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Article

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Drivers and Outcomes of Sustainable Innovation in the Business and Management Field: A Systematic Literature Review

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Abstract Sustainable innovation is a crucial strategic approach to addressing current sustainability challenges. Following the PRISMA guidelines, this study contributes to a comprehensive framework of sustainable innovation, focusing on identifying its drivers and outcomes. Likewise, the conceptual frameworks used and the suggestions and considerations provided by the authors were summarized and analyzed to provide some foundations for future research. The data were retrieved from the Web of Science database. After a selection process, following inclusion/exclusion criteria, a final sample of 30 quantitative articles on sustainable innovation within the Management and Business category published between 2017 and 2023, were analyzed. According to the analysis, the studies focused more on drivers than on outcomes. The findings revealed four main categories of drivers: Technological factors, Organizational capabilities, Managerial approach, and Individual factors. Regarding the outcomes, the findings showed that sustainable innovation contributes to firms' sustainable and responsible growth, improving the social (enhances job quality, upholds human rights and employee engagement and motivation), environmental (reduced energy consumption and waste emissions, resource optimization), and economic performance (growth and competitiveness) as the main outcomes. In sum, this research offers both theoretical and practical implications for advancing the understanding the drivers and outcomes of sustainable innovation. Moreover, by analyzing diverse conceptual models and analytical perspectives, the study contributes to the building of a more unified theoretical foundation. The study also provides practical implications

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for organizations aiming to integrate sustainability into their innovation strategies. Additionally, the study highlights methodological gaps and offers guidance for future research, encouraging a more diverse exploration of drivers and outcomes in sustainable innovation.

Keywords Sustainable Innovation · Drivers of Sustainable Innovation · Sustainable-Drive Innovations · Outcomes of Sustainable Innovation · Sustainability

JEL O39

1 Introduction

The concept of sustainable innovation has been widely used since the early 21st century and has gained prominence (Godin and Gaglio 2019), adopting various terms such as eco-innovation, environmental innovation, and green innovation, among others. Since then, sustainable innovation has been increasingly recognized as a driving force for transformation in both business and society (Larson 2000). It is defined as the development, renewal, or enhancement of products, services, and processes that improve economic outcomes while also enhancing environmental and social performance, both in the short and long term (Bos-Brouwers 2010). Recently, Afeltra et al. (2023) asserted that sustainable innovation includes innovations where economic, social, and environmental objectives are reconciled, creating a “win-win-win” situation. *This sustainable innovation approach encompasses both internal and external factors and can be seen as strategic innovation that achieves sustainable competitive advantages and ensures a prosperous future for all stakeholders.* As illustrated, sustainable innovation covers various areas of the business field, including business strategy, competitive advantage, and market orientation, among many other significant topics (Dzage and Szabados 2024). Hence, the conflict between sustainability and economic performance can be addressed through sustainable innovations, which simultaneously drive the sustainability transition and enhance competitive advantage (Hermundsdottir and Aspelund 2021); that is, a greater emphasis on sustainable innovations has a positive impact on organizational performance, revealing the key role of human capital (Afeltra et al. 2022).

Thus, since the latter half of the 20th century, sustainable development has attracted attention in global development discourses emphasizing the importance of sustainable practices for ensuring firms’ long-term success (Du Pisani 2006; Shahzad et al. 2021). The approach toward sustainability has increasingly permeated innovation, recognized as a critical capability for improving the competitive advantage of organizations (Farida and Setiawan 2022). As a result, in recent decades, more attention has been given to innovations that contribute to economic, social, and environmental goals (Afeltra et al. 2023), making innovation the major driver of sustainability (Xiao and Su 2022). However, despite the growing interest in sustainable innovation and the awareness of its importance for organizations remaining in the market, a comprehensive framework focusing on the identification of the

drivers and outcomes of sustainable innovation is still lacking. Through a systematic literature review, this study aims to bridge this gap by identifying, synthesizing, and analyzing the main research findings of quantitative studies in which diverse variables related to the drivers and outcomes of sustainable innovation were tested. Likewise, studies will be analyzed to identify the conceptual frameworks and the suggestions and considerations provided by the authors, offering some foundations for future research. In this regard, this study contributes to building a more unified theoretical foundation of sustainable innovation, providing implications for organizations that require integrating a sustainable approach to their innovation strategies while meeting the needs of society.

2 Literature Review

To meet the principles of sustainable development, companies are expected to progressively foster sustainable innovations (Cillo et al. 2019), considered a strategic approach to address the current sustainability challenges and achieve better innovation performance (Dey et al. 2020). Lopes et al. (2022) asserted that companies can foster innovation by improving manufacturing processes (producing more with fewer resources) and by developing more sustainable products. Regardless, the success of sustainable innovation depends on ensuring that the value proposition delivers measurable ecological or social benefits concurrently with economic value (Boons and Lüdeke-Freund 2013). Thus, sustainable innovation and its diffusion is a key strategy for a societal transformation toward sustainable development (Fichter and Clausen 2016), which requires constructive engagement between enterprises and stakeholders to address sustainability issues (Rodrigues et al. 2022).

This approach toward sustainable innovation has acquired more relevance since the recent pandemic. COVID-19 has accelerated the need for firms' digital transformation (Nambisan et al. 2019; Serdijn et al. 2021). This situation strengthened the relationship between sustainable and digital-based innovations, which are linked to continued technological advances. Thus, technological innovation and corporate social responsibility are two basic driving forces for sustainable development (Yang et al. 2024). Consistent with this perspective, emerging technologies, driven by the Fourth Industrial Revolution, can facilitate the integration of sustainability into the corporate context (De Oliveira et al. 2024).

However, despite their importance, the literature about digital-based innovations has been more focused on their economic outcomes than on how these digital capabilities contribute to the Sustainable Development Goals (Rodríguez-Espíndola et al. 2022), through sustainable-drive innovations (Trischler et al. 2020; Wang et al. 2023a; Zhang et al. 2021).

Currently, it is difficult to know how digital platforms contribute to achieving sustainable goals (Rodríguez-Espíndola et al. 2022) and how they influence firms' sustainable innovation development (Adams et al. 2016). Nevertheless, companies are increasingly adopting digitalization as a strategy to drive innovation and enhance their sustainability performance (Lin and Mao 2024; Lu et al. 2023), which

requires the development of organizational and relational capabilities that support their sustainable innovations (Ghobakhloo et al. 2021).

2.1 The Drivers and Outcomes of Sustainable Innovation

Sustainable innovation provides relevant opportunities for firms with increased complexity, which, in turn, requires certain organizational capabilities to deal with upcoming challenges (Ketata et al. 2015). The growing awareness of social and environmental responsibility has generated significant opportunities for sustainable innovations and presented relevant challenges for enterprises (De Almeida and De Melo 2017).

