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THE AMBIGUOUS EFFECTS OF ECO-INNOVATIONS: A SYSTEMATIC LITERATURE REVIEW

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ABSTRACT: While eco-innovations can help organisations comply with external stakeholders' expectations, they can also lead to unwanted or unexpected effects. This paper aims to explore business management literature addressing the ambiguous effects of eco-innovation. The methods used included a systematic literature review (SLR) in the Scopus and WoS databases and bibliographic techniques. By critically analysing 53 papers, the study identifies four clusters where negative or ambiguous effects of eco-innovations appear: financial, environmental, social and operational performance. The results indicate that strategic eco innovation had a significantly adverse impact on corporate financing, caused a decrease in employment, and created tensions for employees. Moreover, the bearing of eco-managerial innovations (eco-design) on performance was not significant. We contribute to the literature by suggesting that eco-innovation does not always generate the expected benefits. What is more, different types of eco-innovation can generate contrasting effects for the organisation and may occur at different times.

KEYWORDS: eco-innovations, effects, literature review

Introduction

Most frequently, eco-innovation has been defined as the production, assimilation or exploitation of a product, production process, service management or business method that is novel for the organisation (developing or adopting it) and that, through the life cycle, results in a reduction of environmental risk, pollution and other negative impacts of the use of resources compared to other relevant alternatives (Kemp & Pearson, 2007). Eco-innovations have been at the centre of the policy strategy developed by the European Union (EU) in recent decades. They play a vital role in the future development path, not only because of their environmental impacts but also because they are now – and will be in the coming years – a significant source of employment, economic growth and new business opportunities (Costantini et al., 2023). At the same time, they correspond to win-win situations and competitiveness for organisations (Hermundsdottir & Aspelund, 2021).

In the area of business, a key issue is the relationship between eco-innovation and its effects. Much has been studied recently on this topic and on the impact that eco-innovation can have on business performance (Lopez Perez et al., 2023). Specifically, the positive influence of eco-innovations on economic performance has been widely recognised by advocates of evolutionary economics and management theories (Marín-Vinuesa et al., 2020). According to the ‘Porter hypothesis’, eco-innovations are believed to contribute to economic growth (Shuwaikh et al., 2023), profitability (Kemp & Pearson, 2007; Zhang & Yuan, 2022) and market position (Lin et al., 2013). Moreover, they are considered a key engine of growth (Leoncini et al., 2019) and competitiveness (Oncioiu et al., 2018). Furthermore, authors such as Liao (2018), Marín-Vinuesa et al. (2020), and Scarpellini et al. (2017) argue that eco-innovations can lead to cost reductions and thus improve business performance. Several previous investigations have confirmed that eco-innovations have a positive impact on social (Iranmanesh et al., 2019) or environmental outcomes (Ghisetti & Rennings, 2014). However, they may also bring partially negative effects, or their impact may be vague. Indeed, the evaluation of eco-innovations can be ambiguous, while their application may bring adverse effects. The industrial activity caused by eco-innovation can have negative environmental, economic, and social consequences. For instance, Ghisetti and Rennings (2014) have noted that the costs of implementing eco-innovations to cut externalities may outweigh potential improvements; as a result, eco-innovations can generate perilous financial consequences. In agreement with this finding, Li et al. (2022) demonstrated that green innovation significantly reduces companies’ economic efficiency. According to García-Sánchez et al. (2019), implementing environmental innovation strategies entails high costs that will harm both production and distribution in these companies. In the short horizon, green technology investments cause a decline in social performance; Nie et al. (2022) proved the existence of an inverted U-shaped relationship with these var-

ables. Taking a customer viewpoint, Ottman (2004) showed cases of eco-innovations that did not create positive results, such as reduced or improved product performance. He proved that they performed even worse than conventional solutions. In another context, scholars have noted that, at times, ecological innovations have also had detrimental effects on employment, which have not been entirely compensated by the wave of opportunities coming from the change (Horbach & Rennings, 2013). It has thus become progressively clear that innovations can cause unintended direct effects and negative side effects, and their negative outcomes are characteristically unevenly distributed. Moreover, eco-innovations are more complicated and riskier than non-environmental innovations (Iranmanesh et al., 2019).

