

## RELATIONSHIP BETWEEN ENVIRONMENTAL INNOVATION AND SUSTAINABLE OUTCOMES – EMPIRICAL EVIDENCE FROM POLAND

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**Purpose:** The article refers to a valid and current research area related to business sustainability. The main objective of this article is to identify the relationship between different types of environmental innovations and sustainable outcomes.

**Design/methodology/approach:** For the needs of this article, the researches were conducted in 293 companies operating in Poland. In the course of the research, an additional division of environmental innovations derived from the Oslo Manual classification was taken into account, and the following were distinguished: environmental process innovations, environmental product innovations, environmental organizational innovations, and environmental marketing innovations. In addition, for the analysis of sustainable business performance, it was divided into economic, environmental, and social performance. The relation between the level of types of innovation and organizational outcomes is examined for each of these categories, and three models are presented.

**Findings:** Empirical research confirmed that different types of environmental innovations are essential factors for sustainable outcomes and, as a result, their growth. Research also revealed differences and similarities between different sustainable outcomes and their relationship to innovations of different types.

**Research limitations/implications:** First, although outcomes were measured using subjective indicators consisting of a limited number of items, using objective indicators or collecting data through in-depth interviews would have provided more detailed data. Second, increasing the size of the research sample and expanding the research to include companies operating in other countries (replication of research) would allow for generalization of the results, as the results obtained may be specific to companies operating in Poland.

**Originality/value:** The main value of this article is a broad and holistic view, which made it possible to use the four types of environmental innovations and link them in the model to organizational outcomes and clarify the relationship between them. It seems crucial to take a systemic view of what innovations collectively build the model and to note that organizational innovation appears as an element present in each of the models obtained. Thus, it is an indication that organizational activities should support process, marketing, or product innovations to lead to sustainable results of environmental innovation implementation.

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

**Category of the paper:** Research paper.

## 1. Introduction

In recent years, the relationship between the activities of companies and the environment has become increasingly complex. The reason for this is an increased awareness of the need to care for the environment, linked to the recognition that companies have a measurable impact on the environment in their operations, and this impact is usually negative. This results in an increasing pressure to look for new and innovative solutions that will generate some positive effects on the environment. For these reasons, the sustainability issue, understood as the ability to guarantee a dignified future for future generations (Faber et al., 2009), is becoming more and more topical and is increasingly related to the innovation activities of companies, and the relationship between environmentally friendly innovations or environmentally friendly directions of sustainable business development is attracting the attention of researchers. Companies, in turn, responding to these challenges are seeking new innovative solutions, developing new business and management models, new services or products, and new production processes and marketing solutions that can protect and improve environmental quality (Berry, Rondinelli, 1998; Savitz, Weber, 2006; UN, 2017; Walecka-Jankowska et al., 2017). This means implementing environmental innovations into their operations with the aim of achieving not only better economic, but also social and environmental results. These three perspectives: economic, social, and environmental, are the basic dimensions of sustainable business outcomes (Ch'ng et al., 2021; Fernando et al., 2019; Larbi-Siaw et al., 2022; Tumelero et al., 2019; Wagner, Llerena, 2011). For these reasons, the relationship between environmental innovations, or more precisely its different types (environmental process innovations, environmental product innovations, environmental organizational innovations, environmental marketing innovations) and sustainable outcomes (economic, social, and environmental) is the subject of this article. It presents the results of a survey of 293 Polish companies to examine the impact of types of environmental innovations on organizational outcomes.

The outline of the article is as follows: The first part is devoted to the literature review, the concepts of environmental innovation, and the relationship between environmental innovation and organizational performance. The second part presents the research methodology, research model, research hypotheses, and gathered data. The results of the study on the impact of environmental innovation types on organizational outcomes in companies operating in Poland are presented. The final section summarizes the results of the research and presents its organizational and future research directions.

## 2. 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 ecoinnovation or green innovation interchangeably. 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.

Regarding the concept of environmental innovations, similar to other types of innovation, according to their characteristics proposed, for example, in (OECD/Eurostat, 2018) they can be a product, process, service or method, for example, a business model, they should meet the needs of users, affecting the competitiveness of enterprises. Their distinguishing feature, presented in many definitions but to varying degrees, is the environmental aspect. Most definitions explicitly assume that their distinguishing characteristic is the reduction of negative environmental impacts, compared to the use of alternatives – that is, (Fernando et al., 2019; Garcia et al., 2019; Hahn et al., 2010). Some of the definitions highlight additional features of environmental innovation, in addition to those mentioned above, relating to its purpose. Therefore, the purpose of environmental innovation, according to the assumptions presented by (OECD, 2011), are products and services, processes, marketing methods, organizational and institutional changes. Moreover, this goal can be twofold: technological or nontechnological. Product and process innovations are generally associated with technological changes, while marketing, organizational, and institutional innovations are usually based on non-technological changes (Chan et al., 2016; OECD, 2011).