The knowledge of the drivers of sustainable innovation is still limited (Pellegrini et al. 2019), but there are some internal (those that are more controllable to the innovating company, as the cultural, strategic and operational variables) and external factors that have been related to sustainable innovation (Roman et al. 2022); among them are: governmental regulation and policies that provide incentives for sustainable innovations (Afeltra et al. 2023; Lazaretti et al. 2020), social responsibility initiatives and supply chain partnerships (Tello and Yoon 2008), market demands and economic incentives (Afeltra et al. 2023), technological advancements that allow the creation of new methods and processes that enhance the companies' sustainability (Xiao and Su 2022), companies investments in research and development in sustainable business models (Varadarajan 2017), stakeholder engagement and collaboration (Lazaretti et al. 2020), social and environmental pressures (Silvestre and Țircă 2019), and profit-seeking (Iñigo and Albareda 2016).

Concerning the outcomes, sustainable innovation improves economic performance by reducing costs by adopting cleaner and more efficient technologies (Kuzma et al. 2020). It also enhances companies' ability to adapt to market demands, providing a competitive advantage (Geissdoerfer et al. 2018). Additionally, sustainable innovation helps mitigate environmental impact by utilizing eco-friendly technologies and promotes social equity by improving products and services through collaboration among stakeholders (De Marchi et al. 2022). These social and environmental outcomes generate superior profitability (Weidner et al. 2021). These findings demonstrate the importance of placing greater emphasis on the outcomes of sustainable innovation (Yan et al. 2022).

Drawing from the above, this study aims to identify the main drivers and outcomes related to sustainable innovation in the business and management field. Likewise, the theoretical frameworks, research gaps and methodological issues will be analyzed through a systematic literature review, a method that has been increasingly adopted in the management field. The following questions guide this research:

- RQ1. What variables have demonstrated to drive sustainable innovation in companies?
- RQ2. What are the main outcomes that sustainable innovation brings to companies?
- RQ3. What conceptual or theoretical frameworks have guided research on sustainable innovation?

3 Research Method

To achieve the objectives and address the research questions, we conducted a literature review following the Preferred Reporting Items for Systematic Reviews and Meta-Analysis [PRISMA] guidelines (Liberati et al. 2009). We selected the PRISMA method because it provides a systematic approach to identifying, critically evaluating, synthesizing, and presenting findings from multiple studies (Pati and Lorusso 2018), thereby enabling well-founded responses to the posed research questions. In addition, this methodology was selected to facilitate a more complete, transparent, and accurate research supported by the literature analysis, making the findings more trustworthy and applicable (Page et al. 2021).

The literature search was retrieved from the Web of Science database, which includes documents published from January 01, 2002, to September 19, 2023. We selected this database because it is widely used in literature review research and is recognized as the most comprehensive and reliable citation data source worldwide (Birkle et al. 2020). We decided to search the data from the last two decades because in this period of time more emphasis has been paid to innovations that achieve conciliation with social, environmental, and economic goals (Afeltra et al. 2023). The search query used in this systematic literature review is as follows: Topic= (“Sustainable innovation” OR “Sustainable innovations”); thus, the literature search was based on this topic (as stated in the title of the publication, the abstract, the author keywords and/or the keywords plus). The initial search returned a total of 1124 documents in the Web of Science Core Collection.

3.1 Identification and Selection of Articles

The selection of documents followed established inclusion and exclusion criteria. Only quantitative articles that enabled the identification of underlying drivers and outcomes of sustainable innovation. In line with the PRISMA methodology, methodological homogeneity and consistency in the study design are essential because they ensure comparability among studies, making the analysis feasible and supporting a reliable systematic synthesis. To ensure methodological quality and coherence, we selected only articles (from Web of Science) that presented results directly related to the purpose of our study, excluding other types of documents. Thus, out of 1124 documents, proceedings papers, books, book chapters, review articles, editorial materials, and others were excluded, leaving 977 articles.

Only articles published in Management and Business (Web of Science categories) were considered according to the purposes of this study. The number of articles was reduced to 271, which were screened for inclusion based on the title, abstract content, and full text. In this process, data from each article were extracted, transferred, analyzed, and organized into a Microsoft Excel datasheet for further analyses according to the inclusion and exclusion criteria; therefore, a wide Excel database was created with the required information from each article. Due to this process, conceptual papers, qualitative research, and mixed-method studies were excluded. We selected only quantitative studies where conceptual models were tested because the purpose of this research was identified the drivers that have demonstrated influence

on sustainable innovation and the outcomes reported. To this purpose, quantitative studies are useful because these designs allow for the assessment of the internal validity and reliability of the research models analyzed (Pati and Lorusso 2018). Furthermore, maintaining methodological homogeneity ensures the consistency required for a more rigorous analysis of the reviewed literature.

Unlike other literature review methods, the PRISMA methodology seeks to enhance the accuracy of the analysis through a reduced but rigorously selected set of documents, ensuring more reliable and valid findings. Hence, articles were included in this study if: (a) they addressed sustainable innovation from the management and business perspective; thus, other disciplinary approaches were excluded despite belonging to business and management Web of Science categories (for instance, policy, economy, finance, geography, education, biology, philosophy, among others); (b) they were quantitative studies. According to these criteria, the final sample included 30 articles published between 2017 and 2023. A flowchart of the search strategy is presented in Fig. 1.

