Ekonomia — Wroclaw Economic Review 29/3 (2023)
Acta Universitatis Wratislaviensis
No 4193

https://doi.org/10.19195/2658-1310.29.3.7

Katarzyna Walecka-Jankowska
ORCID: 0000-0002-2764-6763
Wroclaw University of Science and Technology
katarzyna.walecka-jankowska@pwr.edu.pl

Jagoda Mrzygłocka-Chojnacka
ORCID: 0000-0002-5404-4696
Wroclaw University of Science and Technology
jagoda.mrzyglocka-chojnacka@pwr.edu.pl

Relationship between environmental innovation and sustainable outcomes: Empirical evidence from Denmark

Date of submission: 01.08.2023; date of acceptance: 20.09.2023

JEL classification: O30, O31, O35, M14, M30

Keywords: business sustainability, environmental innovations, sustainable outcomes, management

Abstract

The purpose of the described research was to identify the impact of different types of environmental innovations on sustainable organizational performance of companies operating in Denmark. The research considered four types of environmental innovations: process, product, organizational and marketing and sustainable performance in three areas: economic, social, and environmental.

The research methodology involved a survey of 338 Danish companies, using a validated questionnaire, which provided data on their implementation of different types of environmental innovations and their sustainable performance in three basic areas: economic, environmental, and social. Three regression models were built to verify the theoretical relationship between different types of environmental innovations and sustainable performance.

The results showed that all four types of environmental innovations have a positive impact on sustainable performance. Detailed analysis showed that organizational innovations as well as process innovations support organizational performance in all three areas. The article also pointed out the limitations of the research conducted and directions for future research.

1. Introduction

In recent times, there has been an increasing complexity in the connection between corporate activities and the environment. This can be attributed to a growing recognition of the importance of environmental care and the understanding that companies have a negative impact on the environment through their operations. Consequently, there is mounting pressure to explore innovative solutions that can yield positive environmental effects. As a result, the relationship between eco-friendly innovations and the sustainable development of businesses has gained the attention of researchers and there is growing empirical evidence that this link exists and, at least in part, it is positive (Hermundsdottir and Aspelund, 2021).

In response to these challenges, companies are actively seeking new innovative approaches, devising novel business and management models, creating new services and products, and developing fresh production and marketing techniques that can safeguard and enhance environmental quality (Berry and Rondinelli, 1998; Savitz and Weber, 2006; UN, 2017; Walecka-Jankowska et al., 2017). This entails integrating environmental innovations into their operations, aiming not only for improved economic performance but also for positive social and environmental outcomes. These three dimensions – economic, social, and environmental – are the fundamental aspects of sustainable business outcomes (Ch'ng et al., 2021; Fernando et al., 2019; Larbi-Siaw et al., 2022; Tumelero et al., 2019; Wagner and Llerena, 2011). Therefore, this article focuses on the relationship between different types of environmental innovations (such as process, product, organizational, and marketing innovations) and sustainable outcomes (economic, social, and environmental). The article presents the findings of a survey conducted on 338 Danish companies to investigate the influence of environmental innovation types on organizational outcomes. The structure of the article is as follows: The first section provides a literature review, outlining the concepts of environmental innovation and its association with organizational performance. The second section describes the research methodology, research model, research hypotheses, and collected data. The study's results, highlighting the impact of environmental innovation types on organizational outcomes in Danish companies, are presented. Finally, the concluding section summarizes the research findings and proposes future research directions and organizational implications.

2. Theoretical framework of the research

2.1. Environmental innovations

Defining the term environmental innovation is not straightforward because of the lack of consensus among researchers on a common definition. In addition, there

is a lack of consensus on the term environmental innovation itself, with researchers using the terms "green", "eco", "environmental", "social", and "sustainability innovation" interchangeably as terms commonly used to describe innovations that reduce a company's negative impact on the environment and society (Díaz-García et al., 2015; Hermundsdottir and Aspelund, 2021; Schiederig et al., 2012; Tariq et al., 2017). Therefore, the authors of this paper use the term environmental innovation and, for the rest of the terms, assume that they can be treated interchangeably as synonyms.

Similar to other types of innovation, environmental innovations encompass various characteristics as proposed by OECD/Eurostat (2018). They can manifest as products, processes, services, or methods, including business models, and should address user needs while influencing the competitiveness of companies. The distinguishing feature of environmental innovations, as outlined in several definitions to varying degrees, is their environmental aspect. Most definitions explicitly emphasize their role in reducing negative environmental impacts compared to alternative approaches (Fernando et al., 2019; Garcia et al., 2019; Hahn et al., 2010). Some definitions also highlight additional facets of environmental innovation, particularly in relation to its purpose. As per OECD's assumptions (OECD, 2011), the purpose of environmental innovation encompasses changes in products and services, processes, marketing methods, as well as organizational and institutional aspects. Furthermore, this goal can be either technological or non-technological in nature. Technological changes are typically associated with product and process innovations, while non-technological changes pertain to marketing, organizational, and institutional innovations (Chan et al., 2016; OECD, 2011).

