

**Green Ambidextrous Innovation – A Bibliometric Study**

**Ms. Suruchi Chopra<sup>1</sup>, Ms. Chahat Malhotra<sup>2</sup>, Dr. Anju Shukla<sup>3</sup>,**

Assistant Professor, Vivekananda Institute of Professional Studies

Assistant Professor, Vivekananda Institute of Professional Studies

Assistant Professor, Vivekananda Institute of Professional Studies

**Abstract**

The ability of an organization to concomitantly undertake exploratory green inventions and exploitative eco-efficiency increments is known as "Green Ambidextrous Innovation". It has emerged as a critical strategic response to growing demands for sustainability in businesses. However existing literature on this dual capability remains scattered from a theoretical and methodical lens. In order to chart out current empirical trends, identify prevailing theoretical foundations and consolidate conceptual definitions, this bibliometric review critically assesses and synthesizes scholarly ideas on the construct. The study employs a descriptive approach, including identification, classification and synthesis of research from the domains of innovation, organizational behaviour, sustainability and strategic management. The review has prominently identified for antecedents - leadership and governance, organizational culture, structural and resource configurations and external institutional pressures. The study has also highlighted key performance outcomes related to environmental impact, innovation capability, and competitive advantage. It also uncovers persistent tensions, including resource allocation conflicts, ambidexterity implementation challenges and measurement inconsistencies. By assimilating these findings, the review proposes a refined conceptual framework that situates green ambidextrous innovation within dynamic capabilities theory and outlines methodological gaps and opportunities for future research. These include micro-foundational analysis, longitudinal designs, and cross-country comparative studies. This work advances theoretical consolidation and provides a foundation for more rigorous empirical inquiry into sustainable organizational innovation.

**Keywords:** Green Ambidextrous Innovation, Exploration, Exploitation, Sustainability, PRISMA, Bibliometric Analysis

**1. Introduction**

Owing to stakeholder activism, pressure from regulatory forces and climate related risks, firms must pursue concomitant environmental exploration and exploitation. This is pertinent to stay competitive while shifting towards resource efficient business models (Dranev et al., 2020)(Chen et al., 2014). Green Ambidexterity is no longer seen as an optional sustainability stance but rather as a strategic necessity as per contemporary research. This dual endeavour directly addresses the "green paradox," which requires firms to maintain a balance between short-term financial returns and long-term ecological responsibility (Cai et al., 2026).

Green innovation (GI) was initially thought of as a one dimensional idea. It has now evolved into a multifaceted innovation capability that includes both radical technological developments and small-scale improvements. Green incremental innovation emphasizes on efficiency oriented modifications of existing products and processes. Green radical innovation, on the other hand, involves completely changing existing knowledge bases and routines and developing new green technologies (Cai et al., 2026). The coexistence of these two innovation logics highlights the significance of organizational ambidexterity in the environmental domain.

According to Chen et al. (2014), Cai et al. (2026), Makhloufi (2024), and Cui et al. (2019), Green Organizational Ambidexterity (GOA) is the dynamic ability of a firm to integrate both green exploration and green exploitation to improve the economic and environmental performance at one point in time. Previous research indicates that, although green exploration is necessary for long-term adaptability and decarbonization readiness, green exploitation offers the short-term operational efficiency and financial slack needed to support

high-risk environmental investments(Cai et al., 2026) (Asiaei et al., 2026). As a result, ambidexterity serves as a stabilizing mechanism that synchronizes sustainability goals with organizational survival. At the firm level, the successful implementation of green ambidexterity depends on Ambidextrous Intellectual Capital, which includes green human capital, green structural capital, and green relational capital(Cai et al., 2026)(Asiaei et al., 2023)(Martínez-Falcó, Sánchez-García, Marco-Lajara, & Lee, 2024a) (Asiaei et al., 2023). These intangible assets enable firms to sense environmental opportunities, reconfigure routines, and collaborate with external stakeholders to amplify green innovation outcomes. Complementing these resources, top level managers environmental awareness and strategic commitment play a critical role in legitimizing green investments and embedding sustainability into organizational decision-making(Martínez-Falcó, Sánchez-García, Marco-Lajara, & Lee, 2024a)(Cao et al., 2022).

A company's inclination to pursue ambidextrous green innovation is further reinforced by strategic orientations like Green Organizational Identity (GOI) and Green Entrepreneurial Orientation (GEO). While GOI grounds sustainability in the company's core values and self-concept, guiding consistent green behaviour across organizational levels, GEO represents a company's proactive, risk-taking, and innovative approach to environmental opportunities (Makhloufi, 2024) (Chen et al., 2022)(Shafique et al., 2021). Simultaneously, the literature emphasizes the growing significance of the digital-green nexus, especially through the adoption of digital financial literacy and big data analytics capabilities (BDAC). By facilitating the acquisition, assimilation, and application of complex environmental knowledge, these capabilities improve firms' Green Absorptive Capacity (GAC), particularly in resource-constrained SMEs facing "resource paucity" (Makhloufi, 2024)(Huang et al., 2026)(Mayr, 2025). Therefore, digital tools act as a crucial support system that minimise the cost and uncertainty attached with ambidextrous green innovation.

Green ambidexterity is becoming more prominent within inter-firm networks and open innovation ecosystems, that transcend organisational borders. Ambidextrous Open Innovation makes it easier to access external green knowledge, while resilient supply-chain collaborations enable firms manage environmental disruptions without sacrificing sustainability goals (Purnomo, Syafrianita, Rahayu, et al., 2024)(Kim et al., 2025). Green Transformational Leadership (GTL) emerges as a key driver of Green Resilient Supply Chains (GRS) in environmentally intensive sectors such as textiles and manufacturing, ensuring adaptability and environmental integrity under unstable global conditions (Purnomo, Syafrianita, Simatupang, et al., 2024).

