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Mapping the Terrain of Open Innovation in Consumer Research: Insights and Directions from Bibliometrics

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Abstract: Mapping the Landscape of Open Innovation in Consumer Research: Insights and Directions from Bibliometrics examines how publications in the fields of consumer behavior research (Cons) and open innovation (OI) have developed over time. Terms that frequently appear together are explored to elucidate potential future research directions and thematic areas that influence academic writing. Bibliometric maps are created using VOSviewer v1.6.19, and 184 publications are analyzed using high-quality metadata and citation information from the Scopus database. The findings highlight patterns in publications, networks of citations, dynamics in collaboration, and future directions for Open Innovation and Consumer research. Co-word analysis is applied to extract data, and publication density analysis is used to identify popular terms. Eighty-two authors are represented in the dataset, and author collaborations are highlighted through co-citation analysis. The study concludes by outlining potential directions for future research based on component-based, keyword, and publication analyses.

Keywords: systematic review; marketing; bibliometric analysis; content analysis; open innovation; consumer

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1. Introduction

Open innovation (OI), introduced by Henry Chesbrough in the early 2000s [1], is a shift from traditional closed innovation models, focusing on collaboration, knowledge sharing, and cross-disciplinary cooperation. Over time, OI has evolved, transforming innovation processes and impacting society and the economy. OI is crucial for organizations as it allows them to leverage collaboration, diversity, and external innovation to foster sustainable growth, generate value for stakeholders, and tackle societal challenges [2–4]. Its impact on technological advancements in information technology, biotechnology, renewable energy, and materials science is significant [5,6]. OI facilitates global collaboration and knowledge exchange [7], addressing critical issues like healthcare, education, poverty, climate change, and sustainable development [8]. It has sparked cultural shifts in organizations and communities [9]. It holds promise for addressing social and environmental challenges by democratizing innovation and empowering individuals and communities to participate in problem-solving and decision-making processes [10]. This approach drives positive social change and significantly impacts people's lives by promoting collaboration, cooperation, and shared value creation [11]. OI fosters diverse ideas and innovations by allowing access to external resources. This mitigates investment risks, enables organizations to establish consumer relationships, and responds promptly to market demand. OI drives economic growth, creates new markets and industries, and maintains competitiveness in dynamic markets. The study of consumers (Cons) is crucial for implementing OI, as they are the

end-users of products and services [10]. OI allows for co-creation [12], where consumers actively participate in developing new products and services [13]. This engagement allows organizations to gather valuable input, feedback, and ideas, facilitating the creation of more relevant offerings. Organizations can validate ideas before committing resources by involving consumers early in the innovation process.

Consumer feedback can identify potential market demand, mitigate risks, and address real-world needs [14], making the study of consumers essential for enhancing OI initiatives. OI studies are gaining scholarly attention, but more research is needed on the intersection of OI and consumer behavior. Consumer-centric OI studies are crucial for OI development and organizational process design [15]. It is essential to explore the evolution, current status, and future trajectories of OI initiatives related to consumers and propose future research directions.

Bibliometric analyses are a significant research gap in understanding OI and consumer behavior. Despite being crucial, consumer-centric publications may need more attention due to industry priorities [16], resource constraints, intellectual property concerns, and perceived impacts on academic contributions. However, as consumer involvement becomes more prominent in innovation, research attention in this area is expected to increase in the future [17].

The lack of comprehensive bibliometric studies on the relationship between OI and Cons highlights the need for further scholarly inquiry. Understanding how OI opportunities shape consumer roles and the evolving dynamics between consumers and the OI process is crucial. This prompts critical inquiries into consumer participation, related fields, and future research directions. This paper investigates the intersection between Cons and OI, focusing on both domains through a systematic review and bibliometric analysis [18], aiming to fill a research gap by addressing three key research questions:

RQ1: What is the current landscape of publications in OI concerning consumer behavior? This inquiry seeks to scrutinize the evolution of publications regarding OI and consumer behavior from historical contexts to contemporary trends, thereby delineating the trajectory of research topics and fields.

RQ2: What are the intricate interrelationships between OI and Cons, as discerned through exploring and analyzing co-occurring terms? This question aims to discern and explicate the multifaceted connections between OI and consumer behavior, revealing their nuanced interplay within scholarly discourse.

RQ3: What are the prospective avenues for research inquiry and thematic domains within the realm of OI pertinent to consumer behavior? This query endeavors to elucidate forthcoming research directions and thematic domains poised to shape the future trajectory of scholarly inquiry in this interdisciplinary domain.

2. Literature Review

Open Innovation (OI) is a paradigm that uses knowledge, ideas, and resources from internal and external sources to drive innovation [19]. Since its introduction, OI has differed from traditional closed models by integrating external ideas, technologies, and expertise with internal resources [20]. This approach has evolved from closed innovation to involving stakeholders in feedback and collaboration, as businesses now engage with stakeholders more collaboratively and openly [21]. OI comprises inbound innovation, where companies seek external knowledge [22], strategic partnerships for knowledge acquisition [10], and outward flow of innovation through licensing or spin-off companies, as well as strategic partnerships for knowledge acquisition [21]. OI in management involves several key elements, including external collaboration with external entities like customers, suppliers, universities, and research institutions [23], internal innovation by combining internal capabilities with external knowledge and resources [24], ecosystem development to access a wide range of expertise and technologies [25–27], and intellectual property management through licensing agreements, joint ownership arrangements, or legal mechanisms [13] to ensure fair and equitable sharing of innovations [28]. These components work together

to enhance organizational performance and competitiveness. Cultural shifts in innovation management involve encouraging employee contributions, recognizing successful collaborations, and fostering a culture of continuous learning and adaptation [29]; risk management in OI involves assessing and mitigating potential intellectual property disputes, loss of competitive advantage, and integration challenges. Technology platforms like innovation management software [30], collaboration tools, and crowdsourcing platforms [31] streamline the identification, evaluation, and implementation of external ideas. Scalability and flexibility are crucial, emphasizing adaptable partnership models and iterative process refinement [30]. Metrics and evaluation involve defining success metrics like collaboration, idea integration quality, and ROI for ongoing optimization [32]. Leadership and governance are essential for aligning with strategic goals, fostering innovation, and establishing transparent governance [33]. Incentives and recognition promote participation and collaboration in OI, particularly in emerging markets, and should encourage individual employees to adopt a decentralized organizational structure [34]. Community engagement fosters a healthy OI ecosystem [35] involving ethical research, data sharing, and intellectual property management. It also involves creating best practices repositories and fostering a culture of continuous improvement and reflection [36]. Practical organizations learn from successes and failures, investing in talent development, fostering trust, and cultivating shared values for long-term sustainability [37]. Organizational innovation (OI) is crucial for sustainable development and responding to consumer group dynamics. "Consumers" refers to individuals or entities using goods and services that are essential in the innovation process due to their interests, expectations, and opinions. OI is related to fields like AI innovation [38], entrepreneurship [39], and pharmaceuticals [40]. They are influencing the development of products and services. OI is linked to consumer concepts, with knowledge from suppliers promoting process innovation and knowledge from customers relevant to product innovation. OI is crucial in digitalization and technological convergence [41] and should not be underestimated. These factors could lead to OI failures and substantial negative repercussions for companies [42]. The advancement of artificial intelligence (AI) technology and its applications has drastically transformed consumer behavior [43]. AI has required corporations to redesign their innovation processes [38]. OI has many more implications during the pandemic but fewer in publications and citation patterns significantly [44–46].

Consumers play a crucial role in marketing, providing valuable insights into their preferences, needs, and behaviors. They actively develop and refine products and services through co-creation and collaboration initiatives, making their insights invaluable for organizational success [47]. The paper presents a systematic literature review, outlining the review protocol and data retrieval process. It presents the primary findings from a descriptive analysis, including journal, author, and keyword analysis, and identifies the main themes in selected publications. The paper also examines bibliographic, co-occurrence, descriptive co-citation, and authorship connection data. The conclusions and identified research gaps are presented in Section 6, indicating the need for future research.