In recent years, eco-innovation has attracted the attention of researchers from different scientific groups. More research needs to be devoted to its 'dark' effects. However, the few comments that eco-innovations may cause some environmental problems lacked theoretical depth in relation to the considerable amount of work examining their positive effects. To show that the picture is not merely white, it is worth compiling an alternative, complementary list of dimensions where the effects of eco-innovation are not unquestionably positive. Accordingly, in this article, we have chosen to provide a 'darker' description of the innovation by considering more deeply its potential negative effects on organisations and the environment. This study aims to conduct a systematic review of previous research on the dark side of eco-innovations, outlining promising directions regarding potential research areas, contents and predominant effects. An analytical framework is developed in order to explore the antecedents and negative outcomes and to present results according to several classification criteria. We propose the following research questions: Which dominant research themes have been used in analysing eco-innovation effects? What are the antecedents, negative or ambiguous outcomes of eco-innovations? To answer these questions, we systematically review the literature (SLR) to identify (a) the dominant research themes and (b) the unsuccessful or hearsay effects of implementing eco-innovation in organisations, covering 53 empirical contributions published in management-related journals between 2013-2023. Our analysis uses some bibliometric techniques for science mapping techniques and reviewer subjectivity bias, which is typical of qualitative reviews.

The contribution of this paper is twofold. First, we contribute to the literature by suggesting that eco-innovation does not always generate the expected benefits. We, therefore, question claims that eco-innovations have an unequivocally positive effect on any organisational performance. Secondly, we increase understanding of the relationship between types of eco-innovation and performance by showing that different types of eco-innovation can generate various outcomes. Our analysis thus deepens understanding of the generative mechanisms underpinning the potentially deleterious consequences of eco-innovations for organisations and, in so doing, responds to calls to deepen understanding of

the processes underpinning their use. Finally, the paper has practical implications. Managers often present eco-innovations as a 'panacea' for organisations, taking for granted the benefits of their implementation. Knowing the performance outcomes of eco-innovations is essential, given the high financial risk involved in eco-innovations. Understanding that these effects may not always occur will help to prepare the implementation process better and avoid the displacement effect of eco-innovation when making strategic investments.

The remainder of the paper is structured as follows: Section 2 presents the research method employed for the bibliographic analysis. Section 3 presents the study's central results, and Section 4 concludes and suggests future research directions.

Research methods

Researchers can use literature review approaches to conduct a thorough and trustworthy study of published scientific sources. According to (Tranfield et al., 2003) literature reviews consolidate and build knowledge bases within a research field. Because of differing purposes, growing complexity, and the increasing number of publications and research methods, several approaches to developing literature reviews are prevalent. Some labels in current usage are: systematic review; meta-analysis; rapid review; (traditional) literature review; narrative review; research synthesis; and systematic literature research (SLR).

In this paper, we adopted a systematic literature search, supplemented by bibliometric analyses, as our research method. The literature review aims to identify, integrate and evaluate research on eco-innovation's non-obvious and negative effects based on clearly defined criteria. SLR can use literature review approaches to conduct a thorough and trustworthy study of published scientific sources (Calandra et al., 2023). SLRs provide an approach that can help academics discover under-investigated topics and methods, nurturing, therefore, the development of new knowledge areas and research approaches (Massaro et al., 2016). Following Denyer & Tranfield (2006), we assumed that the use of literature review methods would achieve three benefits: 1. the literature review will encompass all research findings relevant to the topic under investigation; 2. the research findings that do not fit with the researcher's intentions will not be overlooked and 3. it will be possible to verify the relevance of the review through replication. In the context of this study, bibliometric analyses of the most frequently cited publications are very useful for understanding research focus and publication output on trends in eco-innovation and the effects of their implementation from the perspective of research progress. The research process involved three stages. These were database selection, publication selection and critical analysis, as recommended by Waltman (2016). While we list these steps in chronological order, it is important to understand that all research is a journey

and not a strict series of events, as the list above presents. Therefore, while we advocate a structure, the ultimate implementation of an SLR is fluid (Massaro et al., 2016).

Central to the integrity of the literature review process is the verification of publications. Bibliographic records, including keywords and citations, are perceived as a “remedy to the fallibilities of the author-based approach” (Dixon-Woods, 2011). These are reliable methods for exploring the scope and dynamics of scientific fields in innovation research (van Oorschot et al., 2018).