The literature is still dispersed although various developments are going on. There is still conceptual disagreement with respect to whether companies should prioritize green or digital innovation provided different contextual limitations (Mayr, 2025). Additionally, failure of exploration, separation drift and organizational obstacles have gotten less attention. For instance, insufficiency of Environmental Management Accounting (EMA) systems constrain the ability to translate green intent into measurable competitive edge in the business environment (Huang et al., 2026) (Asiaei et al., 2026)(Hansen et al., 2022),(Hansen et al., 2019). Methodologically, the field spans diverse analytical approaches ranging from Data Envelopment Analysis to Evolutionary Game Theory, highlighting the need for a structured bibliometric synthesis to map dominant themes, methods, and intellectual trajectories (Cai et al., 2026)(Cui et al., 2019).

This bibliometric study is focussed on filling these prominent gaps by systematizing the developing discourse on green innovation ambidexterity and providing a road map for bridging the gap between theoretical sustainability goals and real-world institutional outcomes, especially for SMEs with limited resources and environment related barriers. Through the analysis of citation and co-citation of dataset acquired from Scopus database, the research is emphasized in exploring the underlying intellectual foundations shaping the research environment, identifying the influential authors, journals, institutions, and countries that have been making essential contributions to the emerging field of research, and analyze the evolution path of publications in the area. Furthermore, it also intends to explore the key thematic groups that arise from the co-occurrence of keywords, and analyze the conceptual relationships between the themes. Furthermore, the study investigates collaborative patterns among scholars and institutions and identifies emerging themes and underexplored areas that provides the directions for future research works.

## **2. Literature Review**

The idea of Green Ambidexterity Innovation (GAI) has its roots associated with foundations of contemporary environmental thinking, driven by the general exploration-exploitation paradigm. As stated by (Chen et al., 2022), green innovation is not a one-off process but a two-step process that includes green exploitative innovation (GEI) and green exploratory innovation (GER). GEI is the improvement and optimization of existing green technologies and processes to satisfy existing environmental requirements. GER, on the opposite end, represents the quest for radically new green information and the development of innovative environmentally friendly products that have the potential to disrupt existing markets. The organizational ability to balance these two conflicting demands at the same time, enabling a business to stay productive in the present while getting ready for upcoming ecological changes, is known as green ambidexterity (Asiaei et al., 2023)(Chen et al., 2022).

The evolution and springing of green ambidexterity are deeply associated to internal organizational resources and strategic leadership. Research in some of the studies identifies Green Transformational Leadership (GTL) as a key driver. Leaders who possess GTL inspire employees to transcend self-interest for the sake of environmental objectives, fostering the flexible mindset essential to balance exploitation and exploration (Purnomo, Syafrianita, Simatupang, et al., 2024). This leadership is essential in high-impact sectors like the Indonesian textile industry, where GTL directly influences a firm's ability to achieve a green resilient supply chain by leveraging GAI as a strengthening mechanism (Purnomo, Syafrianita, Simatupang, et al., 2024). Furthermore, (Chen et al., 2022) posits that Green Organizational Identity (GOI)—the collective perception that environmental protection is a core corporate value—acts as the cognitive foundation for GAI. Firms with a strong GOI are more likely to view green innovation not as a cost, but as a path to a Green Competitive Advantage (GCA), using GEI and GER as mediators to translate values into market performance (Chen et al., 2022).

In addition to leadership and identity, specialized human resource practices and knowledge assets play a vital role. As detailed explanation in study conducted by (Martínez-Falcó, Sánchez-García, Marco-Lajara, & Zaragoza-Sáez, 2024), Green Human Resource Management (GHRM) which includes green hiring, training, and performance appraisals—is a significant antecedent of GAI. GHRM fosters Green Intellectual Capital (GIC), the sum of a firm's green intangible assets (human, structural, and relational). The study conducted on Spanish wineries demonstrates that GIC acts as a "raw material" that must be reconfigured through green ambidexterity to achieve superior environmental performance (Asiaei et al., 2023)(Martínez-Falcó, Sánchez-García, Marco-Lajara, & Zaragoza-Sáez, 2024). Interestingly, the effectiveness of this process is often moderated by Top Management Environmental Awareness (TMEA). When top managers are having immense awareness about environmental concerns, there is higher probability that they allocate resources toward both exploratory and exploitative innovation, thereby making the link between green capabilities and actual performance outcomes stronger (Martínez-Falcó, Sánchez-García, Marco-Lajara, & Lee, 2024a).

The role of technology, particularly emerging digital tools, has also become a critical factor in the "how" of green ambidexterity. Research conducted by (Ruangkanjanases et al., 2025) highlights the impact of Generative AI Capabilities (GAIC) in the manufacturing sector. Generative AI enhances organizational creativity, which in turn fuels both exploratory and exploitative green innovations. By automating routine efficiency tasks (exploitation) and providing novel insights for breakthrough designs (exploration), AI helps firms achieve a green competitive advantage more rapidly than traditional methods (Ruangkanjanases et al., 2025). This technological integration is especially relevant for SMEs, as noted in research conducted by (Hossain et al., 2025), where Green Entrepreneurship Orientation (GEO)—a proactive and risk-taking approach to environmental opportunities drives GAI. For Malaysian manufacturing SMEs, GAI serves as a vital mediator that allows limited resources to be used effectively to meet green performance targets amidst technological turbulence ((Hossain et al., 2025).

Beyond internal performance, GAI is increasingly viewed as a tool for supply chain resilience. As explored in some of the studies the integration of Green Supply Chain Management (GSCM) necessitates an ambidextrous approach (Purnomo, Syafrianita, Rahayu, et al., 2024)(Martínez-Falcó, Sánchez-García, Marco-Lajara, & Lee,

2024b). GSCM practices, such as eco-design and green purchasing, provide the operational framework, but it is GAI that allows firms to innovate within that framework to achieve Sustainable Performance (SP). In the context of the wine industry, GAI helps wineries transition toward a circular economy by balancing the optimization of current water and waste management with the exploration of radically new sustainable viticulture techniques (Martínez-Falcó, Sánchez-García, Marco-Lajara, & Lee, 2024b). Ultimately, GAI acts as a bridge that connects environmental strategy to a Green Resilient Supply Chain (GRC), enabling firms to withstand disruptions while maintaining their commitment to sustainability (Purnomo, Syafranita, Rahayu, et al., 2024).

