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Unpacking the Complexity of Corporate Sustainability: Green Innovation's Mediating Role in Risk Management and Performance

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Abstract: This study investigates the relationships among corporate sustainability development (CSD), enterprise risk management performance (ERMP), and green innovation (GI) in the Jordanian manufacturing firms. The empirical data of 97 companies listed on the Amman Stock Exchange were gathered in a time span of three months (i.e., January 2024 to March 2024). A structural equation modeling was employed to examine these complex dynamics. The findings reveal that CSD is negatively associated with both ERMP and enterprise sustainable performance in the short term, challenging conventional wisdom. However, CSD strongly promotes GI, which in turn positively influences ERMP while negatively affecting short-term performance. GI acts as a significant mediator, positively mediating the CSD–ERMP relationship and negatively mediating the CSD–performance link. These results extend the sustainability paradox concept to emerging economies and highlight the critical role of GI in balancing sustainability initiatives with risk management and performance outcomes. The study suggests that firms may experience initial disruptions when implementing sustainability practices, but these initiatives can drive innovation within organizations. Based on these findings, this study recommends that managers in emerging economies adopt a long-term perspective when implementing sustainability initiatives and develop more flexible risk management systems. Policymakers should consider supportive frameworks to help firms navigate the tensions between sustainability, innovation, and short-term performance. Future research should employ longitudinal designs to capture the dynamic nature of these relationships and explore potential moderating factors such as firm size or industry-specific characteristics.

Keywords: green innovation; corporate sustainability development; sustainable development goals; risk management

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1. Introduction

In recent years, corporate sustainability has emerged as a critical focus for businesses worldwide, driven by increasing environmental concerns, stakeholder pressures, and regulatory requirements. This paradigm shift has brought corporate sustainability development (CSD) and enterprise risk management (ERM) to the forefront of organizational strategies, particularly in developing economies striving to balance industrial growth with environmental stewardship (Goyal et al. 2021; Mani and Wheeler 1998).

Corporate sustainability development refers to the integration of economic, environmental, and social considerations into business operations and decision-making processes (Hörisch et al. 2020; Schaltegger et al. 2016). It encompasses a wide range of initiatives aimed at reducing environmental impact, enhancing social responsibility, and ensuring long-term economic viability. Recent studies have reinforced the importance of integrating CSD into business practices. For instance, Eccles et al. (2014) found that companies with strong sustainability practices demonstrate better operational performance and are more resilient during crises. Additionally, a meta-analysis by Friede et al. (2015) revealed a positive correlation between corporate financial performance and ESG (Environmental, Social, and Governance) criteria, underscoring the business case for sustainability. These findings are further supported by recent research from (García-Sánchez et al. 2019), who demonstrated that sustainability practices contributed to improved financial performance and reduced risk in firms across various industries.

Enterprise risk management, on the other hand, is a comprehensive approach to identifying, assessing, and mitigating potential threats to an organization's objectives and operations (Bohnert et al. 2019; Bromiley et al. 2015). The integration of CSD into ERM has gained traction as organizations recognize the interconnectedness of sustainability issues and business risks. A study by Flammer and Kacperczyk (2019) found that companies integrating sustainability into their core strategies experience lower stock price crash risk, suggesting enhanced risk management capabilities. Similarly, Shahzad et al. (2020b) demonstrated that firms with robust sustainability practices are better equipped to manage environmental and social risks, leading to improved financial performance. These findings are corroborated by recent work from Amel-Zadeh and Serafeim (2018), who found that integrating ESG factors into investment decisions could lead to superior risk-adjusted returns.

In the context of developing economies, the manufacturing sector plays a crucial role in economic growth but also faces significant sustainability challenges (Awan et al. 2021). Jordan, as a case in point, has seen its manufacturing sector grappling with the dual imperatives of industrial expansion and environmental protection (Alastal et al. 2024). This context provides fertile ground for examining the intricate relationships between CSD, ERM, and emerging concepts such as GI.

GI, defined as the development and implementation of new products, processes, or services that contribute to environmental protection and sustainable resource use (Tariq et al. 2017; Ukko et al. 2019), has emerged as a potential bridge between sustainability goals and risk management strategies. Zhang et al. (2019) found that GI positively mediates the relationship between environmental regulations and firm performance, suggesting its potential role in linking sustainability practices with risk management and business outcomes. This finding is supported by recent research from Nadeem et al. (2020), who demonstrated that GI practices contribute to improved environmental performance and competitive advantage in manufacturing firms.