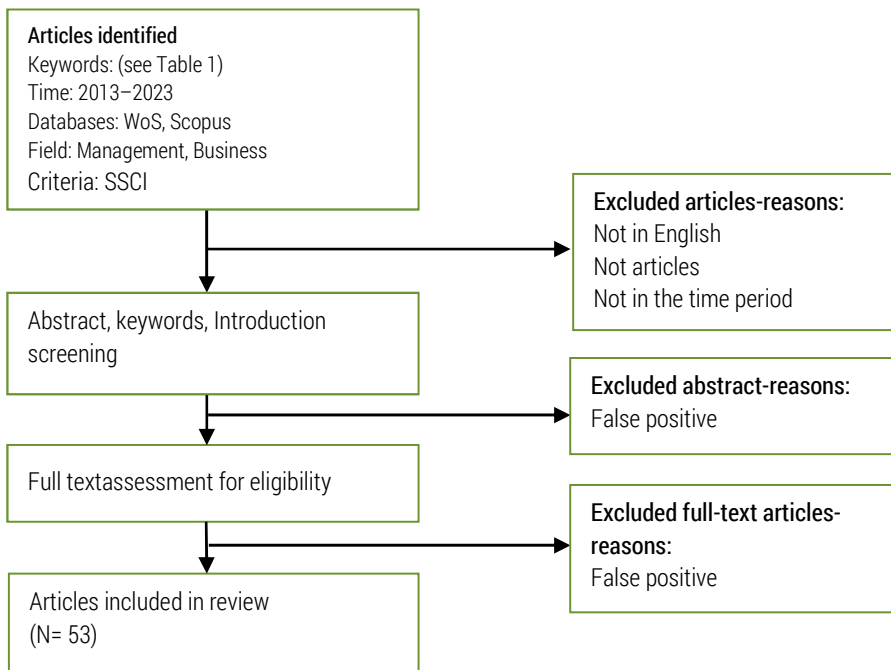
Firstly, we constructed a search query using the WoS and Scopus databases to widen the field of research. By reviewing journals in these databases, we ensure the identification of the “main corpus” of previous research. We chose to use the Social Science Citation Index of Clarivate Analytics Web of Science (WoS SSCI) because of the comprehensiveness and careful selection of publications. Scopus is the largest abstract and citation database of peer-reviewed literature – scientific journals, books and conference proceedings.

According to Shields (1997), “the distribution of articles across topics is consistent with the view that research published in these journals tends to extend topics [...] that have already appeared in them”. Therefore, we used keywords to find relevant articles that extend existing topics in a particular topic. We used search terms (queries) such as eco-innovation OR green innovation OR environmental innovation AND effect OR impact AND organisation AND negative and combinations of related and associated words (Table 1). Therefore, the next stage involved limiting the number of bibliographic records to address the problem of over-fitting (Boyack et al., 2018). As we were interested in literature focused on eco-innovation’s negative and non-obvious impacts on organisations, the search was limited to management, business and economic literature. Following Thyer (2008) and Massaro et al. (2016), we selected only peer-reviewed articles from academic journals in English. Conference papers, book chapters and monographs considered scientific journals at the frontier of knowledge were excluded. Factors related to the geopolitical or geographical situation were not a limitation of the study. The study did not make assumptions about the sectoral or business strategy level. To ensure the validity of the publication results, the period was 2013-2023. Table 1 shows the queries used to calibrate and select more detailed queries. The queries in the table were used to examine the databases in April 2023.

Two co-authors manually checked the initial search, abstracts, keywords and introductions. This allowed for identifying and eliminating false positives (i.e., articles unrelated to the topic or negatively qualified by the search systems). To ensure the study’s reliability, full texts of the selected articles were manually coded. Manual coding has an advantage when “words with similar meaning such as ‘eco-innovation’ and ‘green innovation’ are encountered; they can be understood in their true sense and coded accordingly” (Guthrie et al., 2012). The search process resulted in a sample of bibliographic records (Figure 1).

Table 1. Syntaxes used in query calibration for database exploration

No	Query Syntax	No of results
1	((TITLE-ABS-KEY ("eco-innovation")) AND ("effect")) AND ("organisation")) AND (LIMIT-TO (SUBJAREA, "BUSI"))	222
2	((TITLE-ABS-KEY ("environmental innovation")) AND ("effect")) AND (LIMIT-TO (SUBJAREA, "BUSI"))	71
3	((TITLE-ABS-KEY ("green innovation")) AND (effect AND impact)) AND (organisation AND company) AND (LIMIT-TO (SUBJAREA, "BUSI"))	95
4	((TITLE-ABS-KEY ("eco-innovation")) AND (effect AND negative)) AND (organisation AND company)) AND (LIMIT-TO (SUBJAREA, "BUSI"))	53

**Figure 1.** Data collection process

We used the bibliographic coupling technique for the analyses. It allows for identifying networks and clusters between documents that share references (i.e., references used more than once in the bibliographic sample). It is an indication that a probability exists that the two works treat a related subject matter (Jarneving, 2007; Zhang & Yuan, 2022). More articles with shared citations result in greater coupling. Based on this methodology, we aimed to identify thematic sub-communities on the negative effects of eco-innovation. The bibliographic

coupling analysis used distance-based maps, following Shen et al. (2019) and Bales et al. (2020). The distance between two items (articles) reflects the strength of the relationship. A smaller distance generally indicates a stronger relation. The length (or relative distance) S_{ij} between item i and j is measured as follows: $S_{ij} = C_{ij} / W_i W_j$, where C_{ij} – the number of co-occurrences of items i and j ; W_i – the total number of occurrences of item i ; W_j – the total number of occurrences of item j . We calculated the distance for every pair of articles using Visualisation of Similarities (VOS) viewer software. Its main advantage is the ability to be employed to view any two-dimensional distance-based map, regardless of the mapping technique that has been used to construct the map (van Eck & Waltman, 2010).

