Volume: 8, Issue: 1
Page: 95-111
2022

International Journal of Science and Business

Journal homepage: ijsab.com/ijsb

IJSAB International

Organizational Ambidexterity and Crowdsourcing Through the Lens of Open Innovation: A Systematic Literature Review

Pashchenko Yana, Ye Chengang, & Zhu Yue

Abstract:
The sustainability of open innovation (OI) in organizations depends on both their tools for attracting external and internal knowledge (i.e., crowdsourcing) and their long-term survival capabilities (i.e., organizational ambidexterity). While prior OI studies have mainly focused on managing crowdsourcing (CS) independently of organizational ambidexterity (OA) or vice versa, only partially analyzing the dynamic nature of OI, there is a lack of research on the interactions between them. This paper addresses the gap by integrating 174 articles from CS with 91 articles from OA within OI field, using bibliometric analysis techniques. In the process, we visualize networks of various topics related to CS and OA. The main results show that CS and OA are complementary concepts in OI, thus should be examined simultaneously. Also, the existing literature on this topic falls into nineteen clusters (e.g., community engineering for OI processes, ambidextrous leadership in OI processes, etc.) and the main concepts, future directions for each of them are proposed. Finally, managing OA and CS simultaneously in OI-led organizations will allow practitioners to achieve the sustainability of OI processes by developing all the necessary capabilities and building an effective organizational architecture.

IJSB
Accepted 30 January 2022
Published 4 February 2022
DOI: 10.5281/zenodo.5973474

Keywords: *open innovation, organizational ambidexterity, crowdsourcing, bibliometric analysis, systematic literature review.*

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1. Introduction

The Open Innovation (OI) paradigm has jeopardized the traditional way of doing business (e.g., Kodak, Nokia, Smith Corona, Blackberry, Swarovski, Lucent, Xerox PARC, etc.), showing that companies can successfully overcome organizational inertia by opening to external sources of knowledge and managing internal ones (Gilbert, 2005). In this case, organizations consider OI as the long-term strategy in a complex digital environment that focuses on the direction (inbound, outbound and coupled modes), nature and conditions of external and internal knowledge flows (Bogers et al., 2017; Chesbrough & Bogers, 2013; Chesbrough & Brunswicker, 2014; Pedersen, 2020). Developing and implementing a successful OI strategy in a complex environment highlights the need to move from simply analysing individual causal elements to analysing multiple relationships between them. In other words, the dynamic nature of OI cannot be fully understood by applying any individual concept in isolation, so it is necessary to focus on their configurations. It goes without saying that configurations of elements may lead to the same outcomes or may have a completely different synergic effect for OI-led organizations by overcoming the challenges associated with their separate use (Park & Mithas, 2020). From a theoretical point of view, many questions have been raised in the OI field, due to the complexity inherent in OI strategy. In particular, resource dependence theory (RDT) suggests that inbound OI and outbound OI are strategies aimed at reducing the firm's resource dependence and increasing external dependence on its resources (Mei et al., 2019). OI partners can provide each other with complementary resources due to their heterogeneity and social complexity (Lazzarotti et al., 2017). However, the ways to identify useful external knowledge and apply it to the firm's innovation process remained underestimated. Thus, we use crowdsourcing (CS) literature to shed light on this issue. In the same vein, little research has been done to understand what specific types of dynamic capabilities are required for managing inbound, outbound, and coupled OI activities. Most of them has investigated the absorptive capacity (external exploration) (Lichtenthaler & Lichtenthaler, 2009; Lichtenthaler & Muethel, 2012; Mei et al., 2019; West & Bogers, 2014), and only a few studies emphasized the necessity of organizational ambidexterity (external exploration and internal exploitation) (R. Li et al., 2020; Nobakht et al., 2021). But how to achieve organizational ambidexterity (OA) within OI and cope with the emerging tension still remain unanswered.

Referring to scholars, we recognize that organizations must thoroughly consider both their tools (including CS) and capabilities (OA) to ensure the sustainability of OI processes and leverage them (Bogers et al., 2017). Thus, a conceptualization of OA and CS in the OI context is required. OA and CS are not so much brand new phenomena in the academic field. Conventional wisdom suggests that ambidexterity research focused on handling exploitative and explorative activities inside organizations (Benner & Tushman, 2003; Lichtenthaler & Lichtenthaler, 2009). Meanwhile, crowdsourcing was an organizational and governmental tool for capitalizing on crowd-level engagement by using their knowledge and ideas (Chen & Aitamurto, 2019; Howe, 2006; Nakatsu et al., 2014; Schlagwein et al., 2019). However, in the era of OI, the dominant purposes of OA and CS are shifted. Currently, OA is considered by scholars and practitioners as a new way of developing novel products and services by aligning internal and external knowledge flows of the organization with exploitative and explorative capabilities (R. Li et al., 2020; Lichtenthaler & Lichtenthaler, 2009; Lichtenthaler & Muethel, 2012; Piezunka & Dahlander, 2019; Simula & Ahola, 2014; Wang et al., 2020). While, CS is the short-term tactics that enable organizations to gain access to diverse, marginal and distant external knowledge (Afuah & Tucci, 2012; Bogers et al., 2017; Djelassi & Decoopman, 2013). But how can the integration of these two concepts contribute to the sustainability of OI? Some CS scholars emphasize the importance of CS platforms for achieving ambidexterity in the era of OI (Palacios et al., 2016; Pavlidou et al., 2020). The efforts of researchers to understand the OI phenomenon are intertwined.