3. Materials and Methods

This study uses quantitative bibliometric analysis to analyze innovation and management journals over several decades [48,49]. It uses objective approaches to summarize the field's structure and descriptive analyses to explore study characteristics, article evolution, and distributions by country and journal, aiming to improve understanding of the research landscape.

3.1. Data Processing

To ensure data validity and high-quality outcomes, this study emphasizes the importance of rigorous standards in measuring and data collection processes, research procedures, and paper selection. It highlights the importance of using reliable data to strengthen bibliometric analyses' validity, as Ampornklinkaew suggested [50].

The first step (Figure 1) involves applying a search string without restrictions, using words and connectors (AND; OR) to assess unexplored fields of study and encompass broad but specific terminology related to topics of interest (e.g., OI and consumers). The second step involves searching the "Scopus database" for published research on consumer behavior and OI, focusing on high-quality metadata and citation information [51,52]. In the third step, the parameter "ALL ("OI") AND ALL (consumer)" is selected, resulting in 17,604 documents identified from 2005 to January 2024, based on the search protocol (Figure 1), as per the search protocol. The search was limited to title-abstract-keyword combinations in social science, management, economics, and related technology, with 344 documents returned. The search was also restricted to journal articles and "Article" for document type, yielding 184 results. Küster and Vila [53] emphasize the significance of data verification through dataset integrity to identify errors, inconsistencies, and missing data before analysis, as per step 4. The authors advocate using VOSviewer for data extraction, highlighting its effectiveness in creating and visualizing bibliometric maps and its graphical representation in enhancing research interpretability. Küster and Vila [53] provided VOSviewer for free to the bibliometric research community to promote collaboration and advancement in the field.

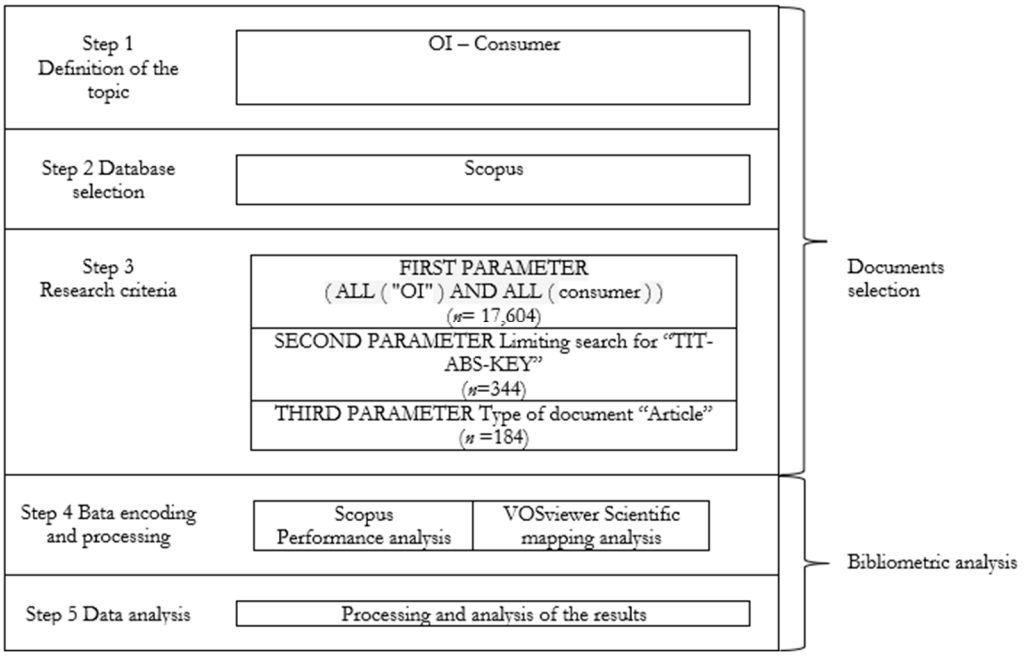


Figure 1. The search protocol and flow diagram were adapted from Vergura [54]. Source: authors' original figure.

3.2. Data Analysis

The final list of publications was defined, and the data were downloaded in CSV Excel format for bibliometric analysis using the Scopus CSV dataset results [55]. The research field's subareas have distinct concerns and priorities, with current scenarios constrained by main hotspots, trends, emerging topics, and deficiencies. The research gap between literature and consumer concerns suggests that reducing this gap could decrease the gap between consumers' awareness and their behavior [56].

The study uses VOSviewer, a mapping tool, to visually represent bibliographic data and analyze bibliometric relationships. It is known for its accessibility and reliability and is effective in conducting bibliometric studies and mapping emerging fields. VOSviewer extracts keywords, titles, and abstracts for content analysis. VOSviewer uses distance-based

visualizations to analyze content by extracting keywords, titles, and abstracts, enabling the identification of co-occurrence relationships between terms.

$$V(x_1, \ldots, x_n) = \sum_{i<j} S_{ij} \|x_i - x_j\|^2 \quad (1)$$

or

$$\frac{2}{n(n-1)} \sum_{i<j} \|x_i - x_j\| = 1 \quad (2)$$

The software's innovative local moving algorithm, developed by Van Eck & Waltman [57], aids in identifying publication network relations, thereby improving scholarly comprehension of research landscapes.

In step 5, data analysis and interpretation are conducted, interpreting bibliometric indicators within the scholarly landscape and disciplinary norms. When interpreting impact metrics, it is crucial to consider factors like publication patterns, citation behaviors, and research collaborations. The study utilizes the Hirsch index (h-index) as an indicator to gauge the influence quality within a group of articles [58]. The study conducted descriptive and performance analyses, including publication patterns, primary sources, citations, journal analysis, author analysis, and relevant keyword analysis. Then, the VOSviewer results are mapped based on network analyses consisting of co-occurrence, co-citation, authorship, and connection analyses. The description in the table consists of TP(R), meaning the total number of publications/papers and ranking, TC(R) is the total number of citations, and TC/TP is the ratio of the total number of papers to the total number of citations [1].

4. Results

4.1. Content Analysis

4.1.1. Decades of Knowledge Transfer

This research examines publication patterns, citation networks, and collaboration in the context of open innovation and consumer behavior. A search of 17,604 articles was conducted, with 184 identified for comprehensive analysis. The study aims to identify the most influential articles and themes among scholars and propose future research areas in this domain. The research question 'What is the current publication trend regarding Open Innovation for Cons?' is addressed with detailed data and explanations.

The study, conducted by Christensen, Olesen, and Kjaer, launched OI in 2005. It analyzed 184 publications across two decades (Figure 2), providing a comprehensive understanding of the field.

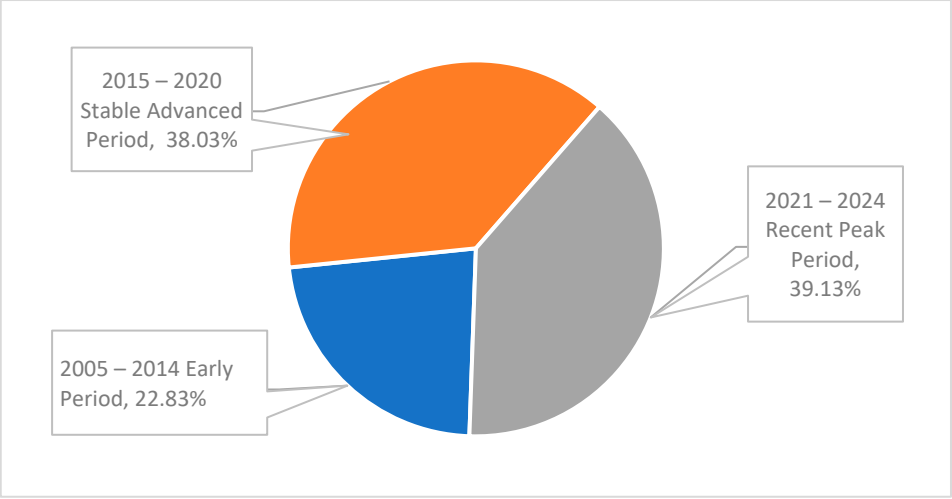


Figure 2. Periods studied. Source: authors' original work.

