreads from top management to employees, removing the traditional gap between innovation strategy and innovation culture.

The above results present possibilities for future lines of research to overcome some of the limitations of this study. Although our sample fits the model well, further studies might consider expanding the sample and exploring other contexts (e.g. specific industries or geographies). Another interesting direction to explore would be that of the background conditions of companies such as level of internationalisation (He et al., 2019) or absorptive

capacity (Kim et al., 2019; Reid, 2019). Both level of internationalisation and absorptive capacity are linked to OI because they account for the interactions of different partners and the way in which firms acquire and internalise new knowledge to innovate. Likewise, it would be of interest to investigate whether the internal functioning of the company (e.g. the business culture and hierarchical structure) moderates the external flows of innovation and shapes firm performance. Finally, we encourage researchers to conduct longitudinal analyses. Innovation is not static but instead evolves over time. Therefore, examining the evolution of innovation strategies and practices is of interest. To do so, larger data sets would be required, and other methods could be used. Nevertheless, comparing the results of both types of studies might provide useful insights that can help managers make better-informed decisions.

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