This study aims to examine the association between corporate sustainability development and enterprise risk management, with a particular focus on the mediating role of GI in the Jordanian manufacturing sector. By investigating this relationship, this study seeks to contribute to the growing body of literature on sustainable business practices and provide practical insights for managers in developing economies.

The significance of this study lies in its potential to bridge a critical gap in our understanding of how CSD, ERM, and GI interact in the context of developing economies, particularly within the manufacturing sector. This research addresses a pressing need identified by scholars and practitioners alike for more nuanced insights into sustainability practices in diverse economic settings (Hussain et al. 2018). The manufacturing sector in developing countries like Jordan plays a crucial role in economic growth but also faces significant sustainability challenges (Al-Ghwayeen and Abdallah 2018). By examining the interplay between CSD, ERM, and GI in this context, this study contributes to both theoretical understanding and practical application of sustainable business strategies. This is particularly important as developing economies grapple with the dual challenges of industrial growth and environmental protection (Mani and Wheeler 1998).

Moreover, while previous research has explored CSD and ERM separately, few studies have examined their integration, especially with GI as a potential mediator (Saunila et al. 2021; Zhang et al. 2019). This study addresses this research gap, offering insights that could inform more effective sustainability strategies and risk management practices. This is crucial in an era where stakeholders increasingly demand that businesses address environmental and social issues while maintaining economic viability (Eccles and Klimenko 2019; García-Sánchez et al. 2019).

Furthermore, by focusing on the Jordanian manufacturing sector, this research provides valuable insights for policymakers and business leaders in similar developing economies. As these countries seek to balance economic growth with sustainable practices, understanding the dynamics between sustainability, risk management, and innovation becomes paramount (Awan et al. 2021; Nadeem et al. 2020). The findings could inform more effective policies and business strategies that promote sustainable industrial development while mitigating associated risks.

Theoretically, this study enriches the stakeholder theory (Freeman 2010) and "Resource-Based View Theory" (RBV) (Barney 1991) through the integration of CSD, GI, and ERM. According to the stakeholder theory (Freeman 2010), businesses should disclose information and create value for all stakeholders, not just shareholders (Shohaieb et al. 2022). Recent extensions of this theory by Jones et al. (2018) to include environmental stakeholders provide a robust framework for understanding how CSD initiatives can address diverse stakeholder expectations while simultaneously mitigating risks through ERM practices. This theoretical lens allows us to explore how GI can serve as a mechanism for aligning stakeholder interests with organizational objectives in the context of sustainability and risk management (Tu and Wu 2021).

In conclusion, this study aims to contribute to the growing body of literature on sustainable business practices in developing economies, offering a nuanced perspective on the challenges and opportunities in balancing economic growth with environmental and social responsibilities. By examining the relationships between CSD, ERM, and GI in the Jordanian manufacturing sector, this study seeks to provide valuable insights for both academic research and practical application in similar economic contexts.

2. Literature Review

2.1. Theoretical Framework

The theoretical underpinnings of the conceptual model draw from several key perspectives that collectively provide a robust foundation for understanding the complex interplay between sustainability, innovation, and risk management. The stakeholder theory (Freeman 2010) informs the model's recognition that effective corporate sustainability and risk management practices must address the diverse needs and expectations of various stakeholders. The RBV theory (Barney 1991) supports the notion that sustainable competitive advantage can be achieved through the development and deployment of unique organizational resources and capabilities related to sustainability and innovation. Grounded on RBV theory, enterprise performance can be triggered by strategic resources, including competencies and green capabilities. According to environmental scholars, enterprises are significantly engrossed in sustainable development strategies when they have adequate levels of resources. This research extends the RBV theory through the interaction of CSD, GI, ERMP. Additionally, the fundamental idea of the RBV theory is based on two theories, the adaptive capability theory and the "dynamic capability (DC)" theory. The DC Theory (Teece et al. 1997) underscores the importance of organizational adaptability and flexibility in responding to changing environmental and market conditions through innovation and risk management. In other words, the DC theory posits that by leveraging internal capabilities, enterprises timely respond to the external environment and improve firm performance. Grounded in the DC theory (Teece et al. 1997), this study proposes that in Jordanian manufacturing firms, corporate sustainability initiatives foster GI capabilities, which in turn enhance an organization's capacity to manage risks and boost sustainable performance in a volatile environment.