Environmental innovations, therefore, refer to the solution of environmental, economic, and social problems (Melece, 2015), by introducing new innovative solutions to reduce negative environmental impacts. They include technological changes and nontechnological changes, which can be implemented in many forms (e.g., product, process, and organizational and/or marketing methods). This approach to environmental innovation refers to (OECD/Eurostat, 2018) and was adopted as the basis for the research presented in this article.

## 3. Environmental innovations and organizational outcomes

Environmental innovation is essential to facilitate the global transition to sustainable development (Dogaru, 2020; OECD, 2009). The 2030 Agenda for Sustainable Development of the UN stipulates that the focus should be on making better use of economic resources and promoting socioeconomic stability and business competition precisely by optimizing economic

goods and services to achieve environmental sustainability. However, many companies have not yet taken sufficient steps to achieve sustainability (Redman, 2018). This is not surprising, since the implementation of environmental innovations involves a number of challenges, and the dual goals of creating financial and environmental value produce tension (Garcia et al., 2019), carry a high level of uncertainty regarding organizational effects and the potentially high setup cost of their implementation, especially in the case of technological eco-innovations (Hanelt et al., 2017). Therefore, empirical evidence is needed showing the impact of environmental innovations on firm performance.

This evidence is provided by studies conducted in various countries and economic sectors, showing that environmental innovation has a positive impact on all aspects of economic and environmental performance studied by researchers (Cheng et al., 2014; da Silva Rabêlo, de Azevedo Melo, 2019; Nishitani et al., 2017; Rabadán et al., 2019; Rennings et al., 2006; Vargas-Vargas et al., 2010; Yurdakul, Kazan, 2020). There is also evidence in the literature that environmental innovation contributes to increasing the competitiveness of companies (Chen et al., 2006; da Silva Rabêlo, de Azevedo Melo, 2019) attracting financial investors (Doh et al., 2010), pondering consumer demand (Horbach, 2008), increasing organizational capacity (Aschehoug et al., 2012), and even improving employee engagement and productivity (Dögl, Holtbrügge, 2014).

However, the introduction of environmental innovations can require research and development or changes in production technologies that can be costly, modifications in supply chain management, promotion of new products or services, adoption of new business models and practices, or employee education (Kok et al., 2013). Therefore, investing in environmental innovation requires considering its impact on financial performance. The literature shows that it is ambiguous (Aldieri et al., 2020; Jaggi, Freedman, 1992; Orlitzky et al., 2003; Porter, 1991; Song et al., 2017). According to a meta-analysis presented in (Garcia et al., 2019), 55% of the studies showed a positive association, 15% showed a negative association and 30% showed a nonsignificant or nonlinear association. (Lin, Zheng, 2016), on the other hand, found that there can be a positive relationship between environmental innovation and economic performance, only under conditions in which a combination of economic, organizational, and environmental innovations shows positive effects. Similar conclusions were reached by (Vasileiou et al., 2022), stating that in the case of enterprise-specific environmental benefits, synergies between environmental innovations and other product and process innovations, as well as organizational innovations, increase the profitability of environmental innovations. On the contrary, for consumer-specific environmental benefits, only organizational innovations increase the profitability of environmental innovations. (Tang et al., 2018), on the other hand, showed that product eco-innovation and process eco-innovation positively affect company corporate performance and productivity. However, in the case of product ecoinnovation, it is necessary to take into account both input costs and conversion costs, as well as the risk of consumer acceptance. This is because environmental innovations that positively affect the

financial performance of companies require adequate internal and external resources (Lampikoski et al., 2014), including the development of green products, optimization of the production process, development of environmentally friendly management and the provision of services that meet the needs of consumers who are aware of the importance of sustainability (Tseng et al., 2013). Therefore, this means constantly investing and improving the operations of companies and making a continuous effort to avoid negative interactions that affect their financial performance (Roper, Tapinos, 2016; Zhang et al., 2020). However, some studies and theoretical perspectives show that environmental innovation has a negative impact on financial performance (Aguilera-Caracuel, Ortiz-de-Mandojana, 2013; Driessen et al., 2013) and a study (Liu et al., 2011) even found that environmental innovation leads directly to higher costs. However, these studies contradict the findings of (Przychodzen, Przychodzen, 2013; Santos et al., 2017). On the other hand, according to (Rezende et al., 2019) there is no significant relationship between environmental innovations and financial performance in the short term, while in the long term this type of innovation and a company's financial success are linked, provided there are sufficient resources to implement and sustain them.