In conclusion, the literature collectively suggests that green ambidexterity innovation is a "pivotal" strategic capability. It does not exist in a vacuum but is born from a combination of green leadership, organizational identity, intellectual capital, and entrepreneurial orientation. By successfully balancing the "dual-core" of exploitation and exploration, firms across diverse sectors from Spanish wineries to Indonesian textile plants and Malaysian SMEs—can navigate the complexities of modern sustainability, turning environmental pressures into long-term competitive advantages.

### **3. Methodology**

A methodical bibliometric review has been employed in the study with a systematic integration with the PRISMA framework. This would ensure transparency, rigor and reproducibility of the study. SCOPUS database was utilised as a source for bibliographic data because of its wide coverage of reputable peer-reviewed journals in the domains of management, sustainability, innovation, and organizational studies. Boolean operators and keywords associated with green innovation, green ambidextrous innovation, exploration and exploitation were used. In the initial database search, a total of 79 records were found. 70 articles from these were carried forward from the screening process after applying filters to include only journal articles and English language publications. One article was excluded during the evaluation of eligible articles since the complete record was not accessible and no DOI was available. As a result, 69 peer-reviewed journal articles that were judged appropriate for bibliometric analysis made up the final sample.

Bibliometric tools such as VOS viewer and Bibliometrix were utilised for performance analysis and science mapping techniques such as citation analysis, key word co-occurrence etc. Thematic evolution of the construct and identification of intellectual structures within the data is made easier through the use of the PRISMA framework and bibliometric approach (Donthu et al., 2021; Page et al., 2021).

#### **3.1 PRISMA Flow Diagram Description**

The PRISMA flow diagram (Figure 1) is a clear representation of detailed process followed for selection of relevant and appropriate articles for our including in this review study and finally in this bibliometric analysis is done. These stages consist of -Identification, Screening, and Inclusion. Each stage ensures transparency, replicability, and methodological rigor in line with the PRISMA framework.

##### **3.1.1 Identification Stage**

The identification stage is the first stage of the search and compilation of articles. A thorough search approach was employed in the Scopus database, and a total of 79 records were acquired. The search term was developed in a way that included relevant keywords and Boolean approach to ensure that all possible studies relevant to the study aims were included.

At this point, there were no duplicate records identified ( $n = 0$ ), and this means that the pool of records was clean and came from a single database source. Moreover, there were no records that were deemed ineligible or excluded for other preliminary reasons before the screening process ( $n = 0$ ). Thus, all 79 records obtained moved to the screening process.

3.1.2 Screening Stage

A preliminary evaluation of the 79 identified records employing predetermined inclusion and exclusion criteria was part of the screening stage. To make sure they fit the parameters of the bibliometric analysis, titles, abstracts, and publication information were examined. Nine articles were screened out at this stage because they either did not fit the eligibility requirements, specifically that they were either non-English publications or non-journal articles (such as conference papers or book chapters). These records were eliminated because the review was limited to peer-reviewed journal articles published in English in order to guarantee quality and comparability.

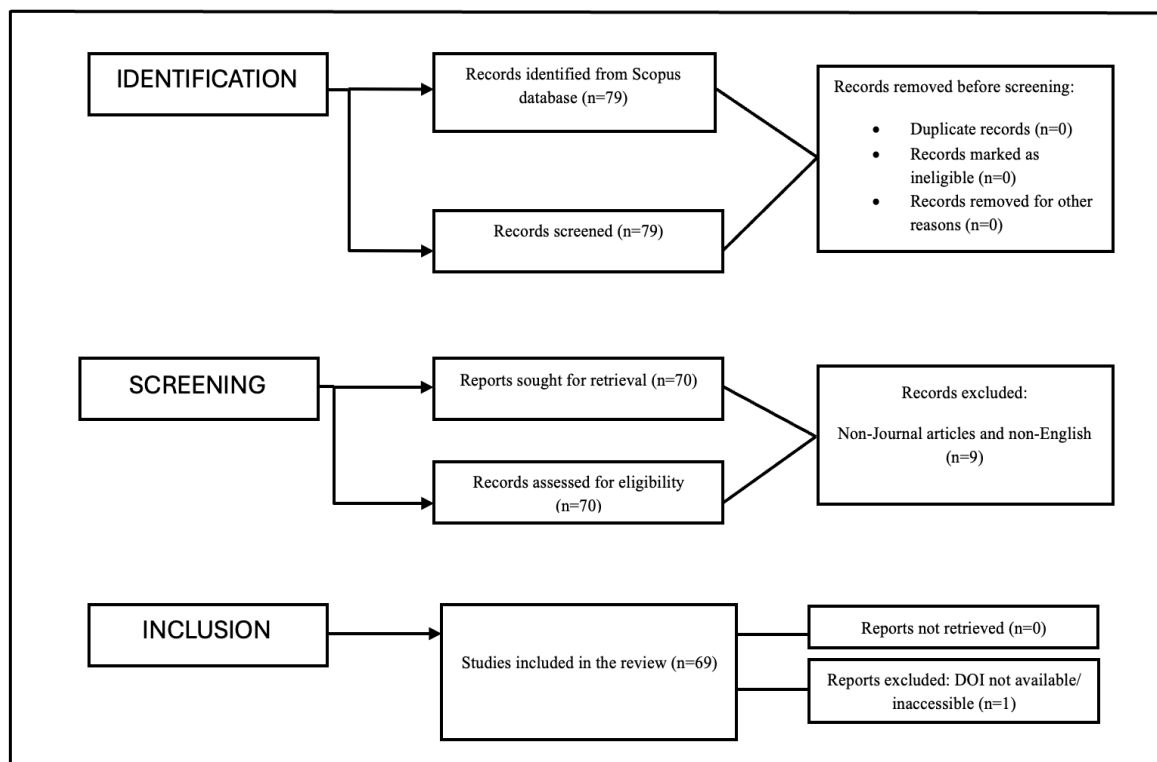
We have got 70 articles at this stage after applying the filters, 70 reports were judged appropriate and requested to be. Complete access to the filtered dataset was demonstrated by the successful retrieval of all 70 reports (n = 0 not retrieved). Following that, these 70 studies progressed to the eligibility assessment stage. In this stage only, the full texts of the 70 retrieved articles were carefully analyzed to ensure their relevance for this bibliometric analysis. This thorough evaluation ensured that each article selected has met the methodological and thematic requirements of the review.