2.2. Corporate Sustainability Development

The Brundtland Commission used the term "sustainable development" and sustainability in its report "Our Common Future" and defined it as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland et al. 1987). According to Kuhn and Deetz (Kuhn and Deetz

2008), it aims to accomplish present development while shielding the ecological and natural resources for future expansion. CSD is a useful business tactic that aims to satisfy stakeholders' demands without jeopardizing the wealth and interests of society (Dyllick and Hockerts 2002). CSD has several dimensions, such as economic prosperity, social equity, and environmental integrity (Chow and Chen 2012); these are together referred to as the "triple bottom line (TBL)" principle (Elkington 1998).

2.3. Enterprise Risk Management

According to Coso (2004), ERM refers to "a process, effected by an entity's board of directors, management and other personnel, applied in strategy setting and across the enterprise, designed to identify potential events that may affect the entity, and manage risk to be within its risk appetite, to provide reasonable assurance regarding the achievement of the entity objectives". ERM has emerged as a critical tool for managing the complex risks associated with sustainable business practices (Florio and Leoni 2017). ERM plays a pivotal role in fostering sustainable development by facilitating the identification, measurement, and management of sustainability-related risks (Shad et al. 2019).

2.4. Green Innovation

According to (Chen et al. 2006), GI refers to "hardware or software innovation that is related to green products or processes, including the innovation in technologies that are involved in energy saving, pollution-prevention, waste recycling, green product designs, or corporate environmental management". GI demonstrates all those innovative efforts in which enterprises consider eco and greener facets (Chen et al. 2012).

2.5. Hypotheses' Development

The development of research hypotheses is a crucial step in empirical studies, providing a foundation for investigating the complex relationships between corporate sustainability, risk management, and innovation. This section presents the main study hypotheses that explore the interconnections between corporate sustainability development (CSD), enterprise risk management (ERM), and GI in the context of the Jordanian manufacturing sector. By examining these relationships, this study aims to contribute to the growing body of knowledge on sustainable business practices and their impact on organizational performance and risk mitigation strategies in developing economies.

Following are the main study hypotheses:

2.5.1. Corporate Sustainability Development and Enterprise Risk Management

In today's rapidly evolving business landscape, organizations face a complex array of risks that necessitate an integrated approach to risk management (Agrawal 2016). Enterprise risk management (ERM) has become crucial for organizational resilience, particularly as public expectations for corporate responsibility and sustainability have intensified (Saardchom 2013; Tewu et al. 2024; Yang et al. 2018). The convergence of risk management and sustainability concerns has given rise to Sustainability Risk Management (SRM), which integrates sustainability agendas into corporate strategy (Wijethilake and Lama 2019). This approach not only influences financial performance but also contributes to long-term viability and competitive advantage (Eccles et al. 2014).

ERM plays a pivotal role in fostering sustainable development by facilitating the identification, measurement, and management of sustainability-related risks (Shad et al. 2019; Shah et al. 2024). The implementation of an integrated ERM framework provides an essential foundation for ensuring corporate commitments to ethical sustainability practices (Saardchom 2013; Wyma 2019).

Recent research has highlighted the positive relationship between ERM implementation and firm performance, particularly in enhancing sustainability outcomes (Florio and Leoni 2017; Syrová and Špička 2023). Companies with robust ERM systems are better positioned to identify and capitalize on sustainability-related opportunities, leading to improved financial performance and stakeholder satisfaction (Alawattegama 2018; Hoyt and Liebenberg 2011). In the context of the Jordanian manufacturing sector, where sustainability challenges intersect with economic development goals, the relationship between corporate sustainability development and enterprise risk management performance becomes particularly salient. The manufacturing industry in Jordan faces unique challenges in balancing economic growth with environmental and social responsibilities, making it an ideal setting to explore the interplay between sustainability initiatives and risk management practices (Hussain et al. 2018).