In this paper, we try to present not only the linear net-effect of independent CS and OA concepts in OI, but also the synergistic effect among them. We systematically review 265 articles, integrating various bibliometric techniques. We visualize networks of various topics related to CS and OA to better analyse trends and their co-evolution. Thus, the research gap and research opportunities can be observed by examining: How are OA and CS concepts defined in the OI domain? What are the possible explanations for the lack of OA and CS studies, despite their importance? What are the implications of their interactions for OI-led organizations? Combining bibliometric techniques, such as keyword co-occurrence (cluster and chronological analyses) and citation analyses, this study examines OA and CS in OI processes and provides answers to our research questions (RQ). The bibliometric analysis allows us to objectively analyse published articles, systematize information, verify the directions of current research and the relationships among OI, OA and CS to predict future scientific trends. Thus, cluster analysis shows that CS and OA are complementary concepts within OI boundaries and identifies five dominant approaches used in OI. This study also reveals that the relationship between OA and CS concepts cannot be explicitly traced due to a small sample of OI research at the intra-organizational and macro-organizational levels in general, and a deficit of comprehensive analysis on both OA and CS in terms of OI, firm performance and innovation in particular. The results of the citation analysis present that the existing literature on this topic falls into nineteen clusters and for each of them the main concepts, future directions are proposed. The implications of the OA-CS interaction for OI-led organizations are then determined. The paper is organized as follows. In Section 2, we describe the research methodology used for 265 articles from the Web of Science (WoS) between 2003 and 2021. In Section 3, we present our findings through descriptive, cluster, chronological, and citation analyses. Finally, in Section 4, we develop a research agenda for further investigation and suggest study limitations.

2. Research Methodology

2.1 Search and Selection of Literature

Due to the availability of high-quality scientific publications and related information, the scientometric Web of Science database was selected. The search was conducted in August 2021. The main parameters were "open innovation", "ambidext*" and "crowdsourcing". The results were not limited to the year of publication or areas of knowledge. According to the search outcomes (see Table 1), there were no studies that addressed all three concepts: OI, OA and CS. However, we found 190 articles mention the keywords "open innovation" and "crowdsourcing" and 92 articles referred to "open innovation" and "ambidext*". Furthermore, materials, conference reports and books (which often duplicate articles), as well as editor's notes (which are also indexed by the scientometric database) were excluded. Thus, there was a sample of 265 articles. Finally, the results were saved in RIS format, which included all the information needed for further bibliometric analysis (including the title, names of authors, keywords, links, etc.).

Table 1. Initial data for further processing

Keywords	Number of articles 1997-2021*	Selected 2003-2021*
open innovation	6554	
open innovation AND crowdsourcing	**190**	**174**
open innovation AND ambidext*	**92**	**91**
ambidext* AND crowdsourcing	0	
open innovation AND ambidext* AND crowdsourcing	0	

Note: 2021* - August 2021

2.2 Data Visualization Method

Visualization of the research network was completed using the VOS Viewer (VOS), a software that has its own coupling aggregation mechanism (Van Eck & Waltman, 2013). In particular, it enabled us to find new developments in given areas by identifying the strength of their links (Boyack & Klavans, 2010). In this case, the size of the circles is determined by the density of the terms used. Coupling refers to citing the same references among articles, and then the clustering mechanism organizes the items with a large number of shared references into groups (clusters). Articles belonging to the same cluster are closely related as a group, indicating possible directions in future research (Van Eck & Waltman, 2007). Furthermore, overlay visualization is chosen as a more reliable tool for checking the latest trends in the academic field, because it allowed us to classify items using a timeline.

3. Results

In this section, we review and synthesize the selected 265 articles applying four types of analysis: (1) descriptive analysis to present the main trends and evolution of articles and citations per year; (2) cluster analysis to classify dominant approaches and answer RQ1 "how are OA and CS concepts defined in the OI domain?"; (3) chronological analysis to observe trends in main concepts over time based on the multi-level framework and answer RQ2 "what are the possible explanations for the lack of OA and CS studies, despite their importance?"; (4) citation analysis to identify clusters with the most significant works in OA and CS areas and answer RQ3 "what are the implications of their interaction for OI-led organizations?". We then reveal the academic outcomes.

3.1 Descriptive analysis

The evolution of CS and OA articles and their citations per year can be illustrated in Figure 1. Thus, it is possible to observe similarities in research trends of these two concepts over time. However, scholars should consider a small number of OA studies (compared to CS) as a possible future direction. In recent years, there has been a significant increase in citations per year: (1) in CS studies with 429 citations in 2016 and 1,403 in 2020; (2) in OA studies with 209 citations in 2016 and 835 in 2020. Processing the initial data allowed us to identify the top 10 authors who have contributed to the development of OA and CS in the OI context over the past two decades.

The top five CS articles with the highest number of citations include:
1 Leimeister J. M. et al., 2009: 323 citations; 24,85 citations per year
2 Bogers M. et al., 2017: 289 citations; 57,8 citations per year
3 Zhao Y. X. and Zhu Q. H., 2014: 247 citations; 30,88 citations per year
4 Franzoni C. and Sauermann H., 2014: 209 citations; 26,13 citations per year
5 Majchrzak A. and Malhotra A., 2013: 200 citations; 22,22 citations per year

The top five OA articles with the highest number of citations include:
1 Lichtenthaler U. and Lichtenthaler E., 2009: 439 citations; 33,77 citations per year
2 Rosing K. et al., 2011: 377 citations; 34,27 citations per year
3 Vrontis D. et al., 2017: 153 citations; 30,6 citations per year
4 Santoro G. et al., 2018: 152 citations; 38 citations per year
5 Lin H. E. et al., 2013: 139 citations; 15,44 citations per year