In essence, environmental innovations refer to the introduction of new and innovative solutions aimed at mitigating negative environmental impacts while addressing economic and social concerns (Melece, 2015). The inclusion of social issues is important because much of the current research related to sustainability innovation is that the term is often reduced to environmental improvements, turning it into a one-dimensional concept (Klewitz and Hansen, 2014; Seuring and Müller, 2008). However, sustainability is a broader concept and also includes social and economic aspects (Ben Arfi et al., 2018). Therefore, this article takes a more holistic approach, which is also called for by other researchers (Adams et al., 2016; Seuring and Müller, 2008). Thus, as written above, the authors of the article assume that environmental innovation refers to new and innovative solutions to mitigate negative environmental impacts while addressing economic and social issues, and includes both technological and non-technological changes, which can take various forms, such as product, process, and organizational or marketing methods. This conceptualization of environmental innovation aligns with the framework presented by OECD/Eurostat (2018) and serves as the basis for the research discussed in this article.

2.2. Environmental innovations and organizational outcomes

Environmental innovation plays a crucial role in facilitating the global shift towards sustainable development (Dogaru, 2020; OECD, 2009). However, many companies have yet to take sufficient steps towards this direction (Redman, 2018). The implementation of environmental innovations presents challenges, as the dual goals of achieving financial and environmental value create tension (Garcia et al., 2019). Moreover, uncertainty surrounds their organizational effects, and there can be high setup costs, particularly for technological eco-innovations (Hanelt et al., 2017). Consequently, empirical evidence is needed to demonstrate the impact of environmental innovations on firm performance.

Various studies provide evidence that environmental innovation positively affects both economic and environmental performance (Cheng et al., 2014; da Silva Rabêlo and de Azevedo Melo, 2019; Hermundsdottir and Aspelund, 2022; Nishitani et al., 2017; Rabadán et al., 2019; Rennings et al., 2006; Vargas-Vargas et al., 2010; Yurdakul and Kazan, 2020). Furthermore, the literature suggests that environmental innovation contributes to enhancing a company's competitiveness (Chen et al., 2006; da Silva Rabêlo and de Azevedo Melo, 2019), attracting financial investors (Doh et al., 2010), meeting consumer demand (Horbach, 2008), improving organizational capacity (Aschehoug et al., 2012), and even boosting employee engagement and productivity (Dögl and Holtbrügge, 2014).

However, implementing environmental innovations often involves research and development or changes in production technologies, which can be costly. It may also require modifications in supply chain management (Fraj et al., 2015), promotion of new products or services, adoption of new business models and practices, and employee education (Kok et al., 2013). As a result, investing in environmental innovation requires careful consideration of its impact on financial performance. The literature on this topic provides mixed results (Aldieri et al., 2020; Hermundsdottir and Aspelund, 2021, 2022; Jaggi and Freedman, 1992; Orlitzky et al., 2003; Porter, 1991; Song et al., 2017). According to a meta-analysis by Garcia et al. (2019) 55% of the studies show a positive association between environmental innovation and financial performance, 15% show a negative association, and 30% show a non-significant or nonlinear relationship. Lin and Zheng (2016) found that a positive relationship between environmental innovation and economic performance is observed only when a combination of economic, organizational, and environmental innovations yields positive effects. Similarly, Vasileiou et al. (2022) conclude that the profitability of environmental innovations increases when there are synergies between environmental innovations and other product and process innovations, as well as organizational innovations, particularly for companies-specific environmental benefits. However, for consumer-specific environmental benefits,

only organizational innovations contribute to enhanced profitability. Tang et al. (2018) demonstrated that both product eco-innovation and process eco-innovation positively affect company corporate performance and productivity. However, for product eco-innovation, consideration of both input costs and conversion costs, as well as consumer acceptance risks, is necessary. Successful environmental innovations that positively impact financial performance require adequate internal and external resources, including the development of green products, optimization of production processes, environmentally-friendly management practices, and the provision of services that cater to sustainability-conscious consumers (Lampikoski et al., 2014; Tseng et al., 2013). Therefore, companies must consistently invest in and improve their operations to avoid negative interactions that could affect their financial performance (Roper and Tapinos, 2016; Zhang et al., 2020). On the contrary, some studies and theoretical perspectives suggest that environmental innovation may have a negative impact on financial performance (Aguilera-Caracuel and Ortiz-de-Mandojana, 2013; Driessen et al., 2013). A study by Liu et al. (2011) even found a direct link between environmental innovation and higher costs. However, these findings contradict the results of (Przychodzen and Przychodzen, 2013; Santos et al., 2017). Rezende et al. (2019), on the other hand, propose that there is no significant relationship between environmental innovations and financial performance in the short term. However, in the long term, the success of such innovations is tied to a company's financial success, provided there are sufficient resources to implement and sustain them.