As can be seen above, there is little research on the impact of environmental innovations on the performance of companies by type, and the studies mentioned focus only on organizational, product, and process types, leaving out the marketing type. These studies tend to overlook the role of environmental innovation in marketing (Driessen et al., 2013). According to (Vasileiou et al., 2022), this is probably due to the fact that researchers overestimate the role of environmental innovation in relation to other types of innovation (process product and organizational). However, (Medrano et al., 2020) found that managers, in relation to environmental innovation, must transform traditional marketing practices (among which he focuses on marketing innovation), which can be seen as identifying their rather weak relationship with environmental innovation. (Kumar et al., 2013), on the other hand, explicitly stated that the environmental orientation and innovation of marketing of companies are contradictory concepts.

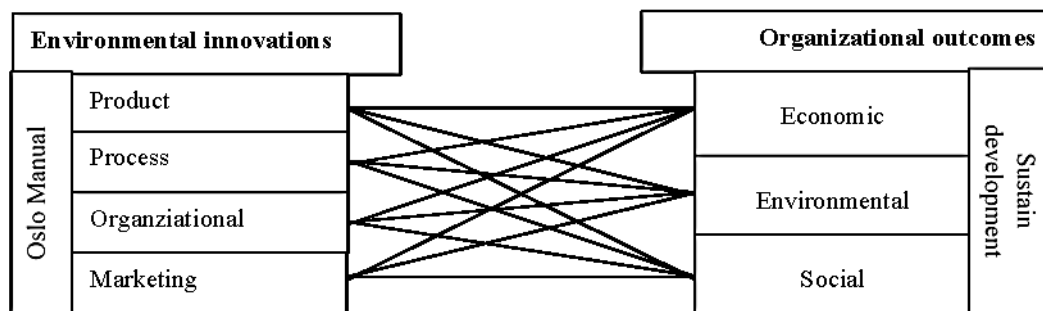
According to our literature survey, the only study on the relationship between types of environmental innovation and sustainable business performance is in the Malaysian technology industry. It examines the relationship between three types of environmental innovation (eco-processes, eco-products and eco-organization) and three dimensions of sustainable business performance (economic, social and environmental) (Ch'ng et al., 2021). Based on these, it can be concluded that only eco-organizational innovations have a direct and positive impact on economic performance (similar findings can be observed in (Cheng et al., 2014; Liao, 2018), while no such impact was observed for other types of innovation, as confirmed by the findings in (Tumelero et al., 2019) for eco-process innovations and in (Boons et al., 2013) and (Driessen et al., 2013) for product innovations, as well as (Cai, Li, 2018) for both eco-process and eco-product innovations. Malaysian research also shows that ecoprocess and ecoproduct innovations showed a positive impact on environmental performance, which is consistent with

previous findings from (Cai, Li, 2018) and (Liao, 2018), while ecoorganisational innovations do not have a direct positive impact on environmental performance, as noted in (Cheng et al., 2014). However, when it comes to sustainable performance in the social dimension, the researchers did not find direct impact for any of the types of environmental innovation analysed. Environmental marketing innovations were not included in this study.

## 4. Research methodology

### 4.1. Purpose and methods of the study

The main of the study is to examine the impact of types of environmental innovation on organizational outcomes. The general research model in the context of the hypotheses presented above is presented in Fig. 1.



**Figure 1.** Research hypothesis.

Source: own work.

### 4.2. Data gathering process and characteristics of the research sample

In order to verify the hypotheses, a survey was conducted, for which the author's questionnaire was used. To verify the relevance of the items in the questionnaire built for the work, the competent judges method was used in the questionnaire development stage. Competent judges, employees of organizations holding senior positions, were engaged to assess the relevance. The judges, independently of each other, individually evaluated the items in the questionnaire.

The study was conducted using a questionnaire that was intended to be appropriate for any organization regardless of size, activity profile, or affiliation to a branch of the economy. Employees with a broad view of the organizations surveyed (each respondent represented a different organization) were asked to complete the survey. The research was carried out at the end of 2020. The general population consisted of companies operating in Poland.

