

Article

The Interplay Between Environmental Ethics and Sustainable Performance: Does Organizational Green Culture and Green Innovation Really Matter?

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Abstract: Although organizational green culture and environmental ethics are increasingly acknowledged as crucial, few studies have comprehensively examined the interconnected relationship between green innovation and sustainable performance, particularly within manufacturing firms. As such, this study empirically examines the relationship between environmental ethics and sustainable performance through the mediating roles of green process and product innovations and the moderating role of organizational green culture on these relationships. It is grounded in stakeholder theory and a resource-based view. This study utilizes 236 valid cross-sectional data points from manufacturing firms in Turkey to test the proposed integrated theoretical model through structural equation modeling (SEM). Environmental ethics is positively associated with sustainable performance, green process innovation, and green product innovation. Green process innovation positively affects sustainable performance. Additionally, both green process and product innovations mediate the relationship between environmental ethics and sustainable performance. Moreover, organizational green culture enhances the relationship between environmental ethics and both green process innovation and green product innovation while moderating its role in sustainable performance. The findings highlight how environmental ethics, mediated by green innovation and moderated by organizational green culture, can drive sustainable performance, offering valuable insights for managers aiming to enhance sustainability initiatives in the manufacturing sector.

Keywords: environmental ethics; green process innovation; green product innovation; organizational green culture; sustainable performance; Turkey's manufacturing sector

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1. Introduction

Organizations are increasingly embedding sustainability into their strategies and operations owing to heightened public awareness of environmental issues [1,2]. The manufacturing sector, which is essential for global economic growth and job creation, is one of the largest contributors to environmental challenges such as resource depletion and ecological degradation [3,4]. With rising discomfort from global warming and the need for ecological balance, stakeholders are placing greater pressure on manufacturing firms to adopt sustainable performance and decrease the environmental impact of their production processes [5]. Despite the acknowledged importance of sustainability, the link between environmental ethics, green innovation, and sustainable performance remains underexplored in the academic literature. While more studies have recognized that green human resource management and CSR influence green innovation and sustainability, the role of environmental ethics, particularly in driving green process and product innovations, has not been extensively examined [6,7]. This leaves a significant gap in

understanding how environmental ethics, when integrated into an organization's culture, can contribute to long-term sustainability [8].

This study seeks to fill this gap by exploring the relationship between environmental ethics, green innovation, and sustainable performance within the context of manufacturing firms in Turkey. In this study, environmental ethics refers to the ethical principles that guide a firm's responsibility toward environmental protection. The study also introduced organizational green culture as a moderating factor in the link between environmental ethics and sustainable performance [9]. The focus on Turkey's manufacturing sector provides a novel context, as environmental sustainability in emerging markets has been less studied than in developed economies. Sustainability initiatives and environmental ethics are widely recognized as contributing to enhanced organizational performance, particularly in the context of green innovation. An empirical study demonstrated that firms that adopt green innovations tend to achieve better financial and environmental outcomes [10]. However, the specific pathways through which environmental ethics drives green innovation and sustainable performance, especially within the manufacturing sectors in emerging markets, remain poorly understood.

The function of environmental ethics as a supporter of green innovation and sustainable performance has not been studied extensively, particularly in the manufacturing sector. Additionally, empirical studies exploring the mediating role of green innovation and the moderating role of organizational green culture in this relationship are scarce. This study seeks to address these gaps by investigating how environmental ethics is associated with both green process and product innovations and how these innovations, in turn, relate to sustainable performance [11]. Moreover, this study investigates how a firm's green culture may strengthen or weaken these relationships.

This research aims to concentrate on the following research questions:

RQ1: What is the nature of the relationship between environmental ethics and sustainable performance among manufacturing firms?

RQ2: What is the nature of the relationship between environmental ethics and green innovation?

RQ3: How do green process and product innovations mediate the relationship between environmental ethics and sustainability performance?

RQ4: How does organizational green culture moderate the relationships among environmental ethics, green innovation, and sustainable performance?

This study contributes to the literature by addressing the gap in empirical evidence concerning the role of environmental ethics in promoting green innovation and sustainable performance. It also highlights the importance of organizational green culture as a critical moderating factor in achieving these outcomes. By offering new insights into the interplay between environmental ethics, green innovation, and sustainability in the manufacturing sector, this study makes both theoretical and practical contributions. Managers can benefit from understanding how fostering a green organizational culture can enhance their firm's sustainability initiatives and overall competitiveness.

The remainder of the paper is organized as follows: Section 2 reviews the relevant literature, presents the conceptual framework, and develops hypotheses related to the direct and indirect relationships through which environmental ethics are associated with sustainable performance. Section 3 outlines the research methodology, including data collection and sampling techniques. Section 4 presents the results, and Section 5 discusses the findings and concludes with implications, limitations, and suggestions for future research.

2. Theoretical Background and Hypothesis Development

2.1. Stakeholder Theory

Stakeholder theory, introduced by Freeman [12], emphasizes the role of stakeholders and environmental organizations in driving businesses to adopt social and environmental

responsibilities. Effective stakeholder engagement leads to sustainable business practices, including green innovation and the development of an organizational green culture [13]. These relationships are built on cooperation, consultation, participation, and information sharing, thus enhancing sustainability efforts [14].

This study applies stakeholder theory to examine the link between green practices and sustainable performance in Turkey's manufacturing sector. Organizations with strong stakeholder theory are achieving social sustainability, aligning with Turkey's work ethics. Moreover, stakeholder theory advocates fairness, honesty, and adherence to ethical codes in all stakeholder interactions, which improves sustainability performance and benefits both the business and its surrounding community [15].

2.2. Resource-Based View

Hart's resource-based view theory offers a nuanced understanding of how organizations interact with their environment, addressing the limitations of traditional resource-based view frameworks [16]. This perspective emphasizes that an organization's interaction with natural resources can enhance its competitive advantage by fostering environmentally sustainable practices. The resource-based view highlights the necessity for organizations to develop expertise in environmental stewardship, recognizing the profound influence of ecological factors in today's competitive landscape. The authors of [17] further argue that, to sustain competitive advantage in the future, businesses must engage in environmentally friendly economic activities, making this commitment central to their operational strategy.

By cultivating a green culture and adopting ethical practices, organizations can enhance productivity and reduce operational costs through innovations in green processes and products. This alignment with resource-based view principles not only leads to improved financial performance but also positions firms favorably in the marketplace [13]. In this study, the resource-based view was used to highlight the importance of green processes and products at the organizational level. This research focuses on how effective interactions with the environment contribute to sustainable performance, ultimately resulting in increased productivity and decreased operational expenses. The accomplishment of green processes and products fosters enhanced environmental security, social performance, and competitive advantage [18].

2.3. Environmental Ethics and Sustainable Performance

Environmental ethics serves as a crucial internal resource that enables firms to develop value-creating strategies, ultimately enhancing their sustainable performance. Sustainable performance refers to how organizations engage with the natural environment, emphasizing resource consumption and stringent pollution control measures [19]. Utilizing the resource-based view, it is posited that firms can naturally formulate strategies that influence their internal resources, including environmental ethics, to improve sustainable performance and achieve a competitive advantage [16]. Moreover, a firm's commitment to corporate environmental ethics fosters proactive environmental initiatives that positively influence its sustainable performance. Such initiatives may include the use of biodegradable materials in products, reducing pollution and waste at the source, minimizing the use of environmentally harmful substances, and enhancing energy efficiency [20]. This proactive approach not only enhances an organization's social acceptability but also provides a competitive edge in the marketplace.