The previous analysis reveals a scarcity of research on how environmental innovations impact company performance by type. The existing studies mainly concentrate on organizational, product, and process innovations, neglecting the role of environmental innovation in marketing (Driessen et al., 2013). Vasileiou et al. (2022) propose that this might be due to researchers overestimating the significance of environmental innovation compared to other types, such as process, product, and organizational innovations. However, (Medrano et al., 2020) found that managers need to transform traditional marketing practices, which implies a relatively weak association with environmental innovation. In contrast, Kumar et al. (2013) explicitly state that environmental orientation and marketing innovation within companies are conflicting concepts.

Based on our literature survey, we found only one study examining the relationship between types of environmental innovation and sustainable business performance in the Malaysian technology industry. This study explores the impact of three types of environmental innovation (eco-processes, eco-products, and eco-organization) on three dimensions of sustainable business performance (economic, social, and environmental) (Ch'ng et al., 2021). The results indicate that only eco-organizational innovations have a direct and positive influence on economic performance, which aligns with findings in other studies, such as (Cheng et al., 2014; Liao, 2018). However, other types of innovation, such as eco-process

innovations (Tumelero et al., 2019) and product innovations (Boons et al., 2013; Driessen et al., 2013), as well as eco-process and eco-product innovations (Cai and Li, 2018), do not show a similar impact on economic performance. Regarding environmental performance, both eco-process and eco-product innovations demonstrate positive effects, consistent with prior research (Cai and Li, 2018; Liao, 2018). However, eco-organizational innovations do not directly contribute to improved environmental performance, as observed in Cheng et al. (2014). In terms of sustainable performance in the social dimension, the researchers did not find a direct impact from any of the types of environmental innovation analyzed. Notably, this study does not consider environmental marketing innovations.

3. Research methodology

This study is a part of wider research on relationships between different types of innovations and business sustainability conducted in Poland and Denmark. This paper concentrates on examining the impact of types of environmental innovation on organizational outcomes in companies operating in Denmark. The general research model in the context of the hypotheses presented above is presented in Figure 1 (the number of items measuring the variables is given in brackets).

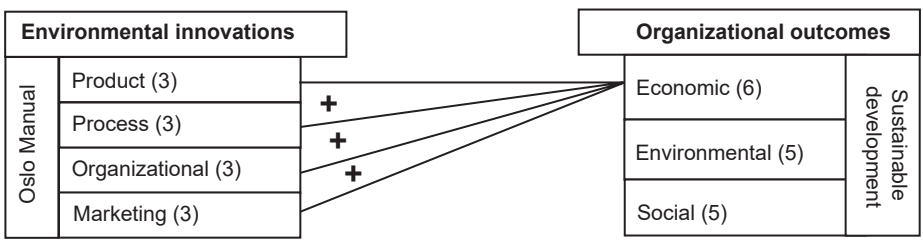

Figure 1. Relationship between environmental innovations and organizational outcomes

Source: own elaboration.

The study was conducted in late 2020 and early 2021, using a questionnaire (validated by the competent judges approach) that was intended to be appropriate for any companies regardless of size, activity profile, or affiliation with a branch of the economy. The respondents to whom the survey was directed (the services of two data collection companies were used) are senior managers with a broad view of the companies surveyed, i.e. CEOs, senior managers, quality managers (each respondent represented a different company). The general population consisted of companies operating in Denmark. As a result, 338 correctly completed surveys were obtained. The respondent profiles are presented in Table 1.

Table 1. The profile of respondents from Denmark

		Frequency	Percentage	Cumulative percentages
Valid	1 (up to 9 employees)	28	8.2	8.2
	2 (10–49 employees)	71	20.9	29.1
	3 (50–249 employees)	116	34.4	63.5
	4 (above 249 employees)	121	36.5	100.0
	Total	338	100.0	

Source: own elaboration.

In order to examine the relationship between the types of environmental innovations and organizational outcomes, the following key variables were defined separately for data collected in Denmark: four environmental innovations (based on the Oslo Manual typology): environmental product innovations (3 items), environmental process innovations (3 items), environmental organizational innovations (3 items), environmental marketing innovations (3 items), and three outcome variables based on sustainable development dimensions (based on Zgrzywa-Ziemak, 2019): economical outcomes (6 items), environmental outcomes (5 items), social outcomes (5 items). The reliability of variables (measured by the Alpha-Cronbach coefficient) is between 0.652 and 0.686 for innovation variables and 0.887–0.930 for outcomes variables), which indicates a high internal consistency and reliability in the measurement of particular variables.