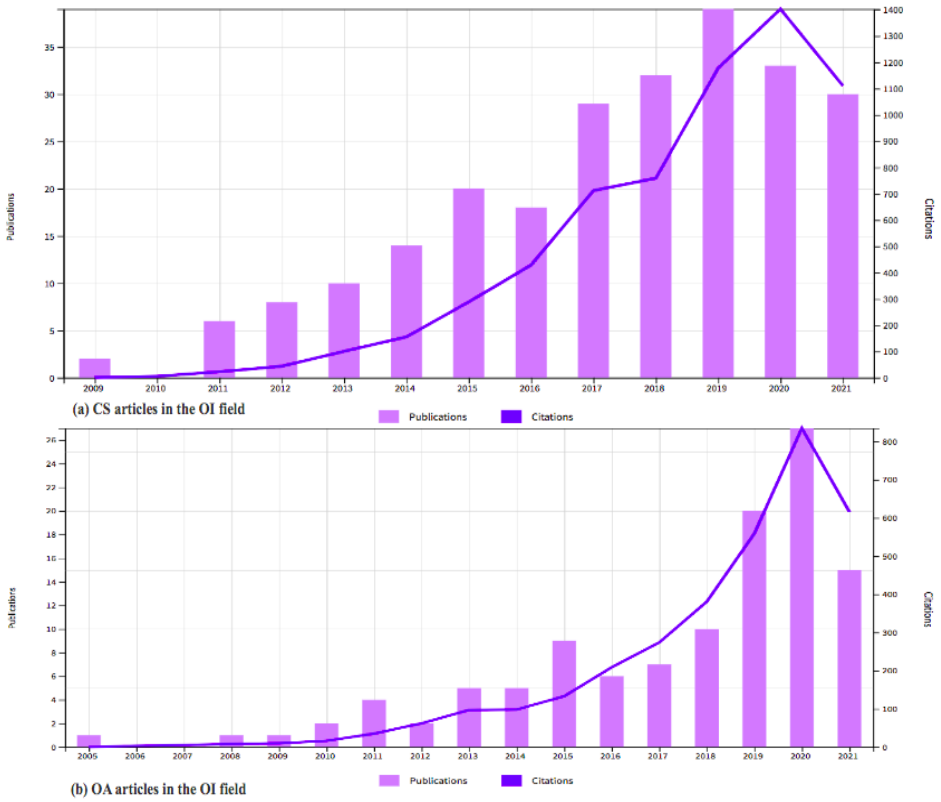

Figure 1. The evolution of (a) CS and (b) OA articles and citations per year

A bibliometric analysis of 265 articles showed that 14% of all research papers over the past 10 years were published in the following journals: R&D Management (8 articles), Technological Forecasting and Social Change (8 articles), California Management Review (8 articles), Research Policy (8 articles), Journal of Knowledge Management (6 articles).

3.2 Cluster analysis

After thorough analysis of each article, a total of 1,340 keywords were extracted from 265 articles. However, only 76 keywords met the threshold (minimum number of occurrences of a keyword = 7), which were refined to 65, excluding duplicates and those that are not relevant to this analysis. For each of the 65 keywords, the total strength of the co-occurrence links with other keywords was calculated. Afterward, we conducted cluster and chronological analyses, where the keywords were units of analysis. 65 items were organized into 5 clusters (see Figure 2): crowdsourcing (cluster 1, red: “crowdsourcing”, “open innovation”, “participation”, “open source software”, etc.); organizational ambidexterity (cluster 2, green: “ambidexterity”, “exploration”, “exploitation”, “performance”, “innovation”, etc.); knowledge management capability (cluster 3, blue: “knowledge management”, “absorptive capacity”, “organizational learning”, etc.); OI strategy and design (cluster 4, yellow: “entrepreneurship”, “business model”, “capabilities”, etc.); and information flows in OI processes (cluster 5, purple: “information”). It should be noticed that the latter includes only one keyword, which means that this cluster is a new area for further expansion.