Results

Descriptive analysis

Based on the scientific publications highlighted by query 1 (for all eco-innovation effects, Table 1), a bibliometric map was proposed in VOSviewer software (van Eck & Waltman, 2013). The results show that eco-innovation is most strongly associated with terms such as sustainable development and sustainability (Figure 2). They also show the association of eco-innovation with firm performance and financial performance. However, Johl and Toha (2021) demonstrated that only a few studies have found a connection between eco-innovation and a company's financial results. The study demonstrate that eco-innovation and financial success are adversely associated from a social standpoint. According to Lopez Santos et al. (2019), there is no significant relationship between eco-innovations and a company's financial success in the first year. According to another study by meta-analysis that included 64 studies, majority of them ie. 55 percent of studies found a positive correlation, 30% found zero impact, and 15% found a negative link between eco-innovation and a firm's performance (Hojnik, 2017). Following a study of the empirical analysis, it is concluded that eco-innovation and a company's financial success yield mixed results Przychodzeń (2014). Santos et al. (2017) found a positive link between eco-innovation and financial success, similar to Hojnik and Ruzzier (2016), and Santos et al. (2017), on the other hand, used market-based metrics like Tobin's Q rather than accounting-based indicators. They argued that market-based interventions, rather than accounting-based measures, produce more efficient outcomes. Hizarci-Payne et al. (2021). While eco-innovation is aimed at accelerating sustainable development, it may also bring negative effects on the financial performance of businesses. These effects can arise from various side effects with the implementation of eco-friendly practices and technologies.



Figure 2. Eco-innovation associations visualised in VOSviewer

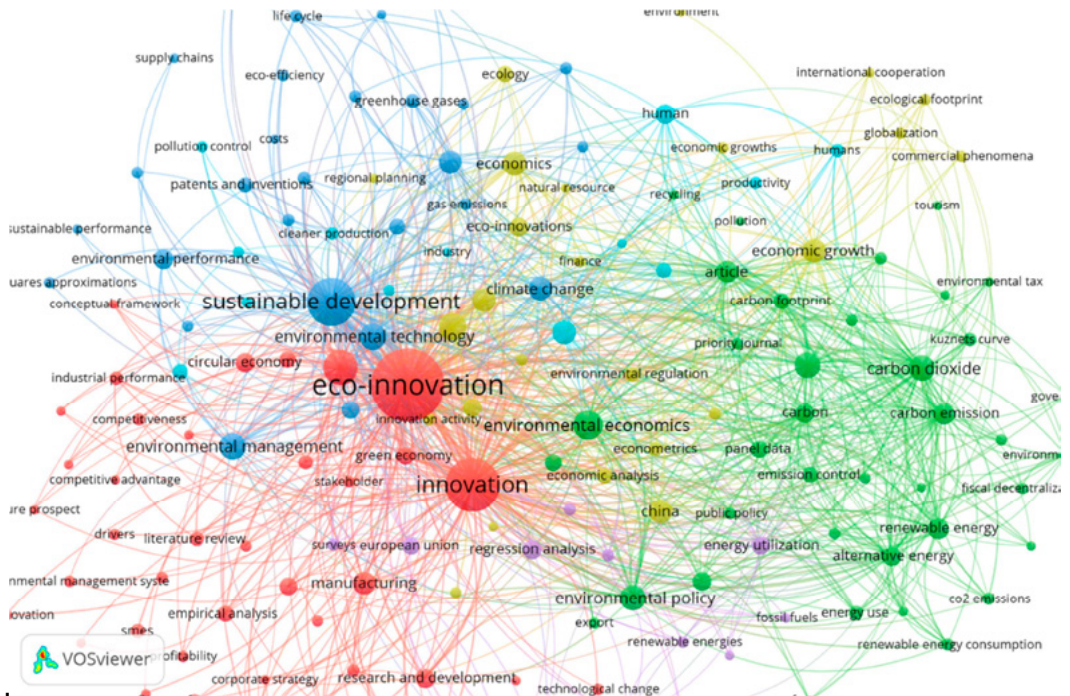


Figure 3. The strength of relationships between eco-innovation and financial performance (in VoS)

Limiting references to negative effects allows the identification of several clusters. The three automatically identified clusters (green, red, blue) were coloured by VOSviewer and presented as a bibliometric map in Figure 3. Adopting eco-innovations often requires significant, costly upfront investments in novel technologies, equipment, or processes. The initial costs can burden a company's financial resources and impact short-term profitability, especially if the expected returns are delayed to materialise.

The red cluster (in Figure 3) connects eco-innovation and innovation with environmental technology, environmental management, competitiveness, circular economy, industrial performance, competitive advantage, manufacturing and corporate strategy; development is connected with environmental sustainability, economic growth, climate change and eco-innovations. The blue cluster connects sustainable development with environmental management, regional planning and business performance. The last one – green – connects eco-innovation with ecological economics, carbon dioxide emissions, alternate energy, renewable energy, carbon emission, carbon footprint, Kuznets curve and energy efficiency.

