

Management of green risk within attaining sustainable development goals

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Abstract. The paper explores the critical role of green risk management in achieving sustainable development goals (SDGs) within companies. As businesses increasingly recognize the significance of sustainability, they are confronted with various environmental, regulatory, and reputational risks that can impact their journey towards sustainability. Effective management of these green risks is imperative to ensure that companies not only meet their sustainability objectives but also contribute to broader societal and economic goals. The study used the COSO ERM methodology to select indicators for the assessment of green risk management efficiency at the company. The paper emphasizes the need for companies to integrate sustainability into their core strategies and operations. It highlights the importance of assessing and prioritizing green risks, staying compliant with evolving environmental regulations, building resilient supply chains, investing in green technologies, engaging stakeholders, and developing robust risk mitigation strategies. Moreover, transparent reporting is emphasized as a means to enhance accountability and trust among stakeholders.

1 Introduction

Managing green risks is essential for companies aiming to achieve sustainable development goals (SDGs) in a digitally driven world [1-23]. These risks encompass a wide array of challenges, including environmental, regulatory, reputational, and digital disruptions, all of which can significantly impact a company's journey toward sustainability. To effectively manage green risks in the digital era, companies must integrate sustainability [24-30] into their core strategies, assess and prioritize risks [31-35], stay compliant with evolving regulations [36-41], build resilient supply chains [42-45], invest in green technologies [46-50] and digital solutions, engage stakeholders [51-56], develop risk mitigation strategies, and ensure transparent reporting [57-62]. Incorporating digital technology into sustainability

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efforts is increasingly critical [63-72]. Digital tools and data analytics can enhance the efficiency of resource management, enabling companies to reduce their environmental footprint and operational costs. These technologies can also assist in monitoring and managing greenhouse gas emissions [73-75], tracking supply chain sustainability [76-79], and optimizing energy consumption [80-85]. Furthermore, cybersecurity is a growing concern, as digitization introduces vulnerabilities that can pose significant green risks [86-89]. Companies must safeguard their digital infrastructure and data to protect against potential breaches that could have environmental, financial, and reputational repercussions. Additionally, the digital era has transformed stakeholder engagement. Social media and online platforms provide opportunities for companies to engage with customers, employees, investors, and communities, allowing them to gather valuable insights and feedback on sustainability initiatives in real time [90-95]. However, these digital channels also bring the risk of rapid reputational damage if sustainability commitments are not upheld or if negative incidents are exposed online. Managing green risks in the digital age requires a multifaceted approach that integrates sustainability into the company's digital strategy. By leveraging digital tools for sustainability, maintaining compliance, fortifying cybersecurity measures, and effectively engaging stakeholders, companies can navigate green risks while advancing their sustainability objectives and contributing to broader societal and economic goals. In this era of digital transformation, green risk management is not only about environmental responsibility but also about harnessing the power of technology to drive sustainable development [96-101].

Numerous studies [102-106] have underscored the economic benefits of integrating sustainability and green risk management into corporate strategies. Researchers [107-109] argue that companies that adopt proactive green strategies are better equipped to identify and mitigate environmental risks, resulting in improved long-term financial performance. This aligns with the view that sustainable companies are more resilient in the face of environmental uncertainties. Effective green risk management begins with comprehensive risk assessment. Research [110-116] highlights the importance of prioritizing green risks based on their potential impact on the company's sustainability objectives. This approach allows organizations to allocate resources efficiently and focus on areas where risks are most significant [117-124]. The role of regulatory compliance in green risk management is well established. Companies must navigate complex and evolving environmental regulations to mitigate legal and reputational risks. Additionally, transparent environmental reporting has gained prominence as stakeholders increasingly demand accountability, leading to the proliferation of environmental, social, and governance (ESG) reporting standards [125-129].

The importance of resilient supply chains in mitigating green risks is a growing research area. Experts [130-134] emphasize the need for companies to assess the environmental risks within their supply chains and develop strategies to reduce vulnerabilities, such as diversifying suppliers and adopting sustainable sourcing practices. Effective engagement with stakeholders, including customers, employees, investors, and communities, plays a vital role in green risk management. Researchers [135-137] argue that companies that actively engage with stakeholders can build trust and gain valuable insights into emerging environmental issues, thereby enhancing their ability to manage risks effectively. Research [138-140] demonstrates that companies that invest in eco-innovation often experience improved resource efficiency, reduced environmental impact, and enhanced competitiveness.