From 2005 to 2014, 42 publications were recorded (Figure 3), with an average of 10 per year. Notable works include "The Industrial Dynamics of Open Innovation—Evidence from the Transformation of Consumer Electronics" (2008), Füller, Matzler, and Hoppe's article on brand community (2008), and studies by Erickson and Isherwood on collective development. Numerous studies emerged on various topics during this period, including online industries, bioplastics businesses, agri-food research, and healthcare. The focus shifted toward consumer characteristics in online innovation projects, with a surge in published articles from 2013–2014. The themes expanded to include consumer role, health interaction, co-creation, creative consumers, and brand perceptions.

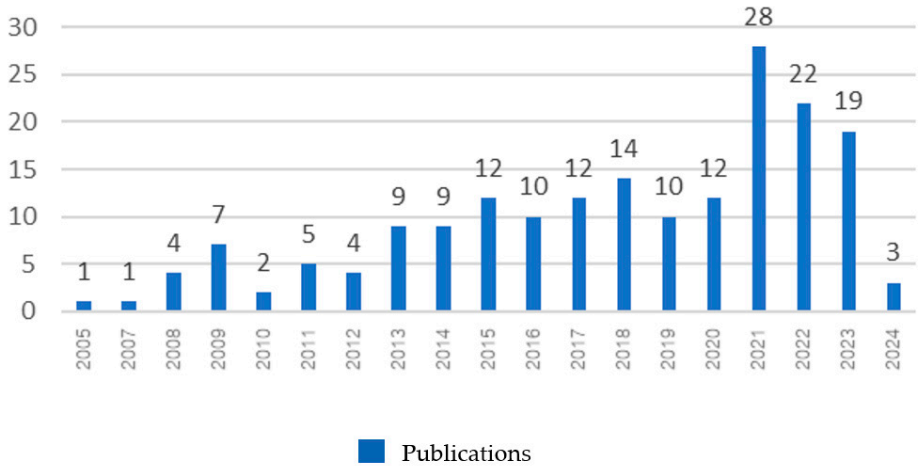


Figure 3. Number of publications by year. Source: authors' original work.

The number of published articles in the stable, mature period exceeded 10 per year, totaling 70. The content themes revealed studies related to crowdsourcing, collective sharing of resources or data, and exploring OI and Cons within the co-creation concept. Since 2016, there has been an increasing focus on studies related to environments or green concepts, such as mobile environments, sustainable energy technologies, sustainable products, sustainable development, and green consumer behavior. The content themes reveal the growing interest in green technologies and consumer behavior.

The productivity of the past few years has seen a significant increase, with 72 publications focusing on the intersection of OI with sustainability consumption, green initiatives, environmental concerns, ecodevelopment, sustainability-OI, and ecology. Additionally, there has been a significant increase in publications examining digital and platform-mediated relations associated with OI and Cons, including studies on online buyers, digital trade, big data, web service platforms, e-CRM, digital media, e-commerce, digital technologies, blockchain, digital social responsibility, cybernetics, live-stream commerce, web-based communication, social media, online applications or communities, green digital platforms, and artificial intelligence. Notable themes emerging in recent years include circular and green innovative economies. These trends highlight the importance of understanding the interplay between OI and Cons in the digital age.

4.1.2. Analysis of the Primary Sources of Publications and Citations

The graph below visually presents the dynamics of the number of published articles, the annual citation rate, and the average citation rate per article.

Based on the literature linking OI and Cons, the initial emergence in publishing occurred in 2005, with a single publication garnering significant academic attention and being referenced up to 495 times. In the subsequent year, there was a gap in scholarly articles, followed by another peak observed between 2007 and 2013, where the citation rate mirrored the volume of published articles (Figure 4). Subsequently, as the number of articles increased (Table 1), the citation rate rose proportionally. In 2021, the number

of published articles increased significantly compared to 2020, with 28 articles being the highest. However, the citation rate per article decreased, and overall citations decreased from 2020 to 2023, resulting in noticeable declines in both the number of published articles and citations.

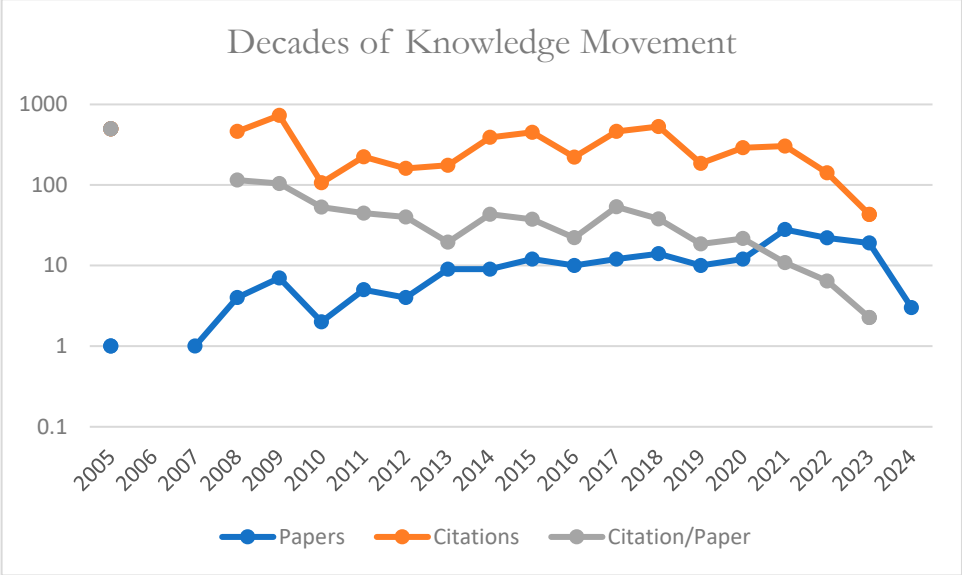


Figure 4. Cumulative publications and citations between 2005 and 2023 (log scale). Source: author's work.

Table 1. Total number of publications per year.

Year	TP	TC	TC/TP	Year	TP	TC	TC/TP
2005	1	495	495.00	2015	12	449	37.44
2006	0	0	0.00	2016	10	221	22.10
2007	1	0	0.00	2017	12	461	53.42
2008	4	460	115.00	2018	14	530	37.86
2009	7	727	103.86	2019	10	185	18.50
2010	2	106	53.00	2020	12	289	21.58
2011	5	223	44.60	2021	28	303	10.82
2012	4	160	40.00	2022	22	141	6.41
2013	9	175	19.44	2023	19	43	2.26
2014	9	389	43.22	2024	3	0	0.00

TP = Total papers, TC = Total citations, TC/TP = Total citations divided by total papers. Source: authors' original work.

4.1.3. Journal Analysis

A total of 184 articles from 104 journals were analyzed (Table 2), focusing on the *Journal of Open Innovation: Technology, Market, and Complexity*, in which 31 articles were published, accounting for 16.85% of the 184 papers. Subsequently, other journals in descending order of publication frequency included *Sustainability* (Switzerland) with ten articles (5.43%), *British Food Journal* with seven articles (3.80%), *Journal of Cleaner Production* with four articles (2.17%), *Technological Forecasting and Social Change* with four articles (2.17%), *IEEE Transactions on Engineering Management* with three articles (1.63%), *International Journal of Knowledge Management* with three articles (1.63%), *International Journal of Technology Marketing* with three articles (1.63%), *Journal of Product Innovation Management* with three articles (1.63%), and *Research Policy* with three articles (1.63%). Notably, Research Policy has the highest citation count of 760, followed by the Journal of Product Innovation Management with 563 and the Journal of Open Innovation: Technology, Market, and Complexity with 384, with a lower citation rate of 253 per issue.