One possible method to infer a particular state is to provide an analysis regarding the factual data independent of the content of the items. Figure 4 shows the number of publications over time between 2013 and 2023. The slight upward trend was bucked in 2021 when fewer publications were recorded on the topic under study. Accordingly, the number of publications confirming the ambiguous effects of eco-innovation instead increases in the following years.

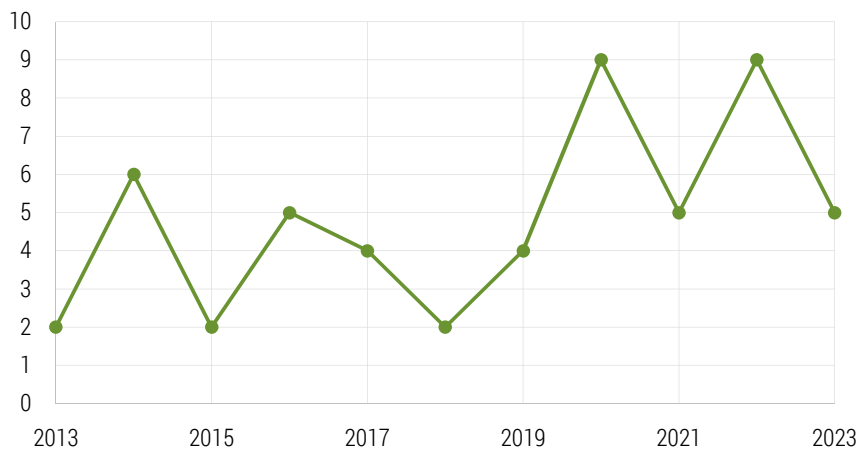


Figure 4. Number of journal publications by year

The distribution of journal publications shows the dominant role of two journals: *Business Strategy* and the *Environment and Journal of Cleaner Production* (Table 2). This is due to the scope of the journals, which focus on environ-

mental and sustainability research, concerning, in particular, eco-innovations, corporate environmental management tools, etc.

Table 2. Distribution of journals in which papers were published

Journal	Paper
Administrative Science	1
Brazilian Business Review	1
Business Strategy and the Environment	6
Business, Management and Economics Engineering	1
Ecological Economics	1
Econ Polit	1
Economic and Social Research Institute Papers	1
Energy	1
Energy Reports	1
Environmental Economics and Policy Studies	1
European Journal of Innovation Management	1
Human Systems Management	1
IEEE Transactions on Engineering Management	1
International Journal of Environmental Research and Public Health	2
International Journal of Business Innovation and Research	1
International Journal of Green Energy	1
International Journal of Innovation Management	1
International Journal of Innovation Science	1
International Journal of Sustainable Development & World Ecology	1
IZA World of Labor	1
Journal of Cleaner Production	8
Journal of Economic Surveys	1
Journal of Engineering, Design and Technology	1
Journal of Innovation & Knowledge	1
Journal of Retailing and Consumer Services	1
Jurnal Manajemen	1
Marketing and Management of Innovations	1
Organization & Environment	1
Research Policy	2
Review of Managerial Science	1
Small Business Economics	1
Sustainability	3
Sustainability Accounting, Management and Policy Journal	1
Sustainable Production and Consumption	1
Technol. Soc.	1
World Review of Entrepreneurship Management and Sustainable Development	1
Zarządzanie Przedsiębiorstwem (Corporate Management)	1

Relationship between eco-innovation and business performance

This section reports the results from the analysis according to the performance areas affected by eco-innovations. The conceptual framework for the evaluation of the relationship between eco-innovation and business performance distinguishes four clusters (categories) (Zheng & Iatridis, 2022), which we

adapted to characterise the main research focus of the article. Accordingly, each article we classified into a single category:

- 1) Financial performance,
- 2) Environmental performance,
- 3) Social performance,
- 4) Operational performance.

Financial performance

Considering the amount of research in this area, little evidence has been found. We determined that the number of studies addressing the relationship between green innovations and business performance has significantly increased. Nevertheless, the conclusions are still ambiguous (Ar, 2012; Arenhardt et al., 2015; Ghisetti & Quatraro, 2017; Li, 2014; Przychodzeń, 2014; Xie et al., 2022). In their literature review, Barbieri et al. (2016) demonstrated that different conclusions have emerged concerning this connection. These inconsistencies may be explained by the different approaches used, the various cultures' choices and circumstances, the sector chosen for analysis, the theory used and other factors.