During this stage, 1 article was excluded because its DOI was not available and was inaccessible for full-text verification. The absence of a DOI and inability to retrieve the complete article limited its suitability for bibliometric analysis, which requires accurate metadata for citation and network mapping.

3.1.3 Eligibility and Inclusion Stage

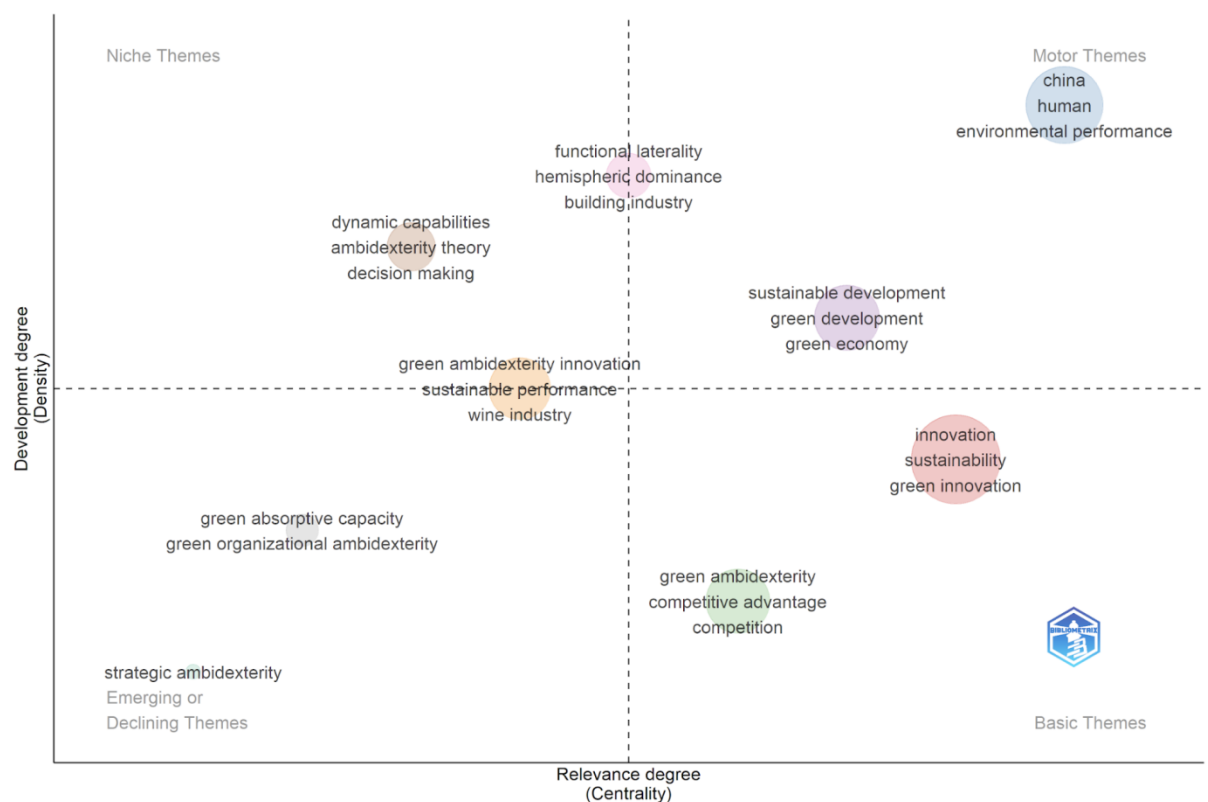
After all the irrelevant articles excluded at this final stage, 69 studies met all the eligibility criteria and were considered for the bibliometric review process. These 69 publications formed the final dataset for analysis, serving as the foundation for subsequent citation analysis, co-authorship mapping, keyword co-occurrence analysis, and thematic exploration.

Figure 1 : PRISMA flow diagram



4.1 Thematic Map

Figure 2 : Thematic Map (using VOSviewer)



Thematic mapping was done to explore the conceptual structure by analysing the co-occurrence of keywords. The technique classifies research themes according to their centrality and density, leading to the identification of motor, basic, niche, and emerging themes within the field (Cobo et al., 2011; Aria & Cuccurullo, 2017).

4.1.1 Motor themes:

This quadrant reflects dimensions that are well-developed and highly coherent to the broader research field. In this study, geographical focus on China, environmental performance and human factors appear as motor themes. This position indicates that the interrelationship between green innovation practices and environmental results is a driving force in the literature currently. The pre-dominance of China suggests that major empirical evidence originates from this context. The presence of human related factors also reflect expanding interest in managerial practices, employee engagement and human capital to drive sustainable innovation and development.

4.1.2 Basic themes:

Basic themes are a part of the quadrant characterised by high centrality and low density. Their high degree of centrality indicates that they are widely connected to the other themes and can provide a fundamental basis to study the concept of Green Ambidextrous Innovation. However a low degree of density portrays that these constructs are still in an evolving stage. Concepts such as Innovation, Sustainability, Green Innovation and Green Ambidexterity are hitherto studied in broader terms and not through a specialised theoretical lens. As a result, green ambidextrous innovation research continues to draw heavily on the wider innovation and sustainability literature to explain how firms reconcile environmental responsibility with competitive performance.

4.1.3 Niche themes:

High density and lower centrality Niche themes include dynamic capabilities, ambidexterity theory and decision-making processes. These themes have been extensively developed within their own scholarly domains. Their presence in this quadrant showcases that while they provide important conceptual foundations for understanding how firms manage exploratory and exploitative green innovation, their integration with the broader sustainability literature is still evolving.

4.1.4 Emerging or Declining themes:

The emerging themes include constructs such as strategic ambidexterity, green absorptive capacity and green organizational ambidexterity. These topics reflect a growing interest of academia in capability based descriptions of sustainable innovation. Their position suggests that future research is likely to move past the outcome based analyses and increasingly emphasize on the mechanisms that enable firms to concomitantly pursue environmental sustainability and competitiveness.