In order to examine the relation between the types of environmental innovations and organizational outcomes, the following key variables were defined separately for data collected in Poland: four environmental innovations (based on Oslo Manual typology): environmental product innovation, environmental process innovations, environmental organizational innovations, environmental marketing innovations, and three out-of-come variables (based on sustain development dimensions): economical out-of-comes, environmental out-of-comes, social out-of-comes. The reliability of variables (measured by the Alpha-Cronbach coefficient) is higher than 0,6 for innovation variables and near 0,9 for out-comes variables) which indicate a high internal consistency and reliability in the measurement of outcomes variables. The reliability of the innovation variables is lower, but this may be due to the fact that the items that were used to measure relate to different aspects: the purpose of the innovation and the scale of implementation.

**Table 1.***Description of the variables*

<b>Variable</b>	<b>Description (variables were accessed on 5-point Likert Scale)</b>
Environmental product innovations	How much is your company implementing? - New products and services Please rate on a 5-point scale. - Is the new product/service that your company is launching usually new on a company, national or global scale? To what extent are the product innovations implemented by the company aimed at improving the following outcomes? - Environmental effects (improving the company's environmental impact, reducing waste, reducing energy consumption)
Environmental process innovations	How much is your company implementing? - Process changes (in procedures, operations, tools). Please rate on a 5-point scale. - Is the new technological processes (also machines/equipment/tools, software) that your company is launching usually new on a company, national or global scale? To what extent are the process innovations implemented by the company aimed at improving the following outcomes? - Environmental effects (improving the company's environmental impact, reducing waste, reducing energy consumption).
Environmental organizational innovations	How much is your company implementing? - Organizational changes (e.g., new organizational methods). Please rate on a 5-point scale. - Are the new ways of organizing business implemented by the company usually new on a company, national or global scale? To what extent are the organizational innovations implemented by the company aimed at improving the following outcomes? - Environmental effects (improving the company's environmental impact, reducing waste, reducing energy consumption).
Environmental marketing innovations	How much is your company implementing? - Marketing changes (e.g., product/service positioning, customer segmentation, pricing strategy). Please rate on a 5-point scale. - Are changes in product/service launch, positioning, customer segmentation, pricing policy) implemented by the company usually new on a company, national or global scale? To what extent are the marketing innovations implemented by the company aimed at improving the following outcomes? - Environmental effects (improving the company's environmental impact, reducing waste, reducing energy consumption).
Economic out-comes	Compared to the competition, your company is worse or better in terms of the following factors? - revenues - productivity (low costs) - quality (reliability, dependability, diligence) - return on investment (ROI) - investments made in regions with high unemployment (poverty) - availability of products or services to those with the lowest incomes

Cont. table 1.

Environmental out-comes	Compared to your competitors, is your company worse or better in terms of the following factors? - emissions, wastewater and waste - consumption of hazardous, toxic, harmful materials - consumption of total resources (materials, energy, water) - environmental impact of products or services sold - impact on biodiversity
Social outcomes	Compared to competition, is your company worse or better in terms of the following factors? - employee satisfaction - occupational health and safety - customer satisfaction - participation in the development of healthy and livable communities - compliance with social and environmental criteria by suppliers

Source: own work.

## 5. Results

To verify the hypotheses describing the relationship between individual components of types of environmental innovations and organizational outcomes, statistical analyzes were carried out. As a first step, a correlation analysis was conducted using Pearson's coefficient. The results are presented in Tables 2.

**Table 2.**  
*Correlations*

		Environmental product innovation	Environmental process innovation	Environmental organizational innovation	Environmental marketing innovation
Economic out-comes	Pearson correlation	,627**	,612**	,538**	,647**
	Relevance (bilateral)	0,000	0,000	0,000	0,000
	N	293	293	293	293
Environmental out-comes	Pearson correlation	,608**	,614**	,533**	,602**
	Relevance (bilateral)	0,000	0,000	0,000	0,000
	N	293	293	293	293
Social out-comes	Pearson correlation	,553**	,567**	,508**	,602**
	Relevance (bilateral)	0,000	0,000	0,000	0,000
	N	293	293	293	293

\*\* Correlation significant at the 0.01 level (two-sided).

Source: own work.

The correlation analysis shows significant relations between all types of environmental innovations and the levels of results in Poland. As a result, it should be stated that there are no grounds to reject the hypothesis.

Since the analysis of pairwise correlations revealed strong associations, it was decided to perform stepwise regressions. Three regression models were obtained - for different organizational outcomes (presented in Table 3).