4. Results

To verify the hypotheses describing the relationship between individual components of types of environmental innovations and organizational outcomes, statistical analyzes were carried out. First, a correlation analysis was conducted using Pearson's coefficient – which revealed significant relationships between all types of environmental innovations and the levels of sustainable outcomes. The results are presented in Table 2.

As a second step of statistical analyses it was decided to perform stepwise regressions. For different organizational outcomes three regression models were obtained. Those models seem to fit the data well (the equations are presented in Table 3). The best fit can be observed in the case of environmental outcomes – R^2 explains 48% of the variance in the dependent variable. When it comes to economic outcomes, the percentage of explained variance is 27%. However, in the case of social outcomes the lowest indicator can be observed, because only 12% of the model explains the variance of the dependent variable. The regression equations can be written as follows:

Table 2. Correlations (Denmark)

		Environmental product innovation	Environmental process innovation	Environmental organizational innovation	Environmental marketing innovation
Economic outcomes	Pearson correlation	0.184**	0.276**	0.313**	0.153**
	Relevance (bilateral)	0.001	0.000	0.000	0.005
	N	339	340	340	340
Environmental outcomes	Pearson correlation	0.127*	0.204**	0.233**	0.246**
	Relevance (bilateral)	0.020	0.000	0.000	0.000
	N	339	340	340	340
Social outcomes	Pearson correlation	0.112*	0.267**	0.309**	0.232**
	Relevance (bilateral)	0.040	0.000	0.000	0.000
	N	338	339	339	339

Source: own elaboration.

$$Y \text{ organizational outcomes} = b_0 + b_1 \times X_1 + b_2 \times X_2 + b_3 \times X_3 + b_4 \times X_4$$

*X_1 – Environmental product innovations, X_2 – Environmental process innovations, X_3 – Environmental organizational innovations, X_4 – Environmental marketing innovations.

Table 3. The regression equations

Economic outcomes (ECL OUT*)	$F(4.334) = 30.238$; $p<0.001$; $r^2 = 0.266$	$YECL\_OUT = 0.639 + 0.099 \times X_2 + 0.228 \times X_3 + 0.232 \times X_4$
Environmental outcomes (ENV_OUT*)	$F(4.334) = 76.590$; $p<0.001$; $r^2 = 0.478$	$YENV\_OUT = 0.131 + 0.220 \times X_1 + 0.228 \times X_2 + 0.236 \times X_3 + 0.223 \times X_4$
Social outcomes (SOC_OUT*)	$F(4.334) = 11.270$; $p<0.001$; $r^2 = 0.119$	$YSOC\_OUT = 0.974 + 0.114 \times X_2 + 0.156 \times X_3$

Source: own elaboration.

5. Discussion

Empirical research presented in this paper confirms that there is a relationship between environmental innovations and sustainable outcomes. If we take a closer look at these relationships, we will be able to observe which innovations are conducive to the various outcomes that make up an organization's sustainable performance. Economic outcomes are most influenced by process, organisational, and marketing innovations (presented in Figure 2). Very surprisingly, there is no significant relationship between product innovations and economic outcomes. Perhaps this is related to the environmental focus of these innovations.

In the case of environmental performance, the results were not surprising. All types of innovation are conducive to increasing these outcomes (presented in Figure 3).

In turn, only product and process innovations proved statistically significant for social outcomes, while organizational and marketing innovations were no longer (presented in Figure 4). The lack of a significant relationship between organizational innovations and social outcomes may be related to the fact that their goals are environmental. Although it is surprising that they do not have an impact on in-

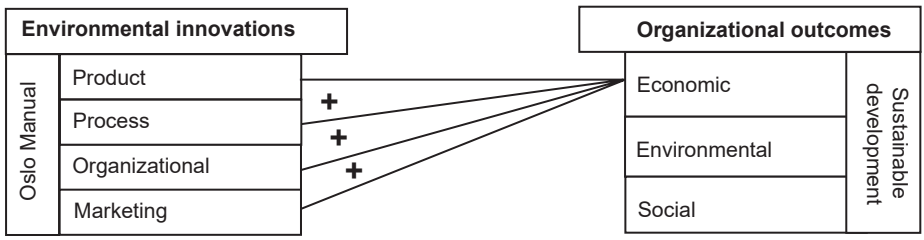

Figure 2. Relationship between environmental innovations and economic outcomes in Denmark

Source: own elaboration.

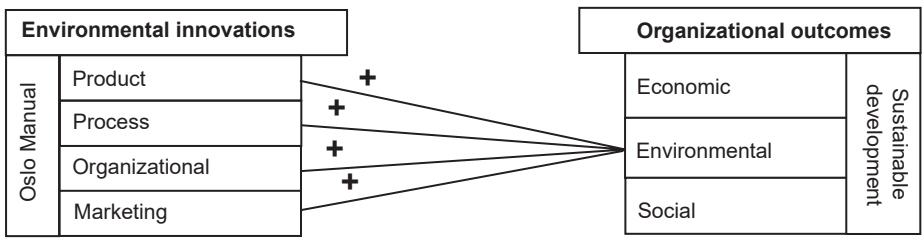

Figure 3. Relationship between environmental innovations and environmental outcomes in Denmark

Source: own elaboration.