4.2 Keyword Co-occurrence network:

The co-occurrence network created using VOS Viewer showcases multi-layered thematic structure revealing how innovation and sustainability are arranged into distinct yet interconnected domains of knowledge. The red cluster captures a macro and policy driven theme inclusive of keywords such as sustainable development, environment performance, environment management and green ambidexterity. The yellow cluster, centered around innovation, represents a strategic management perspective, linking concepts such as dynamic capabilities, CSR and sustainable innovation. The green cluster illustrates performance related dimensions of sustainability with a focus on SMEs and manufacturing. Emerging themes such as absorptive capacity, organisation ambidexterity and green innovation are reflected by the purple cluster. The blue cluster acts as a bridge between strategic and environmental considerations. There is dense interconnections across clusters, particularly through major nodes such as sustainability, innovation and green innovation. While the field is evolving towards integration, it has been fragmented into disciplinary silos. Green ambidexterity still occupies a peripheral area of study but is at the interdisciplinary interaction of these thematic domains and hence a novel arena to research on.

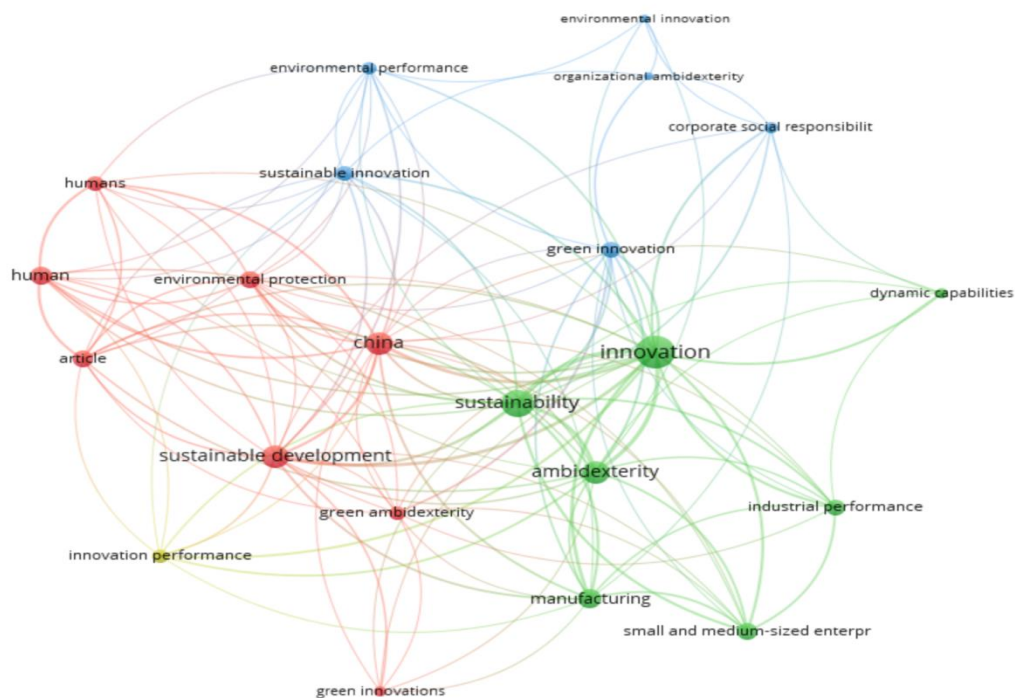


Figure 3 : Keyword Co-occurrence network (using VOSviewer)

## 4.3 Network Visualization of Sources

The visualization of network of major journals created using VOS viewer and based on the Scopus dataset is represented in Figure 2. Every node in this network represents a journal. The publications and citations received by the journal on the specific theme are indicated by the size of the node. The colour of the nodes changes from blue (earlier publications, i.e. around 2022) to green (2023-2024) and yellow (most recent, around 2025). Business Strategy and Environment has been one of the most prominent publication outlets as far as research on sustainability and strategic management is concerned. Journal of Business and Industrial Marketing, Journal of Intellectual Capital, European Journal of Innovation Management, and Corporate Social Responsibility and Environmental Management emerge as pertinent sources shaping the domain's intellectual foundation.

A surge in academic output has occurred recently indicated by the presence of green and yellowish nodes. This is especially in the integration of the fields of digital transformation, green innovation and ESG performance. Additionally, journals like Frontiers in Public Health and Sustainability (Switzerland) show how the field has expanded interdisciplinarity beyond traditional management and strategy outlets.

Collectively, Figure 2 clearly represents that the research area is rooted in strategic management literature that focussing on sustainability as a competitive advantage.