**Table 3.***Fitting regression models*

	<b>Poland</b>
Economic outcomes	$F(4,288) = 64,965; p < 0,001; r^2 = 0,467$
Environmental outcomes	$F(4,288) = 56,154; p < 0,01; r^2 = 0,430$
Social outcomes	$F(4,288) = 47,907; p < 0,001; r^2 = 0,391$

Source: own work.

Those models seem to fit the data well. When it comes to economic outcomes R<sup>2</sup> explains 47% of the variance in the dependent variable. In case of environmental outcomes - the percentage of explained variance is 43%. However, in the case of social outcomes - it is 39%. The regression equations can be written as follows (the equation for three models are presented in table 4):

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

where:

X<sub>1</sub> - Environmental product innovations,X<sub>2</sub> - Environmental process innovations,X<sub>3</sub> - Environmental organizational innovations,X<sub>4</sub> - Environmental marketing innovations.**Table 4.***The regression equations*

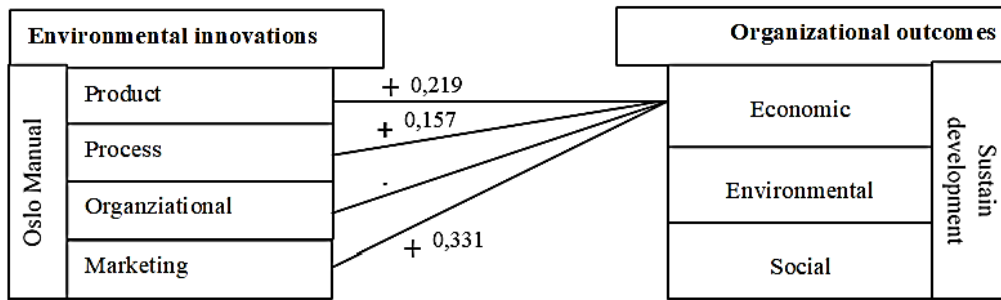
	<b>Poland</b>
Economic out-comes (ECL_OUT*)	$YECL\_OUT = 1.501 + 0,219 \times X_1 + 0,157 \times X_2 + 0,331 \times X_4$
Environmental out-comes (ENV_OUT*)	$YENV\_OUT = 1,427 + 0,197 \times X_1 + 0,246 \times X_2 + 0,249 \times X_4$
Social out-comes (SOC_OUT*)	$YSOC\_OUT = 1,407 + 0,220 \times X_2 + 0,388 \times X_4$

Source: own work.

## 6. Discussion and conclusions

Empirical research confirmed that different types of environmental innovations are essential factors for sustainable outcomes and, as a result, their growth. Research also revealed differences and similarities between companies operating in Poland.

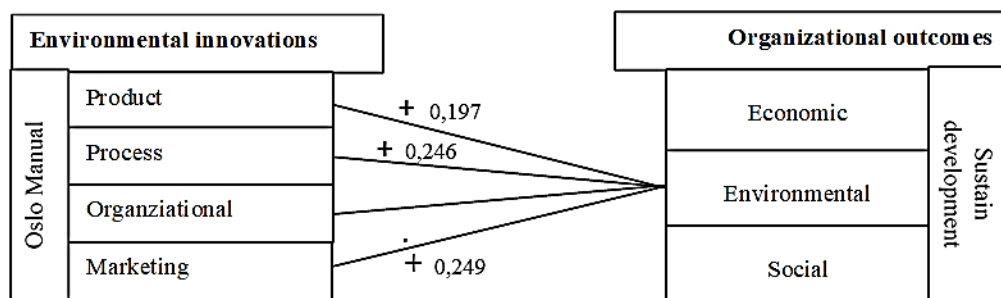
We can note that the relationship between product innovation and economic outcomes is not statistically significant, and process and organizational innovations matter, but marketing innovations do not, for the out-comes (presented on Fig. 2).



**Figure 2.** Relationship between environmental innovations and economic outcomes in Poland.

Source: own work.