According to our results, three indicators appeared in literature to date as predominant to indicate financial performance in the eco-innovation context: 1) sales, 2) market share and 3) return on investment (ROI). Other indicators are also relevant to represent the economic aspects of eco-process innovation, such as profit, production efficiency and material cost. For instance, García-Sánchez et al. (2019) emphasised the negative impact of eco-innovations on business returns, which does not preclude its positive impact on market value. Furthermore, Szutowski (2020) revealed that strategic eco-innovation had a significantly adverse impact on corporate financing (measured by the ratio of long-term and short-term borrowings to total assets). In another publication, Szutowski (2021) further proved the negative impact of eco-innovation (process, marketing and organisational) on stock returns.

Some authors have stressed that eco-innovations are usually riskier, more complex and more uncertain than ordinary innovations, and their capital costs are higher (Berrone et al., 2013; Arena et al., 2018; Cecere et al., 2014). Furthermore, eco-innovations are characterised by the 'double externality' problem (Rennings, 2000), which reduces the business's incentives to develop this type of innovation (Cai & Li, 2018). The empirical findings of Khan et al. (2020) confirm that eco-innovation has a negative impact on human capital, eco-innovation, energy prices, research and development expenditures, total energy consumption (TEC) and non-renewable energy consumption (NREC).

A paper by Doran and Ryan (2016), based on an Irish case, indicates that certain forms of eco-innovation can result in a win-win situation, benefiting both businesses and society, while others present a positive environmental effect but at the expense of productivity. The authors found that while demand-side, supply-side and regulatory drivers had an impact on the likelihood of a business

engaging in eco-innovation, the relative magnitudes of these impacts varied between the different types of eco-innovation considered. Moreover, their study showed that only two of the nine types of eco-innovation (reduced CO₂ 'footprint' and increased recycling of waste, water, or materials) had a positive effect on business performance.

It is also important to remember that the effects of eco-innovation (even if they are positive) can take time to materialise. As noted by Song et al. (2017), environmental spending in the given year impacts the company's financial results with some delay. Aibar-Guzmán and Frías-Aceituno (2021) reported three years during which undesirable financial effects persisted, and, according to Xie et al. (2022), eco-innovation has a U-shaped impact on the financial performance of companies, with the impact initially being negative and then becoming more positive as the level of green innovation increases. We believe this effect must remain scrutinised until further research is conducted.

Environmental performance

Despite the large body of research on this subject, little confirmation has been found regarding the environmental effects of eco-innovations. Zheng and Iatridis (2022) claim that some papers showing the impact of eco-innovations on environmental quality are still being widely contested. Anton et al. (2004) argue that since eco-process innovations focus only on the means (proactive efforts) for pollution control rather than the ends (performance improvement), they do not necessarily guarantee an improvement. Similarly, other studies (Afum et al., 2023; Chiou et al., 2011; Weina et al., 2016) have reported that eco-innovation has a positive effect on environmental performance only occasionally.

It remains unclear whether their impact on the economic goals improves environmental quality at the same time. As noted by Mačiulytė-Šniukienė and Sekhniashvili (2021), although the economic situation is improving in almost all EU Member States, environmental quality is deteriorating in some of them. Between 2010 and 2020, the value of eco-innovation indicators decreased in 13 countries. The biggest negative change occurred in Latvia, Sweden and Slovakia, where EPIs decreased by 10.9, 7.3 and 6.2 points, respectively.

On the other hand, Kubatko (2016) demonstrated the positive influence of increasing innovation spending to decrease non-renewable energy resource consumption. He argued that innovation brought abatement in emissions. This was explained by the specific economic structure in Ukraine (before the Russian invasion), which was based on heavy industries. Most additional innovations in the mentioned sectors were related to environmental pollution due to the rebound effects.

At the organisational level, Achmad Fauzi et al. (2019) indicated no effect of green innovations on environmental performance. Based on a population of 200 companies in Indonesia, they found that eco-innovations did not affect the pollu-

tion and waste produced, the cost of handling waste and pollution, and the environmental damage. They explained this phenomenon by the time lag between the implementation of the innovation and its outcome. Referring to green human relationships management practices (GHRM), some researchers have proven that such innovations have no positive effects on the environmental performance of an organisation (Mittal & Kaur, 2023; Ullah et al., 2023). The results were obtained for Pakistani companies' green product and process innovations. The authors clarified that the absence of positive effects was due to the insufficient knowledge available concerning the execution of GHRM practices and the deficiency of the essential skills to improve environmental quality. Interesting results were also obtained by Barriga Medina et al. (2022). They showed that different types of eco-innovation have other effects on the environmental performance of organisations. In particular, product eco-innovations do not influence the environmental performance of businesses.

Social performance

Social impacts refer to changes in employee behaviour and the social sphere. From the sustainability perspective, new activities and ecological practices can cause considerable behavioural changes (Greenwood et al., 2015) in relationships with stakeholders (Tang et al., 2023).