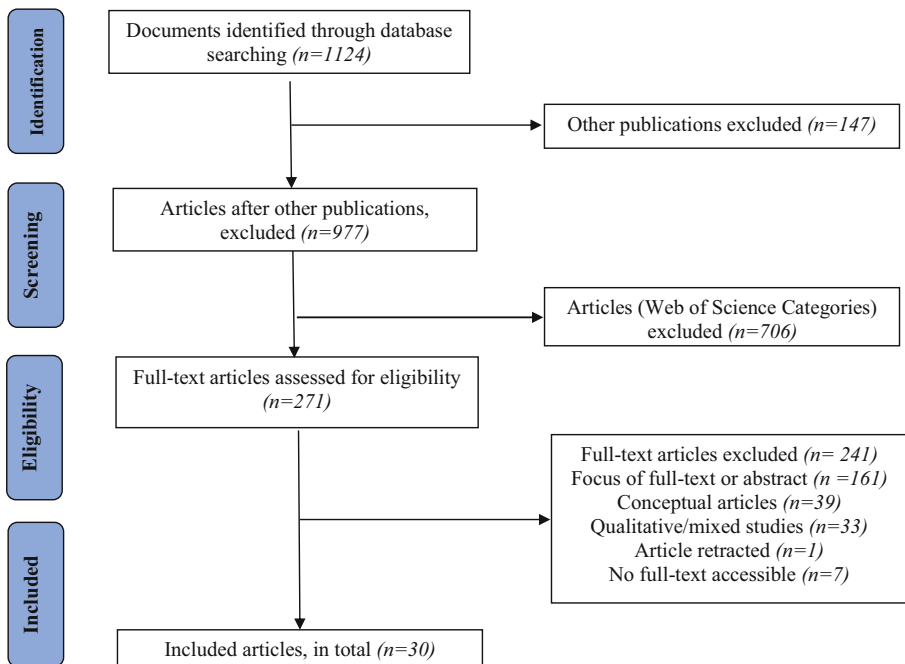
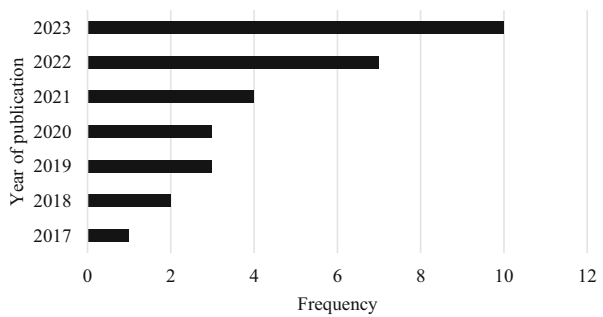


Fig. 1 Flowchart of the search strategy

Fig. 2 Publication years of the final set of selected articles

4 Results and Discussion

4.1 Descriptive Analysis and Comprehensive Literature Review

This study analyzes the advances reported in the scientific literature on sustainable innovation and identifies its drivers and the outcomes that such innovations bring to companies. Likewise, theoretical/conceptual frameworks were identified for each analyzed study included in this systematic literature review. Finally, the methodological suggestions and gaps in knowledge are identified, analyzed, and discussed as guidelines for further studies.

The first part of the results is a bibliometric analysis of the sample data. As mentioned before, data were retrieved from 2002 to 2023; however, the final selection comprised 30 quantitative articles published between 2017 and 2023 (Fig. 2). Of these 30 articles, the largest number were published during 2023 (10 articles, one third part of the total), followed by 2022 (7 articles), 2021 (4 articles), 2020 and 2019 (3 articles each one), 2018 (2 articles), and finally 2017 (1 article).

These articles were published in 20 journals, half of them in 6 journals distributed as follows: Journal of Business Research (5 articles; 16.66%), Business Strategy and the Environment (3 articles; 10%), Technovation (2 articles; 6.66%), Corporate Social Responsibility and Environmental Management (2 articles; 6.66%), Journal of Knowledge Management (2 articles; 6.66%), and Revista de Gestão (2 articles; 6.66%). These 6 journals represent half (15; 50%) of the total scientific production studied. In addition, 14 other journals have published only one article (Table 1).

The 30 articles were authored by 103 researchers. Fernandes, Cristina I.; Ferreira, João J. M.; Veiga, Pedro M.; Zhao, Yan; Qi, Niannian; Scuotto, Veronica; Garcia-Perez, Alexeis; De Guimarães, Julio C. F.; Severo, Eliana A.; Kneipp, Jordana M.; Gomes, Cláudia M.; and Frizzo, Kamila, each have two publications during the 2017–2023 period.

Finally, it is worth highlighting the countries of origin of the authors (criterion: for each author, the country of the first specified university). Thus, 19 countries were included in the sample. In general terms, the United Kingdom (frequency in articles = 8; 26.66%), China (8; 26.66%), Italy (5; 16.66%), France (5; 16.66%), Brazil (5; 16.66%), Portugal (2; 6.66%), United States of America (2; 6.66%), and India (2; 6.66%) were the most prominent countries. Additionally, Spain, Germany, Luxembourg, Denmark, Finland, Canada, Australia, Thailand, Vietnam, Fiji, and South

Table 1 Distribution of the final selected articles by journal and frequency

Journal	Number of articles	Weight (%)
Journal of Business Research	5	16.66
Business Strategy and the Environment	3	10.00
Technovation	2	6.66
Corporate Social Responsibility and Environmental Management	2	6.66
Journal of Knowledge Management	2	6.66
Revista de Gestão	2	6.66
International Journal of Entrepreneurship and Innovation	1	3.33
Technology Analysis & Strategic Management	1	3.33
Social Responsibility Journal	1	3.33
Chinese Management Studies	1	3.33
Journal of Innovation & Knowledge	1	3.33
International Journal of Entrepreneurial Behavior & Research	1	3.33
Operations Management Research	1	3.33
Knowledge Management Research & Practice	1	3.33
European Journal of Innovation Management	1	3.33
Journal of Marketing Theory and Practice	1	3.33
Revista Gestão Organizacional	1	3.33
Journal of Business Ethics	1	3.33
Global Business Review	1	3.33
Long Range Planning	1	3.33
	30	100.00

Africa each have one publication. It is interesting to note the high participation of authors from developed countries in the analyzed literature. It is recommended to conduct research that allows not only to understand the state of sustainable innovation in undeveloped countries but also to understand the gap between developed and undeveloped countries in research production in this regard.

Then, we analyzed and categorized each paper according to its content in Drivers or Outcomes. This procedure involved identifying and analyzing the main findings of each paper included in this study. Likewise, we analyzed the data source and context and identified the conceptual or theoretical framework that provided support for the tested model. In addition, the authors' countries were also included in the analysis. The comprehensive review and classification of scholarly articles shows that the drivers of sustainable innovation have been the main orientation of the studied literature (63.3%) (Table 2), in contrast to studies oriented to outcomes (23.3%) (Table 3). Only a few researchers (13.3%) included both approaches (Table 4).