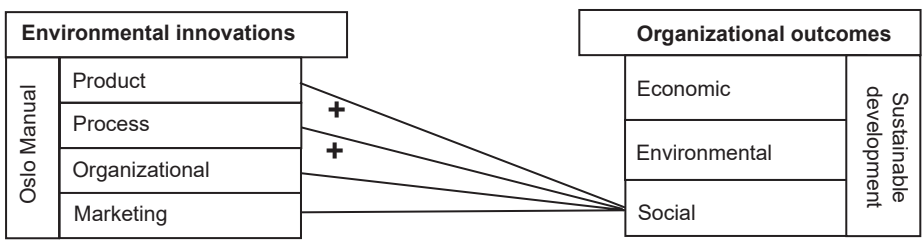

Figure 4. Relationship between environmental innovations and social outcomes in Denmark

Source: own elaboration.

creasing customer satisfaction, or the sense of satisfaction or security in employees. Similarly, the lack of a relationship between marketing innovations and customer satisfaction is surprising. It may be due, for example, to the inadequate information provided to customers about the steps taken in this regard.

6. Conclusions

To sum up, the results obtained, through a broad view, made it possible to use four types of environmental innovation and link them in the model to sustainable performance and clarify the relationship between them. Moreover, it seems crucial to take a systemic view of which innovations collectively build the model and note that process and organizational innovations appear as an element present in each of the models obtained. This is therefore an indication that organizational activities through processes should support product or marketing innovations to lead to sustainable results in the implementation of environmental innovations. Especially since organizational innovations can create support for process innovation implementations, they are most often implemented jointly. It is important to implement metrics to observe the change in various areas of sustainable organizational performance (e.g., related to reducing waste, reducing resource consumption, using renewable resources).

The presented study has some limitations, due to subjective measurement. In the future, an in-depth interview method could be used along with documentation studies, which would allow more objective results to be obtained. Moreover, increasing the size of the research sample and expanding the study to other countries will allow for generalization of the results, as the results obtained may be specific to companies operating in Denmark. Furthermore, examining the relationship between environmental innovation and exogenous contextual factors (e.g., dimensions of national cultures and macroeconomic indicators) and endogenous factors (e.g., age and size of the organization, culture, core values, leadership, management style, or organizational structure) would be of great interest. Likewise, considering the distinction between radical and incremental innovations and verifying whether other dimensions of sustainable performance will be influenced – would also be valuable.

Acknowledgments

The research was funded by an NCN project: Innovation of enterprise oriented on sustainable development (2019/03/X/HS4/01295).

References

Adams, R., Jeanrenaud, S., Bessant, J., Denyer, D., Overy, P. (2016). Sustainability-oriented innovation: A systematic review. *International Journal of Management Reviews*, 18(2), 180–205. https://doi.org/10.1111/ijmr.12068.

Aguilera-Caracuel, J., Ortiz-de-Mandojana, N. (2013). Green innovation and financial performance: An institutional approach. *Organization and Environment*, 26(4), 365–385. https://doi.org/10.1177/1086026613507931.

Aldieri, L., Makkonen, T., Paolo Vinci, C. (2020). Environmental knowledge spillovers and productivity: A patent analysis for large international firms in the energy, water and land resources fields. *Resources Policy*, 69, 101877. https://doi.org/10.1016/j.resourpol.2020.101877.

Aschehoug, S.H., Boks, C., Storen, S. (2012). Environmental information from stakeholders supporting product development. *Journal of Cleaner Production*, 31, 1–13. https://doi.org/10.1016/j.jclepro.2012.02.031.

Ben Arfi, W., Hikkerova, L., Sahut, J.M. (2018). External knowledge sources, green innovation and performance. *Technological Forecasting and Social Change*, 129, 210–220. https://doi.org/10.1016/j.techfore.2017.09.017.

Berry, M.A., Rondinelli, D.A. (1998). Proactive corporate environmental management: A new industrial revolution. *Academy of Management Executive*, 12(2). https://doi.org/10.5465/ame.1998.650515.

Boons, F., Montalvo, C., Quist, J., Wagner, M. (2013). Sustainable innovation, business models and economic performance: An overview. *Journal of Cleaner Production*, 45, 1–8. https://doi.org/10.1016/j.jclepro.2012.08.013.

Cai, W., Li, G. (2018). The drivers of eco-innovation and its impact on performance: Evidence from China. *Journal of Cleaner Production*, 176, 110–118. https://doi.org/10.1016/j.jclepro.2017.12.109.