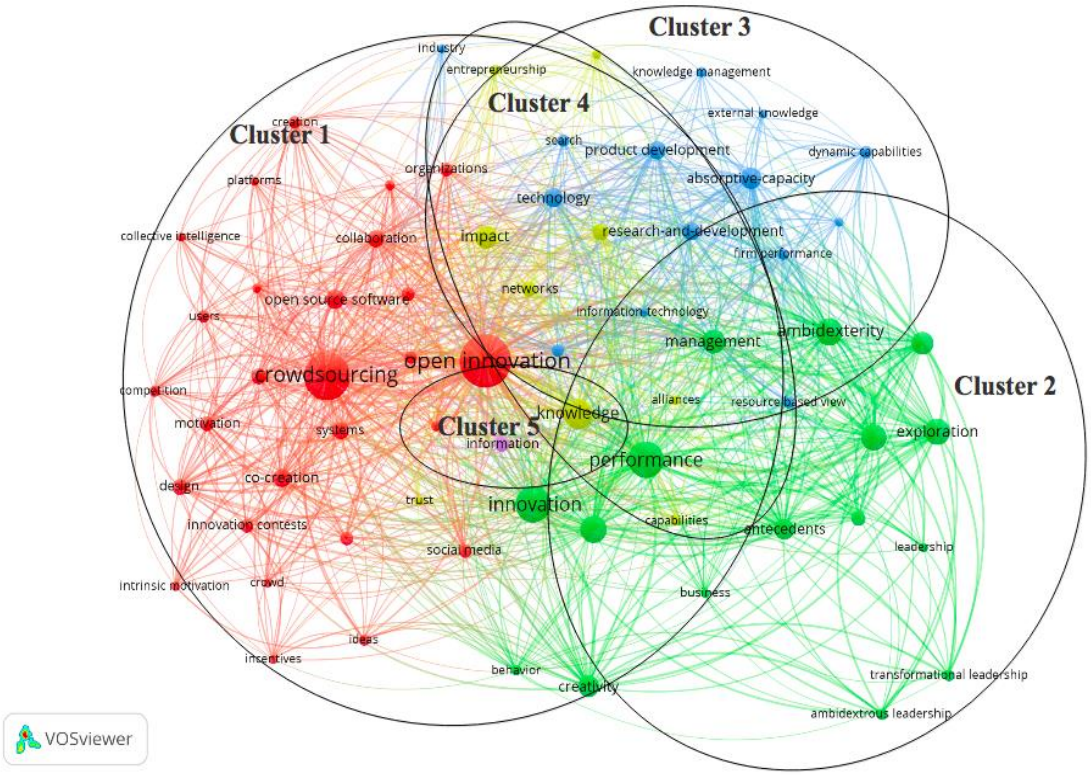

Figure 2. Top approaches in OA and CS articles within OI field

VOS network visualization allows us to assert that OA and CS clusters are complementary concepts within OI. Based on our findings, there is a close relationship between CS and OI, as they lie in the same cluster, and a less strong but still significant one between OA and OI, as they lie in different clusters. Our second discovery is not as expected, specifically that crowdsourcing practices and ambidextrous capabilities both matter to firm performance since they are equal in link strength and located at the same distance from each other. Moreover, innovation concept belongs to the ambidextrous cluster, but has a much stronger connection with crowdsourcing. However, little research has been done in these directions, which can be confirmed by the frequency of using these keywords in OI studies.

3.3 Chronological analysis

It should be noted (see Figure 3) that the frequency of using the concept "open innovation" is the highest (127), "crowdsourcing" is also a widely used word in selected works (109), followed by the terms "performance" and "innovation" (68 and 67, respectively). The list of the top 6 ends with the concepts "knowledge" (48) and "ambidexterity" (44). Keywords other than those aforementioned appeared in the sample 7-40 times (the higher the density, the larger the circle). Moreover, current research in the OI is mainly related to research on "business model", "external knowledge", "product ideas", "firm performance" and "ambidextrous leadership", which are also of great concern when firms face digital transformation. Applying the multi-level framework of (Chesbrough & Bogers, 2013), we identified the levels of research in each academic paper (total 265 articles) in the OI field in general and in CS and OA areas in particular. In our analysis the crowdsourcing concept refers to the inter-organizational level, users and other stakeholders to the extra-organizational level, while organizational ambidexterity and model design to the organizational level, and ambidextrous leadership to the intra-organizational level of research. Then, we divided all the studies into three periods according to the colors in Figure 3. Purple corresponded to the first period (2003-2015 years), turquoise and dark green to the second period (2016-2018 years) and light green and yellow

to the third period (2019-2021 years). Afterward, we summarized the information of different levels of analysis according to the timeline of keyword occurrence (see Figure 4). Some scholars combined two or more levels of analysis in their studies. Finally, we gave some examples of existing articles and analysed current trends in the OI research.

