Supply Chain and Open Innovation: the undeniable relationship
Conceptions from a literature review

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Abstract

The consolidation of Open Innovation (OI) as necessary approach to understand the ability of firms to innovate has demanded more sustained efforts to unfold the continuous connection with other relevant actors across its systems of production (Arabshahi et al., 2014; Chesbrough, 2006; Jimenez-Jimenez et al., 2019). Central to this is the emphasis on a pursuit of knowledge and collaboration from components of the supply chain (SC) (Miyamoto, 2020). Despite the undeniable relationship between these two terms, authors have pointed out that not enough research has occurred (Ardito et al., 2020; Jimenez-Jimenez et al., 2019; R. A. E. Shamah & Elssawabi, 2015; Smith & Blundel, 2012). Therefore, this paper is intended to contribute to the research gap by examining on how the concepts of SC and OI are related in the current state-of-the-art. To accomplish it, a systematic literature review (SLR) is conducted.

Keywords: Innovation, extraction of data, journals, citation.

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1. Introduction

It has been extensively argued that the ability of firms to innovate is crucial for survival (Ardito et al., 2020; Jimenez-Jimenez et al., 2019). More recently, firms have begun to understand innovation as a process that demands continuous connection with other actors (Arabshahi et al., 2014; Roldán Bravo et al., 2016). It has resulted in the rise of a new paradigm termed Open Innovation (OI) (Chesbrough, 2006; West et al., 2014). Central to OI is the stress on a search for knowledge and collaboration from members of the supply chain (SC) (Erzurumlu, 2010; Miyamoto, 2020; Wilhelm & Dolfsma, 2018).

The relevance of SC management is shared by most firms nowadays (Roldán Bravo et al., 2016; R. A. E. Shamah & Elssawabi, 2015). Studies have argued that SC partners should develop strategic relationships to achieve a competitive advantage while improving organizational performance (Dalziel, 2012; Roldán Bravo et al., 2017). In this sense, the relationship between SC and OI has been turned around by arguing that the former cannot be seen just as a source of ideas and knowledge, but also as a substantial terrain for improvement through collaborative OI (Bendavid & Cassivi, 2012; Koh et al., 2013).

Despite the undeniable relationship between these two terms, insufficient research has been materialized (Ardito et al., 2020; Jimenez-Jimenez et al., 2019; R. A. E. Shamah & Elssawabi, 2015; Smith & Blundel, 2012). Therefore, this paper is intended to contribute to the research gap by investigating on how the concepts of SC and OI are related in the current state-of-the-art. The present study seeks to answer the following question: How are the concepts of supply chain and open innovation linked in present business, management and accounting research?

After introducing the discussion in section 1, the following section will explain the research method applied. In addition to carrying out a systematic literature review (SLR), a qualitative analysis of contents included in the studies sampled is performed. Section 3 exposes the main results, concluding in section 4.

2. Methodology

2.1 Recognition, classification, and selection of publications

To explore the relationships between SC and OI, this work has first embraced the SLR approach and then carried out a qualitative examination of the articles sampled. Following Jesus & Jugend (2021), the paper implements the SLR in two different stages: (a) a bibliometric research (Fahimnia et al., 2015), and (b) the analysis of the chosen articles’ content (Bhimani et al., 2019; Gaur & Kumar, 2018).

The identification of publications started by searching for relevant articles in the intertwine of the SC and OI, as the central terms, using the Web of Science (WoS), Scopus and Google Scholar (GS) databases. According to Chapman & Ellinger (2019) these are among the main scientific databases used for academic production. Therefore, the Boolean
terms chosen were “Supply Chain” and “Open Innovation”. Other parameters were applied based on previous SLR conducted such as articles in the final stage, published only in journals, and in English (Jabbour et al., 2020; Jesus & Jugend, 2021; Lu et al., 2018). Since this literature review is conducted for the purpose of specific areas of expertise, the search was focused in one broad research area: “business, management, and accountant” outlines the process of identification of relevant papers. As a result, 88 articles were identified as relevant for this SLR.

