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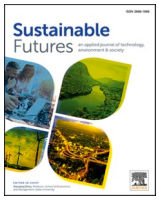

Eco-innovation and openness: Mapping the growth trajectories and the knowledge structure of open eco-innovation

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ABSTRACT

Open innovation runs contrary to the individualistic mentality of traditional corporate R&D implementation while embracing external cooperation in a complex world. Our main motivation for the study is to assess and characterize knowledge structure that represents radical transformation toward accelerating co-development of sustainable innovations. Our review points to the role of the open eco-innovation research landscape as an emerging research domain of potential contributions to sustainable development. Specifically, in this systematic analysis, we apply exploratory, bibliometric, and network visualization techniques to characterize the available knowledge in the field. We trace the growth trajectory of this emerging literature and map the knowledge base of the open eco-innovation (OE) research field. We conceptualised four phases of research domain development and recognised that OE is at the acceleration phase. We emphasized that a synthetic knowledge base is one of the basic ingredients of an open eco-innovation model in addition to analytic and symbolic knowledge bases. Finally, we highlighted what might seem to be budding theoretical perspectives underlining open eco-innovation.

1. Introduction

In the specific research domain of environmental economics, the issue of sources of information and knowledge used by eco-innovative firms is of utmost importance [1,2]. Implementing eco-innovation is a complex endeavor that requires access to a variety of knowledge and skills that are different from the conventional knowledge base for mainstream innovation. Many authors have focused on this issue with more attention paid to 'double externality problem' and determinants of eco-innovation [3–7]. According to traditional economic theory, there is a disincentive to invest in eco-innovation because the value created by an eco-innovative firm often accrues to other firms due to knowledge spillover. More importantly, issues such as these have made access to diverse sources of knowledge to be more important for eco-innovation than mainstream innovation [5]. In fact, eco-innovation is known to require more external knowledge than conventional innovation [1,5].

In addition to the issues raised above, other factors such as inadequate capabilities and resources, value creation, and value capturing within competing goals [8–10] have brought a great deal of interest in understanding how firms and other stakeholders integrate open innovation strategies into the eco-innovation process. This strategy, hereafter called open eco-innovation (OE) has been given different other names such as sustainable open innovation (SOI) [11], open environmental innovation [12,13], open eco- innovation mode (OEIM) [14,15], Open- corporate greening [16] and Corporate-entrepreneur collaborations for the circular economy [17]. Other various terms and definitions are also stated in Chistov et al [18].

Although the OE community is growing rapidly, the OE concept and more importantly its knowledge base (analytical: knowledge institutions, scientific journals, etc. and synthetic: customers, competitors, suppliers etc.) and theoretical structure are still at an early stage [18,19] necessitating thorough systematic analyzes. So far, some of the extant systematic reviews of OE have touched upon bibliometric analysis of emerging research in OE [18,20], inter-organizational cooperation in eco-innovation [21], cooperation in sustainable eco-innovation [20], collaboration in green product innovation [22], and clarification of the sustainable open innovation concept [23]. Some have also been carried out with specific reference to a particular sector of the economy [3,24].

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To the best of our knowledge, no study has focused solely on the knowledge base (analytic and synthetic) and theoretical structure of OE landscape.

The main objective of this study, therefore, is to carry out a bibliometric analysis and systematic literature review with a view to deepening the understanding of the knowledge base and theoretical structure of OE landscape.

To satisfy this objective, the following research questions (RQ) are presented:

RQ1: What is the growth trajectory of OE literature?

RQ2: What is the pattern of the knowledge base of OE?

RQ3: What are the potential theoretical structures with which OE can be developed?

Our study makes a twofold contribution when compared with other related studies. First, our paper contributes to unraveling common philosophical concepts underlying OE research field and in the process identified what could be budding theoretical backgrounds upon which OE literature could be developed. This structure could help scholars to better explain OE processes.

Second, our paper develops a conceptual model that can be used to track the growth trajectories of not only open eco-innovation research field but also other research domains. With this framework, the historical development of theories, disciplines, or concepts can be analyzed and interpreted. This framework will enrich the future analysis of bibliometric and systematic reviews. It will help to bring clarity to historical contexts and future trends of research disciplines, most especially the sustainability research domain. Finally, at the end of this article, our paper came up with several research questions that could form future research agenda for OE.

The rest of this paper is structured as follows Section 2. discusses eco-innovation and external knowledge sourcing; Section 3 explains the methods employed to systematically review the papers selected from Scopus database; Section 4 presents the findings and discussions related to the three research questions, and discusses the emerging trends and research gaps; and Section 5 highlights key findings and states the theoretical and practical implications.

2. Eco-innovation and external knowledge sourcing

Knowledge search mode is defined as the firm's problem-solving strategies through which the firm acquires external knowledge [27,28]. Firms often lack cognitive proximity which is needed to expand their existing knowledge base [29] to make the successful implementation of eco-innovation possible [6]. As a result of this, firms may have to look for alternatives for production processes, inputs, and/or materials that are not necessarily within their core competence which further accentuates the challenges in understanding and implementing the new process or inputs [30]. Eco-innovation requires knowledge inputs from many and diverse sources [31,32]. Knowledge base for innovation process can be categorized into two: 'analytical' and 'synthetic' [25]. An analytical knowledge base places high value on scientific knowledge and systematic development of products and processes [26]. Firms that depend on this kind of knowledge base often have their R&D departments or cooperate with external partners such as universities, research institutes, inventors, etc. In the case of a synthetic knowledge base, most of the firms using this category of knowledge innovate by combining and applying existing knowledge to provide solutions to specific market frictions while interacting with customers, competitors and suppliers, etc. There is also the third category of knowledge base termed 'symbolic' [33]. Here, the innovation is not so much about the creation of products or services; rather it is the impression that the firms attempt to create in the minds of the consumers. Unfortunately, many studies have overlooked the relevance of these external knowledge sourcing modes for eco-innovation [1].

3. Methods

3.1. Background to the systematic review methodology

This paper followed the systematic review method suggested by Tranfield et al., Halilem and Pham et al [34,35,36]. It also aligned with the review process called PRISMA protocol [37] by following these 6 steps:

(1) Framing explicit research questions.
(2) Setting inclusion and exclusion criteria to gather documents.
(3) Searching, locating and identifying studies that meet the inclusion and exclusion criteria.
(4) Evaluating the quality of the selected studies.
(5) Data extraction, and coding.
(6) Data synthesis/analysis and reporting results.

This article adopts a qualitative narrative (exploratory) method for the analysis of the synthesis of the literature [38–40] where we attempt to make sense out of the findings in the selected articles. We also use bibliometric and network visualization mapping techniques to gain insights into the emerging research domain. Data processing and coding are conducted in Microsoft Excel, Mendeley, and VOSviewer.

3.2. The systematic review protocol

3.2.1. Inclusion and exclusion criteria

One of the first conditions for selecting an article for review in this paper is that it must consider eco-innovation, environmental innovation, low-carbon innovation, green innovation, or green patent collaboration among any stakeholder during the innovation process or implementation. Eco-innovation is a relatively new field of study [4]. However, concerns over the negative impacts of human activities on the environment could be said to have started with the Brundtland report where the issue of sustainable development was raised [41]. Technically, eco-innovation came into the scientific literature in the '90 s [42,43] defined it as ''new products and processes which provide customer and business value but significantly decrease environmental impacts''. As such, the third criterion for inclusion will be considering only articles published on eco-innovation between 1990 and 2021. Therefore, any discourse surrounding OE would not be complete without tracking studies around this period. The fourth criteria will be to choose only online peer-reviewed articles published within the period specified above. This criterion will allow us to evaluate papers that have undergone a thorough review process by researchers and experts in the field of environmental sustainability.

3.2.2. Identifying the appropriate articles

The identification of studies to be included in the systematic review entails two steps:

(1) Locating and enlisting studies.
(2) Selecting articles and evaluating its quality.

Locating and enlisting studies.

To locate and select articles that fulfill our criteria, we performed a search mainly across Scopus database. In this review, we based our analysis on this database because it offers great flexibility, particularly with regard to search terms and citations search. It is also one of the largest abstract and citation databases of peer-reviewed literature. We also searched for relevant articles on other citation databases such as Web of Science and Dimensions. However, we decided to use Scopus because its results are far better than the other databases. Our paper established keywords and search strings that allow the combination of keywords and their synonyms into logical expressions to incorporate many journals in the field of interest [39]. Most of the literature in the

area of sustainability often use four different terms (“green”, “eco”, “environmental” and “sustainable’’) interchangeably to depict innovations that decrease the negative impact on the environment. Therefore, our paper considered these four terms as interchangeable and identical [44]. The first search yielded a total of 523,734 journal articles retrieved from Scopus database. It was later reduced to 15,595 when we narrow down the disciplines of interest to social sciences”, “business, management and accounting” and “decision sciences” “environmental science’’, “energy’’, “economics’’, “econometrics’’ and “finance’’. The 15,667 (after adding 72 articles sourced from ResearchGate) articles were reduced to 535 when we gave a cursory look at the title, abstract and keywords of peer-reviewed papers and selected those that examined firms sourcing knowledge strategies or collaborating with external actors such as customers, suppliers, universities, research institutes, consultants, professional associations, formal and informal social networks, etc. to eco-innovate. 15 articles were added (making 520 articles) while checking the references of the 535 articles (snowball technique). The final selection of the 288 papers resulted from a full-text check of all the 535 articles and making sure that all the criteria were fulfilled.