Therefore, organizations are encouraged to adopt environmental management as a core organizational philosophy, involving all employees in the greening process [21]. A substantial body of research supports the addition of environmental ethics to firms' planned methods and organizational green culture to promote sustainable performance [22]. Drawing on the resource-based view, it has been asserted that corporate environmental ethics, as a valuable and rare resource, fosters an environmental philosophy that

governs the management of people, processes, and products, thereby enhancing sustainable performance [16,18]. Thus, we propose the following hypothesis:

H1. *Environmental ethics is positively associated with sustainable performance.*

2.4. Environmental Ethics and Green Process Innovation

Green innovation aims to achieve corporate environmental management [23]. This study categorizes green innovation into two distinct types: green product and process innovations. By improving environmental management performance, green innovation enables companies to meet their environmental protection standards. Firms investing in green innovation not only comply with environmental regulations but also establish competitive barriers against rivals. Historically, many organizations have viewed environmental management as an unnecessary expense [24]. However, an increasingly positive correlation exists between corporate environmental ethics and green process innovation. Organizations are urged to realign their strategies and operations to adapt to the growing emphasis on environmental sustainability.

Companies that demonstrate strong environmental ethics typically enhance resource productivity through green innovation, effectively mitigating environmental costs [25]. Green innovation not only enhances product value but also offsets the costs associated with minimizing environmental impact, thereby increasing overall competitiveness. A study employing content analysis found that green process innovation significantly strengthens a firm's organizational environmental ethics [26]. Furthermore, CSR has been shown to significantly influence firms' adoption of green process innovation. Similarly, stakeholder force plays a decisive role in cheering on associations to implement green process innovation [27]. Based on this discussion, we propose the following hypothesis:

H2. *Environmental ethics is positively associated with green process innovation.*

2.5. Green Process Innovation and Sustainable Performance

Climate change presents significant environmental challenges that impede organizational sustainability. To combat these escalating ecological issues, proactive strategies are essential to achieve long-term performance [28]. Within the framework of sustainable development, green product innovation has emerged as a strategic approach that meets stakeholder needs while providing firms with a lasting competitive advantage. These innovations encompass a range of unique business processes that enhance a firm's sustainable performance [29]. The substantial impact of green product innovation highlights the necessity of implementing eco-friendly practices as a critical driver of organizational sustainability [30].

Numerous studies have identified green process innovation as a vital driver of sustainable performance [31]. In today's industrial landscape, green modifications have significantly improved processes and systems, reduced environmental vulnerabilities, and promoted sustainable production. Manufacturing organizations that adopt green practices experience notable improvements in their sustainable performance [32]. Given its substantial contribution to economic development, the manufacturing sector must prioritize green product innovation to enhance profitability and overall performance [33]. Research further demonstrates that green product innovation is highly beneficial for firms seeking sustainable development and plays a pivotal role in improving social, economic, and ecological outcomes [34]. Based on this argument, we propose the following hypothesis:

H3. *Green process innovation is positively associated with sustainable performance.*

2.6. Environmental Ethics and Green Product Innovation

Green product innovation highlights products that reduce their environmental impact throughout their life cycles [35]. By focusing on green products, companies can conserve resources, mitigate environmental risks, and reduce waste. Improving product design through green innovation enables firms to achieve their environmental objectives. In this study, green product innovation refers to the extent to which companies develop or improve products to mitigate negative environmental effects [36]. To facilitate this, organizations must possess both the motivation and capability to generate innovative ideas for new product development. Previous research highlights the positive impact of well-defined environmental policies and processes on a company's innovation efforts [37]. Clear environmental policies can enhance operational integration across departments and address environmental challenges effectively.

Corporate environmental ethics plays a critical role in proactive environmental management by influencing the adoption of environmental technologies and overall business operations. This study posits that environmental ethics significantly contributes to a company's green innovation, with the breadth and speed of a firm's response to environmental issues positively correlated with top management's environmental concerns [38]. According to the resource-based view, a strong corporate culture that is characterized as valuable, rare, inimitable, and non-substitutable can serve as a vital resource for sustained competitive advantage [18]. Environmental ethics, as a form of superior corporate culture, significantly contributes to sustainable development. Thus, companies with robust environmental ethics employ positive environmental measures to facilitate green innovation [16]. Based on this discussion, we propose the following hypothesis:

H4. *Environmental ethics is positively associated with green product innovation.*

2.7. Green Product Innovation and Sustainable Performance

As globalization accelerates, businesses are confronted with resource limitations and ecological degradation, significantly hindering their sustainable development. Environmental deterioration is a critical challenge across industries worldwide, necessitating proactive and innovative eco-friendly strategies to combat climate change. In this study, environmental innovation and green attributes have become central to achieving sustainability. Research indicates that green product innovation is essential to maintaining a company's long-term sustainability [39]. Furthermore, it plays a pivotal role in reducing the escalating environmental impact on businesses [40]. Consequently, prior studies have advocated the integration of green practices to enhance sustainable performance [41].

Product innovation now serve as a critical driver for accelerating growth within firms as the contemporary business landscape increasingly encourages the adoption of green innovation tools to achieve sustainable performance. The literature highlights a positive relationship between green product innovation and sustainable performance. As organizations increasingly embrace eco-friendly practices, they can effectively mitigate the adverse effects of climate change. Green product innovation, which is characterized by environmentally conscious products, provides firms with a competitive advantage over their market rivals. Stakeholders can leverage these innovations to enhance an organization's sustainability in a highly competitive environment [33]. Based on this discussion, we propose the following hypothesis:

H5. *Green product innovation is positively associated with sustainable performance.*

2.8. The Mediating Role of Green Process Innovation

Environmental ethics management entails strict adherence to all relevant laws, regulations, and environmental requirements, enabling companies to minimize their ecological impact while ensuring compliance with quality standards [42]. Research highlights the

critical role of SMEs in implementing environmental strategies that enhance organizational effectiveness and improve environmental performance [43]. Stakeholders and public authorities expect SMEs to exhibit both environmental and financial performance. This expectation is particularly pronounced for SMEs as they depend more on local communities and engage in closer interactions than larger corporations [44]. Thus, stakeholder-focused ecological fulfillment and disaster improvement are necessary for endurance.

Previous research has established that green process innovation contributes positively to both environmental and economic performance. Moreover, studies indicate that green process innovation enhances a company's competitive advantage and overall sustainability [45]. A significant relationship has also been identified between green process innovation and a firm's reputation and environmental ethics, particularly within the context of SMEs [46]. Additionally, eco-efficiency is vital for achieving environmental performance, with green process innovation serving as a key factor in enhancing sustainability performance, where environmental ethics acts as a mediating variable [47]. Based on this discussion, we propose the following hypothesis:

H6. *Green process innovation mediates the relationship between environmental ethics and sustainable performance.*

2.9. The Mediating Role of Green Product Innovation

Green product innovation performance refers to the growth of narratives and useful ideas related to green products, services, processes, or practices [48]. For companies seeking to create and market green products effectively, it is essential to integrate green management principles with green product innovation activities. According to [49], green innovations encompass both hardware and software innovations associated with green products. Their research indicates that investing in green product innovation positively impacts sustainable performance, underscoring the value of recognizing the role of green innovation in business strategy.