4.2 Drivers of Sustainable Innovation

In this section, we respond to research question 1: *RQ1. What variables have demonstrated to drive sustainable innovation in companies?*

Table 2 Drivers of sustainable innovation

Authors	Author's country	Data source, context and sample size	Main findings	Theoretical/ conceptual framework
Wang et al. (2023a)	China and Canada	347 Chinese firms (CEO, CFO, middle manager, operations manager and IT manager)	Digital platforms enhance sustainability-oriented innovation through open innovation Companies with digital platform capabilities perform better in sustainability-oriented innovation	Dynamic capability theory
Zhao and Qi (2024); first year of publication: 2023	China	1541 Chinese high-tech manufacturing firms (Network of Development Research Center of the State Council; National Railway Administration of the people's republic of China; 2009–2016)	Regional Internet level-measured by Internet penetration—has an inverted U-shaped relationship with firms' sustainable innovation This relationship is mediated by knowledge flow There is a relationship between the regional Internet level and knowledge flow (an inverted U-shaped relationship) Knowledge flow is conducive to the firms' sustainable innovation	Resource-based theory; Innovation diffusion theory
Wang et al. (2023b)	China	3 datasets (World Robotics-Industrial Robots issued by International Federation of Robotics, 1993–2020; State Intellectual Property Office of China, 1985–2013; Annual Survey of Industrial Enterprise which is administered by the National Bureau of Statistics of China, 1998–2013)	Robots and firm innovation are positively and significantly related Robots drive firm sustainable innovation measured as patents that are related to environmental innovation	User innovation theory
Ardito (2023)	Italy	14125 firms operating in diverse sectors and headquartered in several countries (Flash Eurobarometer 486; SMEs, Start-ups, Scale-ups and Entrepreneurship; between February 19 and May 5, 2020)	Digital technology (artificial intelligence, cloud computing, robotics, smart devices, big data analytics, high speed infrastructure, and blockchain) differently affects the likelihood of launching sustainable innovations, while the degree of digitalization is always beneficial Firm digitalization and the adoption of sustainability practices are not complementary	Stakeholder theory

Table 2 (Continued)

Authors	Author's country	Data source, context and sample size	Main findings	Theoretical/ conceptual framework
Zhao et al. (2023)	China	1057 firms of 420 China's new energy industries alliance (Baidu's official website; from January 1, 2009, to December 31, 2019)	Knowledge diversity, ego-network density and honest brokers can boost firms' sustainable innovation Ego-network density plays a negative moderating role in the relationship between knowledge diversity and firms' sustainable innovation	Social network theory; Knowledge-based view
Martínez-Martínez et al. (2023)	Spain and United Kingdom	208 SMEs in the Spanish textile sector (Sistema de Análisis de Balances Ibéricos database; from early January to the end of February 2020)	Engaging with customers and actively listening and addressing their expectations can result in the creation of green knowledge that contributes to both incremental and radical eco-innovation in the textile sector Green knowledge has the potential to lead to eco-innovation in the textile sector	Theory of value co-creation
Su et al. (2023)	China	356 top managers and employees of Chinese enterprises undergoing digital transformation (manufacturing, finance, emerging technology and other industries)	Employee entrepreneurship has a positive impact on sustainable innovation capability, which is partially mediated by value co-creation Stress plays a negative moderating role in the relationship between employee entrepreneurship and value co-creation	Resource dependence theory; Resource conservation theory; Schumpeter's innovation theory; Theory of role stress
Kwangsawad and Jattamart (2022)	Thailand	401 users with no more than 6 months of experience using chatbots for community-enterprise customer service (Thailand)	Perceived privacy and time risk directly affect attitudes and intentions toward using chatbots Technological anxiety is a barrier that affects attitudes toward chatbot usage Perceived information quality indirectly influences users to use chatbots continually Chatbot users are concerned with privacy and time constraints	Diffusion innovation theory

Table 2 (Continued)

Authors	Author's country	Data source, context and sample size	Main findings	Theoretical/conceptual framework
Alerasoul et al. (2022)	Italy, Germany and Finland	373 Italian manufacturing firms (AIDA Bureau van Dijk database; November 2019)	Synergistic co-alignment of technology orientation with both dimensions of market orientation, responsive and proactive, can help firms enhance their sustainable innovation performance Future-oriented entrepreneurs' appear to represent the strongest combination of market orientation with technology orientation, leading them to achieve higher levels of sustainable innovation performance	Resource-based view; Stakeholder theory
Tang et al. (2022)	China	214 China listed companies (Wind database; China Stock Market & Accounting Research database; from 2002 to 2018)	Stock liquidity will affect the sustainable innovation level of the enterprise positively Improvement of ownership concentration promotes the positive relationship between stock liquidity and sustainable innovation	Short-term perspective of management
Wang et al. (2022)	China, United Kingdom, France and Fiji	724 firms across 33 countries and 11 industries, which are predominantly in the manufacturing and technology sector (Thomson Reuters ASSET4 database; from 2009 to 2019)	Eco-innovation performance can be improved by adopting circular economy systems and technologies, such as product take-back and recycling Firms should see the introduction of circular economy systems and technologies as an opportunity for eco-innovation	Path dependence theory
Gao (2021)	China	276 employees from the high-tech industry (China)	There is a significant correlation between complementary knowledge and knowledge acquisition Knowledge acquisition and complementary knowledge are significantly related to continuous innovation	The perspective of sustainable development theory
De Guimarães et al. (2021)	Brazil and United Kingdom	1025 companies from the Brazilian Automotive Metal-Mechanic Clusters (Brazil)	The most innovative companies utilize the project management maturity and product development process maturity constructs more effectively A combination of complementary management methods enhances the use of resources. Companies that take advantage of complementary effects become more innovative and achieve better results in terms of sustainable innovation	The concept of complementarity/the complementary effects perspective

Table 2 (Continued)

Authors	Author's country	Data source, context and sample size	Main findings	Theoretical/ conceptual framework
Scuotto et al. (2020)	France, United Kingdom and Italy	80 SMEs from the high-tech manufacturing sector (Italy)	When combined with stakeholder engagement, sustainable innovation management becomes a pivotal phenomenon for new and established SMEs Stakeholders proved instrumental in generating the sense of environmental responsibility in SMEs Stakeholder-related capabilities, both tangible and intangible, influence the firm's orientation towards sustainable innovation, its environmental responsibility and related capabilities Sustainability, adaptation, innovation and growth orientation of SMEs in a knowledge-intensive environment by recommending that, in their relationship with stakeholders, SMEs become more open to co-create, share and reuse environmental knowledge	Stakeholder theory; Innovation management theory
Poussing (2019)	Luxembourg	286 Luxembourgish firms (Luxembourg Institute of Socio-Economic Research, 2008; Community Innovation Survey, during the period 2008–2010)	Corporate social responsibility activities in general do not lead to sustainable innovation adoption, but strategic corporate social responsibility can have an effect on its adoption Strategic corporate social responsibility is a driver of innovation The internationalized companies have a higher trend for adopting a proactive strategy for sustainable innovation	Strategic corporate social responsibility perspective Not reported
Kneipp et al. (2019b)	Brazil	51 industrial companies that invest in innovation (Brazil)		
Delmas and Pekovic (2018)	United States of America and France	4640 French employees from 1764 firms (the Organizational Changes and Computerization's Survey; the Community Innovation Survey; the Annual Enterprise Survey; the Annual Statement of Social Data; 2003–2006)	Positive impact of intrinsic motivations (through employee social interactions), and the negative impact of job strain (through high imposed work pace), on corporate sustainable innovation Extrinsic rewards, through pay satisfaction, counteract the negative effect of job strain to promote sustainable innovation Intrinsic and extrinsic rewards can work in tandem to facilitate sustainable innovation	Not reported