Selecting articles and evaluating its quality

To select the relevant literature for the study, we adapted Chesbrough & Bogers’ (2014) definition of open innovation [45]. We describe open eco-innovation as a decentralized eco-innovation process based on controlled knowledge flows across organizational boundaries, using pecuniary and non-pecuniary strategies in accordance with the organization’s business model [46]. In order to ensure high quality articles are chosen, we selected any peer-reviewed articles that examine firms sourcing knowledge strategies or collaborating with external actors such as customers, suppliers, universities, research institutes, consultants, professional associations, formal and informal social networks, etc. to eco-innovate Fig. 1. shows the research process for the literature synthesis.

In order to gain a comprehensive insight into the knowledge base of OE, we conducted a bibliometric analysis. The bibliometric technique is a reliable tool for citation analysis, text and data mining [47]. It also permits analysis of the trend, evolution, and structure of a particular research field. With the aid of VOSviewer, we carried out the following analyzes which enable us to comprehend the development and trajectory of OE in the sustainability study landscape. These analyzes include [48]:

(1) Citation analysis: the relatedness of items determined based on the number of times the authors cited each other.
(2) Co-citation analysis: the relatedness of items determined based on the number of times they are cited together.
(3) Bibliographic coupling by sources of the articles and countries.

4. Results and discussions

4.1. Descriptive analyzes

4.1.1. The most cited publication/articles

Some of the most cited OE-oriented articles within the study period include *Environmental innovation and R&D cooperation: Empirical evidence from Spanish manufacturing firms* [6] with well over 517 citations. This is followed by the article, *Extending sustainability to suppliers: A systematic literature* review [49], A paper, *Does the development of environmental innovation require different resources? Evidence from Spanish manufacturing firms* by Cainelli et al [9] is also another influential article on OE research landscape. It recorded 165 citations. *The open eco-innovation mode. An empirical investigation of eleven European countries,* written by Ghisetti et al [14]. with 107 citations. Other highly cited articles include those written by de Marchi and Grandinetti [5], Borghesi et al [50]., Dangelico et al [51]. etc. The visualization network map showing how the highly cited articles are connected is shown in Fig. 2a. This figure reveals connectivity between the new and the old articles. As in many other research fields, some new articles tend to be well connected with the old influential articles suggesting the direction of the flow of

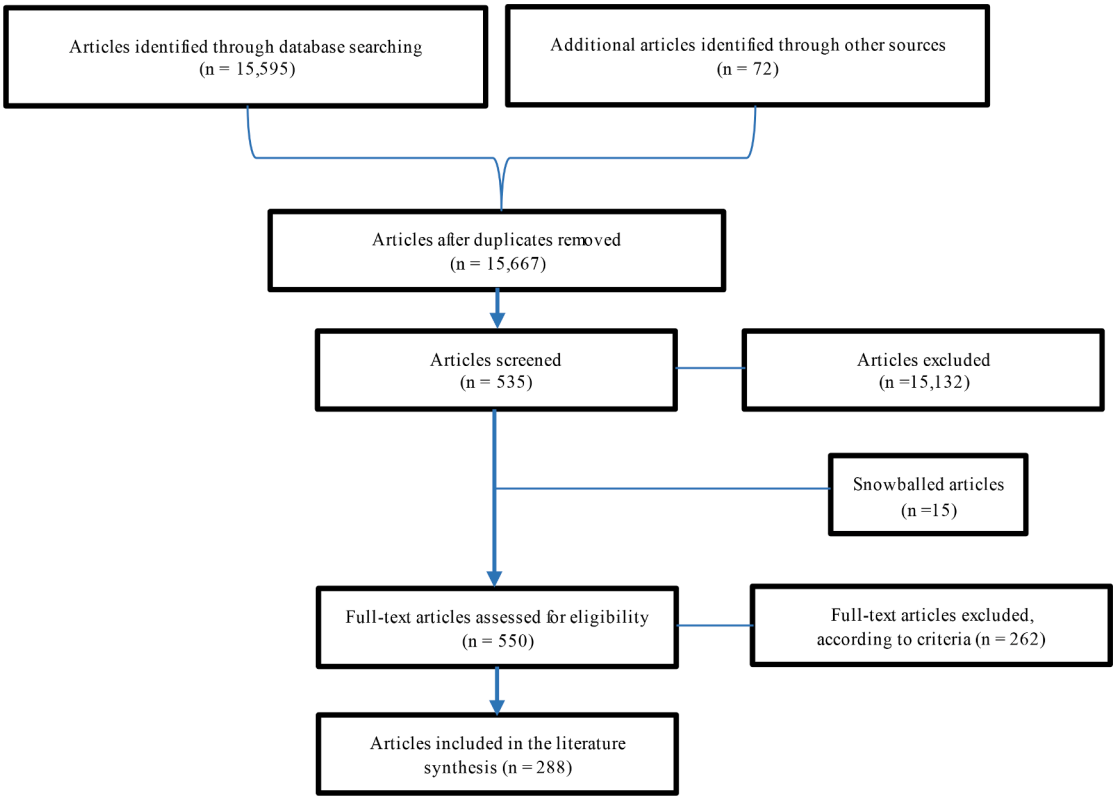

Fig. 1. Research process for the literature synthesis.

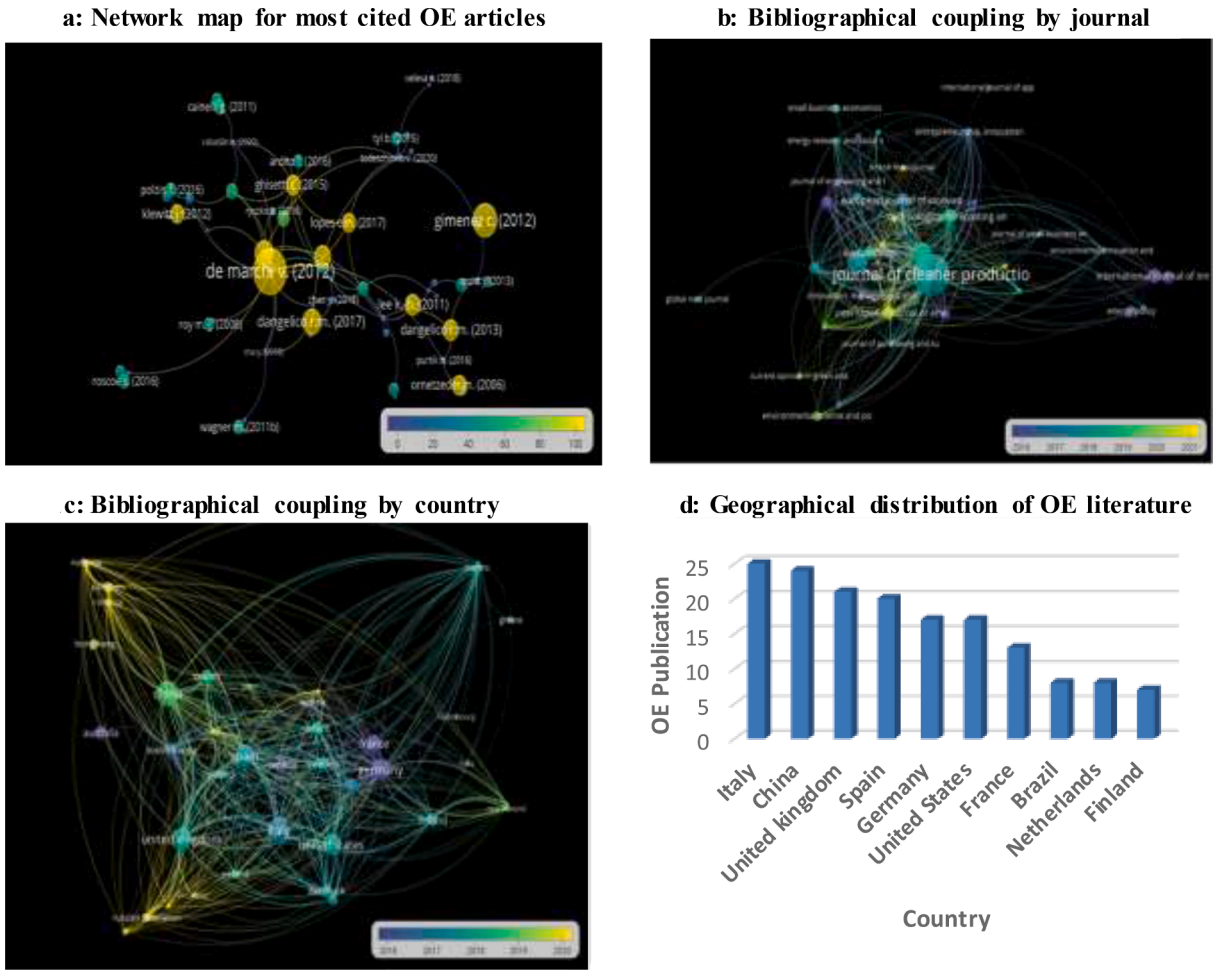

Fig. 2. 2a: Network map for most cited OE articles, 2b: Bibliographical coupling by journal, 2c: Bibliographical coupling by country, 2d: Geographical distribution of OE literature.

knowledge.