As green products become increasingly prevalent globally, the significance of green product innovation is expected to grow. Heightened public awareness of environmental issues has also contributed to a growing focus on green product innovation. Companies design green products to convert market opportunities into offerings that meet the needs of consumers and other stakeholders. However, integrating environmental considerations into product development while complying with regulations and market demands can be challenging [50]. This challenge is underscored by the need for a systematic and innovative approach to designing and innovating products that diminish ecological impact. Growth of ecologically friendly products to achieve company success [51]. Therefore, we propose the following hypotheses:

H7. *Green product innovation mediates the relationship between environmental ethics and sustainable performance.*

2.10. The Moderating Effect of Organizational Green Culture

Organizational green culture is pivotal in shaping employees' mental frameworks and guiding their behaviors. It significantly influences innovation activities within organizations, either by fostering or obstructing them [52]. Among the various factors driving green practices, organizational green culture is particularly noteworthy because establishing a robust green organizational culture is essential for promoting successful green innovation. Scholars suggest that such a culture serves as an optimal framework for achieving success in green innovation initiatives, as embedding environmental awareness into the organizational fabric is vital for stimulating green innovation [53]. The resource-based view framework elucidates the relationship between organizational green culture and both green product and process innovations, emphasizing the strategic importance of leveraging internal resources to attain and maintain a competitive edge [16].

In this research, businesses increasingly view organizational green culture as a valuable and unique asset for achieving sustainable performance. Research indicates that organizational green culture significantly impacts green product and process innovations across both the service and manufacturing sectors, acting as a catalyst for green innovation and sustainable performance [54]. Furthermore, green innovation mediates the relationship between organizational green culture and sustainable performance. Several studies have substantiated the positive correlation between organizational green culture and green innovation, emphasizing that fostering organizational green culture is critical for advancing green product innovation [55]. Based on this discussion, we propose the following hypotheses:

H8. *In a high-organizational green culture, the relationship between environmental ethics and green process innovation is stronger for manufacturing firms with a high level of organizational green culture.*

H9. *In low-organizational green culture, the relationship between environmental ethics and sustainable performance diminishes for manufacturing firms with a low level of organizational green culture.*

H10. *In a high-organizational green culture, the relationship between environmental ethics and green product innovation is stronger for manufacturing firms with a high level of organizational green culture.*

2.11. Conceptual Framework

This study contributes to the sustainability literature by addressing critical gaps in the understanding of the mechanisms and conditions under which environmental ethics influences sustainable performance, specifically through green innovation and organizational green culture. While previous research has established links between green innovation and performance [4] and has emphasized the role of organizational green culture in fostering sustainability [3,5], this study uniquely examines organizational green culture as a moderating factor in the environmental ethics–sustainable performance relationship. This approach provides insights into how organizational green culture strengthens or weakens the influence of environmental ethics on both green product and process innovation, ultimately influencing sustainable performance. Additionally, the study advances the understanding by highlighting the mediating roles of green product and process innovation in this relationship, revealing pathways through which environmental ethics contribute to sustainability outcomes. By exploring these complex interactions, this research offers a comprehensive view that not only enriches theoretical perspectives on green innovation and ethics but also provides practical implications for firms seeking to enhance sustainability through strategic cultural and ethical alignments. The conceptual model of this study is shown in Figure 1.

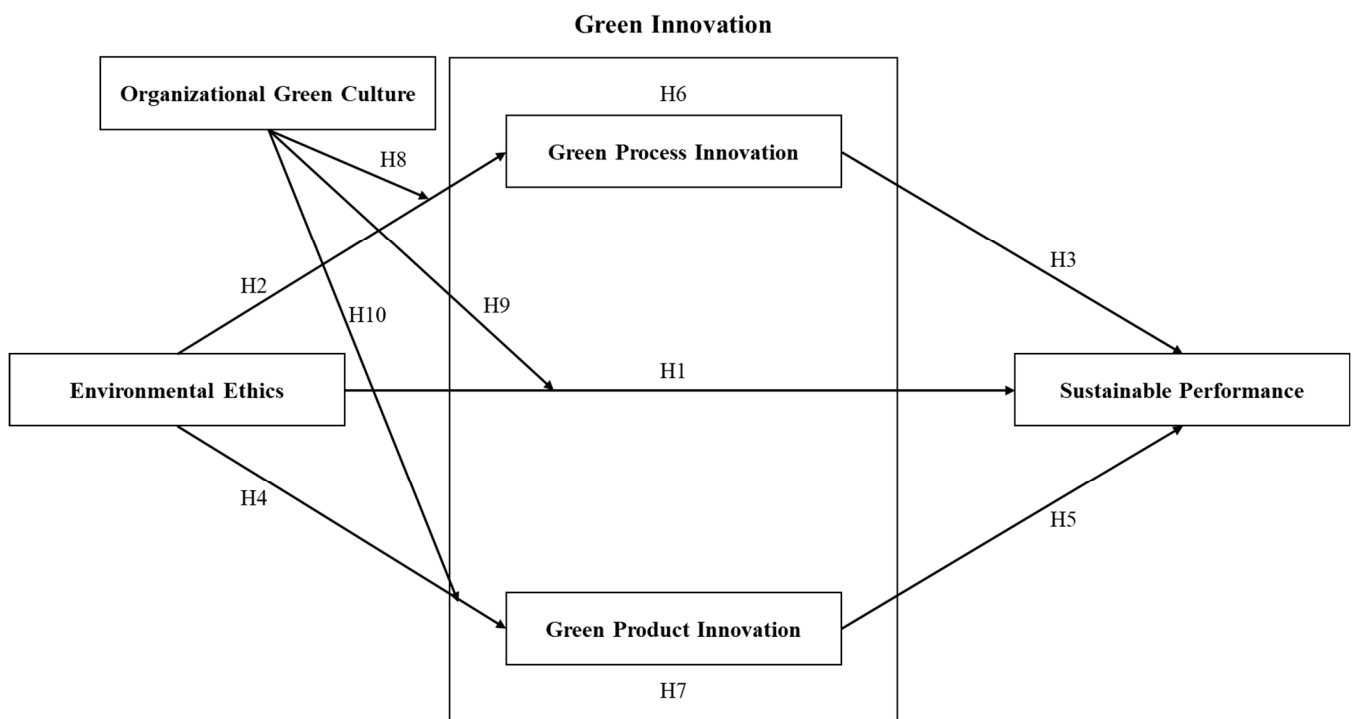


Figure 1. Research model.

3. Methods

3.1. Data Collection and Sampling

This study examines the relationship between environmental ethics and sustainable performance, focusing on organizational green culture within Turkey's manufacturing sector. In 2023, Turkey's manufacturing sector played a significant economic role, accounting for approximately 22.2% of GDP and 20.7% of employment, highlighting its importance to the national economy [56,57]. However, the sector faces challenges including limited financial resources, low production capacity, inflation, and limited technological innovation, which often lead firms to prioritize economic growth over environmental practices [58,59]. Addressing these environmental impacts is essential for emerging economies such as Turkey, which stand to benefit from adopting green practices [60,61].

Data collection followed a cross-sectional design, using the TOBB (The Union of Chambers of Commerce, Industry, Maritime Trade, and Commodity Exchanges of Turkey) database [62] to select a representative sample of 880 manufacturing firms. The initial sample included 1000 firms. Firms with discontinued operations or inaccurate contact information were excluded, leaving 880 firms. Managers from different levels, such as COOs, CFOs, CEOs, HR managers, and production and operations managers, were targeted to gain a comprehensive perspective on green culture and sustainable performance, with each firm represented by a single informant knowledgeable about its environmental practices.

Using a single respondent per firm is a common approach; however, it presents limitations related to social desirability bias, particularly in self-reported assessments of sustainability. Research indicates that respondents often provide answers they believe are expected or socially acceptable, potentially overestimating their sustainable performance [10]. This bias can arise because people and firms tend to report sustainability efforts more favorably than they may actually be, especially on sensitive topics such as environmental responsibility. Additionally, an individual's perception of sustainability behaviors may differ from actual practices, meaning that responses may not fully capture a firm's true activities [63]. Consequently, our study design was unable to fully control for this bias,

and future studies should consider collecting responses from multiple managerial levels to mitigate its effects.