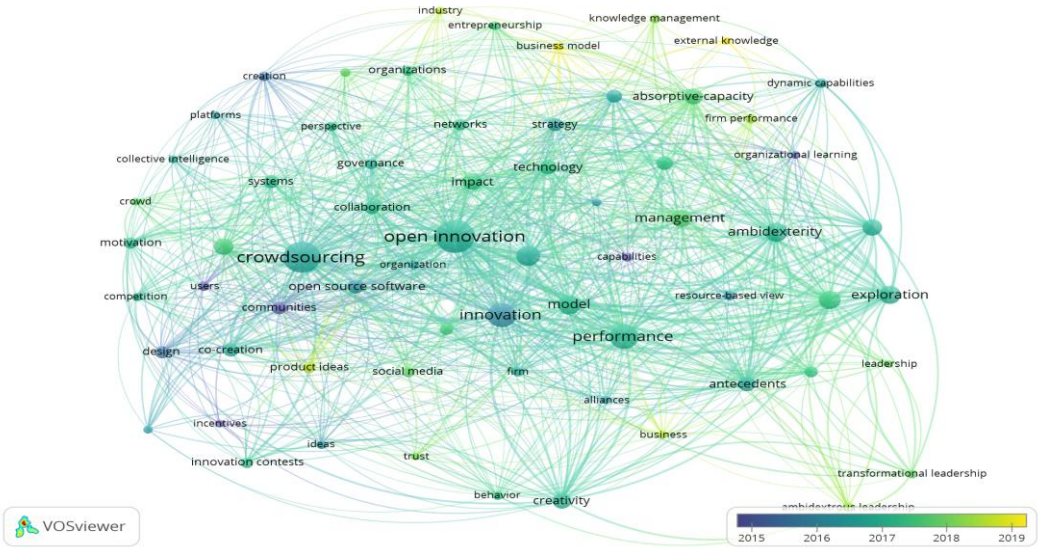

Figure 3. Overlay visualization of the keywords

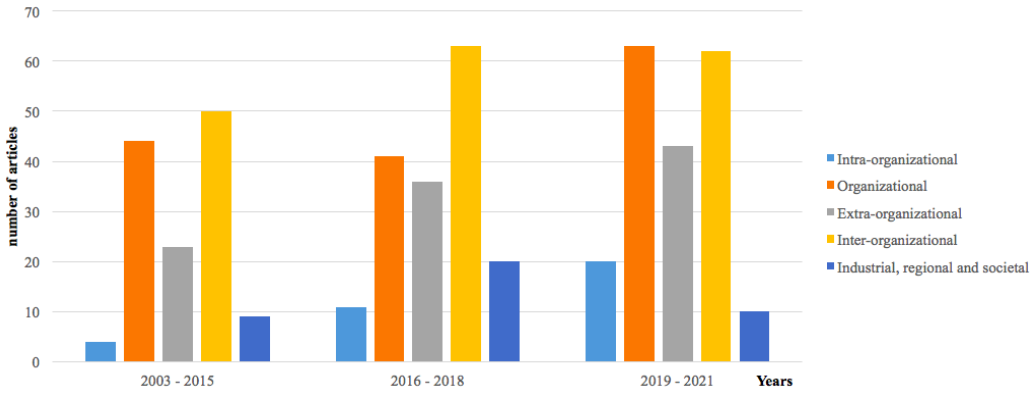

Figure 4. The trends of multi-level analysis in OI in OA and CS articles

During the first and second periods, we observe that the researchers mainly focused on the inter-organizational level (keywords: “communities”, “crowdsourcing”, “innovation”, “open source software”, “governance”, “impact” etc.), frequently combining it with the organizational (keywords: “design”, “capabilities”, “organizational learning”, “absorptive capacity”, “model”, “ambidexterity”, “exploitation”, “exploration”, “technology”, “research and development” etc.) and/or the extra-organizational levels of analysis (keywords: “users”, “incentives”, “participation”, “motivation”, “crowd”, “collective intelligence”, “creativity”, etc.). However, less attention was paid to the applications of OI outside of the company’s R&D (keywords: “smart city”, “alliances”, “platform”). In the same vein, even fewer studies have examined the OI phenomenon at the intra-organizational level (e.g., “transformational leadership”, “leadership”, “entrepreneurship”). In the third period of the study, we can notice some shifts in the upper and lower levels of analysis. From the previously leading inter-organizational level (keywords “external knowledge”, “industry”, etc.), scholarly focus has changed to a more organizational one (see keywords: “search”, “business model”, “business”, “firm performance”, “knowledge

management", etc.), accompanied by the extra-organizational level of analysis (keywords: "product ideas", "generation", etc.). Moreover, changes were made at the bottom level of research as well, in particular, the number of articles at the intra-organizational level (keywords: "ambidextrous leadership") increased compared to previous years and exceeded the number of articles at the industrial, regional, and societal level. Nevertheless, the category of the OI organizational behavior and design is still at its infancy stage (Duc et al., 2020; Foglia et al., 2019; Gerlach et al., 2020; Hu et al., 2020; Wang et al., 2020; Wilms et al., 2019), as are research on open governance and industrial dynamics (Al-Kfairy et al., 2020; Cai et al., 2019; Del Giudice et al., 2021; Michelino et al., 2019; Pedersen, 2020). Therefore, the relationship between OA and CS concepts cannot be explicitly traced due to a small sample of OI research at the intra- and macro-organizational levels.

3.4 Citation analysis

The citation map illustrates the overall number of citations received by all articles (Van Eck & Waltman, 2013). We created this map (see Figure 5) based on bibliographic data. All documents were included in the citation analysis even with zero citations since we noticed that the latest publications (2019-2021) have the least number of citations or even zero due to the short period of circulation. However, the largest set of related items consists of only 200 articles, the remaining 65 were not connected to each other. Thus, our citation analysis includes 200 items that were combined into 19 clusters with a total of 503 links, 6302 citations, and an average of 31.51 citations per article. Using thematic analysis, we identified the top 3 most cited clusters (see Table 2): Community engineering for OI processes (cluster 1: 13.6% of the total number of citations); Ambidextrous leadership in OI processes (cluster 2: 8.3% of the total number of citations); Sustainability of OI processes (cluster 3: 7.3% of the total number of citations). While the least studied clusters are: CS as a technological enabler (cluster 10: 2.8%), Crowdsourced idea generation (cluster 16: 2.1%) and Organizational Ambidexterity in OI processes (cluster 19: 1.6%). Most importantly, we found 3 clusters that show possible results of OA and CS interaction for organizations implementing OI, namely sustainability of OI processes (cluster 3), organizational architecture of OI processes (cluster 9), a capability-based framework for OI processes (cluster 14). In Table 2, we interpret our findings by defining the main concepts and putting forward some recommendations for future research, but they are not exhaustive.

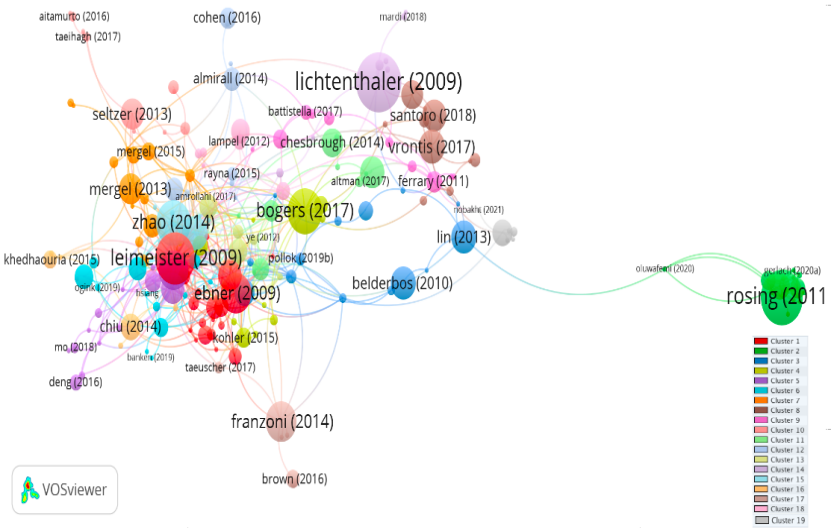

Figure 5. Map of the most influential authors (based on citation analysis)