Majority of these highly cited papers were published in highly-rated journals. Analysis in Table 1 shows the leading 10 productive journals in the field of OE between 1990 and 2021. Among the leading 10 productive journals that have the most publications in OE, the number of publications in the top 6 journals accounted for 86.61% of the total (see Table 1). In particular, the Journal of Cleaner Production (JCP) is the most productive journal with 45 articles accounting for 15.63% of the global total. Results in Table 1 further show that OE has attracted the interests of scholars from various fields including environmental science, science, technology and innovation (STI) management, supply value chain management, ecological economics, energy policy, knowledge management, etc. We also noticed that the closer two journals are cited to each other, the stronger their relatedness [48] Fig. 2.b shows that JCP, BSE, and Technological Forecasting and Social Change do not only belong to the same cluster but are also the journals of choice for scholars publishing in the field of OE.

4.1.2. Geographic distribution of OE literature

The geographic distribution of OE literature in the top 10 most productive countries is shown in Fig. 2d. European countries led by Italy (25), Spain (20), and Germany (17) are the most productive region. This is followed by China (24), the United Kingdom (21), and the United States (17). In all, 10 leading countries accounted for over 55.9% of the total knowledge production of OE in the Scopus database within the study period. It is interesting to note that China and Brazil are the only upper-middle-income countries that made the top ten. Examples of other

Table 1
The leading 10 productive journals in OE.

Journal	Field of the Journal	TP	IF	TC	CPP
Journal of Cleaner Production	Environmental science	45	9.29	1037	23.04
Sustainability	Sustainability and Sustainable Development	14	3.25	108	7.71
Business Strategy and the Environment (BSE)	Competitive strategy and environmental management	12	10.3	442	36.83
Technological Forecasting and Social Change	Technological forecasting and future studies	6	8.59	121	20.17
European Journal of Innovation Management	Innovation management	5	4.69	137	27.40
Research Policy	STI management	4	8.11	749	187.25
International Journal of Environmental Research and Public Health	Environmental Sciences and Engineering, Public Health,	4	3.39	10	2.50
Industry and Innovation	Dynamics of industries and innovation	4	3.42	213	53.25
Ecological Economics	Ecological Economics	3	5.38	71	23.67
Energy Policy	Energy policy and energy supply	3	6.14	107	35.67

Note: TP: total publications; IF: impact factor; TC: total citations; CPP: citations per publication.

developing countries that contributed articles in the field of OE include Malaysia and Mexico. This raises the issue of non-visibility or lack of publications on OE (or specifically in eco-innovation studies) from the developing countries most especially in popular databases such as Scopus (see Fig. 2c).

4.2. Growth trajectory of OE literature

Tracing the evolution of OE, we noticed a pattern (not necessarily in a clear successive manner) starting with studies on exploiting networking relationships and knowledge spillovers among firms, knowledge institutions and other key stakeholders [16,52,53], importance of R&D cooperation with external partners [13,54,55], comparative analysis of knowledge strategies of green and non-green firms [5,56], impact of the 'depth' and 'breadth' of knowledge sources and firm's absorptive capacity [2,14,57], role of regulation policies and green intellectual property [58], role of intermediaries in fostering networking and partnerships [59], role of partnerships in advancing the circular economy [17], roles of external partners in improving sustainability innovation performance [11,60], challenges in creating and capturing value in open eco-innovation networks [61] to role of innovation collaboration with different partners on the typologies of ecological innovation [62,63]. It was also observed that most of the studies on OE were carried out at the firm level with data from national and regional surveys. Data from community innovation surveys seems to be one of the most accessed data sources especially from the European countries [5,13,14,54]. Very few studies used qualitative or mixed-method techniques for their analyzes [16,17,58,59]. This pattern is shown in Fig. 5.

In a bid to understand the growth trajectory of a research domain when applying bibliometric analysis, we conceptualize and develop four phases of knowledge domain development: start, acceleration, transition, and deceleration (see Fig. 3). The *start phase* is described as the initial stage of the research domain when scholars are beginning to explore or understand the field. The *acceleration phase* consists of the period when the research domain becomes popular as a result of a better understanding of the concept or an important event e.g. Paris agreement, the pronouncement of sustainable development goals, etc. The *transition phase* denotes the period when a particular research field or concept becomes matured and is beginning to give rise to some other popular concepts with the capability to evolve or transit to another research domain (e.g. close innovation process giving rise to open innovation). The *deceleration phase* begins when scholars start to lose interest in a particular research domain as a result of a better alternative, lack of relevance, etc. However, it should be noted that the deceleration phase could be rejuvenated as a result of a significant event within the research domain.

In this article, we recognize two phases from the analysis of OE research landscape based on the conceptualized four phases explained above. That is, the *start* and *acceleration* phases. The *start* phase covered a period between 1999 and 2011 (see Fig. 4). The period recorded only 12 articles. In the meantime, the interest in the field of OE began to gain prominence in the 2nd phase. It could be seen that the rate of growth was astronomical when compared with the 1st phase. This period covered 2012 till 2021 when 276 articles were produced compared to only 12 articles produced in the 1st phase. This period also recorded 96.94% of the total citations. This phenomenon increase in citation could be said to owe a lot to the publications of many influential articles: [5,9,14,49,64,65]. However, there was a sharp decrease in the number of publications in 2020. This sharp decrease may be connected with the COVID-19 pandemic as the infections and the lockdown measures put a lot of psychological impacts on the human population [66]. The pandemic has also impacted negatively on the sustainable development goals [67,68]. Meanwhile, there seems to be a resurgence in research activities as the number of publications on open eco-innovation research in 2021 is about to surpass that of 2020 at the time of collecting the data for this paper.

4.3. Pattern of OE knowledge base

4.3.1. Main sources of external knowledge

This paper also examined where firms derived their external sources of knowledge for eco-innovation. (see Fig. 5). The results of the analyzes

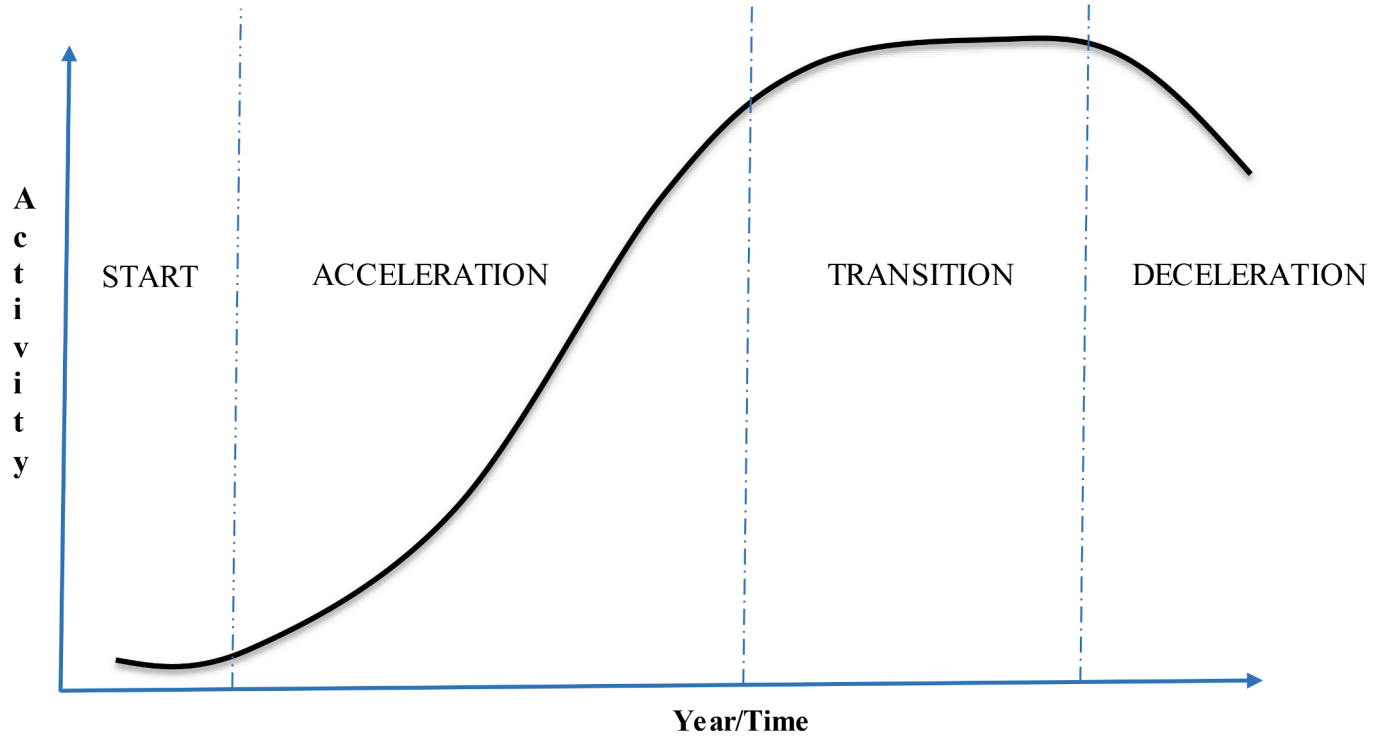

Fig. 3. Growth Trajectory of a Research Domain.