Incorporating multiple respondents could provide a more balanced view, as relying on a single respondent, even a senior executive, does not guarantee an accurate reflection of all strategic components in an organization [64]. Neiroukh et al. [65] argued that strategic decision-making processes vary by managerial level, with each level providing distinct insights into a firm's strengths, weaknesses, and environmental uncertainties. Therefore, including managers from different levels can offer a fuller understanding of the strategy development process and reduce the single-respondent desirability bias [66]. Multiple participants from the same firm would also enhance scale validation [67] and provide a more accurate view of how strategic processes are perceived across organizational levels.

Data collection was conducted from June to September 2023, with two follow-up reminders, yielding 248 responses, of which 236 were valid, resulting in a 26.8% response rate. To address potential non-response bias, we compared early and late responses and found no significant differences. Additionally, we verified that key characteristics (e.g., the number of employees) were consistent between respondents and a sample of non-respondents, reinforcing the robustness of our findings [68].

The demographic profile of the respondents (see Table 1) reflected diversity across firm size and industry: 65.7% were from medium-sized firms, 29.2% from large firms, and 5.1% from small firms. Industry representation included food and beverage processing (33.1%), IT and technology (28.4%), textiles and plastics (16.5%), wood and chemicals (14.8%), and pharmaceuticals (7.2%). Furthermore, 55.5% of respondents were middle-level managers, providing valuable insights aligned with the study's focus on sustainable performance.

Table 1. Respondents' demographic profile.

Variables	Options	Frequency	Percentage (%)
Gender	Male	128	54.2%
	Female	108	45.8%
Age	Less than 30 years old	2	0.8%
	30–39	61	25.8%
	40–49	77	32.6%
	50–59	42	17.8%
	60 years and above	54	22.9%
Respondent's position	Lower-level managers	18	7.6%
	Middle-level manager	131	55.5%
	Top-level managers	87	36.9%
Industry sector	Pharmaceuticals and medical equipment	17	7.2%
	Textile and plastics manufacturing	39	16.5%
	Food and beverage processing	78	33.1%
	Wood and chemical manufacturing	35	14.8%
	IT and technological equipment manufacturing	67	28.4%
Number of employees	Small-sized firms	69	29.2%
	Medium-sized firms	155	65.7%
	Large-sized firms	12	5.1%
Total		236	100%

3.2. Measures

The data were collected using a structured questionnaire. To ensure content validity, the questionnaire was urbanized and back translated from English to Turkish. This process involved scrutiny and refinement of inputs from industrial experts and practitioners. Additionally, a pilot test was conducted among ten manufacturing firms engaged in environmental practices, and feedback from this pilot study was used to make necessary adjustments to enhance the questionnaire's quality and reliability.

The items used to measure the study constructs were derived from previously validated scales (Table 2) and rated on a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). Environmental ethics, the main independent variable, was measured using a 4-item scale adapted from Aftab et al. [10]. This scale effectively captured ethical considerations related to environmental practices within organizations.

The mediating variables, which included green innovations in both the process and product dimensions, were measured using an 8-item scale and each dimension was measured with four items developed by Chen et al. [49] and Aftab et al. [69]. These items assessed the extent of innovative practices aimed at improving the environmental sustainability of manufacturing processes.

The moderating effect of organizational green culture was measured using a 6-item scale developed by Fraj et al. [70] and Wang [71]. This scale evaluated the degree to which companies adopted and institutionalized environmental values through policies, mission statements, and communication programs for employees, thereby reflecting the depth of their green culture [72].

Table 2. Measurement items.

Constructs	Indicators	Sources
Environmental Ethics (EE)	<p>EE1: My company has specific policies for environmental protection.</p> <p>EE2: My company has a budget for environmental protection.</p> <p>EE3: My company integrates environmental programs, strategies, or objectives into marketing campaigns.</p> <p>EE4: My company integrates environmental programs, strategies, or objectives into its culture.</p>	[10]
Green Product Innovation (GPD)	<p>GPD1: The firm chooses the materials of the product that produce the least amount of pollution for conducting the product development or design.</p> <p>GPD2: The firm chooses the materials of the product that consume the least amount of energy and resources for conducting the product development or design.</p> <p>GPD3: The firm uses the fewest number of materials to comprise the product for conducting the product development or design.</p> <p>GPD4: The firm would circumspectly deliberate whether the product is easy to recycle, reuse, and decompose for conducting the product development or design.</p>	[49,69]
Green Process Innovation (GPI)	<p>GPI1: The manufacturing process of the firm effectively reduces the emission of hazardous substances or waste.</p> <p>GPI2: The manufacturing process of the firm recycles waste and emissions that allow them to be treated and reused.</p> <p>GPI3: The manufacturing process of the firm reduces the consumption of water, electricity, coal, or oil.</p> <p>GPI4: The manufacturing process of the firm reduces the use of raw materials.</p>	[49,69]

Organizational Green Culture (OGC)	<p>OGC1: Our firm makes a concerted effort to make every employee understand the importance of environmental preservation.</p> <p>OGC2: Our firm has a clear policy statement urging environmental awareness in every area.</p> <p>OGC3: Environmental preservation is a high-priority activity in our firm.</p> <p>OGC4: Preserving the environment is a central corporate value in our firm.</p> <p>OGC5: Our firm links environmental objectives with our other corporate goals.</p> <p>OGC6: Our firm develops products and processes that minimize environmental impact.</p>	[70,71]
Sustainable Performance (SUP)		
Environmental performance (ENP)	<p>SUP1: Reduction of air emissions.</p> <p>SUP2: Reduction of effluent and solid wastes.</p> <p>SUP3: Reduced consumption of hazardous/harmful/toxic materials.</p>	
Social performance (SOP)	<p>SUP4: Improved social responsibility towards human rights.</p> <p>SUP5: Improved social responsibility towards the safety of employees.</p> <p>SUP6: Improved personal desires of employees to do what is right.</p>	[58,73]
Economic performance (ECP)	<p>SUP7: Reduced in cost of materials purchasing.</p> <p>SUP8: Reduced in cost for energy consumption.</p> <p>SUP9: Reduced fee for waste treatment.</p>	

Sustainable performance, the focal outcome of this study, was assessed using a 9-item scale by Abuzawida et al. [58] and Yavuz et al. [73], which encompasses three dimensions: environmental performance, social performance, and economic performance [10,74,75]. This comprehensive scale provided a nuanced understanding of how sustainability initiatives impact various aspects of organizational performance.

3.3. Common Method Bias

To ensure the reliability of the findings, the study addressed common method bias, which can occur when data are collected from a single source and potentially skew the results if unaddressed [76]. The researchers applied Harman's one-factor test, a widely recognized method for detecting common method bias, which indicates its presence if a single factor accounts for 50% or more of the variance [77]. In this study, the first factor explained only 34.67% of the variance, suggesting a minimal bias. Additionally, the researchers conducted a full collinearity test, as recommended by Kock [78], with variance inflation factors (VIFs) ≤ 5 (see Table 3), confirming that multicollinearity and standard method bias were not significant issues [79]. These steps ensured that the study's conclusions about the relationship between environmental ethics, organizational green culture, and sustainable performance are robust and credible.

Table 3. Construct reliability and convergent validity.