Table 2. Summary of citation analysis and future directions

Cluster# and area (Citations/articles)	Name	Main concepts	Future directions	Main authors
Cluster 1 (860/18) CS	Community engineering for OI processes	The concept of the ideas competition The Community for Innovations concept Working consumers and consuming producers Crowdsourcing as the concept of OI Crowd problem-solving model Open Collaboration Self-determination theory	How do personality traits and contextual factors impact the performance of solvers and seekers? What is the value of solving scientific problems using crowdsourcing? How can companies attract and retain a crowd? Can technology intelligently employ crowd members? What are the best motives to attract a crowd?	Ebner et al. (2009); Marjanovic et al. (2012); Ye & Kankanhalli (2017); Bhatti et al. (2020)
Cluster 2 (526/15) OA	Ambidextrous leadership in OI processes	Transformational leadership Opening and closing leadership behaviors Team innovation Employee exploration and exploitation behaviors Ambidexterity theory of leadership for the OI	What is the contingent role of cultural factors? What are the consequences of different leadership tactics at the individual level? Under what conditions will the leader's behavior lead to successful implementation of the OI?	Rosing et al. (2011); Zacher & Wilden (2014); Wilms et al. (2019)
Cluster 3 (458/14) OA + CS	Sustainability of OI processes	Balancing Exploration and Exploitation Fairness Expectations in Crowdsourcing Learning Capability Organizational Ambidexterity Inbound and outbound OI Paradox of openness Open Sustainable Innovation	What is the role of high-performance work systems (HPWS) in the context of OA? Can different factors of digitalization (i.e., HR, OA, cybersecurity, etc.) solve the paradox of openness? How do the approaches to IP address protection and transmission differ among various crowdsourcing service providers? How should crowdsourcing activities be managed at the micro-level?	Belderbos et al. (2010); Lin et al. (2012); Michelfelder & Kratzer (2013); Pollok et al. (2019b); Cappa et al. (2019b)
Cluster 4 (421/13) CS	CS-based business model	Crowdsourcing Value Creation The concept of empowered co-creators Scaling Crowdsourcing Platforms Knowledge integration process Big data strategy Community-based innovation Absorptive capacity (ACAP)	What are the negative aspects of the internet of things, sensor-based entrepreneurship and passive input crowdsourcing? How is the conceptual gap between the generation & selection of ideas and their transformation into innovations using CS during the Covid-19 pandemic solved? How do stakeholders with overlapping business models share risks and benefits in CS initiatives?	Boger et al. (2016); Kohler (2015); Malhotra & Majchrzak (2014); Bogers & Ihuillery (2011); Kohler (2017)

Cluster 5 (421/14) CS	Managerial, behavioral and technological contextual factors in CS	Co-creation boundary management Intrinsic and extrinsic motivation Knowledge diversity Discourse ethics Cognitive load concept	Is there a gradual tendency for the feedback effect to decrease over time? Will solvers with different levels of knowledge react differently to the seekers' feedbacks? What are the interactive configurations in idea CS groups? How to design support for technological processes in CS?	Frey et al. (2011); Majchrzak & Malhotra (2013); Schlagwein & Bjorn-Andersen (2014)

Table 2. Continued

Cluster# and area (Citations/articles)	Name	Main concepts	Future directions	Main authors
Cluster 6 (246/13) CS	Determinants of individual's idea performance in CS	OUIC-enabled capabilities (OUIC-online user innovation communities) Smart Idea Allocation Idea generation User ideation	What is the relationship between the rater's domain knowledge and the idea's domain in CS? How can machine learning algorithms and advanced language models better represent online texts? Is there a negative impact of the number of received comments on both ideating and commenting behavior in CS?	Dong & Wu (2015); Huang et al. (2014); Acar (2019); Ogink & Dong (2019)
Cluster 7 (339/13) CS	OI processes in the public sector	E-Government Citizen participation Public open innovation	What are the implemented results of CS projects in the public sector? What is the contribution of policy (i.e. e-government) to the involvement of citizens, the creation of innovations and changes in the public sector?	Mergel & Desouza (2013); Piezunka & Dahlander (2019)
Cluster 8 (413/12) OA	Knowledge management capability in the OI context	External knowledge sourcing Ambidextrous knowledge strategy Knowledge management capacity Internal and external knowledge flows Radical innovation and incremental innovation	Do contingent factors such as absorptive capacity, human resource practices, internal learning mechanisms, international diversification and corporate governance have the same or different moderating effects on each specific knowledge source within OI processes? What is the role of knowledge management in OI (including the specific characteristics of the abundance of external knowledge)?	Vrontis et al. (2017); Martinez-Conesa et al. (2017); Ferraris et al. (2018); Gabriel Cegarra-Navarro et al. (2019)
Cluster 9 (200/11) OA + CS	Organizational architecture of OI processes	Open innovation web-based platforms (OIPs) Cluster ambidexterity Specialized organizations Open contract mechanism	How does the effectiveness of ambidexterity in OI processes depend on time dynamics? Does the company's specialization in exploitation and its integration into an ambidextrous cluster in order to get access to exploration give a sustainable competitive advantage in OI?	Ferrary (2011); Battistella & Nonino (2012); Wolf et al. (2019); Li et al.(2020)
Cluster 10 (174/10) CS	CS as a technological enabler	Public planning processes Open source pharma Patient-centered innovation "Do-it-yourself city" imaginary Democratizing innovation	Can CS accelerate several stages of drug development? , How to effectively synthesize crowd suggestions in digital democratic innovations? Whether can CS increase the speed, ease and rate of participation, reduce costs of participation and increase access to the dispersed knowledge of the crowds across different industries?	Seltzer & Mahmoudi (2013); Tucker et al. (2019); Taeihagh (2017)
Cluster 11 (356/9) CS	Orchestrating sustainable CS	Solver Brokerage Direct and mediated OI mechanisms Cross-fertilized Innovation Strategic leadership Social translucence in CS	How is the CS initiative implemented at the project level? How does the development of internal CS lead to an increase in OI performance over time? What are the results of applying CS, using different business models? What are the trade-offs between visibility and constraints in CS?	Kaplan & Henderson (2005); Chesbrough & Brunswicker (2014); Zhang et al. (2020)
Cluster 12 (223/9) CS	OI taxonomy	Hackathon Crowdsourcing & Crowdfunding	How can communities turn into a transnational innovation ecosystem with the help of digital communication technologies once the hackathon is over? How can virtual spaces stimulate multi-level coordination?	Wijnhoven et al. (2015); Randhawa et al. (2019); Bertello et al. (2021)