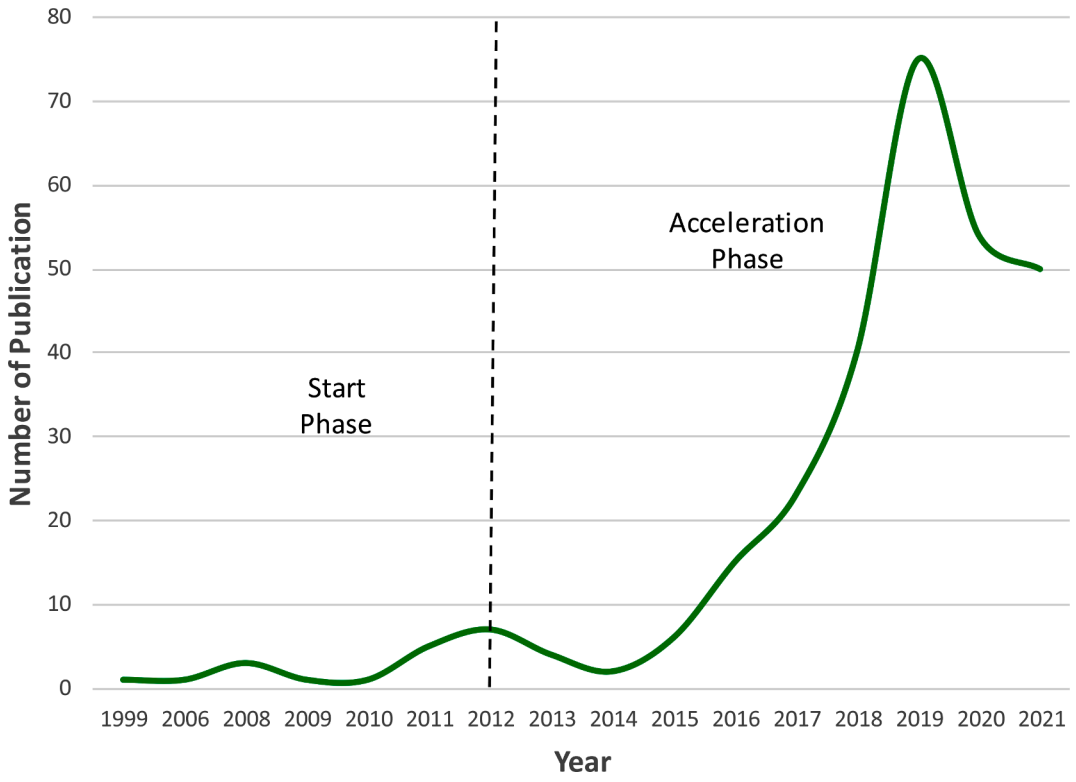

Fig. 4. Temporal variation of publication on OE between 1990 and 2021.

reveal that firms derived knowledge from several key stakeholders across the three main sources of knowledge (i.e. analytic, synthetic or symbolic). Some of the key sources include patents, consultants, private R&D institutes, universities, public research institutes, conferences, trade fairs, exhibitions, scientific journals, trade/technical publications, suppliers, customers, competitors, industrial and eco-designers, professional and industry associations etc. However, deeper analyzes of these sources show that 61% and 35% of the articles reviewed reported that firms consulted synthetic [1] and analytical sources among other key external knowledge providers, respectively. At the same time, 34% of the firms used only both analytic and synthetic sources of external knowledge for eco-innovation [2]. Only 4% of the articles reported that firms used external symbolic sources of knowledge. This analysis indicates that many firms use both analytic and synthetic modes of external knowledge sourcing suggesting that the two modes are complementary. Meanwhile, very few firms (3%) use all three modes at the same time.

Concerning methodological approaches, the study noted the prevalence of quantitative techniques (67%) compared with few qualitative approaches (33%). This is shown in Fig. 5. A lot of authors, mostly from European countries sourced data from community innovation surveys (47%), regular data collection exercises on innovative activities in many European countries [5,9]. The majority of the qualitative studies were case studies conducted on eco-networking activities [69], intermediaries [59], and supply chain management . In the case of quantitative approaches, studies were carried out within the contexts of R&D cooperation [9], depth and breadth of knowledge sources [2,14], green patents [58], green and non-green firms [5,56], knowledge sources [55], and absorptive capacity [57]. Very few studies used bibliographic techniques [18].

4.3.2. *Theoretical structure of OE research domain*

This section attempts to unravel common philosophical concepts underlying OE research field. This analysis also groups authors into clusters of common theoretical perspectives or philosophical underpinnings . Analysis in Fig. 6 shows that there are three groups of authors indicating three different intellectual structures or perspectives. These perspectives either intersect with the body of literature on OE or serve as a background upon which OE developed. For instance, the analysis put authors such as Seuring, Sarkis, Govindan, Klassen, Pujari, Dangelico into the same cluster (blue nodes). Majority of these authors research in the area of green product development and green supply chain management etc. None of them could be said to have researched broadly on open eco-innovation. It is also interesting to note that most of the authors that wrote on environmental sustainability in this cluster did their studies when concepts of sustainable development and sustainability were beginning to get into the consciousness of the researchers.

There are other authors clustered together as red nodes. Some of these authors include von Hippel, Chersbrough, Kemp, Wagner, Sharma, Bessant, Hart etc. Majority of the authors in this cluster are found to have worked and published articles in the area of innovation management, sustainability, environmental management and innovation, cooperation, openness, competitiveness, user innovation, open innovation. However, none of them seem to have worked extensively on open eco-innovation. Another distinct cluster depicted with green nodes reveals authors such as De Marchi, Marzucchi, Mazzanti, Cainelli, Montressor, Ghisetti, del Rio, Rennings, Triguero, Gonzales-Moreno, and Saez-Martinez. We noticed that majority of the authors are researchers in the area of knowledge resources and eco-innovation, open eco-innovation, eco-networks, external knowledge search.

Further anlayses of these three clusters showed that those authors in the blue nodes could be said to have made contributions to the conceptual and theoretical bases of environmental innovation or eco-innovation. Meanwhile, the authors in the cluster denoted with red nodes could be regarded as those who had shaped the discourse around innovation management, economics of innovation, environmental innovation, and open innovation. It will appear then that those authors in the two clusters (those with blue and red nodes) are critical to shaping the trajectories of literature on open eco-innovation. For instance, contributions on lead user and open innovations from researchers such as