Given the growing importance of integrating sustainability into corporate strategy and the critical role of ERM in managing organizational risks, it is crucial to examine how these two areas interact, particularly in emerging economies like Jordan. This leads to the formulation of the following research hypothesis:

H0: *Corporate sustainability development significantly influences enterprise risk management performance in the Jordanian manufacturing sector.*

2.5.2. Corporate Sustainability Development and Green Innovation

Sustainability performance is a crucial metric for organizations, reflecting their ability to meet current stakeholder needs without compromising future generations (Dyllick and Hockerts 2002; Khattak et al. 2023; Moussa and Elmarzouky 2023). This concept has become increasingly intertwined with GI, which encompasses solutions at any stage of a product or service lifecycle that significantly improve resource efficiency while reducing environmental impact (Reid and Miedzinski 2008; Tariq et al. 2023).

GI extends beyond mere environmental protection, encompassing all innovations that contribute to creating new processes, products, or services that minimize ecological damage, prevent degradation, and optimize natural resource utilization (Anas et al. 2023; Leal-Millán et al. 2017). This holistic approach has gained prominence as businesses recognize the strategic importance of sustainability in maintaining competitive advantage and long-term viability.

While previous research on green innovation drivers has predominantly focused on external factors such as stakeholder pressure, environmental regulations, and market demand, there is a growing recognition of the significance of internal factors (Cao and Chen 2019; Singh et al. 2022). These internal drivers, including environmental ethics, organizational culture, and environmental orientation, play a crucial role in shaping an enterprise's commitment to GI (Abbas and Khan 2023; Baah et al. 2024; Jahanger et al. 2024).

In the process of green management, an organization's internal stakeholders increase the allocation of resources towards green products, processes, and services. This shift not only coordinates heterogeneous resources but also strengthens environmental willingness, facilitating the integration of organizational resources and reducing the environmental impact of processes and outputs (Chen et al. 2014; Daily and Huang 2001). Recent studies have highlighted the symbiotic relationship between corporate sustainability development and GI (Hao and Fu 2023; Yang et al. 2024). For instance, Dangelico et al. (2017) found that companies with robust sustainability practices were more likely to engage in and benefit from GI initiatives. Similarly, (Negi et al. 2019) demonstrated that sustainability-oriented organizational cultures fostered environments conducive to GI, leading to improved environmental and financial performance. In the context of the Jordanian manufacturing sector, where balancing economic growth with environmental responsibility is increasingly critical, the relationship between corporate sustainability development and GI becomes particularly relevant (Al-Ghwayeen and Abdallah 2018). This sector faces unique challenges and opportunities in implementing sustainable practices and driving GI, making it an ideal setting to explore this relationship. A recent study conducted by Le et al. (2024), found that CSD significantly contributed to GI. Similarly, in an emerging economy context, Liu and Yan (2018), by conducting a qualitative study, describe that corporate sustainability play a crucial role in GI.

Given the growing importance of integrating sustainability into corporate strategy and the potential of GI to drive both environmental and economic benefits, it is crucial to examine how these two areas interact, particularly in emerging economies like Jordan. This leads to the formulation of the research hypothesis:

H1: *Corporate sustainability development significantly influences green innovation in the Jordanian manufacturing sector.*

2.5.3. Green Innovation and Enterprise Risk Management

In recent years, innovation has garnered significant attention from researchers and business leaders alike, with GI emerging as a crucial strategic tool for resource sustainability and environmental stewardship (Elzek et al. 2021; Shahzad et al. 2021). Concurrently, enterprise risk management (ERM) has gained prominence as a response to rapid globalization and increased regulatory pressure on organizations to manage risk holistically (Florio and Leoni 2017; Shad et al. 2019). The importance of ERM has dramatically increased due to a series of corporate fraud cases, financial scandals, growing risk complexity, and heightened scrutiny from regulatory bodies (Keith 2014). ERM is designed to minimize direct and indirect costs associated with financial distress, earnings volatility, and negative shocks in financial markets. Moreover, it aims to enhance the decision-making process, enabling firms to select optimal investment opportunities and effectively manage various types of operational and non-operational risks (Yang et al. 2018).

The intersection of GI and ERM is particularly relevant in today's business landscape (Mukhtar et al. 2023). As organizations strive to innovate sustainably, they must also navigate the associated risks and opportunities. GI can potentially mitigate certain risks by improving resource efficiency and reducing environmental impacts (Aydin and Degirmenci 2024; Sun et al. 2023), but it may also introduce new risks related to technology adoption and market acceptance (Zhu et al. 2023).