Table 2. Journals with the highest numbers of relevant publications.

Source Title	TP(R)	TP (%)	TC(R)	TC/TP	Q
Journal of Open Innovation: Technology, Market, and Complexity	31(1)	16.85%	384(3)	12.39	1 (97th)
Sustainability (Switzerland)	10(2)	5.43%	194(4)	19.40	1 (87th)
British Food Journal	7(3)	3.80%	122(7)	17.43	2 (74th)
Journal of Cleaner Production	4(4)	2.17%	182(5)	45.50	1 (99th)
Technological Forecasting and Social Change	4(5)	2.17%	175(6)	43.75	1 (98th)
IEEE Transactions on Engineering Management	3(6)	1.63%	22(9)	7.33	1 (84th)
International Journal of Knowledge Management	3(7)	1.63%	18(10)	6.00	2 (63th)
International Journal of Technology Marketing	3(8)	1.63%	53(8)	17.67	4 (26th)
Journal of Product Innovation Management	3(9)	1.63%	563(2)	187.67	1 (96th)
Research Policy	3(10)	1.63%	760(1)	253.33	1 (98th)

TR(R) = Total papers (Rank), TP percentage = percentage of total papers, TC(R) = Total citations (ranking in this list), TC/TR = Total citations divided by total papers, and Q = Scopus quartiles in 2022 (percentile). The quartiles are quartile 1 (Q1): serial titles in the 99th–75th percentiles; quartile 2 (Q2): serial titles in the 74th–50th percentiles; quartile 3 (Q3): serial trials in the 49th–25th percentiles; and quartile 4 (Q4): serial titles in the 24th–0th percentiles [59]. Source: authors' work.

4.1.4. Author Analysis

The 2005 paper "The Industrial Dynamics of Open Innovation—Evidence from the Transformation of Consumer Electronics" by Christensen, Olesen, and Kjaer, with 492 citations (Table 3), highlights the intricate relationship between technology entrepreneurs and incumbents, highlighting that OI initiatives often require high transaction costs management. In 2009, Füller, Mühlbacher, Matzler, and Jawecki researched consumer empowerment through internet-based co-creation, cited 467 times. They also authored a study in the Journal of Product Innovation Management, which received 440 citations. In 2012, they explored consumers' creative talent for open innovation projects. Nambisan, Siegel, and Kenney's study on open innovation, platforms, and entrepreneurship received 260 citations. Kohler, Matzler, and Füller's 2009 study on avatar-based innovation has been cited 217 times.

In 2017, Stanko and Henard conducted a study titled "Toward a Better Understanding of Crowdfunding, Opening and the Consequences for Innovation", which received 199 citations, and Wilden et al. authored "The Evolution and Prospects of Service-Dominant Logic: An Investigation of Past, Present, and Future Research", which has been cited 117 times. Kohler contributed two articles, one in 2015 titled "Crowdsourcing-based business models: How to create and capture value" and another in 2011 titled "Avatar-based innovation: Consequences of the virtual co-creation experience", with Kohler, T., Fueller, J., Stieger, D. and Matzler, K. all listed as authors. Finally, an essential study by Wolfert, J., Verdouw, C.N., Verloop, C.M. and Beulens, A.J.M. titled "Organizing information integration in agri-food-A method based on a service-oriented architecture and living lab approach" was published in 2010. When analyzing the frequency of author names across the 184 articles, we observed that the most prominent names were those with a high density of publications, typically appearing as either the primary author or the listed first author. Additionally, Matzler emerged as a coauthor in four articles, contributing to each as a joint author.

Table 3. Top 10 most-cited papers.

R	CF	Authors	TP	Title	Journal	Y
1	492	Christensen, J.F., Olesen, M.H., Kjær, J.S.	1	The industrial dynamics of Open Innovation - Evidence from the transformation of consumer electronics [60]	Research Policy,	2005
2	467	Füller, J., Mühlbacher, H., Matzler, Jawecki, G.	3 *	Consumer empowerment through internet-based co-creation [61]	Journal of Management Information Systems	2009
3	440	Füller, J., Matzler, K., Hoppe, M.	1	Brand community members as a source of innovation [62]	Journal of Product Innovation Management	2008
4	260	Nambisan, S., Siegel, D., Kenney, M.	1	On open innovation, platforms, and entrepreneurship [63]	Strategic Entrepreneurship Journal	2018
5	217	Kohler, T., Matzler, K., Füller, J. *	1	Avatar-based innovation: Using virtual worlds for real-world innovation [64]	Technovation,	2009
6	199	Stanko M.A.; Henard D.H.	1	Toward a better understanding of crowdfunding, openness, and the consequences for innovation [65]	Research Policy	2017
7	117	Wilden R.; Akaka M.A.; Karpen I.O.; Hohberger J.	1	The Evolution and Prospects of Service-Dominant Logic: An Investigation of Past, Present, and Future Research [66]	Journal of Service Research	2017
8	111	Kohler T.	1	Crowdsourcing-based business models: How to create and capture value [67]	California Management Review	2015
9	107	Kohler T.; Fueller J.; Stieger D.; Matzler K.	1	Avatar-based innovation: Consequences of the virtual co-creation experience [68]	Computers in Human Behavior	2011
10	106	Wolfert J.; Verdouw C.N.; Verloop C.M.; Beulens A.J.M.	1	Organizing information integration in agri-food-A method based on a service-oriented architecture and living lab approach [69]	Computers and Electronics in Agriculture	2010

R = rank, CF = citation frequency, TP = total papers, Y = year. * Füller, J. is the first author of two articles and a co-author of one article, totaling three contributions. * Kohler, T. contributed to three papers and was the first author for each. Source: authors' work.

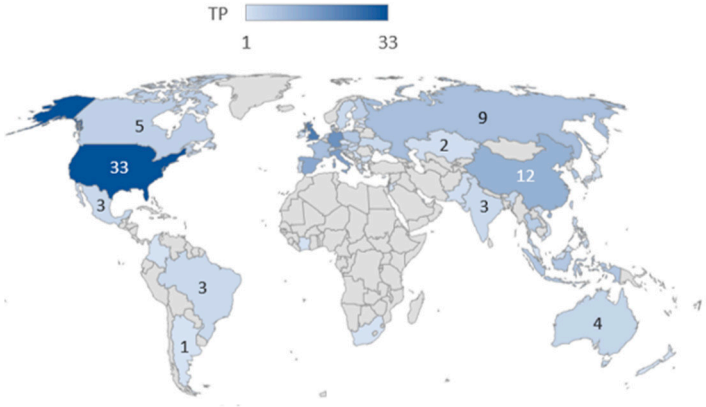
When considering countries as sources of article production (Figure 5), the United States ranks first with 33 articles, followed by the United Kingdom with 24 articles. Germany follows closely with 19 articles, Italy has 16, Spain has 14, China has 12, France and Russia have nine each, and Estonia has eight. Indonesia is among the top 10, with seven published articles.

4.1.5. Most-Relevant-Keyword Analysis

We obtained keywords derived from the content included by numerous scholars in 184 publications based on the components of OI and their relevance to Cons.

The keyword analysis, derived from both author and index keywords, illuminates the developmental trajectory of keywords across three distinct timeframes (Figure 6), beginning before 2005. Apart from core keywords such as "innovation", the analysis reveals a prevalence of keywords focusing on product development. Terms like "consumer product", "new product development", "productivity", "quality of product", "product design", and "product life cycle" are prominently featured in articles during this initial period.