Table 2 (Continued)

Authors	Author's country	Data source, context and sample size	Main findings	Theoretical/conceptual framework
Bag (2018)	South Africa	75 individuals working with manufacturing firms (South Africa)	<p>Organization culture influences leadership skills, supplier development and supplier relationship management</p> <p>Market forces influence supplier development initiatives</p> <p>Supplier development is found to influence supplier performance and supplier relationship management</p> <p>Supplier relationship management is found to influence supplier performance</p> <p>Supplier performance has a positive effect on sustainable innovation in supplier networks</p>	Dynamic capability theory
Olsen et al. (2017)	Denmark	731 search strategies from all search consortia led by private firms (European Seventh Framework Program for Research and Technological Development, 2007–2013; Sixth European Union Framework Program, 2002–2013)	<p>The problem-solving potential of a search strategy increases with the diversity of existing knowledge of the partners in a consortium and with the experience of the partners involved</p> <p>Substantial negative effect from involving partners in a search consortium who collaborate for the first time</p>	Collaborative and problemistic search theory

Table 3 Outcomes of sustainable innovation

Authors	Author's country	Data source, context and sample size	Main findings	Theoretical/conceptual framework
Fernandes et al. (2023)	Portugal, Italy and United Kingdom	43615 SMEs (Community Innovation Survey database; start of 2012 to end of 2014)	Sustainable innovations promote SMEs growth (measured in terms of turnover and employment)	Theory of the growth of the firm
Del Giudice et al. (2023)	Italy, France and United Kingdom	3000 international new ventures that have already adopted cutting-edge digital technologies (The 2020 European Union Labour Force Survey)	Technology adoption can enhance human rights and serve as a means for firms to achieve organic, sustainable, and responsible growth Technology-driven sustainable innovations can enhance job quality and uphold human rights Social entrepreneurship can serve as a constructive mediating role in advancing both human rights and the adoption of automation	The micro-foundation theory
Ostermann et al. (2022)	Brazil	1322 Brazilian manufacturing firms from 22 industrial sectors (Innovation Research Center of the Federal University of Rio Grande do Sul, Brazil; 2015)	There is a difference between the capabilities that effectively receive the companies' attention and the capabilities that should be valued and developed Green companies must focus their efforts on transaction capability, followed respectively by management, development and operation capabilities Gray companies must focus on development capability, followed by management, transaction and operation capabilities	Innovation capabilities' perspective

Table 3 (Continued)

Authors	Author's country	Data source, context and sample size	Main findings	Theoretical/conceptual framework
Fernandes et al. (2021)	Portugal and United Kingdom	591 observations for 32 countries (OECD; between 1990 and 2013)	Sustainable technology transfer and sustainable innovation promote green growth, which in turn positively impacts economic growth	Economic growth theories (theories of endogenous growth)
Severo et al. (2020)	Brazil	107 employees in companies (Brazil)	Sustainable innovation influences product and service innovation. In addition, process innovations can provide reduced energy consumption and waste emissions, indicating awareness regarding environmental issues	Theory of competitive advantage
Weidner et al. (2021)	United States of America	132 individuals representing distinct firms that have worked on sustainable innovations (North America, Europe and Australia)	Market-based sustainability and organizational learning promote sustainable innovation Sustainable innovation contributes to the triple bottom-line by enhancing firms' environmental performance and social performance, and in turn economic performance	Market-based capabilities; Stakeholder theory
Kneipp et al. (2019a)	Brazil	51 industrial companies that invest in innovation (Brazil)	There are significantly positive associations between several variables related to sustainable innovation practices and company performance The adoption of sustainable innovation practices contributes to superior corporate performance	Not reported

Table 4 Drivers and Outcomes of sustainable innovation

Authors	Author's country	Data source, context and sample size	Main findings	Theoretical/conceptual framework
Taneja et al. (2023)	Australia and India	251 middle to senior management employees (working in manufacturing-based consumer goods firms)	Dynamic capabilities, sustainable organizational innovations and smart technologies enhance sustainability-oriented innovations Sustainability-oriented innovations impacts organization's economic performance Sustainability-oriented innovations and green organizational identity are highly related Green organizational identity promotes green image through green commitment	Resource-based theories; Porter hypothesis
Chaudhary and Kumar (2022)	India	125 employees (working in 36 hospitals located in India)	The diffusion of innovation characteristics and organizational environment significantly influence the environmental sustainability index Fostering an organizational environment where employees are encouraged and rewarded for contributing to sustainable innovations can play a substantial role in the implementation of environmental sustainability innovations	Diffusion of innovation theory
Adomako and Nguyen (2020)	United Kingdom and Vietnam	301 Ghana SMEs (CEOs and finance directors of manufacturing firms)	Human resource slack positively relates to sustainable innovation and this relationship is moderated by intangible resource advantage Sustainable innovation mediates the relationship between human resource slack and environmental performance	Resource-based view
Hemonet-Goujot et al. (2022)	France	536 women (exposed to substitution product innovation launched by luxury and non-luxury brands)	Product demand and brand relationships vary according to luxury brands vs. non-luxury brands. Impacts are less favorable for luxury brands Demand for innovations using materials with past identity is less favorable for the luxury brand than for the non-luxury brand Demand for innovations using new materials is not less favorable for the luxury brand than for the non-luxury brand. Luxury brands are not more incompatible with sustainable innovation than non-luxury ones	The consumer-brand relationship theoretical framework and on transgression acts

The main orientation of the analyzed studies was from the perspective of drivers of sustainable innovation. The drivers appear to be the main concern of researchers in the field; however, this observation must be confirmed in future studies using large samples and other methodologies. From this perspective, although closely related to each other, studies have focused on organizational and individual factors. Individual factors in the studied literature have been less studied than the organizational ones. This observation should be analyzed in further studies.

At the organizational level, dynamic capabilities, sustainable organizational innovations, and smart technologies enhance sustainability-oriented innovations (Taneja et al. 2023; Xiao and Su 2022); in particular, the digital platform capabilities and robot use (Wang et al. 2023a, b). However, not all kinds of digital technologies implemented in companies have the same effect on sustainable innovation development (Ardito 2023). In addition, actively engaging with customers, understanding their expectations, and responding to their needs can foster the creation of green knowledge, thereby contributing to improved eco-innovation performance (Martínez-Martínez et al. 2023). Such performance can be improved by adopting circular economy systems and technologies (Wang et al. 2022).