**Figure 1**
*Process of identification of relevant articles*

Following this, the 88 articles were analysed by using a text-analysis software named MAXQDA2022. This software offers the opportunity of conducting text-analysis by combining three elements: documents, codes, and variables summarizes the MAXQDA2022 scores after uploading the final Scopus' outcome.
Table 1
MAXQDA22 scores

<table>
<thead>
<tr>
<th>Category</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of documents imported</td>
<td>88</td>
</tr>
<tr>
<td>Number of codes stated</td>
<td>21</td>
</tr>
<tr>
<td>Number of variables identified</td>
<td>27</td>
</tr>
<tr>
<td>Number of documents ignored</td>
<td>0</td>
</tr>
</tbody>
</table>

The purpose of this text-analysis was to exclude those articles that consider either one or both terms peripheral to their main discussion. Therefore, it is counted as a relevance-control-check procedure (RCCP). The RCCP is stated in 5 main steps.

Figure 2
Relevance cross check procedure

- Step 1: 75 out of 88 articles do have either Supply Chain or Open Innovation in its abstract. Thus, 13 papers were excluded because they did not contain neither of the two terms in their abstracts.
- Step 2: 49 out of 75 mentioned only one of both terms in the abstract. They were removed since it is considered that the relation between the two concepts is not central. Afterwards, only 26 papers made it to the next step.
- Step 3: The relevance of both terms (n) within the paper was measured by computing the number of times the abstract mentions one of the two terms (x) multiplied by the number of times the other term was mentioned within it (y). Then, the papers were ranked.
- Step 4: Those papers that computed 1 (both terms were mentioned only 1 time) were put aside for a more in-depth evaluation to examine the significance of keeping them into the sample. 10 papers did compute 1 and were analysed in-depth.
- Step 5: After reviewing the abstracts more carefully, only 2 papers were removed. As a result, 24 papers were selected for the final sample.
2.2 Extraction of data

Based on Jesus & Jugend (2021), this study managed the extraction of data in two stages. First of all, bibliometric information was extracted and compared. In this stage, variables such as publication year, geographic affiliation of authors, journals of publication and number of citations were examined. Secondly, the articles were read entirely to better understand the relationship between SC and OI for the field of business, management, and accounting. Consequently, the following results are explored:

- a. Chronological distribution of publications
- b. Geographical distribution of research
- c. Journals and numbers of citations
- d. Research methods applied
- e. Content analysis – themes addressed
- f. Content analysis – themes mapping
- g. Direction of the relationship

3. Results

3.1 Chronological distribution of publications

The first article was published in 2010. It may be showing that the integration of Supply Chains and OI has not been addressed by academic publications for a long time, covering its relationship for a bit longer than a decade. However, the number of publications has not increased significantly since the first publication. There is an evident fluctuation in the number of publications that have been achieved.

Figure 3

*Publications per year*
3.2 Geographical distribution

The authors' affiliation was analysed in order to explore where the combination of both topics has taken the attention of scholars (Figure 4).

Figure 4
Countries with publications

Although there are scholars working on these two topics in a wide variety of regions across the globe, the involvement of central European scholars is observed in 54% of them. Scholars affiliated in European institutions take part in 13 publications. The American continent has representatives in 6 publications, while academics in Asian have been part of 5 publications on the theme. Even scholars from Africa have been publishing relating both topics, in particular from Egypt. Relating the year of publication to the context of the research, we observed that while these issues have been addressed in developed countries since 2010, developing countries’ scholars have joined them a few years later (2014). It is possible that advanced industrialized countries had faced problems demanding the intertwining of both fields of study at an early stage than less developed ones.

3.3 Journals and number of citations

Table 1 displays the ranking of the three most-cited articles in the Scopus databases. In general terms, recent papers get more citations than early ones. The 24 articles used as a sample were published in 20 different journals. This means that authors find opportunities for publishing on these topics in a wide variety of sources.
### Table 1  
*Most cited articles*