2 Materials and Methods

Based on the COSO ERM methodology, a system of indicators has been formed to assess the effectiveness of the environmental risk management system of the enterprise. All indicators

have been divided into four components: strategic goals, operational goals, transparency, and compliance with legislation. Formulas (1)-(11) are used to calculate the relevant indicators.

$$Strat = \sum_{i=1}^n Str_i \tag{1}$$

$$Str_1 = \frac{S_i - \bar{S}_i}{\sigma_S} \tag{2}$$

$$Str_2 = \frac{NP_i}{S_i} \tag{3}$$

$$Operat = \sum_{i=1}^n Op_i \tag{4}$$

$$Op_1 = S_i / AT_i; Op_2 = AF_i^{RC} / AF_i^{PC} \tag{5}$$

$$Op_3 = M_i / S_i; Op_4 = \frac{S_i^{t1} / L_i^{t1}}{S_i^{t0} / N_i^{t0}} \tag{6}$$

$$Transp = \sum_{i=1}^n Tr_i \tag{7}$$

$$Tr_1 = Sert_i + EP_i \tag{8}$$

$$Tr_2 = EPW_i + R_i + EI_i \tag{9}$$

$$Compl = \sum_{i=1}^n C_i \tag{10}$$

$$C_1 = \frac{SC_i^{t1}}{SC_i^{t0}}; C_2 = \frac{ET_i + EF_i}{O_i} \tag{11}$$

where S_i – sales of the i -th company; \bar{S}_i – the average sales volume of the studied companies; σ_S – standard deviation of sales for companies in the industry; NP_i – net profit of the i -th company; AT_i – total assets value of the i -th company; AF_i^{RC} – residual value of fixed assets of the i -th company; AF_i^{PC} – initial value of fixed assets of the i -th company; M_i – material costs of the i -th company; L_i – number of employees at the i -th company; t – time period ($t_0, 1$ – current and previous time periods, respectively); $Sert_i$ – availability of information regarding environmental product certification for the i -th company; EP_i – existence of developed environmental policies for the i -th company; EPW_i – availability of information about eco-oriented activities conducted by the i -th company; R_i – presence of financial and nonfinancial reports on the activities of the i -th company; EI_i – availability of results from conducting environmental audits for the i -th company; SC_i – number of lawsuits against the i -th company; ET_i – amount of paid environmental taxes by the i -th company; EF_i – sum of fines for environmental pollution by the i -th company; O_i – obligations of the i -th company..

All mentioned indicators of the company's environmental risk management system were normalized based on their impact direction (formulas 12-13):

$$X_{in}^d = \frac{x_{in}}{x_{max}} \tag{12}$$

$$X_{in}^s = \frac{x_{in}}{x_{min}} \tag{13}$$

X_{in}^S – stimulating indicator (Strat, Operat, Transp); X_{in}^d – inhibitors (Compl); X_{in} – data; X_{min} – minimum value; X_{max} – maximum value.

The integrated value of the effectiveness of the environmental risk management system of the enterprise is calculated by formula 14:

$$EERMI_j = \frac{\sum_{i=1}^n X_{in}^d + \sum_{i=1}^n X_{in}^s}{\max_j \{ \sum_{i=1}^n X_{in}^d + \sum_{i=1}^n X_{in}^s \}} \tag{14}$$

\max_j – the maximum value of the sum of normalized indicators of the effectiveness of the environmental risk management system for the studied companies

The thresholds of the effectiveness of the environmental risk management system of the enterprise are shown in Table 1.

Table 1. The thresholds of the effectiveness of the environmental risk management system of the enterprise

Thresholds	Level
$0,75 \leq EERM < 1,00$	High
$0,50 \leq EERM < 0,75$	Average
$0,25 \leq EERM < 0,50$	Low
$0 \leq EERM < 0,25$	Critical

The information database for the research was compiled by domestic metallurgical industry companies that position themselves as environmentally oriented for 2012-2019.

3 Results and discussion

The results of assessing the effectiveness of environmental risk management systems at enterprises for the period 2012-2019 are presented in Table 2.