Recent studies have highlighted the potential synergies between GI and effective risk management. For instance, Aftab et al. (2023) found that firms engaging in GI practices tended to have more robust risk management systems, as the process of developing eco-friendly solutions often involved comprehensive risk assessment and mitigation strategies. Similarly, Mukhtar et al. (2023) demonstrated that companies with strong ERM practices were more likely to successfully implement and benefit from GI. However, it is crucial to note that unsustainable behaviors can generate potential business risks, damaging an organization's reputation and potentially leading to its downfall (Zhou and Jin 2023). This underscores the importance of aligning GI initiatives with comprehensive risk management strategies to ensure long-term sustainability and resilience. In the context of the Jordanian manufacturing sector, where balancing economic growth with environmental responsibility is increasingly critical, the relationship between GI and enterprise risk management becomes particularly salient (Abdallah and Al-Ghwayeen 2020; Jum'a et al. 2021). This sector faces unique challenges and opportunities in implementing GI while effectively managing associated risks, making it an ideal setting to explore this relationship. Recent studies found that enterprises who opted for greener practices in their business operations could effectively manage the business operational risk (Al-Nimer 2023; Dahlan and Nurhayati 2022).

Given the growing importance of both GI and enterprise risk management in driving sustainable business practices, it is crucial to examine how these two areas interact, particularly in emerging economies like Jordan. This leads to the formulation of the following research hypothesis:

H2: *Green innovation significantly influences enterprise risk management performance in the Jordanian manufacturing sector.*

2.5.4. Corporate Sustainability Development, Enterprise Risk Performance, and Green Innovation

The integration of corporate sustainability development, enterprise risk management (ERM), and GI has become increasingly crucial in today's business landscape. Recent research suggests that these three elements are interconnected and mutually reinforcing (Al-Nimer 2023; Dahlan and Nurhayati 2022). Corporate sustainability, encompassing economic, environmental, and social dimensions, has evolved from a peripheral concern to a core strategic imperative (Montiel and Delgado-Ceballos 2014; Moussa and Elmarzouky 2024; Schaltegger et al. 2022). Concurrently, ERM has emerged as a critical tool for managing the complex risks associated with sustainable business practices (Florio and Leoni 2017; Schulte and Hallstedt 2018). GI, in turn, has been recognized as a key driver of both sustainability performance and competitive advantage (Shahzad et al. 2020a; Wang 2019).

The relationship between these constructs is multifaceted. Corporate sustainability initiatives can stimulate GI efforts (Fosu et al. 2024; Hao and Fu 2023; Liu and Yan 2018), which inherently involve managing new risks and uncertainties (Farooq et al. 2024). Simultaneously, effective risk management can create an environment conducive to sustainable innovation by mitigating potential threats and identifying opportunities (Choi and Lee 2009; Sun et al. 2020). In the context of emerging economies, particularly in the manufacturing sector, the interplay between these elements becomes even more critical. Companies in these markets face unique challenges in balancing economic growth with environmental and social responsibilities (Abdallah et al. 2024; Al-Ghwayeen and Abdallah 2018; Singh et al. 2023). The Jordanian manufacturing sector, for instance, provides an ideal setting to explore these dynamics due to its ongoing efforts to integrate sustainability practices while managing associated risks and driving innovation (Al-Sa'di et al. 2017; Ayoub et al. 2017).

Building on these insights, this study proposes that GI may play a mediating role in the relationship between corporate sustainability development and enterprise risk management. This proposition is grounded in the following logic: corporate sustainability initiatives can drive GI efforts, which in turn necessitate more sophisticated risk management practices to address the uncertainties associated with new technologies and processes. These enhanced risk management capabilities can then feedback into more effective sustainability strategies, creating a virtuous cycle.

Based on this theoretical framework, the following hypothesis is formulated:

H3: *The association between corporate sustainability development and enterprise risk management is mediated by green innovation in the Jordanian manufacturing sector.*

3. Research Model

The proposed research model (see Figure 1) integrates CSD, ERMP, and GI within the context of the Jordanian manufacturing sector, building upon and extending recent scholarly work on sustainability, risk management, and innovation in emerging economies (Al-Ghwayeen and Abdallah 2018; Hussain et al. 2018; Morioka et al. 2022). This conceptual framework positions CSD as the independent variable, recognizing its pivotal role in shaping organizational strategy and performance in today's business landscape. ERMP serves as the dependent variable, reflecting the growing significance of integrated risk management approaches in sustainable business practices. GI is introduced as a mediating variable, acknowledging its potential to influence the relationship between sustainability initiatives and risk management outcomes.