Ch'ng, P.C., Cheah, J., Amran, A. (2021). Eco-innovation practices and sustainable business performance: The moderating effect of market turbulence in the Malaysian technology industry. *Journal of Cleaner Production*, 283, 124556. https://doi.org/10.1016/J.JCLEPRO.2020.124556.

Chan, H.K., Yee, R.W.Y., Dai, J., Lim, M.K. (2016). The moderating effect of environmental dynamism on green product innovation and performance. *International Journal of Production Economics*, 181, 384–391. https://doi.org/10.1016/j.ijpe.2015.12.006.

Chen, Y.S., Lai, S.B., Wen, C.T. (2006). The influence of green innovation performance on corporate advantage in Taiwan. *Journal of Business Ethics*, 67(4), 331–339. https://doi.org/10.1007/s10551-006-9025-5.

Cheng, C.C.J., Yang, C.L., Sheu, C. (2014). The link between eco-innovation and business performance: A Taiwanese industry context. *Journal of Cleaner Production*, 64, 81–90. https://doi.org/10.1016/j.jclepro.2013.09.050.

da Silva Rabêlo, O., de Azevedo Melo, A.S.S. (2019). Drivers of multidimensional eco-innovation: Empirical evidence from the Brazilian industry. *Environmental Technology*, 40(19), 2566. https://doi.org/10.1080/09593330.2018.1447022.

Díaz-García, C., González-Moreno, Á., Sáez-Martínez, F.J. (2015). Eco-innovation: Insights from a literature review. *Innovation: Management, Policy and Practice*, 17(1), 6–23. https://doi.org/10.1080/14479338.2015.1011060.

Dogaru, L. (2020). Eco-innovation and the contribution of companies to the sustainable development. *Procedia Manufacturing*, 46, 294–298. https://doi.org/10.1016/j.promfg.2020.03.043.

Dögl, C., Holtbrügge, D. (2014). Corporate environmental responsibility, employer reputation and employee commitment: An empirical study in developed and emerging economies. *Inter-*

national Journal of Human Resource Management, 25(12), 1739–1762. https://doi.org/10.1080/09585192.2013.859164.

Doh, J.P., Howton, S.D., Howton, S.W., Siegel, D.S. (2010). Does the market respond to an endorsement of social responsibility? The role of institutions, information, and legitimacy. *Journal of Management*, 36(6), 1461–1485. https://doi.org/10.1177/0149206309337896.

Driessen, P.H., Hillebrand, B., Kok, R.A.W., Verhallen, T.M.M. (2013). Green new product development: The pivotal role of product greenness. *IEEE Transactions on Engineering Management*, 60(2), 315–326. https://doi.org/10.1109/TEM.2013.2246792.

Fernando, Y., Chiappetta Jabbour, C.J., Wah, W.X. (2019). Pursuing green growth in technology firms through the connections between environmental innovation and sustainable business performance: Does service capability matter? *Resources, Conservation and Recycling*, 141, 8–20. https://doi.org/10.1016/J.RESCONREC.2018.09.031.

Fraj, E., Matute, J., Melero, I. (2015). Environmental strategies and organizational competitiveness in the hotel industry: The role of learning and innovation as determinants of environmental success. *Tourism Management*, 46, 30–42. https://doi.org/10.1016/j.tourman.2014.05.009.

Garcia, R., Wigger, K., Hermann, R.R. (2019). Challenges of creating and capturing value in open eco-innovation: Evidence from the maritime industry in Denmark. *Journal of Cleaner Production*, 220, 642–654. https://doi.org/10.1016/j.jclepro.2019.02.027.

Hahn, T., Figge, F., Pinkse, J., Preuss, L. (2010). Editorial trade-offs in corporate sustainability: You can't have your cake and eat it. *Business Strategy and the Environment*, 19(4), 217–229. https://doi.org/10.1002/bse.674.

Hanelt, A., Busse, S., Kolbe, L.M. (2017). Driving business transformation toward sustainability: Exploring the impact of supporting IS on the performance contribution of eco-innovations. *Information Systems Journal*, 27(4), 463–502. https://doi.org/10.1111/isj.12130.

Hermundsdottir, F., Aspelund, A. (2021). Sustainability innovations and firm competitiveness: A review. *Journal of Cleaner Production*, 280, 124715. https://doi.org/10.1016/J.JCLEPRO.2020.124715.

Hermundsdottir, F., Aspelund, A. (2022). Competitive sustainable manufacturing: Sustainability strategies, environmental and social innovations, and their effects on firm performance. *Journal of Cleaner Production*, 370, 133474. https://doi.org/10.1016/J.JCLEPRO.2022.133474.