Regarding strategy, the synergistic co-alignment of technology orientation and responsive and proactive market orientation helps companies enhance their sustainable innovation performance. Such orientation is more likely to be adopted by future-oriented entrepreneurs (Alerasoul et al. 2022). Another related variable is firms' stock liquidity. According to Tang et al. (2022), the higher the stock liquidity, the weaker the enterprise's sustainable innovation level, especially in state-owned enterprises. However, these authors highlight that the diversification of the shareholding structure, the improvement of corporate governance, the supervision mechanism of management and the improvement of ownership concentration help to increase the motivation for innovation activities. In this context, stock liquidity positively affects enterprises' sustainable innovation level.

On the other hand, in market-based sustainability, organizational learning promotes sustainable innovation (Weidner et al. 2021), making knowledge a relevant factor for sustainable innovation. From this same approach, Internet penetration (regional Internet level) has an inverted U-shaped relationship with firms' sustainable innovation, and this relationship is mediated by knowledge flow (Zhao and Qi 2024). Likewise, knowledge acquisition and complementary knowledge are significantly related to continuous innovation (Gao 2021). In this same line, in the context of the network structure, each network actor maintains a unique relationship with other actors in the network, producing what Yderfält and Roxenhall (2017) called "ego-network". According to Zhao et al. (2023), ego-network density, knowledge diversity, and honest brokers can boost firms' sustainable innovation. Moreover, because internationalized companies are more inclined to the diversity of both partners and knowledge (Olsen et al. 2017), they are more likely to have a higher problem-solving potential and adopt sustainable innovations (Kneipp et al. 2019b). The above with complementary management methods (project management and product development processes) can help companies enhance the availability and use of their resources. As pointed out by De Guimarães et al. (2021), companies

that take advantage of complementary effects become more innovative and achieve better sustainable innovation performance.

Other relevant drivers of sustainable innovation are related to organizational strategy. In this regard, strategic corporate social responsibility (Poussing 2019) and social and environmental pressures (Silvestre and Țircă 2019) affect sustainable innovation adoption. Likewise, organizational culture has been demonstrated to influence supplier relationship management and performance, both of which are highly related to sustainable innovation in supplier networks (Bag 2018). From the same organizational perspective, the diffusion of innovation characteristics and the organizational environment significantly influence the environmental sustainability index (Chaudhary and Kumar 2022); also, human resource slack positively relates to sustainable innovation, and this relationship is moderated by intangible resource advantage (Adomako and Nguyen 2020). Moreover, a green organizational identity is highly related to sustainability-oriented innovations and generates a green commitment (Taneja et al. 2023). Such identity permeates individual spheres of sustainability.

At the individual level, employee entrepreneurship (either in manager or executor roles) has a positive impact on sustainable innovation capability, which is partially mediated by value co-creation, a feature that has been demonstrated to exert a positive impact on firms' sustainable innovation capability (Su et al. 2023). Likewise, it was found that attitudes and intentions toward the use of technology as chatbots are affected by perceived privacy, time constraints, and perceived information quality, which can produce technological anxiety, an important barrier that affects attitudes toward the use of technology (Kwangsawad and Jattamart 2022). On the other hand, Delmas and Pekovic (2018) found a positive impact of intrinsic motivation (through employee social interactions) and a negative impact of job strain (through high imposed work pace), incorporating sustainable innovation. According to these authors, both intrinsic and extrinsic rewards may facilitate sustainable innovation, and this last (pay satisfaction) might counteract the negative effect of job strain on sustainable innovation.

The findings described above are grouped into four main categories that drive sustainable innovation in companies. These are: Technological factors, Organizational capabilities, Managerial approach, and Individual factors.

4.3 Outcomes of Sustainable Innovation

In this section, we respond to research question 2: *RQ2. What are the main outcomes that sustainable innovation brings to companies?*

Regarding the outcomes, sustainable innovation, both technology-driven sustainable innovations and sustainable technology transfer, promote companies' growth, measured in terms of turnover and employment (Fernandes et al. 2023). Also, sustainable innovation enhances job quality and promotes human rights through organic, sustainable, and responsible growth (Del Giudice et al. 2023), while positively impacting firms' economic performance (Kuzma et al. 2020; Taneja et al. 2023).

As can be seen, firms' sustainable innovation contributes to the achievement of Sustainable Development Goals. De Marchi et al. (2022) and Severo et al. (2020)

argued that companies can contribute to sustainability not only with their innovative product and service innovations and innovative sustainable processes (e.g. reduced energy consumption and waste emissions). Thus, cultivating an organizational environment that encourages and rewards employee contributions to sustainable innovations can significantly contribute to the implementation of environmental sustainability initiatives (Chaudhary and Kumar 2022). In this regard, Adomako and Nguyen (2020) found that sustainable innovation mediates the relationship between human resource slack and environmental performance. In sum, the green-sustainable innovation approach positively impacts firms' growth (Fernandes et al. 2021) since the triple bottom line by enhancing firms' environmental, social, and economic performance (Kneipp et al. 2019a; Weidner et al. 2021), providing a competitive advantage (Geissdoerfer et al. 2018).

Due to the above, Ostermann et al. (2022) highlighted the importance of green companies to focus their efforts on transaction, management, development, and operation capabilities to enhance their innovation capabilities for sustainability. Finally, companies should continue to inquire how this sustainable-driving innovation can enhance their competitiveness and permanence in the current times. For example, Hemonnet-Goujot et al. (2022) found that the demand for innovations using materials with past identity is less favorable for the luxury brand than for the non-luxury brand; however, the demand for innovations using new materials is not less favorable for the luxury brand than for the non-luxury brand. Thus, luxury brands are not more incompatible with sustainable innovation than non-luxury brands. These findings highlight an interesting opportunity for sustainable innovation in luxury brands. As expected, the outcomes of sustainable innovations contribute to the three dimensions of the Sustainable Development Goals. The main finding in this regard is that sustainable innovation promotes sustainable and responsible firm growth while improving social, environmental, and economic performance. Figure 3 illustrates the variables identified as both drivers and outcomes in the analyzed articles.

4.4 Conceptual and Theoretical Frameworks

In this section, we respond to research question 3: *RQ3. What conceptual or theoretical frameworks have guided research on sustainable innovation?*

In this regard, it is interesting to notice the high diversity of the conceptual frameworks used in the studied literature, among them are the following: Dynamic capability theory, Resource-based theory, Diffusion innovation theory, User innovation theory, Stakeholder theory, Social network theory, Knowledge-based view, Theory of value co-creation, Resource dependence theory, Resource conservation theory, Schumpeter's innovation theory, Porter hypothesis, Theory of role stress, Theory of competitive advantage, Market-based capabilities, Innovation capabilities' perspective, Economic growth theories (theories of endogenous growth), Collaborative and problemistic search theory, Theory of the growth of the firm, The micro-foundations theory, Short-term perspective of management, Path dependence theory, Sustainable development theory, Innovation management theory, Complementarity/the complementary effects perspective, and Strategic corporate social responsibility perspective.