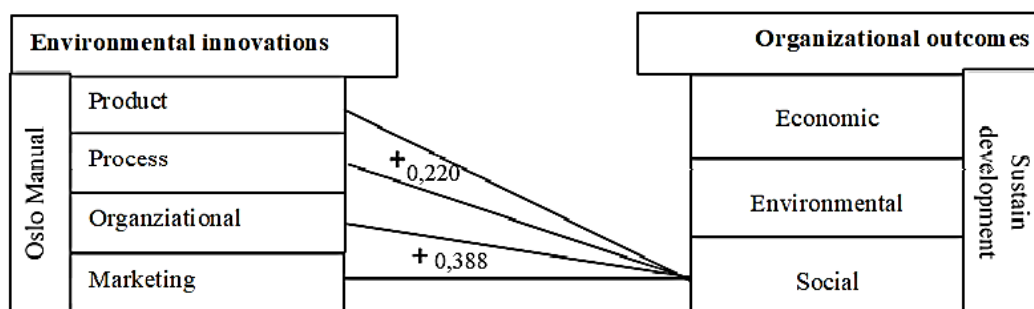
The relationship between all types of innovation and environmental performance proved statistically significant (presented in Fig. 3). What can result from consistency in setting environmental goals and pursuing them in order to achieve not only the goal resulting from the implementation of the innovation itself, but also the measurement of the assumed environmental effects.



**Figure 3.** Relationship between environmental innovations and environmental outcomes in Poland.

Source: own work.

In terms of social outcomes the relationship between process and organizational innovations was revealed to be statistically significant, although the relationship with marketing innovations is significant only for companies operating in Poland (presented on Fig. 4).



**Figure 4.** Relationship between environmental innovations and social outcomes in Poland.

Source: own work.

Undoubtedly, the challenges of sustainable development are an important motivator for business innovation while allowing the creation of competitive advantages (Hansen et al., 2009). Coupled with increasing concern for sustainability and sustainable development issues, environmental innovations have been of increasing interest among both scholars and practitioners (Hizarci-Payne et al., 2021). Furthermore, the relationship between environmental management practices and company performance has been an ongoing focus of academic research (Tsai et al., 2020). However, reports in the literature on the impact of environmental innovations on business performance are inconclusive (Tang et al., 2018). Studies presented in the related literature focus mainly on the technological aspect, less on the social (Cheng et al., 2014) and organizational aspects.

This study adds to the literature on the relationship between the types of innovation identified in the Oslo Manual and the dimensions of sustainable performance. The research presented in the article shows that distinguished types of innovation support sustainable performance of companies, but differences can be observed between companies operating in Poland. The observed differences may be due to culturally different contexts and longer practice in sustainability-oriented activities. Furthermore, this study analyzes different types of innovations, indicating that there is no significant relationship between them and the dimensions of sustainable performance (presented in Table 5).

**Table 5.**

*Summary of the research*

<b>Outcomes</b>	<b>Product</b>	<b>Process</b>	<b>Organizational</b>	<b>Marketing</b>
Economic	+	+		+
Environmental	+	+		+
Social		+		+

Source: own work.

The research revealed a surprising lack of a relationship between environmental product innovation with social performance. However, in the case of environmental performance, this research confirmed some of the results presented in (Ch'ng et al., 2021) on the relationship with innovation in process. At the same time, a different result for organizational innovation was noted, which in the article in (Ch'ng et al., 2021) – lack of relationships, while this research also indicates a link with all sustainable outcomes and lack of relationship between product innovations and social outcomes. Moreover, marketing innovation in Poland supports economic, environmental and social outcomes. This seems to be an interesting conclusion - perhaps again, it is related to cultural conditions, perhaps the goals set for the activities (their priorities) related to the dimensions of sustainable development.

In this sense, the main contribution of this study is a broad and holistic view, which made it possible to use the four types of environmental innovations and link them in the model to organizational performance and clarify the relationship between them. It seems crucial to take a systemic view of what innovations collectively build the model and to note that organizational innovation appears as an element present in each of the models obtained. Thus, it is

an indication that organizational activities should support process, marketing, or product innovations to lead to sustainable results of environmental innovation implementation.

### **Research limitations**

This study has several limitations that should be taken into account in the interpretation and implications of its results. First, although outcomes were measured using subjective indicators consisting of a limited number of items. Using objective indicators or collecting data through in-depth interviews would have provided more detailed data. Likewise, increasing the size of the research sample and expanding the research to include companies operating in other countries (replication of research) would allow for generalization of the results, as the results obtained may be specific to companies operating in Poland.

### **Future research directions**

Future research could address the relationship between environmental innovation and sustainable organizational outcomes with exogenous contextual factors, eg, dimensions of national cultures and macroeconomic indicators. Likewise, the link with exogenous factors, e.g. age and size of the organization, culture, core values, leadership, management style, or organizational structure. It is also ambiguous whether radical or incremental innovation, or some combination of the two, contributes more to higher sustainable performance. Therefore, it would seem interesting to consider the distinction between radical and incremental innovations and verify whether other dimensions of sustainable outcomes will be influenced. For it cannot be assumed that the assumption should be made that radical innovations promote sustainability more than incremental ones. Similarly, an analysis of all types of innovation - social, environmental, economic, and sustainable outcomes - would also be valuable.