		Open innovation contests (OICs) Urban Labs and OI 2.0		

Table 2. Continued

Cluster# and area (Citations/articles)	Name	Main concepts	Future directions	Main authors
Cluster 13 (200/9) CS	CS integration into OI processes	Social Media strategy for CS Idea Competition Open Strategic Planning Intellectual property right arrangement Open and proprietary CS platforms	What dynamic capabilities does CS include that are necessary for successful integration of the company into OI processes? Why don't hybrid CS platforms exist and in what specific contexts can they arise? Will CS mechanisms lose their PR power and their attractiveness?	Mount & Martinez (2014); de Mattos et al. (2018); Schenk et al. (2019)
Cluster 14 (446/9) OA + CS	A capability-based framework for OI processes	Knowledge management capacities Knowledge capacities Technical and Evolutionary Fitness Knowledge-based dynamic capabilities Dynamic ambidexterity Organizational inertia	What are the methods for detecting dynamic capabilities in OI? What is the impact of digitalization, renewal, innovation and globalization on the dynamic capabilities of firms in mature industries in OI processes? What is the impact of the absorptive, desorptive, and connective capacities on the successful transfer of knowledge?	Lichtenthaler & Lichtenthaler (2009); Armisen & Majchrzak (2015b); Dąbrowska et al. (2019)
Cluster 15 (373/7) CS	CS through the IS lens	Online innovation communities Collective intelligence Information and communication technology in international development (ICT4D) Web 2.0 and 3.0 Virtual innovation platform	Can coopetitive platforms that offer higher rewards block the success of others? What is the impact of dynamic aspects of user profiles over time? What is the effect of knowledge leakage in the context of virtual innovation platforms?	Hutter et al. (2011); Zhao & Zhu (2014); Fuger et al. (2017); Renard & Davis (2019)
Cluster 16 (131/6) CS	Crowdsourced idea generation	The wisdom of the crowd User-generated content Crowdfunding Knowledge reuse for OI	Does the user's position in the network affect the crowdsourced idea generation? How to identify improper use of crowdsourcing? How to foster shared culture and value in the crowdsourcing process?	Khedhaouria & Jamal (2015); Jarvenpaa & Standaert (2018)
Cluster 17 (257/6) CS	Crowd science	"Broadcasting" the needs of the crowd Open collaborative culture A decentralized version control system Citizen science	To what extent may crowd science replace traditional scientific research or reduce the need for research funding? What are the challenges of managing the digital information commons?	Franzoni & Sauermann (2014); Taüscher (2016); Mansell (2013)
Cluster 18 (160/6) CS	Open competitions as a tool for expanding OI	Breakthrough and incremental innovations Innovation agenda Innovation contests Free revealing and knowledge brokering	What team interaction factors can affect the team's performance in OI activities? Is there a trade-off between knowledge brokering and free revealing behaviors?	Dunlap-Hinkler et al. (2010); Martinez & Walton (2014)
Cluster 19 (98/6) OA	OA in OI processes	The Productivity Dilemma Conflict management Dynamic capabilities The symbiotic relationships	What is the relationship between OI and OA over a long period? What resources facilitate OA in the context of open source ecosystems? How is OA achieved in various fields and how does it manifest itself through daily organizational routines in the digital age?	Benner & Tushman (2003); Martin et al. (2019); Diesel & Scheepers (2019)

4. Conclusion and Future Research Agenda

4.1 Directions for Future Research

After presenting the findings of the bibliometric analysis, this section addresses the question of "what is new?" by putting forward future routes for practitioners and researchers in OA and CS areas. The streams and clusters that require additional investigations by the research community are as follows:

OI research at the macro-organizational level. There is a lack of research in both CS and OA studies at the industrial, regional and societal level. For example, it is unclear *whether crowdsourcing can provide a new form of intersectoral collaboration, can it be a policymaking tool* (Aitamurto & Landemore, 2016) and *how it may contribute to achieving dynamic ambidexterity within OI processes*. Some exceptions should be highlighted, which shed light on the citizen participation in OI initiatives in the public sector and, consequently, the emergence of a new form of CS – "citizen participation" (Almirall, 2014; Díaz-Díaz & Pérez-González, 2016; Y. Li et al., 2018; Mergel, 2018; Stieger et al., 2012; Taeihagh, 2017; van Etten, 2011).

OI research at the intra-organizational level. During the Covid-19 pandemic, the previous organizational hierarchical system (matrix), along with top-down innovation processes, showed its inefficiency and further blocked organizational resources in silos. As a result, many questions have arisen within the category of OI behavior and cognition (Bogers et al., 2017). For instance, *what competitive strategies will live in the boardroom and in the behavior of its employees when it is necessary to be closer to customers. How individual-level attributes affect inter-organizational knowledge flows with OI stakeholders*. Furthermore, *what problems occur at the individual level when employees and/or managers implement crowdsourcing and try to achieve ambidextrous capabilities simultaneously* (Allen et al., 2018; Altman & Tushman, 2017; Bogers et al., 2017; Enkel et al., 2017; Rosing et al., 2011; Zacher et al., 2016; Zacher & Wilden, 2014). Also, *how to develop, assimilate and integrate the "ambidextrous mental model" into an organization with its own internal culture and deep beliefs* (Steiber & Alänge, 2013). Moreover, the biggest challenge we face today in CS for innovation is an evaluation by internal staff and external audiences. When an organization opens up its boundaries, the upper and lower levels of management believe in the idea that innovation comes from diversity. Thus, *how managers and employees, on the one hand, invite the breadth of ideas, on the other hand, do not use the same narrow judgment to reject every single novel idea.*

Sustainability of OI processes. OI is an umbrella term that links ambidexterity with crowdsourcing as complementary elements in the context of sustainable innovation development at the network level. In this case, the OA provides an answer to the question "what" organizational capability is needed at intra- and inter-organizational levels to benefit from the inbound, outbound and coupled OI activities, while crowdsourcing helps determine "how" to reach the external knowledge that is beyond the companies boundaries and thereby to achieve dynamic ambidexterity. However, this relationship has not yet been empirically proven. Therefore, we call for future evidence of our assumption that *uniting both CS and OA might be a way for firms to balance innovative activities that exploit existing competencies and open them to new technological approaches. Another interesting question about the definition of key competencies for OI and how they can be integrated into the organizational competence model.*