Construct/Indicators	Outer Loadings	Means	Standard Deviation	VIFs	CA	CR	AVE
Environmental Ethics (EE)					0.856	0.903	0.698
EE1	0.859	5.08	1.178	2.112			
EE2	0.834	5.22	1.312	2.055			
EE3	0.831	5.26	1.284	1.952			
EE4	0.819	5.40	1.179	1.793			
Green Product Innovation (GPD)					0.846	0.896	0.683
GPD1	0.781	5.53	1.089	1.526			
GPD2	0.816	5.41	1.150	2.070			
GPD3	0.848	5.44	1.127	2.546			
GPD4	0.860	5.36	1.124	2.279			
Green Process Innovation (GPI)					0.813	0.871	0.628
GPI1	0.752	5.28	1.236	1.828			
GPI2	0.804	5.54	1.299	2.300			
GPI3	0.817	5.81	1.198	2.097			
GPI4	0.795	5.47	1.193	1.322			
Organizational Green Culture (OGC)					0.770	0.832	0.555
OGC1	0.794	5.31	1.285	2.258			
OGC2	0.700	5.35	1.275	2.099			
OGC3	0.691	5.20	1.269	1.735			
OGC4	0.632	5.18	1.564	2.751			
OGC5	0.645	5.23	1.525	2.955			
OGC6	0.561	5.22	1.588	2.447			
Sustainable Performance (SUP)					0.924	0.937	0.623
Environmental performance (ENP)					0.868	0.919	0.791
SUP1	0.870	4.83	1.393	2.166			
SUP2	0.911	4.57	1.524	2.587			
SUP3	0.887	4.81	1.523	2.199			
Social performance (SOP)					0.798	0.881	0.713
SUP4	0.865	5.07	1.223	1.940			
SUP5	0.861	5.03	1.417	1.907			
SUP6	0.806	4.97	1.396	1.448			
Economic performance (ECP)					0.852	0.910	0.772
SUP7	0.877	4.94	1.337	2.129			
SUP8	0.866	4.78	1.301	2.429			
SUP9	0.892	4.87	1.334	2.206			

Note(s): Variance inflation factors (VIFs), Cronbach's alpha (CA), composite reliability (CR), average variance extracted (AVE).

4. Analysis and Results

The analysis of this study was conducted using partial least squares structural equation modeling (PLS-SEM), a robust statistical technique well regarded for its ability to handle complex reflective models without requiring strict distributional assumptions [79]. PLS-SEM is particularly valuable in the fields of operations and green management as it efficiently handles data noise and tests causal relationships between constructs [80]. This method was chosen because of its high predictive accuracy and effectiveness in evaluating both the measurement model's reliability and hypothesized relationships of the structural model [81]. Through PLS-SEM, this study rigorously assessed the reliability and validity of the instruments used and tested the proposed hypotheses, providing a comprehensive understanding of how environmental ethics, mediated by organizational green culture, is associated with sustainable performance.

4.1. Reliability and Validity of the Measurement Model

To ensure the robustness of the measurement model, its reliability and validity were meticulously assessed. Construct reliability was determined using Cronbach's alpha (CA) and composite reliability (CR), with both metrics surpassing the recommended threshold of 0.70 (Table 3), indicating strong internal consistency [79]. Convergent validity was confirmed through factor loadings and average variance extracted (AVE); all factor loadings were above 0.50, and AVE values exceeded the minimum requirement of 0.50, ensuring that the constructs were well measured [82]. Discriminant validity was established using the Heterotrait-Monotrait Ratio (HTMT), with all values below the 0.9 threshold (see Table 4), affirming that the constructs were distinct from one another [83]. These steps collectively confirmed the reliability and validity of the measurement model, providing a solid foundation for subsequent hypothesis testing.

Table 4. Discriminant validity (HTMT).

Constructs	EE	GPD	GPI	OGC	SUP
1. Environmental Ethics (EE)	0				
2. Green Product Innovation (GPD)	0.470	0			
3. Green Process Innovation (GPI)	0.394	0.826	0		
4. Organizational Green Culture (OGC)	0.523	0.253	0.217	0	
5. Sustainable Performance (SUP)	0.627	0.415	0.411	0.638	0

4.2. Assessment of the Structural Model

The structural model was meticulously assessed to ensure the reliability and validity of the hypothesized relationships. Multicollinearity was first examined and found to be non-problematic, with all VIFs ≤ 5 , indicating no significant collinearity issues [78,81]. This study employed a bootstrapping procedure with 5000 resamples to determine the significance of the model's path coefficients [84].

As shown in Table 5 of Figure 2, the results demonstrated that environmental ethics was significantly and positively associated with sustainable performance ($\beta = 0.240$, $t = 4.537$, $p = 0.000$), supporting H1. Additionally, environmental ethics significantly enhanced green process innovation ($\beta = 0.399$, $t = 6.986$, $p = 0.000$), thus supporting H2. In turn, green process innovation was significantly related to sustainable performance ($\beta = 0.197$, $t = 3.169$, $p = 0.002$), supporting H3. Furthermore, environmental ethics significantly promoted green product innovation ($\beta = 0.437$, $t = 6.431$, $p = 0.000$), thus supporting H4. However, green product innovation was not significantly associated with sustainable performance ($\beta = 0.049$, $t = 0.732$, $p = 0.464$), thus providing no support for H5. These results underscored the vital role of environmental ethics and process innovation in driving sustainable performance; however, the direct impact of product innovation may require further exploration.

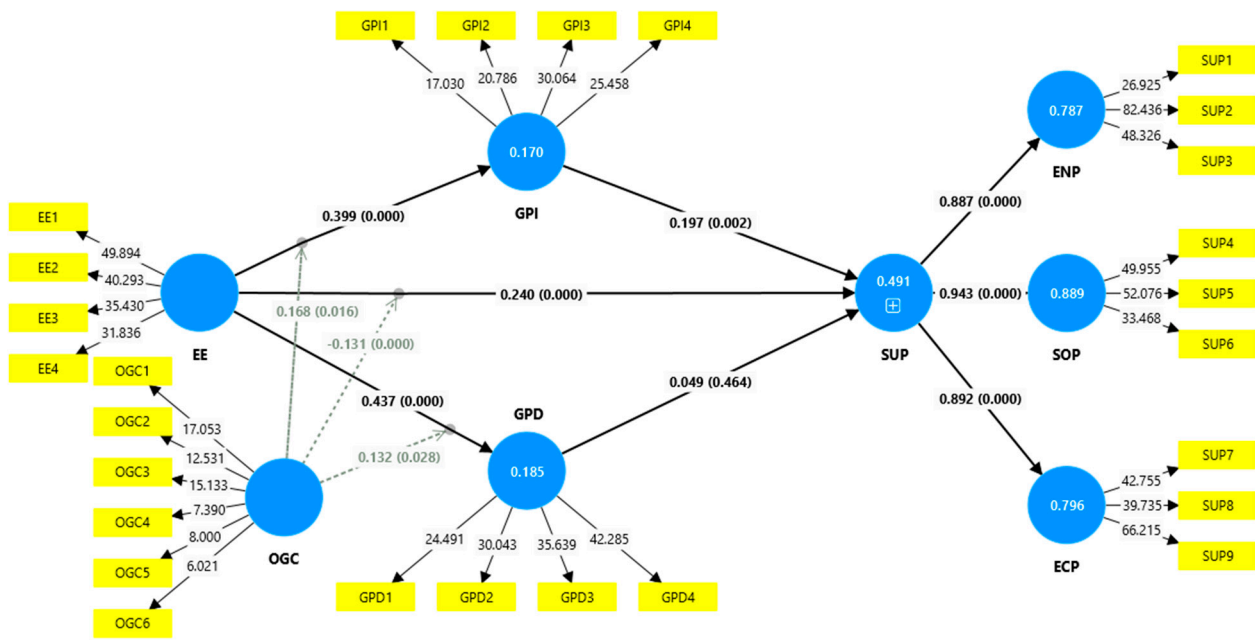


Figure 2. Structural model estimation. Note(s): Environmental Ethics (EE), Green Product Innovation (GPD), Green Process Innovation (GPI), Organizational Green Culture (OGC), Sustainable Performance (SUP).