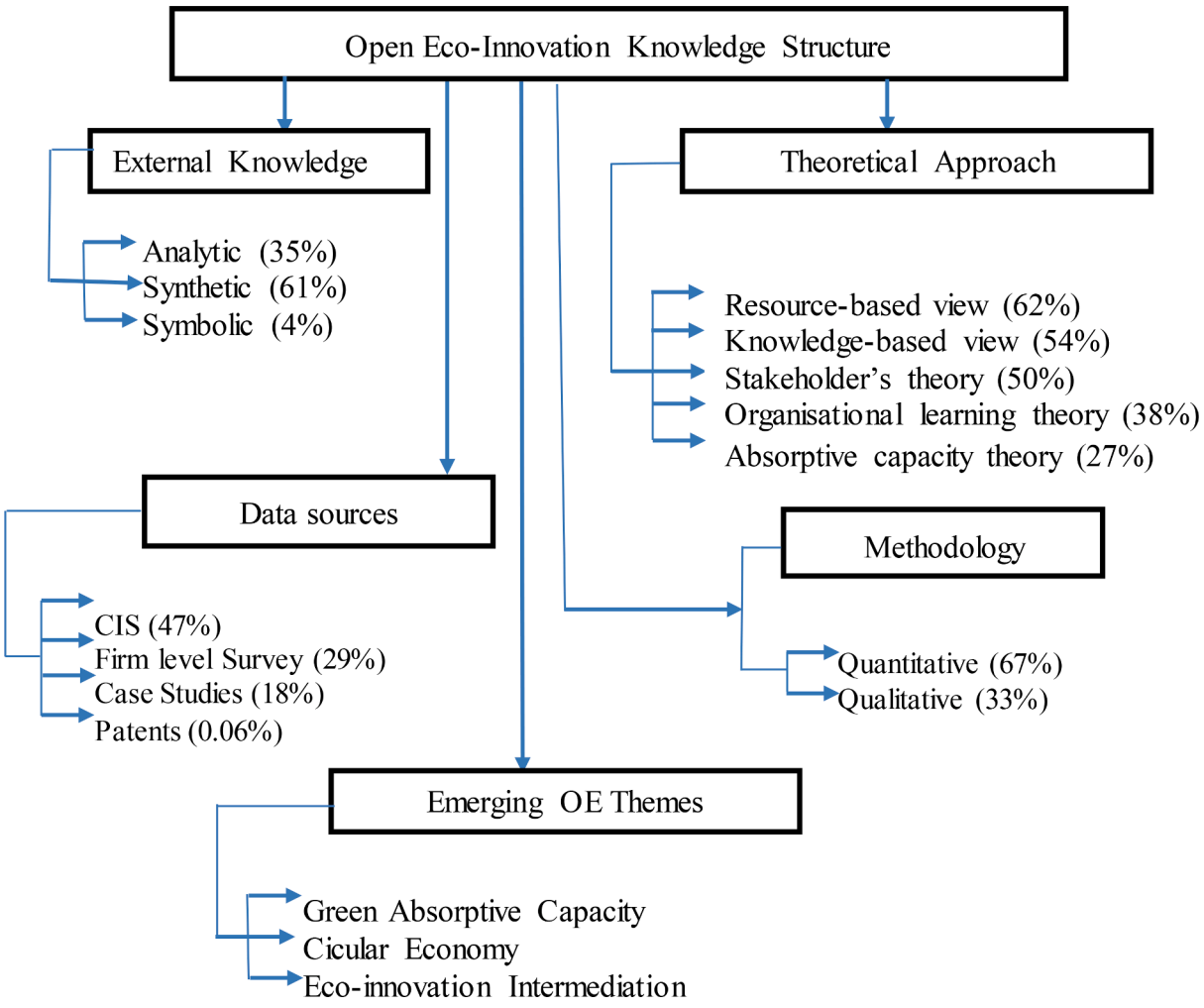

Fig. 5. Pattern of knowledge base for OE research landscape .

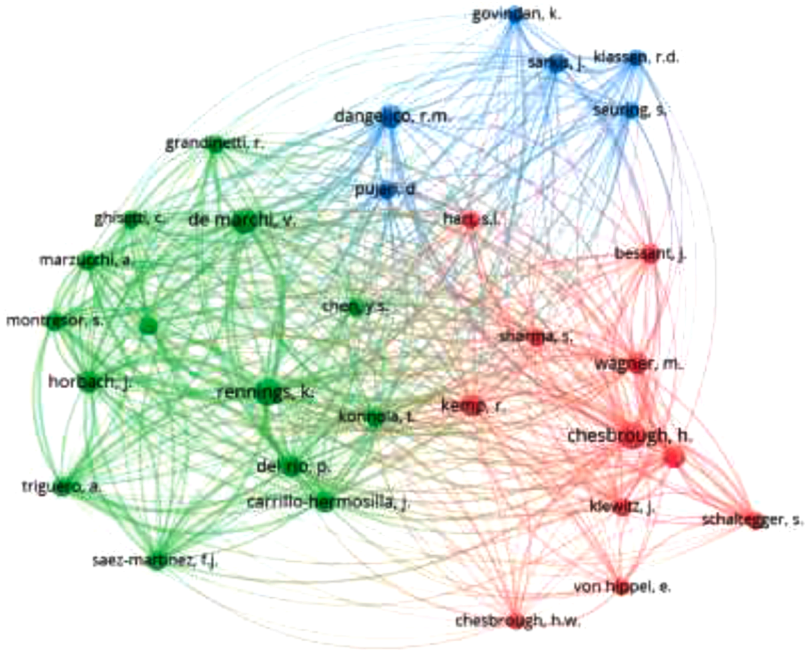

Fig. 6. Author co-citation analysis of the OE literature .

von Hippel and Chesbrough are critical to the development of OE . So it is not surprising then to notice that some of the most cited articles on open eco-innovation by De Marchi and Ghisetti et al [6]. and [14] referenced all these groundbreaking articles. This goes to show that these clusters could represent theoretical perspectives with which a common theory of open eco-innovation could be built. More importantly, the fields of green supply chain management, innovation management and economics of innovation which are central to these pivotal articles, could be explored deeply to provide a viable theoretical framework for effective collaborative engagements for sustainable transitions.

4.3.3. Current trend in OE research landscape and future studies

The section discusses the relationship among certain common themes and concepts within OE landscape by using the technique of keyword co-occurrence analysis . It also shows research clusters that are currently emerging in the OE research field. In all, the co-occurrence of the author's keywords generated 9 clusters on the network visualization map representing what could be regarded as emerging research areas/ themes (see Fig. 7). Yellow nodes on the network map signify emerging concepts that have just been introduced to the field of OE. For instance, some of the new concepts that showed up on the visualization network map include circular economy, green absorptive capacity, intermediation etc. The next section provides further details on these new concepts and future research areas that could come from them.

Green absorptive capacity

This concept allows firms to be adaptive and flexible to green market turbulence which are important ingredients for external knowledge exploitation . Studies have shown that successful implementation of eco-innovation is strongly affected by organizational absorptive capacity for external knowledge and its subsequent conversion into internal capability [70,71]. More importantly, however, is the recombination of both the inbound and outbound knowledge sources during the eco-innovation process [71]. In essence, green absorptive capacity is one of the preconditions for the successful implementation of collaborative eco-innovation.

To improve further discussions on the green absorptive capacity, we propose the following RQs for future studies:

RQ1: How does green absorptive capacity moderate external knowledge appropriation and eco-innovative performance?

RQ2: What is the relationship between green absorptive capacity, external collaboration and typology of eco-innovation?

RQ3: Are there sectoral differences in the drivers of green absorptive capacity between eco-innovative manufacturing and service firms with open strategies?

RQ4: Does green absorptive capacity improve external collaboration among eco-innovative SMEs?

Circular economy

Many scholars have pushed for this concept as capable of solving the challenges of waste generated from excessive consumption of both renewable and non-renewable resources [72]. In order to be able to provide adequate solutions to this problem, firms, government agencies, and other stakeholders need to incorporate strategies such as reuse, refurbishment, remanufacturing, and recycling in their operations. However, the knowledge, technological capabilities, resources, and infrastructural facilities needed are distributed across many partners and actors [73]. Therefore, there is an urgent need to create a new network of actors to create value within the global value chain [11,74]. Unfortunately, as reported from the analysis of this study, most of the research activities on eco-innovation including circular economy were carried out in the developed countries. This result accentuates the need to carry out more research in developing countries and see if there could be synergies or collaboration between developed and developing countries.

Therefore, we propose that future studies could aim to answer the following RQs:

RQ1: What are the effects of green R&D networking and management capabilities on circular economy adoption?

RQ2: What is the association between open strategies for circular economy and green jobs in the manufacturing sector of developing countries?

RQ3: What drives stakeholder's engagement in circular economy among SMEs in developing countries?

RQ4: What economic incentives can promote international collaboration between developed and developing countries in circular economy?

Eco-innovation Intermediation

Implementation of eco-innovation is often laden with many

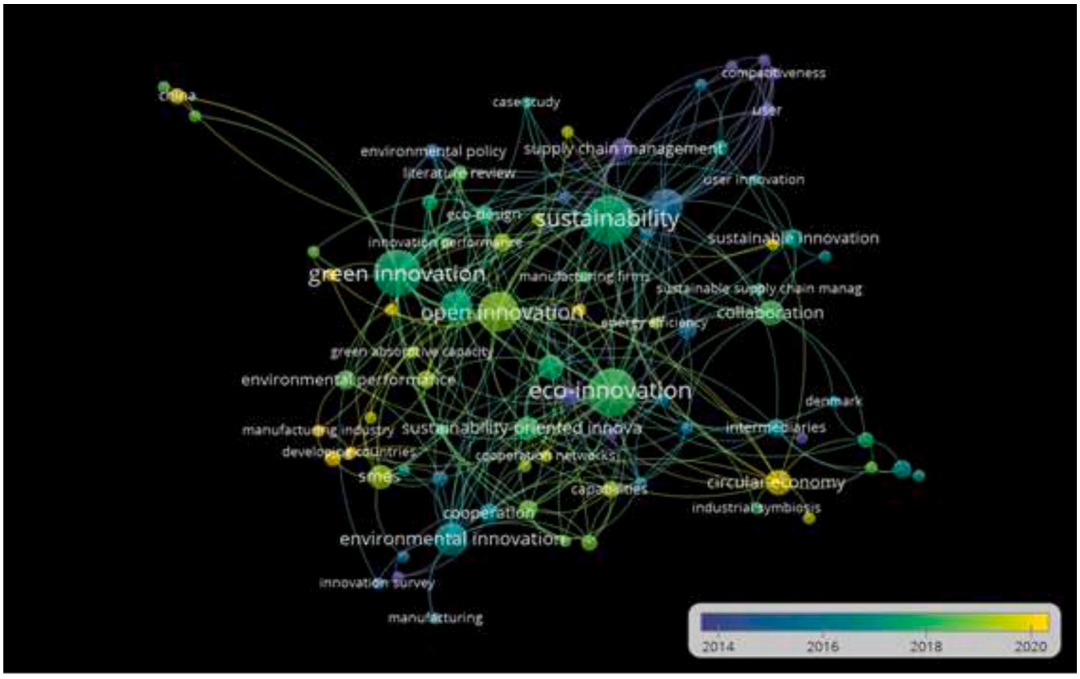

Fig. 7. Network author's keyword co-occurrence map for open eco-innovation .

challenges most especially for the SMEs with little or no capability to successfully launch eco-innovative products [75]. More often than not eco-innovation entails modification of raw materials, logistics, and the re-engineering of products and services [76]. As a result of this, many eco-innovative firms usually seek for external supports to link up with suitable partners that can help them achieve their goals. These support systems help firms to access competence and resources from external partners and actors [59]. Such actors that bring succors to firms by linking them up with relevant external partners are called intermediaries [77].