Firstly, introducing eco-innovation can cause negative psychological tensions, such as changes in feelings, attitudes and motivation. Iranmanesh et al. (2019) have noted that product and process eco-innovations negatively affect job satisfaction through job intensity. Changes create costs for workers. These can be related to the intensification of work activities and the reduction of idle times, as well as to psychological and physical pressures. The increase in labour efficiency through eco-innovation reduces employee satisfaction. Similar results were obtained by Falchi et al. (2023).

Secondly, organisations implementing eco-innovations also observed their negative impact on employment. Horbach and Rennings (2013) notes that eco-innovations can cause a decrease in employment due to higher production costs. Process innovations can have a negative impact on employment, particularly concerning labour productivity. End-of-pipe innovations may require hiring additional workers, which would positively impact employment. However, their indirect effects will be negative, as these technologies generate higher costs, leading to decreased production and employment. In the case of process innovations, their impact on employment is not clear-cut and depends on the labour intensity of the substituted products (Horbach & Rennings, 2013). The results of empirical studies support these conclusions. According to Hojnik (2017), implementing eco-innovation induces a decrease in employment over two business years (223 Slovenian organisations). For Carvella and Crespi (2022), this relationship applies to high-growth businesses where eco-innovation activities do not impact employment growth (5,284 Italian organisations).

Another group where ambiguous effects of eco-innovation were noted are external stakeholders. Based on an analysis of the literature, Zheng and Iatridis (2022) showed that eco-technological and eco-management innovations do not significantly impact social performance. According to their findings, companies seeking to improve social performance through eco-innovation should prudently choose the type of innovation. In the short to medium term, choosing between two kinds of eco-innovation will not lead to complementary outcomes regarding external stakeholder engagement. The absence of this relationship is confirmed by Zhao et al. (2021). Their study of 206 Chinese companies indicates that eco-innovations in supply chains and social performance are negatively related. Their findings suggest little success in integrating green suppliers to improve public image, stakeholder relations and brand image. They explain this by China's inadequate environmental regulatory oversight system, making it difficult to communicate information about the environmental activities of companies.

Considering customer behaviour, Alyahya et al. (2023) have confirmed that customers in developed societies boycott reactive eco-innovations – passive innovations implemented to ensure compliance with environmental regulations. The boycott occurs despite the eco-innovations when customers feel that companies violate their psychological contracts or fail to implement environmental programs. These results align with Liao & Liu (2022) and Wang et al. (2022). However, it should be noted that the opposite results were obtained for active eco-innovation (Machova et al., 2022).

Operational performance

The unexpected impact of eco-innovations on operational performance refers to the inability to deliver greater flexibility, productivity, lead times and quality. Marin (2014) shows that eco-innovations provide substantially weaker operational effects than non-ecological innovations. Using the extended Cobb-Douglas production function on a group of Italian workers, he showed that eco-innovations slightly reduced labour productivity. Productivity improvements due to implementing environmentally friendly technologies in polluting companies amounted to only a quarter of the productivity improvements provided by other innovations. Other studies also did not confirm the positive impact of eco-innovation on operational performance. Fernando and Uu (2017) report that the bearing of eco-managerial innovations (eco-design) on performance involving product quality improvements, delivery and flexibility improvement is not significant. Analogous results for eco-technological innovations were obtained for eco-products by Zheng and Iatridis (2022) and Zulkiffli et al. (2022). Doran and Ryan (2016) highlighted the positive impact of eco-innovation on productivity for only two of the nine types of eco-innovation. While some forms of eco-innovation may lead to a win-win situation, most result in improved environmental performance at the expense of productivity. According to Stucki (2019), the productivity impact of investments in green energy technologies is positive for only

19% of companies with high energy costs. This demonstrates that eco-innovations tend to crowd out resources from other innovations that are more cost-effective, at least in the short term.

Discussion

The results of this study provide three contributions. First, while previous studies have focused on the positive effects of eco-innovation, this study fills this gap in the literature by pointing to their ambiguous or negative effects. Our reflections show that, despite managers' commitment and good intentions, eco-innovations can reduce various outcomes. This phenomenon applies to different types of eco-innovation, with our findings pointing to potentially undesirable effects on financial, environmental, social and operational performance. This responds to the calls to increase understanding of how organisations experience eco-innovation. Secondly, this study contributes to the literature on sustainability. While previous research has shown that eco-innovations can act as enablers and offer considerable advantages for sustainability (Larbi-Siaw et al., 2022), our research highlights that implementing eco-innovations does not necessarily contribute to sustainability. For eco-innovations to be as progressive as possible, it is crucial that they (1) result in a win-win outcome; (2) do not prioritise economic performance over social or environmental performance; and (3) do not blind innovators to possible negative impacts. Eco-innovations do not always meet these conditions. Hence, more holistic/systemic thinking about their impact on sustainable performance is needed. Third, our research expands knowledge in the field of innovation management. Eco-innovations are a form of intervention or transformation and, as such, disrupt organisations. This means that the transformational nature of eco-innovation entails a disruption of the status quo and, therefore, requires innovators to use innovation management methods to minimise resistance to change and counteract the undesirable effects of eco-innovation.