Table 5. Direct relationship results.

Hypothesis	Path coefficient	t-Value	p-Value	Result
H1: EE → SUP	0.240	4.537	0.000	Supported
H2: EE → GPI	0.399	6.986	0.000	Supported
H3: GPI → SUP	0.197	3.169	0.002	Supported
H4: EE → GPD	0.437	6.431	0.000	Supported
H5: GPD → SUP	0.049	0.732	0.464	Not supported

Note(s): Environmental Ethics (EE), Green Product Innovation (GPD), Green Process Innovation (GPI), Sustainable Performance (SUP).

4.3. Mediation Analysis of Green Innovation

Mediation analysis aimed to determine whether green process innovation and green product innovation mediate the relationship between environmental ethics and sustainable performance. Following the method validated by [85,86], this study compared the path coefficients and the significance of the direct and indirect effects. The results presented in Table 6 show that green process innovation provided a partial mediation effect between environmental ethics and sustainable performance ($\beta = 0.079$, $t = 2.820$, $p = 0.005$), supporting H6. This indicated that environmental ethics directly and indirectly enhanced sustainable performance by fostering green process innovation. However, green product innovation did not mediate this relationship ($\beta = 0.021$, $t = 0.719$, $p = 0.472$), indicating that H7 was not supported. This suggested that while environmental ethics promoted green product innovation, the latter was not significantly related to sustainable performance within the scope of this study, potentially because of the longer timeframes needed for product innovations to impact sustainability metrics.

Table 6. Indirect and interaction relationship results.

Path	Path Coefficient	t-Value	CI 2.5%	CI 97.5%	p-Value	Result
H6: EE → GPI → SUP	0.079	2.820	0.028	0.137	0.005	Supported
H7: EE → GPD → SUP	0.021	0.719	-0.038	0.079	0.472	Not supported

H8: EE × OGC → GPI	0.168	2.412	0.025	0.297	0.016	Supported
H9: EE × OGC → SUP	-0.131	3.713	-0.197	-0.057	0.000	Supported
H10: EE × OGC → GPD	0.132	2.198	0.005	0.241	0.028	Supported

Note(s): Environmental Ethics (EE), Green Product Innovation (GPD), Green Process Innovation (GPI), Organizational Green Culture (OGC), Sustainable Performance (SUP).

4.4. Moderation Role Results of Organizational Green Culture

This study examined the moderating effects of organizational green culture on the relationships among environmental ethics, green innovation, and sustainable performance. Using the product indicator method [87–89], the PLS-SEM results in Table 6 revealed that organizational green culture positively moderated the relationship between environmental ethics and green process innovation ($\beta = 0.168$, $t = 2.412$, $p = 0.016$), supporting H8. This finding, illustrated in Figure 3, indicated that the positive relationship between environmental ethics and green process innovation was stronger for firms with a high level of green culture. This suggested that a strong green culture within an organization enhanced the effectiveness of ethical environmental practices, leading to greater innovation in green processes.

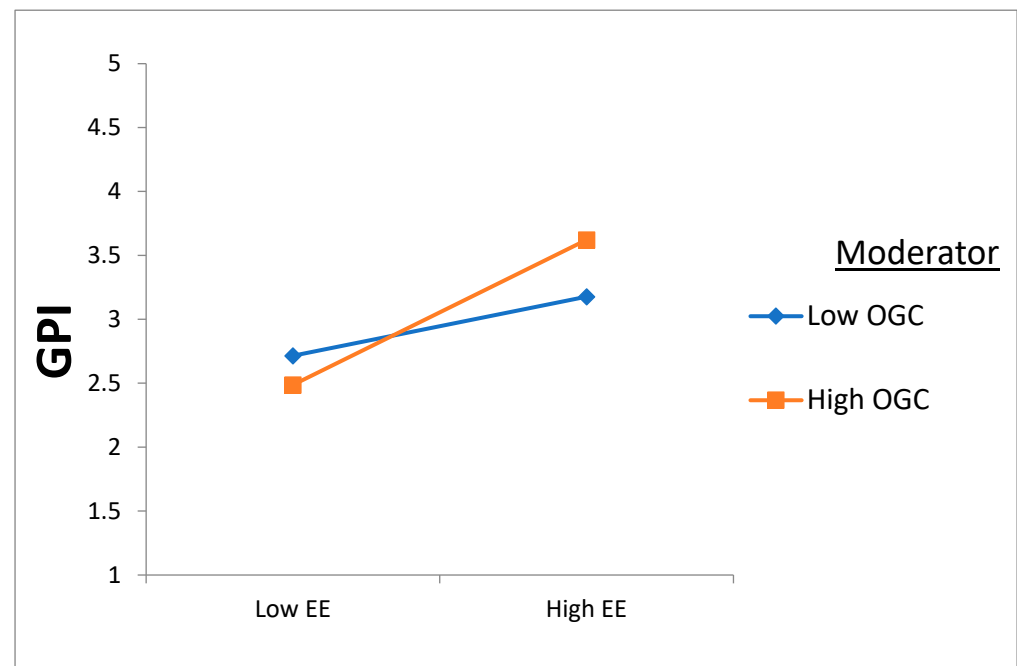


Figure 3. The interaction role of organizational green culture (OGC) in the relationship between environmental ethics (EE) and green process innovation (GPI).

Conversely, organizational green culture negatively moderated the link between environmental ethics and sustainable performance ($\beta = -0.131$, $t = 3.713$, $p = 0.000$), supporting H9. As depicted in Figure 4, this suggested that, in firms with a low level of green culture, the positive relationship between environmental ethics and sustainable performance was diminished. This counterintuitive finding might reflect the challenges faced by firms with a weak green culture in translating ethical practices into tangible sustainability outcomes, possibly because of a lack of supportive infrastructure or employee engagement.

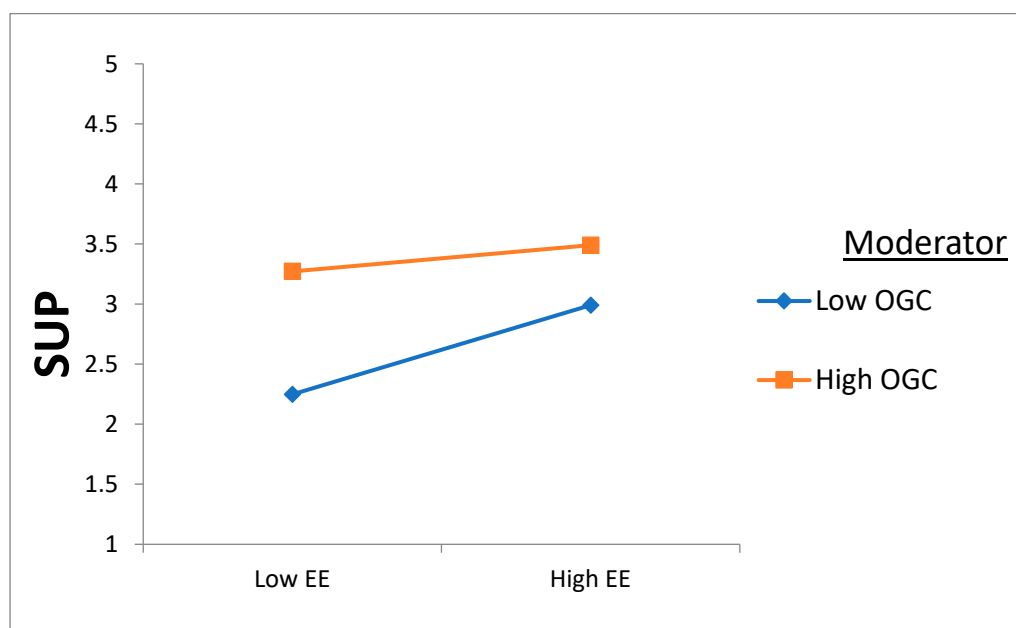


Figure 4. The interaction role of organizational green culture (OGC) in the relationship between environmental ethics (EE) and sustainable performance (SUP).