To further explore eco-innovation intermediation for a firm's competitive advantage, we suggest the following RQs for future research:

RQ1: What is the impact of intermediaries on the economic performance of an eco-innovative firm?

RQ2: What determines the choice of an intermediary for eco-innovative firms with open strategies?

RQ3: Do eco-innovative firms with openness strategies require more intermediaries than the mainstream innovative firms?

RQ4: Do eco-innovative firms with openness strategies need a general-focused or sustainability-focused intermediary?

5. Conclusion

5.1. Conclusions and contributions to knowledge

The open eco-innovation research landscape has experienced considerable growth most especially between 2012 and 2021. Based on our conceptualized categorization of the research domain growth trajectory, we noted that OE research landscape is at the acceleration phase. The reason for this could be that this particular research field has found relevance in the sustainable innovation landscape. We noticed the under-representation of experts from the developing countries as the most productive countries on the field of OE are dominated by European countries and the United States of America. China, Brazil, Malaysia, and Mexico are the few emerging economies with some sorts of significant presence on the OE literature map. We detected certain current and emerging themes around the OE research landscape such as circular economy, green absorptive capacity, intermediation, etc. The paper generated research questions for future studies around these themes. The theoretical and practical implications of these results are outlined below.

5.1.1. Theoretical implications

This study extends extant literature reviews such as those concerning OE [18,20–23,49,78] by examining knowledge structure of OE. More importantly, the paper examined the philosophical underpinning of OE by investigating the underlying theoretical background of OE. It was noted that the theoretical background surrounding the concept of open eco-innovation is presently taking shape around stakeholder's theory, resource-based view, organisational learning theory, knowledge-based view, and absorptive capacity theory. In some instances, stakeholder's, knowledge-based views, resource-based views, and natural resource-based views were used together. It should be noted that the natural resource-based view was proposed to mitigate the deficiencies of the resource-based view because it incorporates the natural environment [79]. The paper, therefore, proposes that an appropriate combination or configuration of stakeholder's theory (because it deals with the human elements), knowledge-based views, natural resource-based views, and absorptive capacity theory may provide a good theoretical background for OE.

The paper also conceptualized four phases of growth trajectories for which the growth of a research domain can be tracked: start, acceleration, transition, and deceleration. This framework can be used to analyze both emerging and matured research fields. With this framework, the historical development of theories, disciplines, or concepts can be analyzed and interpreted. The study also analyzed the knowledge base of OE based on the typology of external knowledge sources: analytical, synthetic, and symbolic. The prevalence of synthetic sources could be an indication of the importance of informal learning by Doing, Using, and Interacting (DUI) mode [26] to OE. However, it should be noted that more than one-third of the articles reported that firms and organisations used both analytic and synthetic external sources. This suggests that managers or business owners should endeavor to evolve a combination of both sources that fit better into their eco-innovation strategies. The study also noted that the majority of the studies on OE are quantitative (with the majority of the data coming from community innovation surveys) leaving in-depth qualitative and case studies few and far between. Meanwhile, qualitative approaches are known to have the potentials to advance theories on inter-organizational collaborations [80,81]. There is the need to carry out more qualitative and case studies to leverage its interpretative nature for theory development.

5.1.2. Practical implications

One of the major emerging themes from the analysis of results include circular economy, green absorptive capacity, intermediation, etc. For firms to be competitive and increase the bottom line at the same time, managers and employees must learn to innovate around environmental challenges. The global prominence of sustainability issues has given many firms the impetus to incorporate environmental strategies into their business models. The current pandemic has further accentuated the need to harness external knowledge for eco-innovative initiatives and projects [82]. However, firm's capability to eco-innovate will depend on the active participation of other stakeholders and firms' green absorptive capacities. In recent times, more of them are also requiring the services of eco-innovation intermediaries. With intermediaries showing up as one of the emerging themes for OE, this could be an indication that its use among eco-innovative firms is increasingly becoming popular. Managers or business owners may want to engage them to assist in aggregating external knowledge for new eco-innovation implementation. The results also showed that there is an increasing interest in the circular economy where scholars have talked about different strategies such as material efficiency, product life extension, and product recycling [83]. In view of this, managers and entrepreneurs, and other industry players may take this opportunity to create a strategy that will help optimize product design and strenghten green absorptive capacity to cut down on the consumption of resources while extending the lifespan of the product.

In spite of the robust analysis in this article, there are some limitations. First, although we used citation index as the measure of impact of the articles, it has been stated on several platforms that citations do not necessarily reflect the value of an article. In addition to citation index, other measures such as utilization by policy makers, social media mentions, number of lead authors influenced by an article etc. are possible alternatives that can be used for future systematice literature reviews. Also, the study used mainly articles domiciled in Scopus database. Scopus is known to be biased towards articles written in English and countries with a large number of journals indexed in its database. In the same light, even though Scopus is the largest database of peer-reviewed articles, there are still other databases that may contain articles not listed in Scopus database. However, co-citation analysis would have reduced the effects of this limitation. We also compared our data with other databases such as Web of Science and Dimensions to reduce the bias that could come from Scopus database. The third limitation of the study has to do with the fact that the results of the study are based on the current situation of the OE research domain and this could change as new articles emerge and more citations are added to the extant articles. This is why it is important to interpret the results of the study within the context of the period of study. Regardless of the study limitations above, this study has made theoretical and practical contributions to OE research landscape and identified some research gaps in the OE research domain for future studies.

Declaration of Competing Interest

None.