Additionally, emerging terms such as "online", including "online system", "online community", and "social network (online)", begin to play a minor role during this time. In the subsequent period spanning from 2015 to 2020, as depicted in Figure 6B, the analysis highlights "creation" as a significant keyword, evidenced by terms such as "co-creation", "internet-based co-creation", "value creation", "creation experience", "creation of innovation", "creation of value", and "consumer creation". Another notable keyword during this period is "consumer", with terms like "end consumer" and "consumer development" appearing with frequency. For the current timeframe of 2021–2024, standout keywords include "sustainable", exemplified by terms such as "sustainable development", "sustainable open innovation", "sustainability-oriented innovation", "sustainability marketing", "sustainability crisis", and "sustainability project". Additionally, several noteworthy terms related to "digital" emerge, including "digital technologies", "digitalization", "digital economy", "digital platform", "digital divide", "digital market", "digital innovation", "digital social responsibility", "digital transformation", and "digital communication". Throughout all three periods, these keywords consistently revolve around the foundational themes of "innovation" and "consumer".



R	Country/Territories	TP
1	United States	33
2	United Kingdom	24
3	Germany	19
4	Italy	16
5	Spain	14
6	China	12
7	France	9
8	Russian Federation	9
9	Austria	8
10	Indonesia	7

Figure 5. Primary sources of publications. Source: authors' work.

2005–2014 (**A**) 2015–2020 (**B**) 2021–2024 (**C**)

Figure 6. (**A**–**C**). Keyword intensity plot in three periods produced with Pro-Word Cloud v1.0.0.3.

4.2. Descriptive Analysis of the Bibliographic Data

A commonly employed method for mapping scientific knowledge is co-word analysis, designed to explore connections among various themes by scrutinizing the content of selected publications within a research domain. Through co-word analysis, words frequently co-occurring and sharing thematic relationships are identified. This technique was utilized in this study to enhance comprehension of the derived research themes and provide detailed insights into each theme, thereby shedding light on the implications for OI and Cons. By utilizing the keywords, titles, and abstracts extracted from 184 papers, this study addressed the following question: What are the interrelations between OI and consumers (Cons), as determined through the exploration and analysis of co-words and coauthors?. The linkages among keyword groups are also explored, as described in detail in the following sections.

4.2.1. Co-Occurrence

Two or more terms or keywords generally appear together in documents, such as scholarly articles, books, or patents. Thus, co-occurrence measures the degree of association or relationship between terms based on their simultaneous appearance in the same document or within a specified context. Co-occurrence analysis involves identifying term usage patterns and exploring the relationships between terms within a corpus of documents. This analysis can help researchers uncover thematic clusters, identify emerging topics, and understand the intellectual structure of a field or research area.

In addition to terms, co-occurrence analysis can also be applied to other entities, such as authors, institutions, or concepts, to identify patterns of association and relationships within the scholarly literature. This type of analysis is valuable for knowledge discovery, literature mapping, and trend analysis in bibliometrics and related fields.

Theme and subtheme are co-word relations that connect keywords in co-occurrence analysis, as shown in Figure 7. Cluster 1 (red) focuses on consumer behavior and product development (18 items) and is centered around themes such as decision-making processes, education, industry, marketing strategies, product development, sustainability, and the COVID-19 pandemic. It highlights the interconnectedness of human behavior, economics, and environmental aspects, particularly in sectors like food and manufacturing. The keywords also emphasize the importance of sustainability and the green economy, highlighting the need for businesses to integrate sustainability principles into their operations. Cluster 2 (green) focuses on technology and business, highlighting the importance of collaboration, knowledge management, and living lab approaches in navigating the evolving business landscape. It emphasizes using big data, digitalization, and information technology in decision-making processes, highlighting the need for interdisciplinary approaches to address complex business challenges and opportunities.

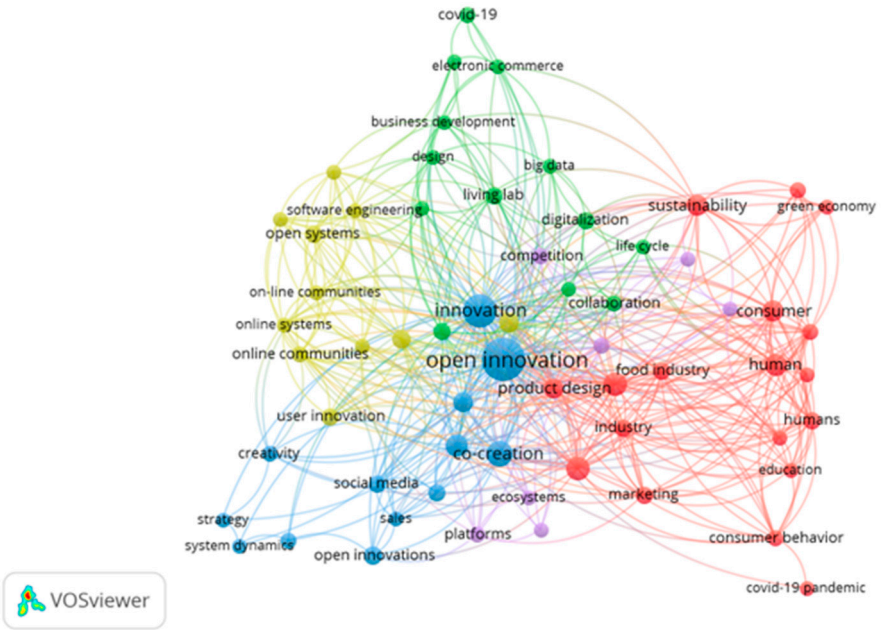


Figure 7. Co-occurrence with all keywords (Threshold 67).

Cluster 3 focuses on open innovation strategies, crowdsourced creativity, sales dynamics, and integrating social media and strategy in innovation processes. Key keywords include co-creation, creativity, innovation management, and social media strategy. The cluster emphasizes the importance of leveraging open innovation strategies, collaborating with external partners, and leveraging social media for customer engagement and feedback gathering. Cluster 4 emphasizes new product development, crowdsourcing, online commerce, user-driven innovation, social networking, and open systems in technological

development and software engineering. It emphasizes the importance of online platforms, user engagement, and open-source ideas for technical advancement and innovation in the digital age. Social networks foster communication, collaboration, and information sharing, while open systems promote accessibility.

Cluster 5, the smallest keyword group, is termed "entrepreneurial ecosystems", encapsulating key themes of entrepreneurship, competition, crowdfunding, and sustainable development within such ecosystems. The subthemes include entrepreneurial ecosystems, which focus on environments supporting entrepreneurship, innovation, and business development; competition, which highlights competitive dynamics and challenges faced by entrepreneurs; crowdfunding, a financing method prevalent in innovative and startup environments; and sustainable development, which emphasizes long-term viability and responsibility within entrepreneurial ecosystems.

The Scopus dataset can be analyzed using overlay visualization to identify patterns and trends, identify four key themes and clusters, and establish relationships for further analysis and interpretation. Figure 8 categorizes four groups based on color levels at a biannual scale from 2014 to 2020, focusing on key keywords such as innovation management, software engineering, online communities, online systems, industry, marketing, humans, and organizational innovation, starting from dark blue in 2014. This period sees a shift towards software development, the initiation of online community building, industrial production, marketing connections with production processes, and contemporary organizational model development. In the green phase in approximately 2016, keywords such as "human", "co-creation", "competition", "creativity", "innovation", "open innovations", "sales", "product design", "user innovation", and "food industry" gained significance. This period emphasizes the significance of human resources in fostering creativity and consumption, promoting co-creation, competition, and the creation of innovative organizational structures.