From a practical point of view, this study highlights the potential adverse effects of eco-innovation. It may help managers understand why, despite the costs incurred, eco-innovations do not generate the expected effects, may encounter employee resistance and could even fail. Taking a short-term view of eco-innovations does not work, as their unexpected adverse results will result in a negative perception. Hence, it is necessary to assess the effects of eco-innovation in the long term and to build awareness among internal and external stakeholders regarding the expected results of eco-innovation per se and the results of non-ecological innovations. It is also important to consider the possibility of integrating the issue of unintended consequences into the discourse on eco-innovation. Describing eco-innovation as a solution that generates multiple benefits often helps to legitimise actions for political or management purposes. A better awareness of the unintended effects of eco-innovation helps to challenge them.

This study is exploratory but based on a limited number of publications. Firstly, keywords have been established top-down and a limited number of searches was assumed. This may have led to the exclusion of some papers (false negatives) or the selection of irrelevant literature with low correlation (false positives). Secondly, the selected literature is mainly based on two databases, which may have omitted important literature. Thus, this review should be seen as complementing alternative fine-grained content analyses.

Conclusions

While eco-innovations are widely regarded as beneficial solutions, they can also have non-obvious and negative consequences for organisations. Although most research has focused on the positive effects of eco-innovation, we refer to research confirming the negative effects in this paper. We have identified four clusters of results (economic, environmental, social, operational) in which undesirable effects may appear. Research was conducted in parallel and rarely addressed more than one effect at a time. We believe that there are legitimate reasons to draw attention to the downside of eco-innovation. It stems from environmental policies and stakeholder pressure for this type of innovation. Therefore, exploring the nature and non-obvious consequences of eco-innovation is expedient.

In the past, researchers were convinced that innovations could have short-term adverse effects, but these would certainly be offset by the added value that would occur in the long term. Nowadays, it is advocated that there is a shift away from a juxtaposition of positive and negative effects of innovations towards more nuanced assessments. As Coad et al. (2021) noted, 'innovation can have good and bad effects, and those positive and negative outcomes are typically unevenly distributed'.

Future studies in this field may concentrate more on the less explored effects of eco-innovation. While many articles investigate financial performance and productivity issues, little evidence is available on the impact of eco-innovation on competitiveness, flexibility or resilience. There may be no negative impact. Furthermore, while analyses of eco-innovation-performance causal relationships are crucial for the organisation, assessing their undesirable consequences for external stakeholders has been downplayed and can create future research avenues. This evidence is vital to identify winners and losers in eco-innovations and their distributional effects.

The contribution of the authors

Conceptualization, A.K. and P.B.; literature review, A.K. and P.B.; methodology, A.K. and P.B.; writing, A.K. and P.B.; conclusions, A.K. and P.B.

The authors have read and agreed to the published version of the manuscript.

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NIEJEDNOZNACZNE SKUTKI EKOINNOWACJI: SYSTEMATYCZNY PRZEGLĄD LITERATURY

STRESZCZENIE: Choć ekoinnowacje mogą pomóc organizacjom w spełnieniu oczekiwań zewnętrznych interesariuszy, mogą również prowadzić do niepożądanych lub nieoczekiwanych efektów. Niniejszy artykuł ma na celu zbadanie literatury dotyczącej zarządzania przedsiębiorstwem w odniesieniu do niejednoznacznych skutków ekoinnowacji. Zastosowane metody obejmowały systematyczny przegląd literatury (SLR) w bazach danych Scopus i WoS oraz techniki bibliograficzne. Analizując krytycznie 53 artykuły, w badaniu zidentyfikowano cztery klastry, w których pojawiają się negatywne lub niejednoznaczne skutki ekoinnowacji: wyniki finansowe, środowiskowe, społeczne i operacyjne. Wyniki wskazują, że ekoinnowacje strategiczne miały znacząco negatywny wpływ na finanse przedsiębiorstw, powodowały spadek zatrudnienia i powodowały napięcia wśród pracowników. Co więcej, wpływ innowacji w zakresie ek zarządania (ekoprojektowania) na wyniki nie był znaczący. Ukazany wkład do rozwoju literatury, polega na pokazaniu, że ekoinnowacje nie zawsze przynoszą oczekiwane korzyści. Co więcej, różne rodzaje ekoinnowacji mogą generować kontrastujące skutki dla organizacji i mogą występować w różnym czasie.

SŁOWA KLUCZOWE: ekoinnowacje, organizacje, efekty przegląd literatury