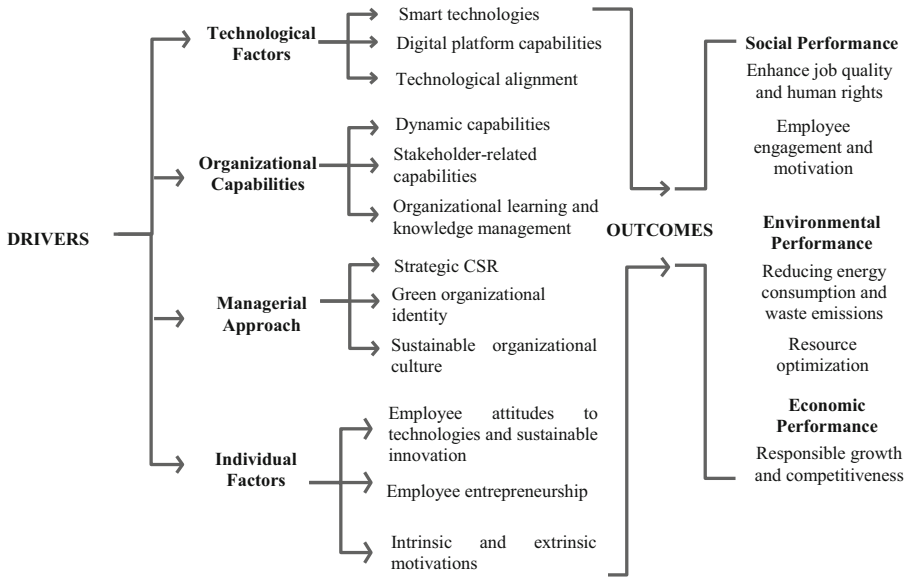


Fig. 3 Categorization of key drivers and main outcomes of sustainable innovation

Diverse conceptual frameworks may offer a richer understanding of the drivers and outcomes of sustainable innovation, giving a more holistic and comprehensive approach. Likewise, the research findings from different conceptual frames provide complementary insights that enhance the comprehension of the concept. In addition, diverse perspectives allow scholars to build and test more integrative and novel frames to address this phenomenon, enhancing the validity and robustness of their research. However, the high diversity of conceptual frameworks can be problematic because they can lead to inconsistencies, thus avoiding the consolidation of research findings. Thus, conceptual overload makes it harder to draw clear and consistent conclusions. Integrating research findings to build more comprehensive research approaches is a relevant challenge and opportunity for scholars in this field of knowledge.

4.5 Methodological Considerations

The authors of the reviewed literature provided the following methodological recommendations: obtain more objective data using multiple sources and conduct cross-country studies to both analyze the applicability of the research findings (Wang et al. 2023a) and compare regions, sectors, and production regarding sustainable innovation (Severo et al. 2020). It is crucial to conduct comparative studies based on research findings (Scuotto et al. 2020). It is strongly recommended that research samples be more diverse in both demographic and geographical aspects to enhance the generalizability and applicability of the findings (Kwangsawad and Jattamart 2022). To this purpose, Hemonnet-Goujot et al. (2022) recommend turning to websites such as “Prolific” to recruit people around the world to enhance results generalization.

Furthermore, longitudinal research is recommended to improve cross-sectional limitations (Alerasoul et al. 2022). Longitudinal studies would help to assess and understand the dynamics of sustainable innovation efforts over time (Adomako and Nguyen 2020; Ostermann et al. 2022; Taneja et al. 2023; Weidner et al. 2021) and could bring us closer to understanding the causal mechanisms of sustainable innovation (Delmas and Pekovic 2018). It is also important to conduct longitudinal follow-ups of the studied firms (Ostermann et al. 2022) and to include objective data that improve the limitation of subjective perceptual scales (Alerasoul et al. 2022).

Because small samples affect the results' generalization and achieve conclusive findings, larger samples are recommended (Bag 2018; Chaudhary and Kumar 2022; Severo et al. 2020). Likewise, larger samples would allow the inclusion of more variables in the tested models (Poussing 2019) and control variables to increase data robustness (Zhao et al. 2023). Moreover, it is important to consider the size of the company because it is a variable related to the adoption of sustainable innovation (Poussing 2019); according to Kneipp et al. (2019a), future studies should be oriented to expand the sample in order to deepen research findings and search for new variables that explain sustainable innovation practices. In addition, further research should conduct case studies (Delmas and Pekovic 2018) and experimental designs (Adomako and Nguyen 2020).

4.6 Knowledge Gaps to Be Addressed in Future Research

According to the analysis of the literature review, significant progress has been made in sustainable innovation knowledge in recent years. However, there are still notable gaps that, according to the authors, should be studied in future studies. From a broader perspective, it is necessary to continue investigating the antecedents, contingencies, and consequences of sustainable innovation on organizational performance by adopting the triple bottom-line approach (Weidner et al. 2021). It is crucial to examine the role of variables such as budgetary constraints, environmental commitment and stakeholders' ideologies in the proposed models to enhance the understanding of sustainable innovation (Chaudhary and Kumar 2022).

Furthermore, the influence of organizational culture and strategic orientation on sustainability-oriented innovation remains scarcely understood (Wang et al. 2023a). Longitudinal studies could provide valuable insights into the dynamics underlying the relationship between strategic orientation and sustainable innovation performance (Alerasoul et al. 2022). Additionally, expanding research from the domain of strategic innovations is suggested, given the acknowledged role of sustainability knowledge in enhancing sustainability-oriented innovations (Taneja et al. 2023). Innovation and strategy research emphasizes the importance of firms' external knowledge search to improve innovation performance. Therefore, firms should collaborate to develop strategies to solve environmental problems in particular. In this regard, research should be conducted to understand the diversity of sources of collaboration and how they influence search strategies (Olsen et al. 2017).

As can be seen in the analyzed literature, models of sustainable innovation have been predominantly tested within specific contexts, industries, and countries, most of which have developed. It is interesting to note the high collaboration between

countries in sustainable innovation research, the prominent participation of China in such studies, and the scarce participation of developing countries. Except for Brazil, we did not find articles published in Latin America that fit our search criteria. It is suggested to study sustainable innovation within specific entrepreneurial ecosystems and assess the influence of economic development and income inequality on green growth (Fernandes et al. 2023, 2021). Furthermore, it is crucial to explore the extent to which findings on sustainable innovation can be generalized (Delmas and Pekovic 2018). For this purpose, it is necessary to validate the theoretical models using larger sample sizes (Chaudhary and Kumar 2022; Martínez-Martínez et al. 2023; Zhao et al. 2023), across different cultural, economic, and political contexts (Adomako and Nguyen 2020; Alerasoul et al. 2022; Fernandes et al. 2021) and degree of knowledge intensity (Scuotto et al. 2020).