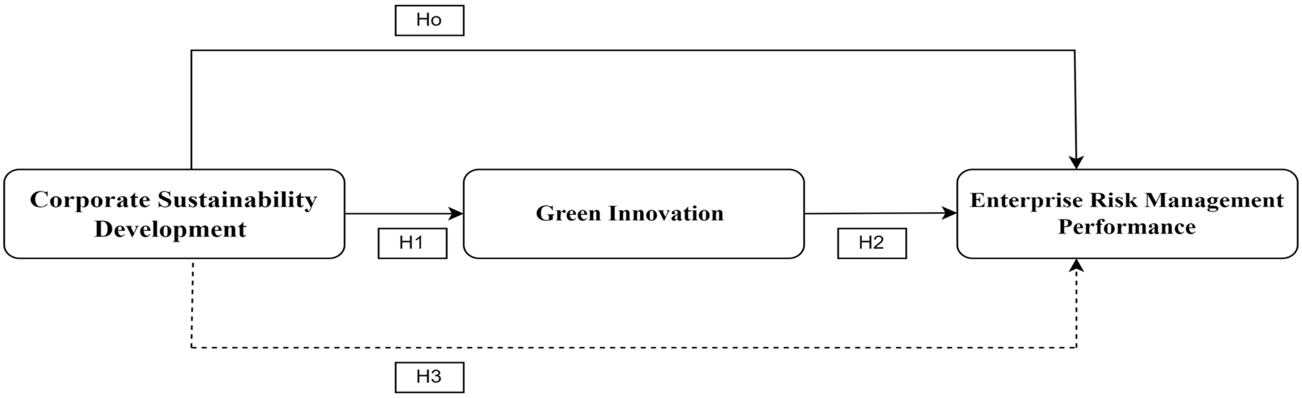

Figure 1. Conceptual model of the study.

4. Materials and Methods

This study employs a quantitative approach to examine the relationships between corporate sustainability development (CSD), enterprise risk management performance (ERMP), and GI in the Jordanian business context. The Jordanian manufacturing firms are designated as a context for this research because the manufacturing industry in Jordan faces unique challenges in balancing economic growth with environmental and social responsibilities, making it an ideal setting to explore the interplay between sustainability initiatives and risk management practices. This study utilize a cross-sectional survey design to capture these complex relationships at a specific point in time (Rindfleisch et al. 2008).

4.1. Sample and Population

The sampling frame comprised companies listed on the Amman Stock Exchange as of 31 December 2023. The population consisted of 233 manufacturing companies. This study employed a stratified random sampling technique to ensure proportional representation across sectors (Taherdoost 2020). Sample size was determined using a G power analysis, targeting a minimum detectable effect size of 0.3 at $\alpha = 0.05$ and power = 0.8, resulting in a required sample of 158 firms (Buchner et al. 2017).

Data collection was conducted via a structured questionnaire using the Qualtrics XM platform. Following Dillman's tailored design method (Dillman et al. 2014), this study implemented a four-wave contact strategy over a 10-week period. Of the 233 companies contacted, we received 97 responses in a three-month time period from January 2024 to March 2024, yielding a response rate of 41.63%. The sectoral breakdown of responses is presented in Table 1.

This distribution aligns with the evolving structure of the Jordanian economy, which has experienced a shift towards service-oriented industries in recent years. The substantial representation of manufacturing firms is noteworthy, given the sector's critical role in sustainability practices and environmental management (Rashid et al. 2024). Recent research by Hossain et al. (2022) suggests that manufacturing sectors in emerging economies often exhibit different patterns in adopting sustainability practices, with manufacturing firms typically facing more stringent environmental regulations and stakeholder pressures. This sectoral diversity in the sample allows for a nuanced examination of how industry-specific factors may influence the relationships between corporate sustainability development, enterprise risk management, and GI.