Table 2. Empirical results for calculating the effectiveness of environmental risk management systems

Company	Year							
	2012	2013	2014	2015	2016	2017	2018	2019
Company 1	0,808	0,851	0,870	0,884	0,899	0,912	0,953	1,000
Company 2	0,405	0,416	0,512	0,364	0,395	0,608	0,543	0,474
Company 3	0,384	0,429	0,384	0,417	0,543	0,591	0,550	0,496
Company 4	0,527	0,429	0,532	0,518	0,415	0,590	0,420	0,312
Company 5	0,267	0,229	0,694	0,612	0,597	0,692	0,537	0,485

Sources: developed by the authors.

The calculation results have indicated that among the studied enterprises, only Company 1 exhibited a positive trend in the change in the integrated index of the environmental risk management system's efficiency. This index increased from 0.81 in 2012 to 1.00 in 2019. The catalyst for the improvement in the efficiency of the company's environmental risk management system was the simultaneous reduction in the amounts of paid environmental taxes and fines, as well as an increase in the transparency of the company's environmental reporting. The graphical interpretation is presented in Figure 1.

It was found that the values of this index ranged from low to moderate levels during 2012-2019 for the following companies: Company 2 (maximum – 0.61 in 2017, minimum – 0.4 in 2012), Company 3 (maximum – 0.59 in 2017, minimum – 0.38 in 2012 and 2014), and Companies 4 and 5 (maximum – 0.69 in 2014, minimum – 0.23 in 2013).

This trend is attributed to the asynchrony in the changes of indicators in the components of the environmental risk management system (Strat and Operat indicators served as inhibitors) and the lack of alignment within the internal subsystems of the company's management.

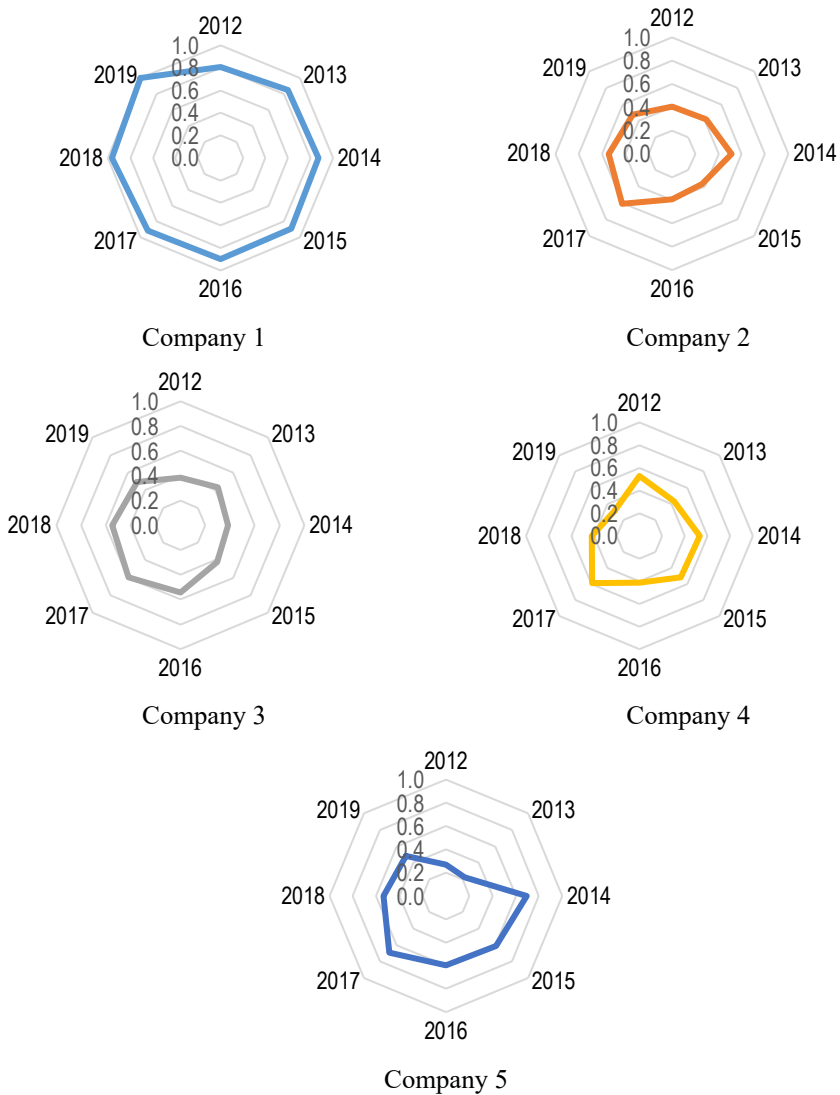


Fig. 1. Graphical interpretation of the consolidated results of the calculation of the environmental risk management system effectiveness index.