Moreover, sustainable innovation research should encompass a wide array of variables, such as market share, new products, profitability, environmental supply chain, the general performance of the firm, and managerial models, among others, to provide a comprehensive understanding of its implications (Wang et al. 2022; Zhao et al. 2023). In addition, exploring variables related to consumers' commitment to sharing green knowledge and organizations' commitment to listening to customers is crucial (Martínez-Martínez et al. 2023).

Future investigations should analyze how to develop innovation capabilities for sustainability and design effective sustainable business models that contribute to firms' economic and green growth, fostering a more sustainable society (Fernandes et al. 2021; Ostermann et al. 2022). In this regard, understanding the impact of firms' technology adoption on sustainable innovations is quite relevant (Wang et al. 2023b), and determining which digital technologies or which combination of multiple digital technologies promotes sustainable innovation are important avenues for further studies. In this same line, further studies should be conducted to understand why tensions exist between digitalization and corporate sustainability and how to manage them (Ardito 2023).

As supported by the reviewed literature, scholars have paid less attention to the individual level of sustainable innovation. There is a need to analyze different entrepreneurial environments and identify the factors that either inhibit or promote integration with technology (Del Giudice et al. 2023). Moving forward, future research should explore technological anxiety from a psychological approach, aiming to provide insights that enable operators to better understand users' concerns (Kwangsawad and Jattamart 2022).

Additionally, it is recommended to investigate the underlying socio-psychological processes that influence the relationship between the characteristics of innovation diffusion/adopters and their impact on the implementation of eco-innovations (Chaudhary and Kumar 2022). Moreover, exploring the relationship between automation and the protection of human rights while reconsidering the role of human talent in knowledge-intensive enterprises, needs to be investigated. Research endeavors should also focus on understanding the efficiency and performance of automation, taking into account the firms' remuneration systems and potential work-life conflicts that may arise (Del Giudice et al. 2023). Moreover, it is essential to examine the influence of environmental and social factors on product/service innova-

tions and investigate how companies can effectively encourage workers to innovate while adhering to socio-environmental principles (Severo et al. 2020). Additionally, a comprehensive analysis of employee behavior toward sustainable innovation could benefit from the inclusion of variables such as job satisfaction and job strain (Delmas and Pekovic 2018). Furthermore, future studies may explore the moderating role of buyers' behavioral uncertainty in sustainable innovation within supply networks (Bag 2018). Overall, these avenues of inquiry are promising for advancing our understanding of sustainable innovation at the individual level and its broader societal implications. In sum, the main gaps that should be addressed in future research are continuing to study the antecedents and consequences of sustainability innovation on performance from the triple helix approach. Topics such as culture, strategic orientation, the impact of digital technologies/digitalization, ecosystems of collaboration, advances in undeveloped countries, managerial strategies, the role of consumers and stakeholders in a wide sense, and employees' behavior toward sustainable innovation are topics that need to be studied in a deeper way.

5 Theoretical and Practical Implications

This research has both academic and practical implications. In the first case, this research contributes to building a comprehensive framework of sustainable innovation knowledge through a literature review. Variables demonstrating the influence of sustainability innovation can be integrated into new models and tested in future research. Likewise, the results indicate the need to identify and analyze new understudied variables in both drivers and outcomes related to each dimension in the sustainability framework (social, environmental, and economic). In addition, this research offers scholars the main conceptual and theoretical frameworks used in the analyzed literature. The high diversity in this regard demonstrates the necessity of identifying the most robust and useful frameworks to address sustainable innovation studies, thus allowing replicability. Finally, this research contributes to identifying gaps in knowledge regarding sustainable innovation, which will be useful for future studies. Regarding the practical implications, our results can help companies not only improve their performance but also enhance their contribution to Sustainable Development Goals framed in the triple helix approach. Based on these findings, this research is valuable not only to CEOs, managers, and employees of national and multinational corporations involved in innovation, but also to any organization that must innovate to remain competitive in today's complex business environment. The results provide practical guidance for adjusting innovation strategies along with their sustainable strategies in an unpredictable context, using continuous improvement as the cornerstone. In this way, sustainable innovation practices can contribute to generating value both within companies and for society.

6 Conclusions and Limitations

This study allowed us to identify the main drivers of sustainable innovation and its outcomes, supported by a systematic literature review. A greater emphasis on drives than outcomes is observed in the literature studied. The results configured four differentiated categories of drivers: Technological factors, Organizational capabilities, Managerial approach, and Individual factors. Although the outcomes of sustainable innovation have been focusing on its impact on the triple bottom line, as was expected, the variables involved in each dimension seem to be limited. In this research, we found that improving job quality, promoting human rights, and fostering employee engagement and motivation were the most frequently reported social outcomes. Additionally, reducing energy consumption and waste emissions, along with optimizing resource use, were the main environmental outcomes. Finally, growth and competitiveness emerged as the primary economic outcomes. Regarding the theoretical and conceptual frameworks used, we found that they were highly varied, and there was not a common conceptual framework that guided the research in the field. As a guideline for future research, the methodological suggestions and identified gaps of knowledge are discussed.

Finally, this research has important limitations. As is common in this type of research, the findings are constrained to the analyzed articles. First, the information was collected from a single database, which, although Web of Science is one of the most important, could exclude significant studies that are in other relevant databases (e.g. Scopus). Another limitation was the reduced article sample size. Future research should widen the number of documents and include a more inclusive methodological approach. Although (“sustainable innovation” and “sustainable innovations”) are quite representative terms in the field, some relevant research where other terms were used cannot be included (e.g. eco-innovation), making that relevant contributions were missed. In addition, while the PRISMA guidelines are widely recognized and valued within the academic community for their systematic approach, this method is relatively narrow in scope and does not allow large sample sizes as other literature review methods. Another limitation was that the last quarter of 2023 was not included, and as it was mentioned, this year had a high production. As a result, some relevant research was not included in this study. Moreover, our research included only two categories of Web of Science (Management and Business), excluding many others related to the field of knowledge, such as finance and economics. Finally, given the objective of this study, only quantitative studies were included. However, this may limit the extent to which the findings capture the complexity of the studied topic. Therefore, future research employing other methodological approaches is recommended to provide a more comprehensive understanding. We also recommend conducting other types of literature reviews on sustainable innovation, such as bibliometric analyses that, through large samples, can help reveal the intellectual structure underlying this approach toward innovation. Furthermore, future research should explore other related topics such the positive and negative impacts of sustainable innovation.

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