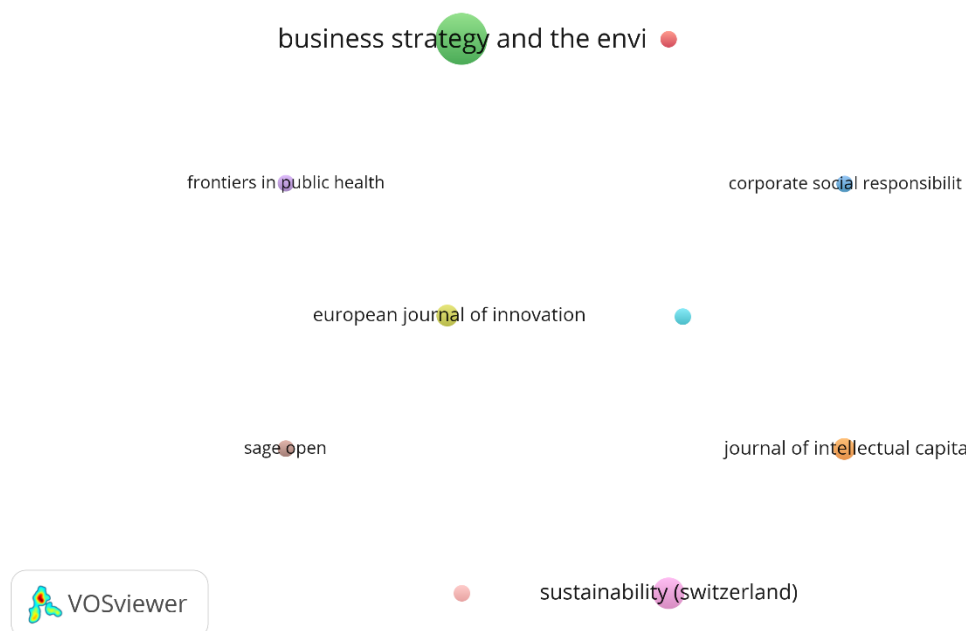


Figure-2

## 4.4 Country-Level Citation and Collaboration Network

The country-level citation and collaboration network, which was created using the same Scopus dataset and displayed with the VOS viewer, is depicted in figure 3. Every node in this network represents a nation that makes contributions to the field of study. While the node's spatial positioning reflects the strength of collaboration or bibliographic links between nations, its size indicates relative research productivity and citation impact.

With a significant publication output and citation influence, China is identified on the map as one of the most significant contributors. Australia and the United States are also well-represented, which is indicative of their longstanding leadership in research on strategic management, innovation, and sustainability.

Europe's substantial involvement in promoting sustainability and green innovation studies is demonstrated by the steady scholarly participation of European nations such as Germany, the United Kingdom, France, Spain, Portugal, and Switzerland. Furthermore, the network includes emerging economies like Pakistan, South Africa, Indonesia, and the United Arab Emirates, demonstrating the research theme's increasing global diffusion.

The field has developed into a globally interconnected research area, as evidenced by the geographical distribution of nodes across Asia, Europe, North America, Africa, and Oceania. The growing prominence of developing countries indicates broader internationalization and collaborative expansion, even though research influence is still concentrated in major academic economies.

In conclusion, Figure 3 depicts both the concentration of citation strength specially in the nations where immense research is taking place in chosen research theme and the growing participation of emerging regions, confirming the global relevance and diffusion of the research domain.



Figure-3

#### 4.5 Network Visualization of Institutions

The institutional citation network produced by the VOS viewer from the Scopus dataset is shown in figure 4 (Van Eck & Waltman, 2010). An affiliated institution is depicted by each node, and the size of each node indicates the impact of citations and the productivity of research. Stronger scholarly contributions are indicated by the more central appearance of prestigious universities like Sonoma State University, Shandong University, Aston University (Birmingham), Beijing Normal University, and Stellenbosch University. It depicts the organizational and geographic distribution of knowledge production and identifies the top academic centres advancing research on sustainability and green innovation.

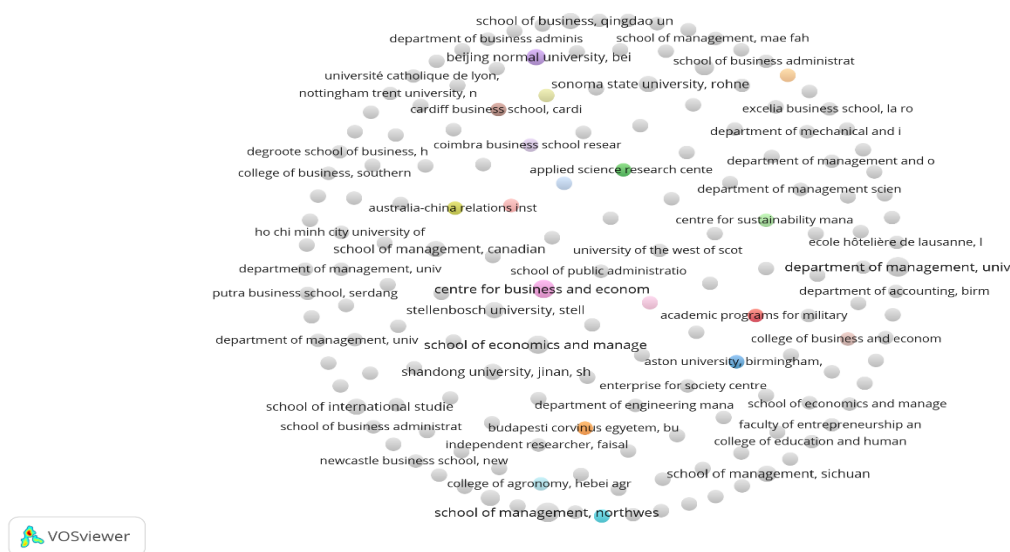
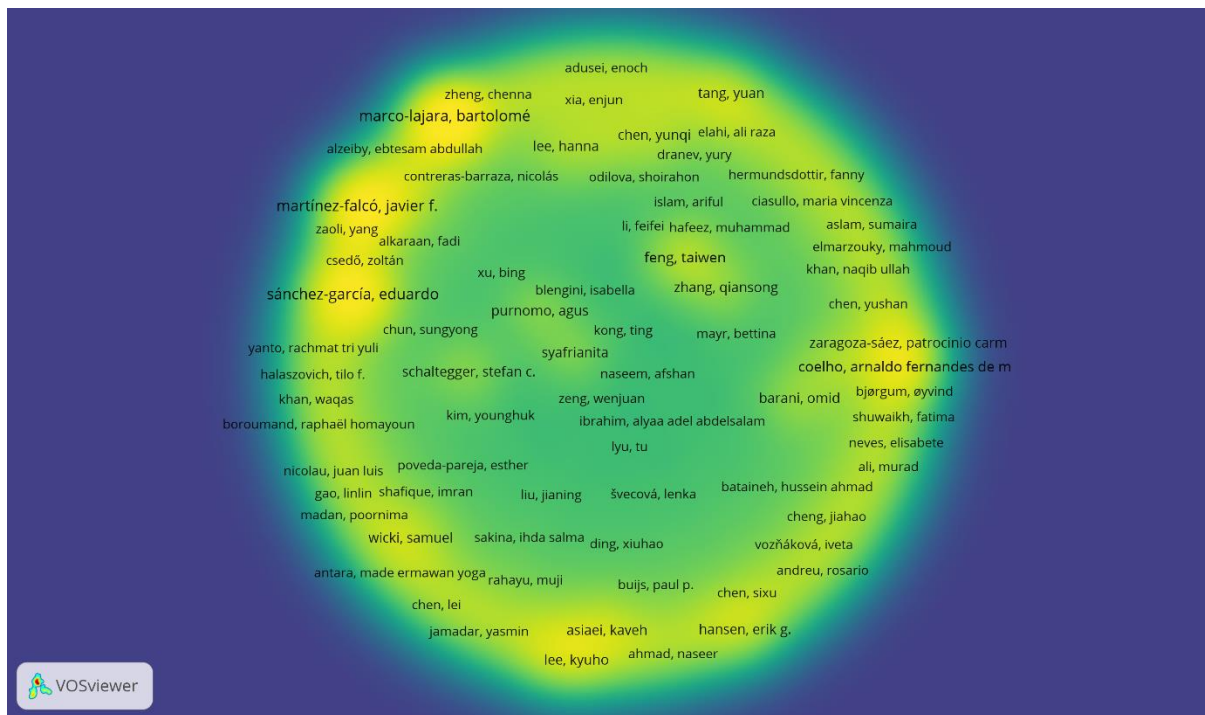