<table>
<thead>
<tr>
<th>Author</th>
<th>Main contribution of the research</th>
<th>Journal</th>
<th>Country</th>
<th>Year</th>
<th>Citations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lenny Koh, S. C., Genovese, A., Acquaye, A. A., Barratt, P., Rana, N., Kuylenstiema, J., Gibbs, D.</td>
<td>They demonstrate the application of supply chain environmental analysis tool (SCEnAT), especially the advantage of using a robust carbon accounting methodology, to a Supply Chain case study.</td>
<td>International Journal of Production Research</td>
<td>UK</td>
<td>2013</td>
<td>60</td>
</tr>
<tr>
<td>Ardito, L., Messeni Petruzzelli, A., Dezi, L., Castellano, S.</td>
<td>Based on a sample of 5897 firms that participated in the Italian Innovation Survey (IIS)(2008-2010), we reveal that sourcing knowledge from suppliers, customers, and competitors has a positive influence on innovation ambidexterity</td>
<td>Journal of Business Research</td>
<td>Italy, France</td>
<td>2020</td>
<td>51</td>
</tr>
<tr>
<td>Jimenez-Jimenez, D., Martinez-Costa, M., Sanchez-Rodriguez, C.</td>
<td>The paper shows that information technology (IT) directly enhances both types of product innovation (incremental and radical) indirectly through supply chain collaboration by using data collected from a sample of 200 manufacturing firms.</td>
<td>Journal of Knowledge Management</td>
<td>Spain, Canada</td>
<td>2019</td>
<td>41</td>
</tr>
</tbody>
</table>
3.4 Research method applied

Figure 5 shows that the most used research method within the sample is the quantitative approach (12), which doubled the number of papers that conducted qualitative methods (6). There is a vast variety of methods being applied, which also includes conceptual approaches, modelling and 2 papers that deployed quantitative and qualitative methods along.

Figure 5
Research methods used

3.5 Content analysis – themes addressed

Contents were also analysed according to the issues that the papers are intended to address. Consequently, 22 themes were identified after reading the papers. The related issues and the number of papers addressing them are listed in.

Industrial performance, innovation and organizational studies are those themes that came up in a larger number of articles. For instance, Arabshahi et al. (2014) state that open innovation practices conducted along the supply chain may have a direct and strong effect over industrial performance. In addition, Ardito et al., (2020) prove that open innovation can be considered a path towards ambidexterity, something that is nowadays required for firms in order to be competitive in the short- and long-run. The external source of knowledge needed can be found along the companies’ supply chain partners (Benitez et al., 2022).

In terms of innovation and organizational studies, Wilhelm & Dolfsma, (2018) discuss the unchallenged assumption in the open innovation literature that organizational boundaries become “porous” after adopting this approach. Therefore, the authors propose a deeper analysis on the organizational boundaries that may prevent companies from moving forward in their innovation capacity by integrating SC actors. In addition, Roldán Bravo et al., (2016) attempt to explain how orientation to open innovation and open
innovativeness, advances an organization’s functioning in the context of SC management. A number of articles discuss the relationship between SC and OI from a Knowledge flow perspective, by assuming the former as a source of knowledge for firms through the practicability of the latest (Alletto et al., 2017; Ardito et al., 2020; Pellegrini & Lazzarotti, 2019; Rahmanzadeh et al., 2020; Roldán Bravo et al., 2016; J. Song et al., 2022; Wilhelm & Dolfsma, 2018).

Table 2
Themes addressed

<table>
<thead>
<tr>
<th>Themes</th>
<th>Number of articles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial performance</td>
<td>10</td>
</tr>
<tr>
<td>Innovation</td>
<td>10</td>
</tr>
<tr>
<td>Organizational studies</td>
<td>9</td>
</tr>
<tr>
<td>Knowledge flow</td>
<td>7</td>
</tr>
<tr>
<td>Collaboration</td>
<td>6</td>
</tr>
<tr>
<td>Trust</td>
<td>5</td>
</tr>
<tr>
<td>Globalization</td>
<td>4</td>
</tr>
<tr>
<td>Competitiveness</td>
<td>3</td>
</tr>
<tr>
<td>Research &amp; Development (R&amp;D)</td>
<td>3</td>
</tr>
<tr>
<td>SME</td>
<td>3</td>
</tr>
<tr>
<td>Strategic Management Decision (SDM)</td>
<td>3</td>
</tr>
<tr>
<td>Information Technology (IT)</td>
<td>2</td>
</tr>
<tr>
<td>Sustainability</td>
<td>2</td>
</tr>
<tr>
<td>Value Chain</td>
<td>2</td>
</tr>
<tr>
<td>Behavioural theory</td>
<td>1</td>
</tr>
<tr>
<td>E-commerce</td>
<td>1</td>
</tr>
<tr>
<td>Family firms</td>
<td>1</td>
</tr>
<tr>
<td>Industry 4.0</td>
<td>1</td>
</tr>
<tr>
<td>Institutional theories</td>
<td>1</td>
</tr>
<tr>
<td>Living laboratory</td>
<td>1</td>
</tr>
<tr>
<td>Social Capital</td>
<td>1</td>
</tr>
</tbody>
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Erzurumlu, (2010) explores the strategic impact of open innovation, in particular through partners’ collaboration, and supplier integration on the profits and decisions of the supply chain participants. In addition, collaboration across the SC is seen as central element of firms catch up with innovation (Jimenez-Jimenez et al., 2019; Miyamoto, 2020). However, a considerable amount of articles pointing out the challenges of trusteeship among supply chain actors (El-Ellla et al., 2016; Beckeman et al., 2013; Roldán Bravo et al., 2017; R. A. E. Shamah & Elssawabi, 2015; R. A. M. Shamah & Elsawaby, 2014). For instance, Abu El-Ella et al. (2016) provide solid insights on how trust enables the information flow through OI, and show how trust is becoming increasingly intermediated along the SC.