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## References

1. Aguilera-Caracuel, J., Ortiz-de-Mandojana, N. (2013). Green Innovation and Financial Performance: An Institutional Approach. *Organization and Environment*, 26(4). <https://doi.org/10.1177/1086026613507931>.
2. 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. <https://doi.org/10.1016/j.resourpol.2020.101877>.
3. Aschehoug, S.H., Boks, C., Storen, S. (2012). Environmental information from stakeholders supporting product development. *Journal of Cleaner Production*, 31. <https://doi.org/10.1016/j.jclepro.2012.02.031>.
4. 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>.
5. Boons, F., Montalvo, C., Quist, J., Wagner, M. (2013). Sustainable innovation, business models and economic performance: An overview. *Journal of Cleaner Production*, 45. <https://doi.org/10.1016/j.jclepro.2012.08.013>.
6. Cai, W., Li, G. (2018). The drivers of eco-innovation and its impact on performance: Evidence from China. *Journal of Cleaner Production*, 176. <https://doi.org/10.1016/j.jclepro.2017.12.109>.
7. 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>.
8. 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. <https://doi.org/10.1016/j.ijpe.2015.12.006>.
9. 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). <https://doi.org/10.1007/s10551-006-9025-5>.
10. 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. <https://doi.org/10.1016/j.jclepro.2013.09.050>.
11. da Silva Rabêlo, O., de Azevedo Melo, A.S.S. (2019). Drivers of multidimensional eco-innovation: empirical evidence from the Brazilian industry. *Environmental Technology (United Kingdom)*, 40(19). <https://doi.org/10.1080/09593330.2018.1447022>.
12. Dogaru, L. (2020). Eco-innovation and the contribution of companies to the sustainable development. *Procedia Manufacturing*, 46. <https://doi.org/10.1016/j.promfg.2020.03.043>.

13. Dögl, C., Holtbrügge, D. (2014). Corporate environmental responsibility, employer reputation and employee commitment: An empirical study in developed and emerging economies. *International Journal of Human Resource Management*, 25(12). <https://doi.org/10.1080/09585192.2013.859164>.
14. 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). <https://doi.org/10.1177/0149206309337896>.
15. 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). <https://doi.org/10.1109/TEM.2013.2246792>.
16. Faber, N., Jorna, R., van Engelen, J. (2009). The sustainability of “sustainability” — A study into the conceptual foundations of the notion of “sustainability”. In: *Tools, Techniques and Approaches for Sustainability: Collected Writings in Environmental Assessment Policy and Management*. [https://doi.org/10.1142/9789814289696\\_0016](https://doi.org/10.1142/9789814289696_0016).
17. 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>.
18. 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. <https://doi.org/10.1016/j.jclepro.2019.02.027>.
19. Hahn, T., Figge, F., Pinkse, J., Preuss, L. (2010). Editorial Trade-Offs in Corporate Sustainability: You Can't Have Your Cake and Eat It. In: *Business Strategy and the Environment*, Vol. 19, Iss. 4. <https://doi.org/10.1002/bse.674>.
20. 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). <https://doi.org/10.1111/isj.12130>.
21. Hansen, E.G., Grosse-Dunker, F., Reichwald, R. (2009). Sustainability innovation cube - A framework to evaluate sustainability-oriented innovations. *International Journal of Innovation Management*, 13(4). <https://doi.org/10.1142/S1363919609002479>.
22. Hizarci-Payne, A.K., İpek, İ., Kurt Gümüş, G. (2021). How environmental innovation influences firm performance: A meta-analytic review. *Business Strategy and the Environment*, 30(2). <https://doi.org/10.1002/bse.2678>.
23. Horbach, J. (2008). Determinants of environmental innovation-New evidence from German panel data sources. *Research Policy*, 37(1). <https://doi.org/10.1016/j.respol.2007.08.006>.
24. 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). <https://doi.org/10.1111/j.1468-5957.1992.tb00652.x>.