Figure 4-Network Visualization of Institutions



The author citation density produced by VOS viewer is shown in Figure 5. Based on the density of citations, the map illustrates the intellectual framework of green ambidextrous innovation. In a density map, yellow regions show authors with greater bibliographic influence, while green and blue regions show areas of lesser citation density.

A dense core of highly cited authors is visible from the density map. Chen et al. (2014), (Asiaei et al., 2023), Alkaaran, Fadi (Alkaaran et al., 2024) are some of the most cited works in the field. Other influential contributors located within moderate-to-high density areas include Shafique et al. (2021), Peters & Buijs (2022), Sánchez-García, Eduardo, Martínez-Falcó, Javier F., Schaltegger, Stefan C., and Zhang, Qiansong. Their proximity within the visualization suggests thematic and citation interconnectivity, particularly in sustainability management, environmental strategy and corporate social responsibility domains.

According to the clustering pattern, green ambidextrous innovation research is an interdisciplinary domain that draws from:

- Environmental management and sustainability
- Social responsibility of corporations
- Dynamic capabilities and strategic management
- A strategy for innovation and digital transformation

The field is leading toward theoretical consolidation from fragmentation, based on the comparatively dense and centralized structure. Newer works that are progressively receiving more citations are represented by emerging authors in lighter green zones, which indicates that the field of study is still growing.

#### 4.7 Keyword Co-occurrence Word Cloud

Figure 6 presents the keyword co-occurrence visualization derived from the Scopus dataset using bibliometric analysis. The frequency of occurrence of the words in title, abstract and keywords is reflected by size of the word. Larger fonts are more prominent terms with higher reoccurrence and stronger conceptual importance.

The most frequent keyword is ‘innovation’, emphasizing that literature is fundamentally focussed on innovation theory. Other closely connected words include ‘sustainability’; ‘green innovation’, ‘ambidexterity’ and ‘green

ambidexterity’. This is a confirmation that the field integrates environmental sustainability with organisational ambidexterity.

There are many terms that relate to performance metrics such as ‘environmental performance’, ‘sustainable performance,’ ‘industrial performance,’ and ‘competitive advantage’ suggest that a major stream of research examines the outcomes of green ambidextrous innovation. The presence of ‘dynamic capabilities’, ‘organizational ambidexterity’ and ‘green entrepreneurial orientation’ indicates theoretical grounding in the resource-based view and dynamic capability frameworks.

Country-specific prominence, particularly “China,” reflects the geographical concentration of empirical studies. Sector-specific terms such as “manufacturing,” “SMEs,” “wine industry,” and “supply chain management” indicate applied research contexts.

Additionally, emerging themes such as ‘green transformational leadership’, ‘digitization’, ‘green economy’ and ‘green absorptive capacity’ suggest the evolving conceptual direction of the field toward digital sustainable innovations.



Figure 6- word Cloud

#### 4.8 Keyword Co-occurrence Density MAP

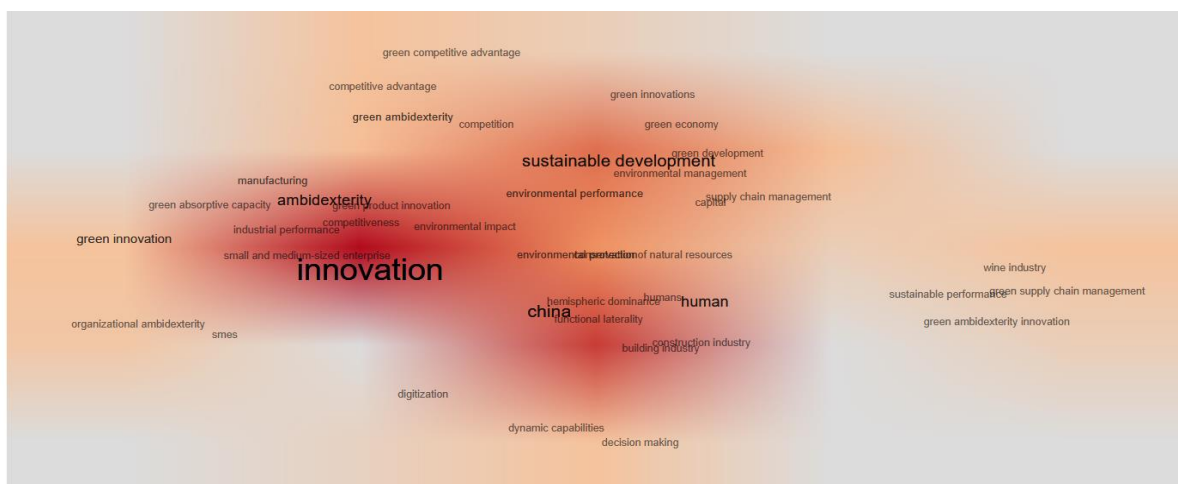


Figure 7 – Density Map

The figure 7 clearly depicts a keyword co-occurrence density visualization produced through the usage of the Biblioshiny interface of the Bibliometrix package in R Studio. The map shows the strength of connections between author keywords based on their frequency and co-occurrence. In the map, the ardent colours (red and dark orange) show deeper linkage and higher density of the keywords, while the lighter colours show lower density and weak linkages.