Sources: developed by the authors.

Regarding recommendations, here are tailored suggestions for optimizing their environmental risk management systems:

- Foster a culture of sustainability within the organization by promoting environmental awareness and engagement among employees.
- Regularly update and adapt environmental risk management strategies in response to changing regulations and market dynamics.
- Explore opportunities for eco-friendly initiatives, such as energy-efficient technologies, waste reduction, and sustainable sourcing.
- Enhance cross-functional collaboration to ensure that environmental goals are integrated into all aspects of the business.

- Benchmark against industry peers to identify areas for improvement and best practices.
- Invest in employee training and development to ensure that staff members are well equipped to manage environmental risks effectively.
- Engage with stakeholders, including customers and investors, to gather feedback and demonstrate a commitment to sustainability.
- Consider seeking external expertise or environmental audits to gain a fresh perspective on environmental management practices.

Each company should tailor its environmental risk management approach to its unique circumstances while keeping these overarching recommendations in mind. By continually striving for improvement, embracing sustainability, and aligning environmental goals with overall business strategies, these companies can make significant progress in managing green risks and contributing to a more sustainable future.

4 Discussion and conclusion

The results of the assessment of the effectiveness of the environmental risk management system of the enterprise for the years 2012-2019 have shown that only Company 1 among the surveyed companies in the metallurgical industry exhibits a positive trend in the change of the integrated index of the system's efficiency (increasing from 0.81 in 2012 to 1.00 in 2019). This positive trend is attributed to a reduction in the amounts of paid environmental taxes and fines at the company, as well as an increase in the level of transparency in its environmental reporting. For the other companies, the values of the integrated index of the environmental risk management system efficiency remained within low to moderate levels throughout the study period. It is argued that the main inhibitors were the Strat and Operat indicators in combination with the lack of alignment within the internal management subsystems of the companies.

The effective management of green risk within companies for attaining Sustainable Development Goals (SDGs) requires a strategic policy framework that encourages and enforces sustainability practices. These policy implications can guide governments and regulatory bodies in fostering a sustainable business environment. Thus, governments should establish and strengthen environmental regulations and standards to ensure that companies align with sustainability goals. These regulations should incentivize green practices and penalize noncompliance with stringent penalties. Policymakers could provide financial incentives, tax breaks, or grants to companies that invest in green technologies and innovation. This can stimulate research and development in sustainable practices.

Governments should require companies to disclose comprehensive environmental, social, and governance (ESG) data in annual reports. This transparency fosters accountability and helps stakeholders make informed decisions. Policymakers could introduce requirements for companies to evaluate and improve the sustainability of their supply chains. This could involve auditing suppliers' practices and enforcing sustainable sourcing. Governments should support educational programs that promote environmental awareness and sustainability among businesses. Training initiatives can help companies develop the necessary skills for managing green risks effectively. The implementation of carbon pricing mechanisms, such as carbon taxes or cap-and-trade systems, can encourage companies to reduce emissions and adopt greener practices. Encourage collaboration among industry stakeholders, academia, and government bodies to share best practices, research findings, and innovations related to green risk management and sustainable development. Introduce requirements for companies to conduct comprehensive environmental impact assessments before embarking on large-scale projects. This helps identify and address potential environmental risks. Governments should promote sustainability by incorporating green criteria into their procurement

processes. This encourages companies to develop and provide environmentally friendly products and services. Encourage collaboration between government bodies and the private sector to jointly develop and implement green initiatives. This could include joint research projects, infrastructure development, or environmental conservation efforts. Establish mechanisms for continuous monitoring and evaluation of companies' sustainability efforts and green risk management. This ensures that policies remain effective and relevant.

Effective policies play a pivotal role in guiding and incentivizing companies to manage green risks while striving to attain sustainable development goals. These policies should strike a balance between regulatory requirements and supportive measures that encourage innovation and long-term sustainability. Policymakers, in collaboration with businesses and other stakeholders, have a critical role in shaping the future of green risk management and sustainable development.

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