Horbach, J. (2008). Determinants of environmental innovation: New evidence from German panel data sources. *Research Policy*, 37(1), 163–173. https://doi.org/10.1016/j.respol.2007.08.006.

Jaggi, B., Freedman, M. (1992). An examination of the impact of pollution performance on economic and market performance: Pulp and paper firms. *Journal of Business Finance & Accounting*, 19(5), 697–713. https://doi.org/10.1111/j.1468-5957.1992.tb00652.x.

Klewitz, J., Hansen, E.G. (2014). Sustainability-oriented innovation of SMEs: A systematic review. *Journal of Cleaner Production*, 65, 57–75. https://doi.org/10.1016/j.jclepro.2013.07.017.

Kok, L., Wurpel, G., Ten Wolde, A. (2013). *Unleashing the Power of the Circular Economy*. Amsterdam: IMSA Amsterdam.

Kumar, V., Rahman, Z., Kazmi, A.A. (2013). Sustainability marketing strategy: An analysis of recent literature. *Global Business Review*, 14(4), 601–625. https://doi.org/10.1177/0972150913501598.

Lampikoski, T., Westerlund, M., Rajala, R., Möller, K. (2014). Green innovation games: Value-creation strategies for corporate sustainability. *California Management Review*, 57(1), 88–116. https://doi.org/10.1525/cmr.2014.57.1.88.

Larbi-Siaw, O., Xuhua, H., Owusu, E., Owusu-Agyeman, A., Fulgence, B.E., Frimpong, S.A. (2022). Eco-innovation, sustainable business performance and market turbulence moderation in emerging economies. *Technology in Society*, 68, 101899. https://doi.org/10.1016/J.TECHSOC.2022.101899.

Liao, Z. (2018). Corporate culture, environmental innovation and financial performance. *Business Strategy and the Environment*, 27(8), 1368–1375. https://doi.org/10.1002/bse.2186.

Lin, B.C., Zheng, S. (2016). A new direction in environmental economics. *Journal of Economic Surveys*, 30(3), 397–402. https://doi.org/10.1111/joes.12166.

Liu, X., Dai, H., Cheng, P. (2011). Drivers of integrated environmental innovation and impact on company competitiveness: Evidence from 18 Chinese firms. *International Journal of Technology and Globalisation*, 5(3–4), 255–280. https://doi.org/10.1504/IJTG.2011.039767.

Medrano, N., Cornejo-Cañamares, M., Olarte-Pascual, C. (2020). The impact of marketing innovation on companies' environmental orientation. *Journal of Business and Industrial Marketing*, 35(1), 1–12. https://doi.org/10.1108/JBIM-10-2018-0319.

Melece, L. (2015). Eco-innovation and its development in Baltic states. *Management Theory and Studies for Rural Business and Infrastructure Development*, 37(3), 415–425. https://doi.org/10.15544/mts.2015.36.

Nishitani, K., Jannah, N., Kaneko, S. (2017). Does corporate environmental performance enhance financial performance? An empirical study of Indonesian firms. *Environmental Development*, 23, 10–21. https://doi.org/10.1016/j.envdev.2017.06.003.

OECD. (2009). *Sustainable Manufacturing and Eco-Innovation: Framework, Practices and Measurement*. Paris: The OECD Policy Brief.

OECD. (2011). *Better Policies to Support Eco-Innovation*. Paris: OECD Publishing.

OECD/Eurostat. (2018). *Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation, 4th Edition*. Paris: OECD Publishing.

Orlitzky, M., Schmidt, F.L., Rynes, S.L. (2003). Corporate social and financial performance: A meta-analysis. *Organization Studies*, 24(3), 403–441. https://doi.org/10.1177/0170840603024003910.

Porter, M.E. (1991). America's green strategy. *Scientific American*, 264(4).

Przychodzen, J., Przychodzen, W. (2013). Corporate sustainability and shareholder wealth. *Journal of Environmental Planning and Management*, 56(4), 474–493. https://doi.org/10.1080/09640568.2012.685927.

Rabadán, A., González-Moreno, Á., Sáez-Martínez, F.J. (2019). Improving firms' performance and sustainability: The case of eco-innovation in the agri-food industry. *Sustainability*, 11(20), 5590. https://doi.org/10.3390/su11205590.

Redman, A. (2018). Harnessing the sustainable development goals for businesses: A progressive framework for action. *Business Strategy and Development*, 1(4), 230–243. https://doi.org/10.1002/bsd2.33.

Rennings, K., Ziegler, A., Ankele, K., Hoffmann, E. (2006). The influence of different characteristics of the EU environmental management and auditing scheme on technical environmental innovations and economic performance. *Ecological Economics*, 57(1), 45–59. https://doi.org/10.1016/j.ecolecon.2005.03.013.