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References

[1] J. Horbach, V. Oltra, J. Belin, Determinants and specificities of eco-innovations compared to other innovations-an econometric analysis for the French and German industry based on the community innovation survey, Ind. Innov. 20 (6) (Aug. 2013) 523–543, https://doi.org/10.1080/13662716.2013.833375.
[2] Á. González-Moreno, Á. Triguero, F.J. Sáez-Martínez, Many or trusted partners for eco-innovation? The influence of breadth and depth of firms' knowledge network in the food sector, Technol. Forecast. Soc. Chang. 147 (Oct. 2019) 51–62, https://doi.org/10.1016/j.techfore.2019.06.011.
[3] L.M. Avellaneda-Rivera, F.J. Sáez-Martínez, Á. González-Moreno, Open and eco-innovations in traditional industries. Innovation Strategies in Environmental Science, Elsevier, 2019, pp. 145–178.
[4] M. Cristina Díaz-García, et al., Eco-innovation: insights from a literature review, Organ. Manag. 17 (1) (2015) 6–23, https://doi.org/10.1080/14479338.2015.1011060.
[5] V. de Marchi, R. Grandinetti, Knowledge strategies for environmental innovations: the case of Italian manufacturing firms, J. Knowl. Manag. 17 (4) (Jul. 2013) 569–582, https://doi.org/10.1108/JKM-03-2013-0121.
[6] V. De Marchi, Environmental innovation and R&D cooperation: empirical evidence from Spanish manufacturing firms, Res. Policy 41 (3) (Apr. 2012) 614–623, https://doi.org/10.1016/j.respol.2011.10.002.
[7] K. Rennings, Redefining innovation - eco-innovation research and the contribution from ecological economics, Ecol. Econ. 32 (2) (Feb. 2000) 319–332, https://doi.org/10.1016/S0921-8009(99)00112-3.
[8] Frigon, Anthony, David Doloreux, and Richard Shearmur. "Drivers of eco-innovation and conventional innovation in the Canadian wine industry." *Journal of Cleaner Production* 275 (2020): 124115, doi:10.1016/j.jclepro.2020.124115.
[9] G. Cainelli, V. De Marchi, R. Grandinetti, Does the development of environmental innovation require different resources? Evidence from Spanish manufacturing firms, J. Clean. Prod. 94 (2015) 211–220, https://doi.org/10.1016/j.jclepro.2015.02.008.
[10] R. Garcia, K. Wigger, R.R. Hermann, R.Rivas Hermann, Challenges of creating and capturing value in open eco-innovation: evidence from the maritime industry in Denmark, J. Clean. Prod. 220 (May 2019) 642–654, https://doi.org/10.1016/j.jclepro.2019.02.027.
[11] M. Bogers, H. Chesbrough, R. Strand, Sustainable open innovation to address a grand challenge: lessons from carlsberg and the green fiber bottle, Br. Food J. 122 (5) (Apr. 2020) 1505–1517, https://doi.org/10.1108/BFJ-07-2019-0534.
[12] T.R. Spena, N. Di Paola, Moving beyond the tensions in open environmental innovation towards a holistic perspective, Bus. Strateg. Environ. 29 (5) (Jul. 2020) 1961–1974, https://doi.org/10.1002/BSE.2481.
[13] V. De Marchi, Environmental innovation and R&D cooperation: empirical evidence from Spanish manufacturing firms, Res. Policy 41 (3) (Apr. 2012) 614–623, https://doi.org/10.1016/j.respol.2011.10.002.
[14] C. Ghisetti, A. Marzucchi, and S. Montresor, The open eco-innovation mode. An empirical investigation of eleven European countries, in Res. Policy, 2015, vol. 44, no. 5, pp. 1080–1093, doi:10.1016/j.respol.2014.12.001.
[15] A. Fabrizi, G. Guarini, V. Meliciani, Green patents, regulatory policies and research network policies, Res. Policy 47 (6) (Jul. 2018) 1018–1031, https://doi.org/10.1016/J.RESPOL.2018.03.005.
[16] E. Störmer, Greening as strategic development in industrial change - why companies participate in eco-networks, Geoforum 39 (1) (Jan. 2008) 32–47, https://doi.org/10.1016/j.geoforum.2006.12.001.
[17] V. Veleva, G. Bodkin, Corporate-entrepreneur collaborations to advance a circular economy, J. Clean. Prod. 188 (Jul. 2018) 20–37, https://doi.org/10.1016/j.jclepro.2018.03.196.
[18] V. Chistov, N. Aramburu, J. Carrillo-Hermosilla, Open eco-innovation: a bibliometric review of emerging research, J. Clean. Prod. 311 (2021), 127627, https://doi.org/10.1016/j.jclepro.2021.127627.
[19] Á. González-Moreno, Á. Triguero, F.J. Sáez-Martínez, Many or trusted partners for eco-innovation? The influence of breadth and depth of firms' knowledge network in the food sector, Technol. Forecast. Soc. Chang. 147 (Oct. 2019) 51–62, https://doi.org/10.1016/J.TECHFORE.2019.06.011.
[20] S. Fernández, Open innovation, collaboration and sustainable eco-innovation: a bibliometric study, in: A. Triguero, A. Gonzalez-Moreno (Eds.), Research on Open-Innovation Strategies and Eco-Innovation in Agro-Food Industries., Chartridge Books, Oxford, 2019, pp. 25–36.
[21] R.M. Pereira, M.L.F. MacLennan, E.F. Tiago, Interorganizational cooperation and eco-innovation: a literature review, Int. J. Innov. Sc. 12 (5) (2020) 477–493, https://doi.org/10.1108/IJIS-01-2020-0008. Emerald Group Holdings Ltd. 30-Nov.
[22] L. Melander, Achieving sustainable development by collaborating in green product innovation, Bus. Strateg. Environ. 26 (8) (Dec. 2017) 1095–1109, https://doi.org/10.1002/BSE.1970.
[23] R. Rauter, E. Perl-Vorbach, R.J. Baumgartner, Is open innovation supporting sustainable innovation? Findings based on a systematic, explorative analysis of existing literature, Int. J. Innov. Sustain. Dev. 11 (2/3) (2017) 249–270.
[24] F.J. Sáez-Martínez, C. Díaz-García, A. Gonzalez-Moreno, Firm technological trajectory as a driver of eco-innovation in young small and medium-sized enterprises, J. Clean. Prod. (2016), https://doi.org/10.1016/j.jclepro.2016.04.108.
[25] S. Laestadius, Technology level knowledge formation and industrial competence in paper manufacturing, in: G. Eliasson (Ed.), Micro Foundations of Economic Growth, The University of Michigan Press, Ann Arbour, 1998, pp. 212–226.
[26] A. Marzucchi, S. Montresor, Forms of knowledge and eco-innovation modes: Evidence from Spanish manufacturing firms, Ecological Economics 131 (2017) 208–221.
[27] R. Katila, G. Ahuja, Something old, something new: a longitudinal study of search behavior and new product introduction, Acad. Manag. J. 45 (6) (2002) 1183–1194.
[28] K. Laursen, A. Salter, Open for innovation: the role of openness in explaining innovation performance among U.K. Manufacturing Firms, Strateg. Manag. J. 27 (2) (Feb. 2006) 131–150, https://doi.org/10.1002/smj.507.
[29] R.A. Boschma, Proximity and innovation: a critical assessment, Reg. Stud. 39 (1) (Feb. 2005) 61–74, https://doi.org/10.1080/0034340052000320887.
[30] D.J. Teece, G. Pisano, A. Shuen, Dynamic capabilities and strategic management, Strateg. Manag. J. 18 (7) (1997) 509–533, https://doi.org/10.1002/(SICI)1097-0266(199708)18:7.509::AID-SMJ882.3.0.CO;2-Z.
[31] V. Oltra, M. Saint Jean, Sectoral systems of environmental innovation: an application to the French automotive industry, Technol. Forecast. Soc. Chang. 76 (4) (May 2009) 567–583, https://doi.org/10.1016/j.techfore.2008.03.025.
[32] K. Rennings, C. Rammer Increasing energy and resource efficiency through innovation-an explorative analysis using innovation survey data ZEW-Centre Eur. Econ. Res. Discuss. (2009), pp. 09–056.
[33] R. Martin, J. Moodysson, Innovation in symbolic industries: the geography and organization of knowledge sourcing, Eur. Plan. Stud. 19 (7) (2011) 1183–1203.
[34] D. Tranfield, D. Denyer, P. Smart, Towards a methodology for developing evidence-informed management knowledge by means of systematic review, Br. J. Manag. 14 (3) (2003) 207–222.
[35] N. Halilem, Inside the triple helix: an integrative conceptual framework of the academic researcher's activities, a systematic review, J. Res. Adm. 41 (3) (2010) 23–50.
[36] D.D.T. Pham, P. Paillé, N. Halilem, Systematic review on environmental innovativeness: a knowledge-based resource view, J Clean Prod (2019), https://doi.org/10.1016/j.jclepro.2018.11.221.
[37] D. Moher, A. Liberati, J. Tetzlaff, D.G. Altman, and others, Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement, Int J Surg 8 (5) (2010) 336–341.
[38] D.A. de J. Pacheco, C.S. ten Caten, C.F. Jung, H.V.G. Navas, V.A. Cruz-Machado, Eco-innovation determinants in manufacturing SMEs from emerging markets: systematic literature review and challenges, J. Eng. Technol. Manag. JET-M 48 (Apr. 2018) 44–63, https://doi.org/10.1016/j.jengtecman.2018.04.002.
[39] N. Hazarika, X. Zhang, Factors that drive and sustain eco-innovation in the construction industry: the case of Hong Kong, J. Clean. Prod. 238 (Nov. 2019), https://doi.org/10.1016/j.jclepro.2019.117816.
[40] B. Snilstveit, S. Oliver, M. Vojtkova, Narrative approaches to systematic review and synthesis of evidence for international development policy and practice, J. Dev. Eff. 4 (3) (2012) 409–429.
[41] G.H. Brundtland, Our common future—Call for action, in: Our Common Future, 8, Environmental Conservation, 1987, pp. 291–294.
[42] C. Fussier, P. James, Driving Eco-Innovation: A Breakthrough Discipline For Innovation and Sustainability, Pitman Publishing, London, 1996.
[43] P. James, The sustainability cycle: a new tool for product development and design, J. Sustain. Prod. Des. (1997) 52–57.
[44] A.F. Xavier, R.M. Naveiro, A. Aoussat, T. Reyes, Systematic literature review of eco-innovation models: opportunities and recommendations for future research, J. Clean. Prod. 149 (15-Apr. 2017) 1278–1302, https://doi.org/10.1016/j.jclepro.2017.02.145. Elsevier Ltd.
[45] H. Chesbrough, M. Bogers, Explicating open innovation. New Frontiers in Open Innovation, Oxford University Press, 2014, pp. 3–28.