Additionally, organizational green culture positively moderated the relationship between environmental ethics and green product innovation ($\beta = 0.132$, $t = 2.198$, $p = 0.028$), supporting H10. Figure 5 illustrates that this relationship was stronger in firms with a high level of organizational green culture. This underscored the role of an ingrained green culture in fostering product innovation that aligns with environmental ethics, potentially leading to the development of eco-friendly products and sustainable business practices. Collectively, these findings underscored the critical role of organizational green culture in enhancing the effectiveness of environmental ethics in fostering green innovation and achieving sustainable performance in the manufacturing sector.

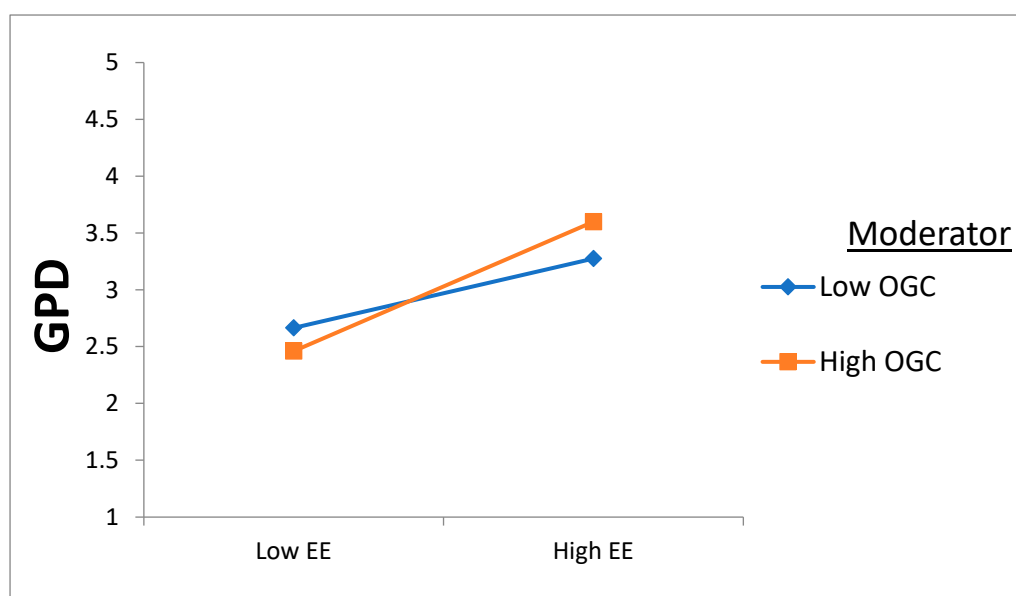


Figure 5. The interaction role of organizational green culture (OGC) in the relationship between environmental ethics (EE) and green product innovation (GPD).

5. Discussion

This study investigated the relationship between environmental ethics and sustainable performance, emphasizing the mediating roles of green process and product innovations, as well as the moderating role of organizational green culture within the Turkish manufacturing industry. The results contribute to the increasing body of literature on environmental ethics and sustainability by demonstrating how ethical business practices can enhance sustainability outcomes.

The results confirm a positive correlation between environmental ethics and sustainable performance, indicating that companies prioritizing ethical practices tend to achieve better sustainability results. This aligns with recent studies highlighting that organizational ethics, particularly environmental responsibility, significantly drives sustainable development [10]. This study supports the resource-based view framework by positioning ethical practices as internal resources that provide firms with a competitive advantage, subsequently leading to improved long-term performance. In this context, environmental ethics serves as a valuable asset, enabling firms to mitigate environmental risks, comply with regulations, and satisfy stakeholder expectations for enhanced sustainable performance [90].

The mediation investigation indicated that green process innovation significantly mediates the link between environmental ethics and sustainable performance. This finding reinforces previous research indicating that organizations adopting green process innovations, such as waste reduction, energy efficiency, and eco-friendly production methods, are better equipped to meet their sustainability goals. By embedding environmental ethics into their operational strategies, firms not only improve sustainability performance but also enhance their overall efficiency and competitiveness [90]. The positive mediating role of green process innovation suggests that companies with strong ethical foundations are more likely to support process innovation, resulting in notable improvements in both environmental and economic performance [63]. Conversely, green product innovation did not mediate the relationship between environmental ethics and sustainable performance, contradicting recent literature that emphasizes the growing importance of green product innovation in sustainability efforts [91]. This discrepancy may be attributed to the longer timeframes required for the benefits of green product innovation to materialize compared to green process innovation. Developing green products often necessitates substantial investments in research and development (R&D), longer product life cycles, and extended market adaptation periods, potentially delaying the realization of sustainability benefits [27]. Although firms may invest in green product innovation, the time required for these innovations to translate into measurable sustainability outcomes may extend beyond the scope of this study.

A significant moderating role of organizational green culture was identified, whereby firms with a strong green culture amplified the positive association of environmental ethics with both green process and product innovations. This finding supports recent research that highlights the critical role of organizational culture in fostering innovation and advancing sustainability [55]. Companies that embed green values within their organizational culture are more likely to create an environment conducive to promoting and supporting innovations aligned with ethical practices. Studies have demonstrated that a robust organizational green culture not only enhances environmental performance but also strengthens a firm's competitive advantage through innovation [92]. Notably, organizations with a weak green culture exhibited diminished relationships between environmental ethics and sustainable performance. This suggests that, without a supportive organizational culture, firms may struggle to translate their ethical commitments into tangible sustainability outcomes. The findings introduce a new perspective in the ongoing debate on the role of culture in sustainability, positing that ethical behavior alone is insufficient to achieve sustainability goals without a strong supporting green culture. In companies lacking a green culture, even well-intentioned ethical practices may fail to yield the

desired sustainability results, potentially owing to inadequate engagement, coordination, or strategic alignment [2].

This study empirically confirms the integration of environmental ethics with innovative practices to achieve sustainable performance. While previous research has often explored these concepts in isolation, this study demonstrates that ethical practices, innovation, and culture are interconnected and collaboratively drive sustainability [10]. Specifically, the mediating role of green process innovation underscores operational improvements that reduce environmental impacts while increasing organizational efficiency. Concurrently, the moderating role of organizational green culture indicates that firms with strong environmental values are better positioned to convert their ethical commitments into advantages in innovation and sustainability. To capitalize on these findings, managers should foster a robust green organizational culture while implementing ethical practices. By embedding green values within the organizational culture, firms can cultivate an environment that inspires and nurtures innovation, ultimately leading to enhanced sustainable performance. Furthermore, this research highlights the relevance of green process innovation as an efficient pathway to achieving sustainability, particularly in industries where product innovation may take longer to realize [91]. This study elaborates on the complex interactions among environmental ethics, green innovation, and sustainable performance, emphasizing the critical roles of ethical practices and organizational green culture in driving sustainability while illustrating the distinct contributions of process and product innovations within this dynamic.