Dalziel (2012) asserts that the era of OI establishes multiples ways for companies to be part of global markets. The author identifies the explore-exploit continuum as a dimension along which the strategies of high-growth companies from developing countries will fluctuate, pointing out that exploitation specialists influence low cost inputs to participate in international SCs on the basis of superior efficiencies of globalization (Dalziel, 2012). At the other side of the stream, authors discuss over competitiveness in certain territories by arguing that OI practices enhanced by SC partners can be central to regional development (Abu El-Ella et al., 2016; Smith & Blundel, 2012; H. Song et al., 2020). Accordingly, the literature also highlights the increasing recognition of the Small-medium Enterprises’ (SME) role in
innovation (Benitez et al., 2022; Pellegrini & Lazzarotti, 2019; Smith & Blundel, 2012; H. Song et al., 2020). For those looking global, as well as for authors searching at the local level, both R&D and SMD seem to be relevant topics that come across SC and OI (Bendavid & Cassivi, 2012)

Finally, within the SC and OI dialogue, the literature sampled offers insights from a wide range of other topics such as IT (Jimenez-Jimenez et al., 2019; Yan et al., 2019), sustainability (Koh et al., 2013; Rahmanzadeh et al., 2020), value chains (Beelaerts van Blokland et al., 2012; Lee & Schmidt, 2017), and e-commerce (Yan et al., 2019) among others.

3.6 Content analysis – themes mapping

Figure 6 shows the addressed themes in relation to the two principal concepts: SC and OI. After reading the articles, themes were directed towards the term that was most relevant to their discussion. Several of them are relevant for both SC and OI, however, the classification was made considering just the articles analysed. The size of each dot is according to the number of papers that address this issue.

3.7 Direction of the relationship

The last element evaluated in terms of contents is the direction that the main concepts are related to each other. 20 out of 24 articles consider the SC as a relevant source of knowledge for OI enhancement. Only 4 papers approach these terms assuming that the later would improve the former.
Table 3
Direction of the relationship between SC and OI

<table>
<thead>
<tr>
<th>Direction of the relationship</th>
<th>Number of articles</th>
</tr>
</thead>
<tbody>
<tr>
<td>From SC to OI</td>
<td>20</td>
</tr>
<tr>
<td>From OI to SC</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>24</td>
</tr>
</tbody>
</table>

4. Discussion
This paper has intended to contribute to the literature by investigating on how the concepts of SC and OI are related in the current state-of-the-art. In addition to carrying out a SLR, a qualitative analysis of the articles has been accomplished. Results have shown that relevant research in this theme has been produced since 2010, in a wide range of regions across the globe, and sourced by a variety of journals. Although different research designs have been deployed, quantitative methods are the most used by academics in this field. In the junction of these two topics several other issues have been addressed. The great majority of the studies analysed consider the SC as a relevant source of knowledge for OI enhancement.

One the main limitation for this research the number of Boolean terms used which can be enlarged to take into consideration a more extensive literature that discusses this undeniable relationship between supply chains and open innovation. Furthermore, the fact that this research has taken into consideration only academic articles written in English can be seen as a main limitation. To explore the academic production addressing the relationship between supply chains and open innovation in other languages such as Spanish can beneficial for future research.

5. References