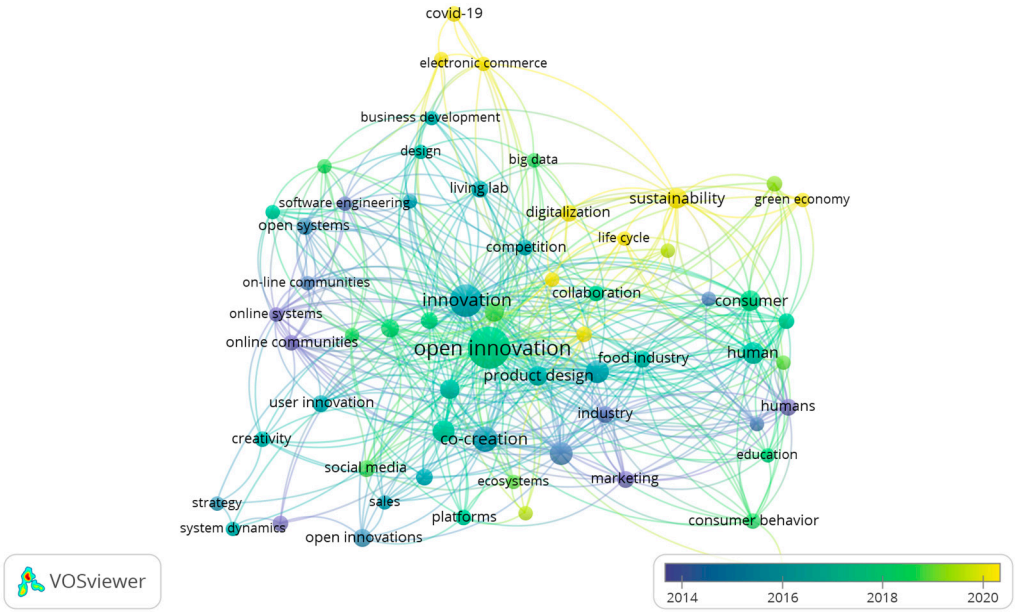


Figure 8. Keyword co-occurrence overlay visualization.

Starting in 2018, popular keywords in the period, as shown in light green, included open innovation, social networking (online), social media, knowledge management, crowdsourcing, websites, commerce, consumer, consumer behavior, collaboration, human experimentation, sustainable development, etc. This phase emphasizes using OI, online platform-based activities, user-driven product and service development, and a focus on sustainable development. From 2020, popular keywords like sustainability, green economy, life cycle, digitalization, technological innovation, crowdfunding, electronic commerce, and

market conditions reflect an era focusing on sustainable products and services, the green economy, product life cycle management, digitalization, and technological innovation, providing insights into knowledge development related to OI and Cons.

4.2.2. Descriptive Co-Citation

Figure 9 shows a visual representation of a dataset with 82 authors, each labeled with a reference cited at least fifteen times. It aims to explain the data analysis findings by illustrating a plot. Authors' co-citations are categorized into four color-coded nodes in red, green, blue, and yellow based on co-citation patterns. The subsequent text will explain these groups according to their color characteristics.

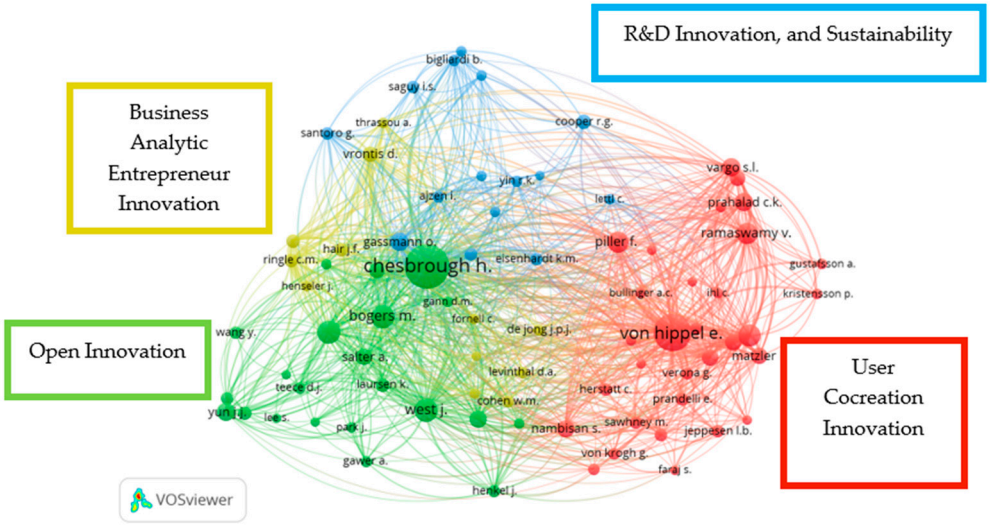


Figure 9. Author co-citation map (n = 16,702 authors in the co-citation network; threshold 82 citations per author, 82 authors).

The red cluster, comprising 31 authors, focuses on user co-creation innovation. Notable figures include von Hippel, Ramaswamy, Fuller, Prahalad, Vargo, Lusch, and Piller. Their contributions span customer-centric innovation, including "Democratizing Innovation" and "Co-creation Experiences". Other authors include Dahl, Nambisan, and Bajozzi, who contribute to consumer behavior and digital innovation management discussions. Cluster 2, with 22 co-cited authors, primarily focuses on open innovation. Key contributors include Chesbrough, West, Bogers, Vanhaverbeke, Yun, Salter, Dahlander, Gawar, Henkel, and Lausen. Their work covers open innovation dynamics, business models, ecosystem management, corporate venturing, and business model innovation, shaping discourse and understanding. Cluster 3, consisting of 15 authors, focuses on R&D innovation and sustainability. Notable figures include Gassman, Lichtenthaler, Santoro, Saguy, and others. They share similarities with Cluster 2 in terms of research emphasis, focusing on business models, R&D management, sustainability, digital transformation, open innovation, knowledge management, and platforms. Cluster 4, consisting of 12 authors, focuses on business analytics and entrepreneurial innovation. Notable authors include Hair, Foss, De Jong, Ringle, Fornell, Henseler, Levintal, Majchizak, Sarstedt, Thrassou, Vrontis, and Cohen, who have contributed to the discourse on business analytics and entrepreneurial innovation.

4.2.3. Authorship Connection

The interconnectedness among broad schools of thought became apparent upon analyzing author co-citations, prompting inquiries into the countries contributing to these collaborations for publications. As illustrated in Figure 10A,B, the countries of origin of relevant authors can be classified into five groups.

According to Table 4, the United States and the United Kingdom exhibit the highest levels of collaboration among authors, with scores of 23 and 21, respectively. Italy, France, Russia, and Germany form a closely knit collaborative community, ranked 3rd, 4th, 5th, and 6th in total link strength, respectively. Despite producing 12 documents, China needs more significant connections, with only 2 TLSs. However, China is emerging as a notable collaborator, similar to India, and is also gaining prominence in cross-national collaboration. This trend is evident in Figure 10B (highlighted in yellow).

Table 4. Top 30 links among the countries of origin of authors.

R	Country	TLS	D	C	R	Country	TLS	D	C
1	United Kingdom	23	24	558	16	Thailand	5	6	89
2	United States	21	32	1495	17	Australia	4	4	141
3	Italy	13	16	330	18	Israel	4	3	88
4	France	11	9	118	19	Netherlands	4	5	169
5	Russian Federation	9	9	57	20	Republic of Korea	4	7	134
6	Germany	8	19	707	21	Sweden	3	3	52
7	Indonesia	7	7	97	22	Switzerland	3	3	101
8	Spain	7	14	242	23	China	2	12	183
9	Austria	6	8	1437	24	Hungary	2	3	23
10	Canada	6	5	203	25	Mexico	2	3	23
11	Denmark	6	4	641	26	Portugal	2	3	3
12	India	6	3	28	27	Romania	2	3	30
13	Philippines	6	3	49	28	Ukraine	2	3	16
14	Poland	5	7	39	29	Brazil	1	3	24
15	Taiwan	5	5	25	30	Finland	1	5	192

R = rank, D = document, C = citation, TLS = total link strength. Source: authors' work.