[46] M. Sanni, E. Verdolini, Open eco-innovation research landscape: a systematic review and future outlook, SSRN Electron. J. (Jun. 2021), https://doi.org/10.2139/SSRN.3865497.
[47] S.P. Nerur, A.A. Rasheed, V. Natarajan, The intellectual structure of the strategic management field: an author co-citation analysis, Strateg. Manag. J. 29 (3) (2008) 319–336.
[48] N.J. Van Eck, L. Waltman, VOSviewer Manual, 1, Leiden: Univeristeit Leiden, 2013, pp. 1–53.
[49] C. Gimenez, E.M. Tachizawa, Extending sustainability to suppliers: a systematic literature review, Supply Chain Manag. 17 (5) (Aug. 2012) 531–543, https://doi.org/10.1108/13598541211258591.
[50] S. Borghesi, G. Cainelli, M. Mazzanti, Linking emission trading to environmental innovation: evidence from the Italian manufacturing industry, Res. Policy 44 (3) (Apr. 2015) 669–683, https://doi.org/10.1016/j.respol.2014.10.014.
[51] R.M. Dangelico, P. Pontrandolfo, D. Pujari, Developing sustainable new products in the textile and upholstered furniture industries: role of external integrative capabilities, J. Prod. Innov. Manag. (2013), https://doi.org/10.1111/jpim.12013.
[52] M. Mazzanti, M. Mazzanti, R. Zoboli, The drivers of environmental innovation in local manufacturing systems, Econ. Polit. XXII (3/2005) (2005) 399–438, https://doi.org/10.1428/21177.
[53] G. Cainelli, M. Mazzanti, S. Montresor, Environmental innovations, local networks and internationalization, Ind. Innov. 19 (8) (Nov. 2012) 697–734, https://doi.org/10.1080/13662716.2012.739782.
[54] G. Cainelli, V. De Marchi, R. Grandinetti, Does the development of environmental innovation require different resources? Evidence from Spanish manufacturing firms, J. Clean. Prod. 94 (May 2015) 211–220, https://doi.org/10.1016/j.jclepro.2015.02.008.
[55] C. Mothe, U.T. Nguyen-Thi, Persistent openness and environmental innovation: an empirical analysis of French manufacturing firms, J. Clean. Prod. 162 (Sep 2017) S59–S69, https://doi.org/10.1016/j.jclepro.2016.12.063.
[56] J. Leitão, D. Pereira, S. de Brito, Inbound and outbound practices of open innovation and eco-innovation: contrasting bioeconomy and non-bioeconomy firms, J. Open Innov. Technol. Mark. Complex. 6 (4) (Dec. 2020) 1–34, https://doi.org/10.3390/joitmc6040145.
[57] J. Zhang, G. Liang, T. Feng, C. Yuan, W. Jiang, Green innovation to respond to environmental regulation: how external knowledge adoption and green absorptive capacity matter? Bus. Strateg. Environ. 29 (1) (Jun. 2019) https://doi.org/10.1002/bse.2349 p. bse.2349.
[58] A. Fabrizi, G. Guarini, V. Meliciani, Green patents, regulatory policies and research network policies, Res. Policy 47 (6) (Jul. 2018) 1018–1031, https://doi.org/10.1016/j.respol.2018.03.005.
[59] W. Kanda, O. Hjelm, J. Clausen, D. Bienkowska, Roles of intermediaries in supporting eco-innovation, J. Clean. Prod. 205 (Dec. 2018) 1006–1016, https://doi.org/10.1016/j.jclepro.2018.09.132.
[60] R. Rauter, D. Globocnik, E. Perl-Vorbach, R.J. Baumgartner, Open innovation and its effects on economic and sustainability innovation performance, J. Innov. Knowl. 4 (4) (Oct. 2019) 226–233, https://doi.org/10.1016/j.jik.2018.03.004.
[61] R. Garcia, K. Wigger, R.R. Hermann, Challenges of creating and capturing value in open eco-innovation: evidence from the maritime industry in Denmark, J. Clean. Prod. 220 (May 2019) 642–654, https://doi.org/10.1016/j.jclepro.2019.02.027.
[62] S. Kobarg, J. Stumpf-Wollersheim, C. Schlägel, I.M. Welpe, Green together? The effects of companies' innovation collaboration with different partner types on ecological process and product innovation, Ind. Innov. 27 (9) (Oct. 2020) 953–990, https://doi.org/10.1080/13662716.2020.1713733.
[63] E. Acebo, J. Miguel-Dávila, M. Nieto, External stakeholder engagement: complementary and substitutive effects on firms' eco-innovation, Bus. Strateg. Environ. (Mar. 2021), https://doi.org/10.1002/bse.2770 p. bse.2770.
[64] E. Di Maria, V. De Marchi, K. Spraul, Who benefits from university–industry collaboration for environmental sustainability? Int. J. Sustain. High. Educ. 20 (6) (Oct 2019) 1022–1041, https://doi.org/10.1108/IJSHE-10-2018-0172.
[65] A. Marzucchi, S. Montresor, Forms of knowledge and eco-innovation modes: evidence from Spanish manufacturing firms, Ecol. Econ. 131 (Jan. 2017) 208–221, https://doi.org/10.1016/j.ecolecon.2016.08.032.
[66] M. Passavanti, et al., The psychological impact of COVID-19 and restrictive measures in the world, J. Affect. Disord. 283 (Mar. 2021) 36–51.
[67] Q. Wang, R. Huang, The impact of COVID-19 pandemic on sustainable development goals – a survey, Environ. Res. 202 (Nov. 2021), 111637, https://doi.org/10.1016/J.ENVRES.2021.111637.
[68] M. Ranjbari, et al., Three pillars of sustainability in the wake of COVID-19: a systematic review and future research agenda for sustainable development, J. Clean. Prod. 297 (May 2021).
[69] E. Störmer, Greening as strategic development in industrial change-Why companies participate in eco-networks, Geoforum 39 (2008) 32–47, https://doi.org/10.1016/j.geoforum.2006.12.001.
[70] W. Ben Arfi, L. Hikkerova, J.M. Sahut, External knowledge sources, green innovation and performance, Technol. Forecast. Soc. Chang. 129 (Apr. 2018) 210–220, https://doi.org/10.1016/j.techfore.2017.09.017.
[71] C.H. Yang, H.L. Lin, Openness, absorptive capacity, and regional innovation in China, Environ. Plan. A 44 (2) (2012) 333–355, https://doi.org/10.1068/A44182.
[72] M. Lieder, A. Rashid, Towards circular economy implementation: a comprehensive review in context of manufacturing industry, J. Clean. Prod. 115 (Mar. 2016) 36–51, https://doi.org/10.1016/J.JCLEPRO.2015.12.042.
[73] F. Blomsma, Collective 'action recipes' in a circular economy – on waste and resource management frameworks and their role in collective change, J. Clean. Prod. 199 (Oct. 2018) 969–982, https://doi.org/10.1016/J.JCLEPRO.2018.07.145.
[74] A. Urbinati, D. Chiaroni, V. Chiesa, Towards a new taxonomy of circular economy business models, J. Clean. Prod. 168 (Dec. 2017) 487–498, https://doi.org/10.1016/J.JCLEPRO.2017.09.047.
[75] O. Hjelm, M. Lindahl, Roles of academia in supporting eco-design in small companies for better environmental and economic performance, Procedia CIRP 50 (Jan. 2016) 745–750, https://doi.org/10.1016/J.PROCIR.2016.04.094.
[76] W. Kanda, T. Sakao, O. Hjelm, Components of business concepts for the diffusion of large scaled environmental technology systems, J. Clean. Prod. 128 (Aug. 2016) 156–167, https://doi.org/10.1016/J.JCLEPRO.2015.10.040.
[77] J. Howells, Intermediation and the role of intermediaries in innovation, Res. Policy 35 (5) (Jun. 2006) 715–728, https://doi.org/10.1016/J.RESPOL.2006.03.005.
[78] R. Araújo, M. Franco, The use of collaboration networks in search of eco-innovation: a systematic literature review, J. Clean. Prod. (Jun. 2021), 127975, https://doi.org/10.1016/j.jclepro.2021.127975.
[79] R.T. Munodawafa, S.K. Johl, A systematic review of eco-innovation and performance from the resource-based and stakeholder perspectives, Sustain 11 (21) (Nov. 2019), https://doi.org/10.3390/su11216067.
[80] S. Ollila, A. Yström, Action research for innovation management: three benefits, three challenges, and three spaces, R&D Manag. 50 (3) (Jun. 2020) 396–411, https://doi.org/10.1111/RADM.12407.
[81] A. Yström, S. Ollila, M. Agogué, D. Coghlan, The role of a learning approach in building an interorganizational network aiming for collaborative innovation, J. Appl. Behav. Sci. 55 (1) (Mar. 2019) 27–49, https://doi.org/10.1177/0021886318793383.
[82] Y. Chernysh, H. Roubík, International collaboration in the field of environmental protection: trend analysis and COVID-19 implications, Sustain 12 (24) (Dec. 2020) 1–18, https://doi.org/10.3390/SU122410384.
[83] S. Goyal, S. Chauhan, P. Mishra, Circular economy research: a bibliometric analysis (2000–2019) and future research insights, J. Clean. Prod. 287 (Mar. 2021), 125011, https://doi.org/10.1016/j.jclepro.2020.125011.