Organizational architecture of OI processes. According to the network visualization and literature review, we found that the relationship between OA and innovation is weaker than the connection between CS and innovation. From TCE perspective, the expenses increase when the firm simultaneously conducts both exploitative and explorative activities, which leads to a

decrease in innovation performance. These findings can be explained by some scholars who present a non-linear effect of OA on innovation performance (R. Li et al., 2020). They further conclude that simply relying on internal sources of innovation is not as effective as balancing both internal and external flows. In this case, outbound and inbound OI strategies were proposed as contingent factors. Even before, it was stated that outsourcing tactics of innovation make organizations more competitive at the inter-organizational level, than solely OA at the intra-organizational level, because it helps overcome internal pressure (Ferrary, 2011; Haim Faridian & Neubaum, 2021). Furthermore, a crowdsourcing strategy helps a company coordinate its innovation activities by involving different stakeholders in R&D. It also manages hierarchy and administrative issues, for example how to coordinate ideas and innovations, how to allocate authority, which groups of actors play an active role in innovation, and what forums and platforms are available for knowledge sharing. But, it is still unknown *whether CS practices within inbound OI activities have a contingent effect on the relationship between OA and innovation performance?* Moreover, *in the case of unbalanced ambidexterity* (Michelino et al., 2019)*, can crowdsourcing within inbound OI activities be a useful tool when only explorative innovation is a priority for firms?*

A capability-based framework for OI processes. Referring to OA studies, ambidexterity could be a beneficial strategy for improving firm performance, fostering second-order and dynamic capabilities that help companies manage OI activities while simultaneously organizing the daily routine (Rodriguez Ferradas et al., 2017). Along with our logic, we found tacit linkages between ambidexterity capability and crowdsourcing, some researchers proved that pursuing OA in external knowledge sourcing improves firm performance (Podmetina et al., 2018; Vrontis et al., 2017). This is consistent with the fact that crowdsourcing is defined as the open act of involving external sources in the innovation process. Therefore, by acknowledging prior literature, the mediating effect of crowdsourcing should be considered in the relationship between OA and performance when implementing OI (Ardito et al., 2020; Vrontis et al., 2017). Thus, *does CS facilitate the relationship between OA and organizational performance when implementing OI?* This phenomenon should be proven empirically. Until now, it can only be supported theoretically. According to CS literature, several scholars argue that crowdsourcing may be applied as an effective mechanism for balancing ambidextrous capabilities (Afuah & Tucci, 2012; Palacios et al., 2016; Pavlidou et al., 2020; Randhawa et al., 2019). Moreover, many researchers are concerned about *how to overcome organizational problems associated with the paradoxes of simultaneous managing closed and open business models* (Altman & Tushman, 2017).

4.2 Conclusion

Digital transformation and the global pandemic are accelerating firms' transition to more dynamic business models, prompting scholars to reconsider existing theories and add a more heterogeneous perspective to OI studies. Therefore, our paper connects two independent research flows (CS and OA) in order to shape our understanding of the dynamic nature of OI phenomenon. This study generates three main contributions to OI. First, this article has conceptualized CS and OA concepts within OI field, using bibliometric techniques. Thus, we develop a comprehensive understanding of OA and CS and their relationship in OI, explore the content-related gaps, as well as implications for OI-led organizations. In particular, keywords co-occurrence visualization (cluster analysis) has shown that CS and OA are complementary concepts within OI boundaries. Further, chronological analysis has revealed that the relationship between OA and CS concepts cannot be explicitly traced due to a small sample of OI research at the intra- and macro-organizational levels. Finally, according to findings of citation analysis, managing OA and CS simultaneously (the synergic effect) in organizations will allow practitioners to achieve the sustainability of OI processes (cluster 3) by developing all

the necessary capabilities (cluster 14) and building an effective organizational architecture (cluster 9). Second, since the OI paradigm is the result of discontinuous changes, in particular digital transformation, this work calls for new theories to form theoretical foundation for OI, CS and OA concepts. Finally, it sheds light on practical areas of OI literature in achieving OA and sustainable OI processes. In particular, it highlights the need for focal agents to consider CS as a tool for outsourcing some explorative activities to the crowd and focusing on exploitative ones, in order to: (i) manage environmental uncertainty by internalizing and complementing current knowledge and thus meet existing customer requirements; (ii) stimulate new technological or marketing trajectories by externalizing and combining implicit knowledge. These are necessary to help firms overcome organizational rigidity in the transition to an OI strategy under such uncertainty.

However, the limitations of this study should be taken into consideration. First, the sample of articles was retrieved only from the WoS database, which challenges the generalization of our results. Thus, future researchers can apply the same technique to articles from other databases and compare their results. Next, the link between OI and OA was weaker, than between OI and CS, partly due to the small sample of articles available in this area. We believe that scholars will intertwine their efforts to contribute to this field. Therefore, we call for future empirical research in OI field in terms of organizational ambidexterity and crowdsourcing at the individual and firm's ecosystem levels.

Acknowledgements

We deeply thank Prof. Dongming Xu and my friends Yanpei Lin, Zhiyuan Zhang from the University of Queensland, as well as my colleague Schyonne Adderley from University of International Business and Economics for their valuable comments on an early version of this manuscript

***Declarations of interest**: none*

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Cite this article:

Pashchenko Yana, Ye Chengang, & Zhu Yue (2022). Organizational Ambidexterity and Crowdsourcing Through the Lens of Open Innovation: A Systematic Literature Review. *International Journal of Science and Business, 8*(1), 95-111. doi: https://doi.org/ 10.5281/zenodo.5973474

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