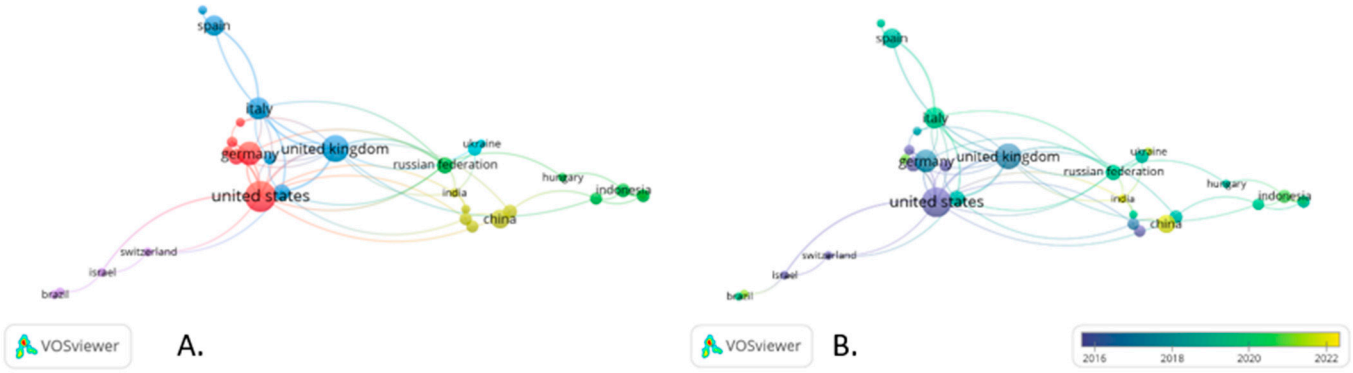


Figure 10. (**A**,**B**) Country of connection in co-authorship visualization and cluster progression map (color-coded; threshold of 30).

The analysis identifies five distinct groups of countries based on collaborative patterns in scholarly publications. The first group, highlighted in red, encompasses eight countries, Canada, China, Finland, India, Poland, Romania, Republic of Korea, and Ukraine, characterized by extensive co-authorship. The second group, shown in green, includes Australia, Austria, Denmark, Germany, Sweden, and the United States, with significant collaboration, particularly in OI and Cons, with the US contributing notably to collaborations. The third group, numbered light blue nodes, includes Hungary, Indonesia, the Philippines, the Russian Federation, Taiwan, and Thailand, indicating significant author collaboration among ASEAN Union nations and Russia. The fourth group, denoted by yellow nodes, comprises France, Italy, Mexico, the Netherlands, Spain, and the United Kingdom, demonstrating sustained popularity in author collaboration akin to that originating from the United States.

Finally, the fifth group, depicted in purple and encompassing Brazil, Israel, Portugal, and Switzerland, exhibits comparatively lower levels of co-authorship collaboration.

5. Discussion

5.1. Current Trends in Open Innovation Research: Focus on Consumer Behavior

The analysis of cumulative publications and citations is limited to the period between 2005 and 2023, as data for the year 2024 are incomplete because the duration is less than 12 months. However, it is important to acknowledge potential factors that may influence the results. For instance, the global COVID-19 pandemic significantly impacted publication and citation patterns [44]. Particularly noteworthy is the contrast observed between 2020 and 2021, which is evident in the graph. Following the onset of the pandemic, there was a notable increase in the number of publications by 133% in 2020. However, in subsequent years, the publication rate declined to approximately 21% and 13%, respectively, attributed to the disruptive effects of COVID-19 [45]. This decline highlights the divergence in trends resulting from the pandemic's impact on scholarly output and citation patterns [46]. The study's contribution is expected to trend towards increasing focus on sustainability research, necessitating researchers to adapt accordingly.

5.2. An Exploration and Analysis of Co-Occurring Terms

The bibliographic data reveals that recent research trends increasingly focus on sustainability, the green economy, the life cycle, and COVID-19. Sustainability has gained importance since 2010 [69], with a notable increase in studies on this keyword after the COVID-19 pandemic in 2019, peaking in 2021. The seven papers reviewed examine the integration of open innovation, consumer behavior, and sustainability, emphasizing the competitive advantage of sustainability in agri-food systems and the role of bioplastics in packaging and textiles. They stress the necessity for SMEs to combine technology with market adaptation and highlight technological innovation's broader social and national implications. The papers propose guidelines for incorporating consumer and environmental considerations into food development.

The COVID-19 pandemic is framed as a sustainability crisis, emphasizing the need for early and broad stakeholder integration. These studies collectively underscore the critical role of open innovation in advancing sustainable practices in the food industry. Therefore, this study supports the view that future research on open innovation and consumer behavior will increasingly relate to sustainability. Furthermore, the collaboration network analysis indicates a growing trend in Chinese studies on open innovation and consumer behavior over the past four years, focusing on business models, commerce, and buying behavior. This study recommends exploring other dimensions of open innovation that still need to be extensively studied.

5.3. The Future of Exploring Complex Relationships: OI and Consumer Behavior

Three main components are delineated for future research trends. First, trends derived from keyword analysis are outlined. Second, findings resulting from analyzing the samples categorized based on the components of OI and Cons are presented. Finally, trends originating from the analysis of publication counts are discussed.

5.3.1. Emerging Trends and Gaps in Open Innovation Research

The study's findings unveil a set of trending keywords that have gained prominence since 2021, offering potential avenues for selecting essential research topics. These emerging themes include sustainability, the green economy, life cycle analysis, digitalization, technological innovation, crowdfunding, electronic commerce, market conditions, etc. Moreover, areas of notable interest include product life cycle management, digitalization, and technological innovation. Notably, these keywords have been increasingly associated with OI since 2020. Gao, Ding, & Wu [70] argued that while OI has historically been predominant in specialized disciplines and innovation-centric journals, there has been a discernible shift

toward fostering a more open ecosystem by exerting influence across diverse disciplinary boundaries. This study also identifies notable research gaps within open innovation and consumers, particularly regarding sustainability, as evidenced by the limited scholarly output derived from keywords in the post-2021 period.

5.3.2. Identifying Future Research Directions in Open Innovation: Insights and Examples

The study's results are crucial for identifying future research directions and topic areas that may influence scholarly inquiry in this multidisciplinary field. Based on analyses of samples categorized by OI and Cons components, Table 5 provides information and illustrative examples to help enhance OI by identifying areas requiring further exploration.

Table 5. Themes and future research paths for multidisciplinary scholarly inquiry.

OI and Cons	Scope of Research	Questioning Idea
1. External collaboration	Effective Consumer Engagement Strategies	- What are the key strategies for effectively engaging consumers in Open Innovation? - How can gamification and incentive-based programs be utilized to enhance consumer participation in innovation activities?
	Cultural and Contextual Factors	- How do cultural factors influence consumer participation in Open Innovation, and what adjustments can companies make to accommodate these differences? - What research methods can be employed to better understand the impact of cultural and contextual factors on consumer behavior in Open Innovation? - How can companies effectively adapt their engagement strategies to align with local norms and values when expanding into new markets?
2. Technology Platforms and Tools	Integration of Offline and Online Channels	- How can offline and online platforms be effectively combined to engage customers across various channels? - What strategies maximize customer engagement by integrating digital platforms with traditional techniques like focus groups and workshops?
3. Ethical Considerations	Ethical Considerations and Consumer Privacy	- What frameworks and guidelines can be developed to safeguard consumer rights during the innovation process, particularly in terms of transparent data practices and consumer control over information usage? - How can the concept of the right to benefit from big data as a public resource? - What areas require additional research to comprehensively address consumer rights and the utilization of public data rights?
4. Co-creation	Consumer Co-Creation Platforms	- How can consumer co-creation platform design be enhanced to facilitate more meaningful interactions between consumers and companies in innovation projects? - What specific aspects of consumer co-creation platform design warrant further research and optimization?
5. Long-term sustainability	Empowering Marginalized and Underrepresented Consumers	- How do the unique challenges faced by marginalized and underrepresented groups impact their ability to engage effectively in Open Innovation processes? - What role can mentorship programs, networking events, and skill-building workshops play in overcoming barriers and fostering meaningful participation of marginalized and underrepresented groups in Open Innovation?
	Consumer Learning and Knowledge Transfer	- How can companies best capture and integrate consumer insights into internal learning processes within Open Innovation initiatives? - What strategies effectively facilitate knowledge sharing among consumers and internal stakeholders in Open Innovation projects?