Rezende, L. de A., Bansi, A.C., Alves, M.F.R., Galina, S.V.R. (2019). Take your time: Examining when green innovation affects financial performance in multinationals. *Journal of Cleaner Production*, 233, 993–1003. https://doi.org/10.1016/j.jclepro.2019.06.135.

Roper, S., Tapinos, E. (2016). Taking risks in the face of uncertainty: An exploratory analysis of green innovation. *Technological Forecasting and Social Change*, 112, 357–363. https://doi.org/10.1016/j.techfore.2016.07.037.

Santos, D.F.L., de Lima, M.M., Basso, L.F.C., Kimura, H., Sobreiro, V.A. (2017). Eco-innovation and financial performance at companies established in Brazil. *International Journal of Business and Emerging Markets*, 9(1), 68–89. https://doi.org/10.1504/ijbem.2017.080783.

Savitz, A.W., Weber, K. (2006). *The Triple Bottom Line: How Today's Best-Run Companies Are Achieving Economic, Social, and Environmental Success. And How You Can Too*. San Francisco: Jossey-Bass.

Schiederig, T., Tietze, F., Herstatt, C. (2012). Green innovation in technology and innovation management: An exploratory literature review. *R and D Management*, 42(2), 180–192. https://doi.org/10.1111/j.1467-9310.2011.00672.x.

Seuring, S., Müller, M. (2008). From a literature review to a conceptual framework for sustainable supply chain management. *Journal of Cleaner Production*, 16(15), 1699–1710. https://doi.org/10.1016/j.jclepro.2008.04.020.

Song, H., Zhao, C., Zeng, J. (2017). Can environmental management improve financial performance: An empirical study of A-shares listed companies in China. *Journal of Cleaner Production*, 141, 1051–1056. https://doi.org/10.1016/j.jclepro.2016.09.105.

Tang, M., Walsh, G., Lerner, D., Fitza, M.A., Li, Q. (2018). Green innovation, managerial concern and firm performance: An empirical study. *Business Strategy and the Environment*, 27(1), 39–51. https://doi.org/10.1002/bse.1981.

Tariq, A., Badir, Y.F., Tariq, W., Bhutta, U.S. (2017). Drivers and consequences of green product and process innovation: A systematic review, conceptual framework, and future outlook. *Technology in Society*, 51, 8–23. https://doi.org/10.1016/j.techsoc.2017.06.002.

Tseng, M.L., Wang, R., Chiu, A.S.F., Geng, Y., Lin, Y.H. (2013). Improving performance of green innovation practices under uncertainty. *Journal of Cleaner Production*, 40, 71–82. https://doi.org/10.1016/j.jclepro.2011.10.009.

Tumelero, C., Sbragia, R., Evans, S. (2019). Cooperation in R & D and eco-innovations: The role in companies' socioeconomic performance. *Journal of Cleaner Production*, 207, 1138–1149. https://doi.org/10.1016/j.jclepro.2018.09.146.

UN. (2017). *Work of the Statistical Commission Pertaining to the 2030 Agenda for Sustainable Development*. A/RES/71/313.

Vargas-Vargas, M., Meseguer-Santamaría, M.L., Mondéjar-Jiménez, J., Mondéjar-Jiménez, J.A. (2010). Environmental protection expenditure for companies: A Spanish regional analysis. *International Journal of Environmental Research*, 4(3), 373–378.

Vasileiou, E., Georgantzis, N., Attanasi, G., Llerena, P. (2022). Green innovation and financial performance: A study on Italian firms. *Research Policy*, 51(6), 104530. https://doi.org/10.1016/J.RESPOL.2022.104530.

Wagner, M., Llerena, P. (2011). Eco-innovation through integration, regulation and cooperation: Comparative insights from case studies in three manufacturing sectors. *Industry and Innovation*, 18(8), 747–764. https://doi.org/10.1080/13662716.2011.621744.

Walecka-Jankowska, K., Zgrzywa-Ziemak, A., Zimmer, J. (2017). Innowacje zorientowane na zrównoważony rozwój z perspektywy różnych koncepcji zrównoważenia przedsiębiorstwa. In P. Kubiński (ed.), *Innowacje w biznesie: nowe modele i nowe praktyk* (63–81). Wrocław: Exante.

Yurdakul, M., Kazan, H. (2020). Effects of eco-innovation on economic and environmental performance: Evidence from Turkey's manufacturing companies. *Sustainability*, 12(8), 3167. https://doi.org/10.3390/SU12083167.

Zgrzywa-Ziemak, A. (2019). *Model zrównoważenia przedsiębiorstwa*. Wrocław: Oficyna Wydawnicza Politechniki Wrocławskiej.

Zhang, Y., Sun, J., Yang, Z., Wang, Y. (2020). Critical success factors of green innovation: Technology, organization and environment readiness. *Journal of Cleaner Production*, 264, 121701. https://doi.org/10.1016/j.jclepro.2020.121701.