25. Kok, L., Wurpel, G., ten Wolde, A. (2013). Unleashing the Power of the Circular Economy. Report by IMSA Amsterdam for Circle Economy. *The Circul Economy*.
26. Kumar, V., Rahman, Z., Kazmi, A.A. (2013). Sustainability Marketing Strategy: An Analysis of Recent Literature. *Global Business Review*, 14(4). <https://doi.org/10.1177/0972150913501598>.
27. Lampikoski, T., Westerlund, M., Rajala, R., Möller, K. (2014). Green innovation games: Value-creation strategies for corporate sustainability. *California Management Review*, 57(1). <https://doi.org/10.1525/cmr.2014.57.1.88>.
28. 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>.
29. Liao, Z. (2018). Corporate culture, environmental innovation and financial performance. *Business Strategy and the Environment*, 27(8). <https://doi.org/10.1002/bse.2186>.
30. Lin, B.C., Zheng, S. (2016). A new direction in environmental economics. *Journal of Economic Surveys*, 30(3). <https://doi.org/10.1111/joes.12166>.
31. 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). <https://doi.org/10.1504/IJTG.2011.039767>.
32. 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). <https://doi.org/10.1108/JBIM-10-2018-0319>.
33. Melece, L. (2015). Eco-innovation and its development in Baltic states. *Management Theory and Studies for Rural Business and Infrastructure Development*, 37(3). <https://doi.org/10.15544/mts.2015.36>.
34. Nishitani, K., Jannah, N., Kaneko, S., Hardinsyah. (2017). Does corporate environmental performance enhance financial performance? An empirical study of Indonesian firms. *Environmental Development*, 23. <https://doi.org/10.1016/j.envdev.2017.06.003>.
35. OECD (2009). Sustainable Manufacturing and Eco-Innovation: Framework, Practices and Measurement. In: *Oecd*.
36. OECD (2011). Better Policies to Support Eco-Innovation. In: *OECD Studies on Environmental Innovation*.
37. OECD/Eurostat (2018). Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation. The Measurement of Scientific, Technological and Innovation Activities. *Handbook of Innovation Indicators and Measurement*.
38. Orlitzky, M., Schmidt, F.L., Rynes, S.L. (2003). Corporate social and financial performance: A meta-analysis. *Organization Studies*, 24(3). <https://doi.org/10.1177/0170840603024003910>.

39. Porter, M.E. (1991). America's green strategy. *Scientific American*, 264(4).
40. Przychodzen, J., Przychodzen, W. (2013). Corporate sustainability and shareholder wealth. *Journal of Environmental Planning and Management*, 56(4). <https://doi.org/10.1080/09640568.2012.685927>.
41. 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 (Switzerland)*, 11(20). <https://doi.org/10.3390/su11205590>.
42. Redman, A. (2018). Harnessing the Sustainable Development Goals for businesses: A progressive framework for action. *Business Strategy and Development*, 1(4). <https://doi.org/10.1002/bsd2.33>.
43. 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). <https://doi.org/10.1016/j.ecolecon.2005.03.013>.
44. 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. <https://doi.org/10.1016/j.jclepro.2019.06.135>.
45. Roper, S., Tapinos, E. (2016). Taking risks in the face of uncertainty: An exploratory analysis of green innovation. *Technological Forecasting and Social Change*, 112. <https://doi.org/10.1016/j.techfore.2016.07.037>.
46. Santos, D.F.L., Lima, M.M. de, 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). <https://doi.org/10.1504/ijbem.2017.080783>.
47. 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. *Trusteeship, Vol. 16, Iss. 5*.
48. 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. <https://doi.org/10.1016/j.jclepro.2016.09.105>.
49. 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). <https://doi.org/10.1002/bse.1981>.
50. Tsai, K.H., Huang, C.T., Chen, Z.H. (2020). Understanding variation in the relationship between environmental management practices and firm performance across studies: A meta-analytic review. *Business Strategy and the Environment*, 29(2). <https://doi.org/10.1002/bse.2386>.



51. 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. <https://doi.org/10.1016/j.jclepro.2011.10.009>.
52. 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. <https://doi.org/10.1016/j.jclepro.2018.09.146>.
53. UN (2017). A/RES/71/313. Work of the Statistical Commission pertaining to the 2030 Agenda for Sustainable Development. *General Assembly, July*.
54. 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).
55. 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>.
56. 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>.
57. 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* (pp. 63-81). Exante.
58. Yurdakul, M., Kazan, H. (2020). Effects of eco-innovation on economic and environmental performance: Evidence from Turkey's manufacturing companies. *Sustainability (Switzerland)*, 12(8). <https://doi.org/10.3390/SU12083167>.
59. 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. <https://doi.org/10.1016/j.jclepro.2020.121701>.