6. Conclusions

6.1. Theoretical Implications

This study makes important theoretical contributions to the understanding of sustainable performance and green innovation, particularly in Turkey's manufacturing sector. By integrating environmental ethics, organizational green culture, and both green process and product innovations into a comprehensive framework, this study links ethical business practices to sustainable outcomes based on stakeholder theory and the resource-based view. This framework enhances the existing literature by highlighting the moderating role of organizational green culture and mediating role of green innovation.

The first contribution of this research is its extension of the existing knowledge regarding the link between environmental ethics and sustainable performance. Studies have primarily focused on ecological supply chains or technological innovation, emphasizing the ethical foundations necessary for firms to achieve sustainable performance [1]. This demonstrates that environmental ethics is positively associated with both green process and product innovations, thereby addressing a significant gap in the literature on ethical imperatives for sustainable innovation. This finding challenges the traditional economic perspective that profit maximization impedes sustainability, suggesting that ethical business frameworks can drive competitive advantages [4].

Additionally, this study distinguishes green process innovation and green product innovation as mediating factors in the relationship between environmental ethics and sustainable performance. Although previous research has examined the relationship between green innovation and firm performance, few studies have investigated the separate roles of process and product innovations in promoting sustainable performance [10]. This study provides empirical evidence that while both forms of innovation mediate this relationship, green process innovation has a stronger and more immediate impact on sustainable performance than green product innovation. This finding aligns with earlier research indicating that operational improvements are crucial for achieving sustainability [91].

Furthermore, this study contributes to the theoretical discourse on organizational green culture by identifying its significant moderating role in the relationship between environmental ethics, green innovation, and sustainable performance. Previous studies have suggested that corporate culture fosters sustainability; however, this research offers

robust empirical support for this claim [55]. This finding suggests that firms with a strong green culture derive greater benefits from ethical leadership. This underscores the notion that ethical behavior alone may not suffice to achieve high levels of sustainability without enabling organizational culture.

In terms of stakeholder theory, this research provides insights into the manufacturing sector in Turkey, an emerging economy facing unique challenges, such as resource constraints and environmental degradation [10]. This illustrates how stakeholder power encompassing consumers, regulators, and non-governmental organizations drives firms to adopt green innovations and align ethical practices with sustainability goals. This research broadens the application of stakeholder theory, extending its discourse from a Western context to new insights relevant to emerging markets [2]. Finally, this study enriches the resource-based view by positing that environmental ethics is a vital internal resource for firms to develop distinctive capabilities, especially in the realm of green innovation [93]. These findings support earlier studies asserting that green capabilities can confer sustained competitive advantages. By integrating the resource-based view with stakeholder theory, this study creates a holistic framework that elucidates how firms can overcome sustainability challenges while maintaining competitive market positions [24,94].

This study connects environmental ethics, green innovation, and sustainable performance, highlighting the mediating roles of both process and product innovations and the moderating role of organizational green culture. It offers new insights into how ethical practices and organizational culture can facilitate sustainability, particularly in emerging market contexts.

6.2. Practical and Managerial Implications

This study offers significant practical and managerial implications for firms seeking to enhance their sustainable performance by integrating environmental ethics, green innovation, and organizational culture. The findings emphasize the importance of focusing on green process innovation and fostering green organizational culture as essential drivers of sustainability, which is particularly relevant for managers in environmentally conscious industries.

This study highlights the necessity of embedding environmental ethics in core business strategies. Prior research indicates that prioritizing environmental ethics can enhance corporate reputation, ensure regulatory compliance, and align with the increasing consumer demand for green products [2,10]. From a managerial perspective, environmental ethics should be viewed not only as a moral obligation but also as a strategic advantage that strengthens stakeholder relationships and reduces operational risks [49]. Firms that prioritize environmental ethics can better anticipate regulatory challenges and meet the needs of eco-conscious consumers, ultimately improving their economic performance [90].

Green process innovation serves as a crucial mechanism through which environmental ethics translates into sustainable performance [27,91]. Managers are encouraged to prioritize the adoption of greener process innovations, such as energy-efficient manufacturing and waste reduction initiatives, because these innovations can decrease environmental footprints and operational costs, while enhancing efficiency. Investments in green process innovation are likely to yield long-term sustainability benefits, especially in resource-intensive industries, where substantial cost savings can be achieved [10]. While green product innovation offers significant advantages, these benefits may take longer to materialize compared to process innovation. Recent research indicates that substantial investment in R&D and extended market adaptation periods are required for successful green product development. Consequently, managers should consider green product innovation from a long-term perspective [27]. Although immediate benefits may be delayed, investing in green product innovation positions firms as leaders in sustainability, providing a competitive edge as the demand for eco-friendly products continues to grow [2].

The findings also illustrate the significant moderating role of organizational green culture on the link between environmental ethics and sustainable performance [92].

Industries with a robust organizational green culture are enhanced in order to effectively implement green innovations; as such, the culture fosters an atmosphere that is favorable to sustainable performance and innovation [55]. This highlights the importance of leadership commitment to sustainability, employee engagement in environmental initiatives, and the integration of environmental values into an organization's mission and vision. Without a supportive green culture, even the best-intentioned ethical practices may fall short of driving meaningful sustainability outcomes. Managers should focus on cultivating this culture through training programs, sustainability initiatives, and encouraging employee participation in green practices [2].

In organizations lacking a green culture, the influence of environmental ethics on sustainable performance may be limited. To address this, managers should prioritize cultural transformation by promoting sustainability initiatives at all levels and creating a framework that supports ethical practices [92]. This can be achieved through active leadership, sustainability-focused performance metrics, and clear communication regarding environmental goals. This research aligns with the United Nations Sustainable Development Goals (SDGs), particularly Goals 12 (Responsible Consumption and Production) and 13 (Climate Action). By prioritizing environmental ethics and green innovation, firms can reduce their environmental impact and support global objectives for responsible consumption and climate change. Managers can leverage these findings to enhance organizational sustainability, while contributing to broader societal goals for a sustainable future.

6.3. Limitations and Future Studies

This study contributes to the understanding of how environmental ethics and green innovation are associated with sustainable performance, moderated by organizational green culture. However, there are several limitations that open avenues for future research. First, the cross-sectional design restricts the ability to infer causality, as it captures relationships at a single point in time [77]. Future studies could adopt longitudinal designs to better understand how green innovations evolve over time and their sustained impacts on performance. Second, while this study used self-reported survey data from manufacturing firms, this approach may oversimplify the complexity of green innovation and sustainable performance, given the potential for social desirability bias in self-reported data [66]. High-quality secondary datasets, such as the Community Innovation Survey and Eurobarometer flash survey, offer rich modules for green innovations and could provide more robust insights into sustainable-led innovation practices [95–97]. Third, the theoretical model focuses on organizational green culture and green innovation but does not account for critical external factors such as regulatory frameworks, market dynamics, and stakeholder pressures, which are essential drivers of sustainability strategies [27,69]. Future research could integrate these external determinants to provide a more comprehensive view of sustainability. Finally, while this study assesses sustainable performance across environmental, social, and economic dimensions, a deeper exploration of how these dimensions interact with broader SDGs is warranted [58,73]. Advanced analytical methods, such as mixed-method approaches and machine learning, can offer nuanced insights into these complex interrelations and aid in developing innovative strategies for sustainable performance. By addressing these limitations, future research can build on these findings to offer a more holistic and actionable framework for enhancing sustainability in diverse organizational contexts.

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