The word “innovation” has come forward as the most critical and dense node, indicating its significance in the intellectual structure of the subject. Innovation is highly interlinked with keywords such as ambidexterity, green innovation, environmental performance, competitiveness, and small and medium-sized enterprises (SMEs), suggesting that innovation is largely studied through strategic and sustainability-focused lenses.

Another very dense thematic group revolves around “sustainable development,” which is closely linked with green economy, green development, environmental management, and supply chain management. This is a clear indication of a strong integration of the sustainability discourse with innovation studies.

The density map also sheds light on the emergence of strategic constructs such as green absorptive capacity, dynamic capabilities, and organizational ambidexterity, which indicate a capability-oriented perspective underlying sustainable and green innovation studies. Industry-specific terminology such as manufacturing, construction industry, and wine industry also emerges in the density map, which indicates the application of these themes in a sector-specific manner.

In conclusion, the density map generated by Biblioshiny indicates that the research area is primarily organized around innovation-driven sustainable development, with a growing focus on green competitiveness, ambidexterity, and capability-building as approaches to improve environmental and organizational performance.

## **5. Implications**

There are most significant methodological, theoretical, and practical implications of this bibliometric study. From a theoretical point of view, this study is combination of different bits of knowledge and it has systematically articulated the conceptual and intellectual foundations of a body of knowledge. By using a keyword co-occurrence analysis to locate thematic clusters, it is possible to identify the streams of research that are most prominent and how different concepts are related to each other within the overall knowledge structure. This study has put forward the theoretical foundations that have significantly impacted the evolution of a body of knowledge by pointing on prominent publications and citation patterns that have indicated a transition from foundational concepts to more integrative and application-oriented views. For managers and organisations who truly wish to go beyond symbolic sustainability initiatives and integrate real environmental responsibility, this study offered significant practical implications. Valuable suggestions such as the idea that green innovation should not be treated as a next level initiative or compliance requirement. Instead, firms are required to deliberately balance two strategies: improving existing processes to decrease waste and emissions along with investing in new, forward-looking environmental solutions. The organization who are effective in maintaining this equilibrium achieve both positive impact on the environment and long-term competitiveness in the market.

Sustainability must come from top down, according to top leaders. When supervisors actively support green initiatives, allocates resources to environmental innovation, and communicates a strong sustainability vision, employees are more likely to embrace and implement green practices. Encouraging a culture that values environmental responsibility, providing green training, and integrating sustainability into HR systems can strengthen the organization’s internal abilities.

The study also highlights the importance of using technology wisely. Digital tools, data analytics, and knowledge-sharing systems can help organizations make informed environmental decisions and reduce the uncertainty that often surrounds green investments. Collaboration is equally important. Working closely with suppliers, customers, and research partners can make green innovation more practical, affordable, and impactful.

For small and medium-sized enterprises (SMEs), the findings are particularly relevant. Even with limited resources, SMEs do not have to choose between short-term efficiency and long-term sustainability. By carefully combining incremental improvements with selective innovative green projects, they can remain competitive while responding to environmental expectations and regulatory pressures.

Methodologically, this article shows the advantages and effectiveness of employing bibliometric software such as VOS viewer in combination with the PRISMA methodological approach in systematically synthesizing and organizing a vast amount of literature. The integration of performance analysis and visualization in systematic

reviews enhances transparency, replicability, and in-depth analysis. This methodological approach can serve as a model for future studies on bibliometric analysis in other related fields of study.

## 6. Limitations

The study has certain limitations despite its contributions. Because the analysis is limited to publications that are indexed in the Scopus database, pertinent studies that are available in other databases, like Web of Science or Google Scholar, may not be included. The findings' potential global comprehensiveness may have been limited by the exclusion of important regional or non-English contributions due to the restriction to English-language publications. Furthermore, conference proceedings, book chapters, and grey literature that might provide supplementary insights are not included due to the emphasis on particular document types, mainly peer-reviewed journal articles. Citation metrics, which may represent visibility and publication age rather than inherent research quality, are also a major component of bibliometric analysis. Finally, network visualizations provide a structural snapshot of relationships at a particular time and do not fully capture the dynamic and quickly evolving nature of the research domain.

## 7. Future Research Directions

The bibliometric mapping's conclusions point to a number of directions for further investigation. The overlay visualization's emerging themes point to the need for more thorough empirical and theoretical investigation, especially in fields that are still unexplored despite rising scholarly interest. Interdisciplinary approaches may be used in future research to improve conceptual richness and integrate various theoretical viewpoints. Increasing the scope of research in various industrial and geographic contexts would enhance generalizability and provide cross-cultural understanding. To confirm and expand the fields and topics of research, other choices may include incorporating systematic reviews, meta-analyses, or empirical researches into the results of bibliometric analysis. A deeper insight into the paths and paradigm shifts could be acquired by longitudinal and comparative studies emphasizing on the progression of themes. Moreover, a synthesis of micro, meso, and macro standpoint outlook may assist in formulating more inclusive and multi-level. Additionally, a micro, meso, and macro perspective synthesis may help in formulating more inclusive and multi-level theoretical frameworks.

## 8. Conclusion

This research has methodologically analysed the research domain's publication trends, key contributors, intellectual underpinnings, and thematic development, this article provides a thorough bibliometric survey. The study depicts the emerging field's structural arrangement and focuses on the relationship between essential and critical ideas, writers, and organizations by making use of performance analysis and science mapping methodologies. A progressive shift from fundamental theoretical discussions toward more applied, interdisciplinary, and context-specific research streams can be seen in the visualization of keyword co-occurrence and citation networks. The study improves methodological rigor, provides a strategic roadmap for future research, and strengthens theoretical clarity by combining disparate scholarly contributions into an ordered and understandable knowledge structure. All things considered, it helps the field mature and solidify while pointing out new avenues that will influence its ongoing development.

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