Table 5. *Cont.*

OI and Cons	Scope of Research	Questioning Idea
6. Consumer	Consumer Insights and Analytics	- What methods and techniques are utilized in analyzing large volumes of consumer data to identify patterns and trends? - How can companies leverage consumer insights and analytics to inform innovation opportunities, product development, and marketing strategies?
	Personalization and Customization	- How can companies effectively leverage consumer data and insights to personalize products, services, and experiences in Open Innovation initiatives? - What impact does personalization and customization have on customer satisfaction, loyalty, and retention in the context of Open Innovation?
7. Community Engagement	Community Engagement and Brand Advocacy	- How does community engagement impact brand loyalty and advocacy? - What strategies enhance the effectiveness of community engagement initiatives in fostering brand loyalty and satisfaction?
8. Leadership and governance	Lack of Leadership Support and Alignment	- What are the consequences of a lack of alignment between Open Innovation efforts and organizational goals? - What strategies can be employed to ensure alignment between senior leadership and Open Innovation objectives?
9. Risk Management	Trust and Relationship Building	- How does trust-building among collaborators impact the success of Open Innovation initiatives? - What are the main factors influencing trust and relationship building in Open Innovation collaborations? - How can perceived risks, conflicts of interest, and lack of transparency be mitigated to foster effective collaboration in Open Innovation projects?

The OI process requires customer involvement, but there seems to be a significant knowledge gap regarding the best ways to involve them. More studies are needed to identify effective strategies for customer feedback, teamwork promotion, and long-term customer engagement. For example, future research should explore how product innovation affects consumer behavior and the significant variations in preferences across different cultural contexts and geographic regions to determine the best product innovation approach and satisfy user preferences; collaboration, sharing of knowledge, and interdisciplinary cooperation occur in every interaction between a company and its stakeholders. More research is required to comprehend how cultural factors impact consumer participation and how companies can adapt their strategies accordingly. For instance, a comparative examination of consumer values and attitudes, whether in a developing economy like China or a developed economy like the US, could underscore crucial roles in advancing OI and sustainability [37].

The literature on OI primarily focuses on technology platforms and tools, including digital platforms such as online discussion boards, crowdsourcing websites, social media, crowdfunding platforms, collaboration tools, and innovation management software, which are widely used in various fields. However, the ongoing need for synchronized development efforts in offline and online domains is crucial to address market and consumer evolution effectively. To expand customer reach, businesses must understand how to mix offline and online platforms [31], combining digital platforms with traditional methods like focus groups and in-person workshops to engage customers across various media frameworks. However, the growing reliance on consumer data in OI projects necessitates

a thorough evaluation of ethical implications and privacy protection. At the same time, progressive perspectives advocate for the potential benefits of data use and the creation of reliable procedural systems [26]. Businesses should be encouraged to share data for public interest, with recommendations for regulatory sandboxes and safe harbors similar to those used in fields like intellectual property law, financial technology, and antitrust for future discussion.

Research on consumer co-creation has made significant progress, but further research is needed to improve platforms by refining design principles and methods for meaningful participant interactions based on consumer knowledge to maximize the platform's benefits [12,27]. Empowering marginalized and underrepresented consumers and advancing consumer learning and knowledge transfer is crucial for the long-term sustainability of OI, requiring addressing barriers and the development of inclusive strategies. Research could explore the unique challenges faced by SME groups and people with disabilities while enhancing consumer learning and knowledge transfer, which involves extracting knowledge from consumers and facilitating its transfer between companies [7]. Mechanisms such as knowledge management systems or communities of practice could be explored to achieve this integration of consumer insights into organizational learning processes. Further study in the consumer sector is crucial in consumer insights and analytics, which involve analyzing vast consumer data to identify patterns and make recommendations for innovation and marketing strategies. Companies leverage consumer data to personalize products, services, and experiences to improve customer satisfaction, loyalty, and retention by integrating personalized offerings into OI initiatives [71]. Research on community engagement and brand advocacy suggests that initiatives can boost brand loyalty, advocacy, and customer satisfaction. Future studies should explore how organizations use online forums, user communities, and co-creation workshops to build consumer connections, gather feedback, and foster brand ownership. Saorin et al. [72] assert that successful Open Innovation (OI) initiatives require robust leadership support and alignment with organizational goals and strategies, as persistent leadership intensifies OI practices.

In contrast, ineffective leadership can negatively impact the organization. The study highlights the need to explore the consequences of a need for more alignment between OI efforts and organizational goals and strategies to ensure senior leadership alignment with OI objectives. Effective strategies rely on cultivating trust and strong relationships among collaborators, including partners.

After reviewing the literature related to OI and its challenges (Cons), 20 domains were identified. Further analysis revealed that among all publications, only eight domains had relatively low publications, indicating potential areas for further research development to enhance the understanding of relevant components, data, or contextual content. These domains are (1) ecosystem development, (2) intellectual property management, (3) scalability and flexibility, (4) leadership and governance, (5) long-term sustainability, (6) risk management, (7) incentives and recognition, and (8) ethical considerations, aligning with findings from previous studies indicating that intangible assets have received relatively little attention in OI research.

Acknowledging the limitations of the analysis tool used, Pro Word Cloud provides qualitative visual data. However, it needs more detailed quantitative analysis, potentially skewing emphasis toward frequently used words over less common yet significant terms. Supplementing with another tool for confirmation may be necessary. Our analysis includes 184 documents, some of which are non-English papers, suggesting the potential benefit of adding additional databases to enhance the depth and inclusiveness of network analyses for more meaningful and robust insights into the research field.

For practitioners, the findings underscore the importance of aligning OI strategies with organizational goals and addressing challenges in intellectual property, scalability, and ethics. Focusing on neglected domains such as ecosystem development and risk management can enhance practical applications of OI principles, fostering collaboration and innovation within diverse disciplinary boundaries.

6. Conclusions

This research delves into the publication patterns, citation networks, collaboration dynamics, and future research directions within OI and Cons. The prominent authors are identified based on their publication density, with the United States leading from a country perspective, with 33 articles, trailed by the UK with 24 and Germany closely following with 19. Overall, based on 184 articles on OI and its intersection with Cons, prevalent keywords such as 'Innovation', 'Open Innovation', 'Development', 'Consumer', 'Management', 'Digital', 'Process', 'Crowdsourcing', 'Customer', 'Communities', and 'Commerce' are identified. This finding underscores the significance of external collaboration, internal innovation, ecosystem development, and technology platforms for consumers who advocate for structured organization-wide adoption of OI and the creation of collaborative tools.

Using co-word analysis, the connections among research themes are scrutinized in the context of OI and Cons. Five clusters are identified: Cluster 1 focuses on consumer behavior and decision-making processes, Cluster 2 focuses on technology-driven innovation and business development, Cluster 3 focuses on crowdsourcing creativity and sales dynamics, Cluster 4 focuses on online platforms and technical advancement, and Cluster 5 focuses on entrepreneurial ecosystems. The Scopus dataset spanning 2014 to 2020 reveals evolving themes, from innovation management and software engineering in 2014 to human activities, co-creation, and competition from 2016 to 2018 to the emergence of sustainability, the green economy, and digitalization since 2020, emphasizing sustainable products and services.

The dataset encompasses 82 authors, with a focus on user co-creation innovation. Notably, Chesbrough emerges as the most cited author in Cluster 2, emphasizing OI. The author's co-citation analysis highlights the United States and the United Kingdom as leaders, followed by Italy, France, Russia, and Germany in Europe. Moreover, the study outlines future research trends derived from keyword analysis, component-based analysis, and publication count analysis. Finally, in forthcoming bibliometric examinations, various domains associated with this field could be explored, the connections between OI and other research streams could be analyzed, and essential aspects of business administration could be assessed in the OI context.

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