The age profile, with 69.1% of firms operating for 15 years or less, indicates a relatively young corporate landscape. The predominance of companies with narrower product ranges (80.5% offering 10 or fewer products/services) may indicate a trend towards specialization or reflect resource constraints faced by firms in developing economies. Small- and medium-sized enterprises (SMEs) were prevalent in the sample, with 68.1% of firms employing 150 or fewer staff. The sample included firms with 50–450 employees and ages ranging from less than 10 years to more than 25 years. Table 1 provides a detailed breakdown of the sample characteristics.

Table 1. Sample characteristics.

	Frequency	**Percentage**
Age:		
1. Less than 10 years	42	43.29%
2. 10–15 years	25	25.77%
3. 16–20 years	18	18.55%
4. 21–25 years	9	9.27%
5. More than 25 years	3	3.09%
Products/Services:		
1. 4 products/services	44	45.36%
2. 5–10	34	35.05%
3. 11–20	15	15.46%
4. 21–40	4	4.12%
5. 41 or more	0	0%
Number of employees:		
1. Less than 50	47	48.45%
2. 50–150	19	19.58%
3. 151–300	21	21.64%
4. 301–450	10	10.3%
5. More than 450	0	0%

4.2. Measures

All multi-item constructs were measured using 7-point Likert scales (1 = strongly disagree to 7 = strongly agree). The survey instrument was developed in English and translated into Arabic using a back-translation procedure to ensure conceptual equivalence (Brislin 1980).

4.2.1. Corporate Sustainability Development (CSD)

CSD was operationalized using a 17-item scale adapted from the Global Reporting Initiative Standards (Initiative 2021) and recent literature, encompassing economic, environmental, and social dimensions. We incorporated five items from the sustainability practices indicator (Imran et al. 2018) to measure the overall focus of the organization on sustainability practices and principles. Additionally, we included sustainable competitive advantage indicators adopted from de Guimarães et al. (2018), such as having an advantage in environmental care, a focus on green initiatives, and social responsibility compared to competitors.

4.2.2. Enterprise Risk Management Performance (ERMP)

ERMP was assessed by using a 9-item scale adapted from prior studies (Al-Nimer et al. 2021; Rehman and Anwar 2019). We measured ERMP on a five-item Likert scale.

4.2.3. Green Innovation (GI)

GI was measured using a 15-item scale adapted from recent studies, comprising green product, process, and organizational and technological innovation dimensions. We incorporated a five-item Likert scale from (Kraus et al. 2020).

4.2.4. Control Variables

Control variables are used to reduce spurious results. We included several firm-level control variables: firm size (log of total assets), firm age, industry sector (dummy-coded), number of products/services, and number of employees. When analyzing the sustainability outcomes of enterprises, Previous researchers have suggested that firm-level variables should be incorporated as control variables in the model. Firm-level factors play a crucial role in the enterprise's sustainable performance and risk management practices (Anwar et al. 2020; Rehman and Anwar 2019; Ullah et al. 2024; Yang et al. 2018).

5. Data Analysis and Results

The analytical approach began with preliminary analyses using IBM SPSS 29.0, including data screening for outliers, normality, and multicollinearity, as well as an exploratory factor analysis. Harman's single-factor test was conducted to check for common method bias (Podsakoff et al. 2003). Subsequently, a Confirmatory Factor Analysis was employed using PLS 4.0 to assess the validity and reliability of measures, evaluating model fit using multiple indices: χ^2/df, CFI, TLI, RMSEA, and SRMR (Hair et al. 2022). Hypothesis testing was conducted using structural equation modeling with maximum likelihood estimation in PLS 4.0. PLS-SEM was used due to several significant reasons. PLS-SEM enhances the validation of outcomes through different kinds of validity and reliability. Moreover, it separates measurement errors from the items and improves the accuracy of outcomes. Additionally, it is more suitable for mediation analysis and for non-normal empirical data sets.

5.1. Descriptive Statistics

The descriptive statistics (mean and standard deviation) of the main constructs are presented in Table 2 and Figure 2. The descriptive results indicate that enterprise sustainable performance had the highest mean score (3.3052) and enterprise risk management had the lowest mean score (2.33222). As regarding standard deviation, corporate development sustainability had the highest value (0.42098), while GI had the lowest score (0.32290). Additionally, the data normality assumption was corroborated by skewness and kurtosis scores (less than +/−2), as suggested by (Wooldridge 2009).

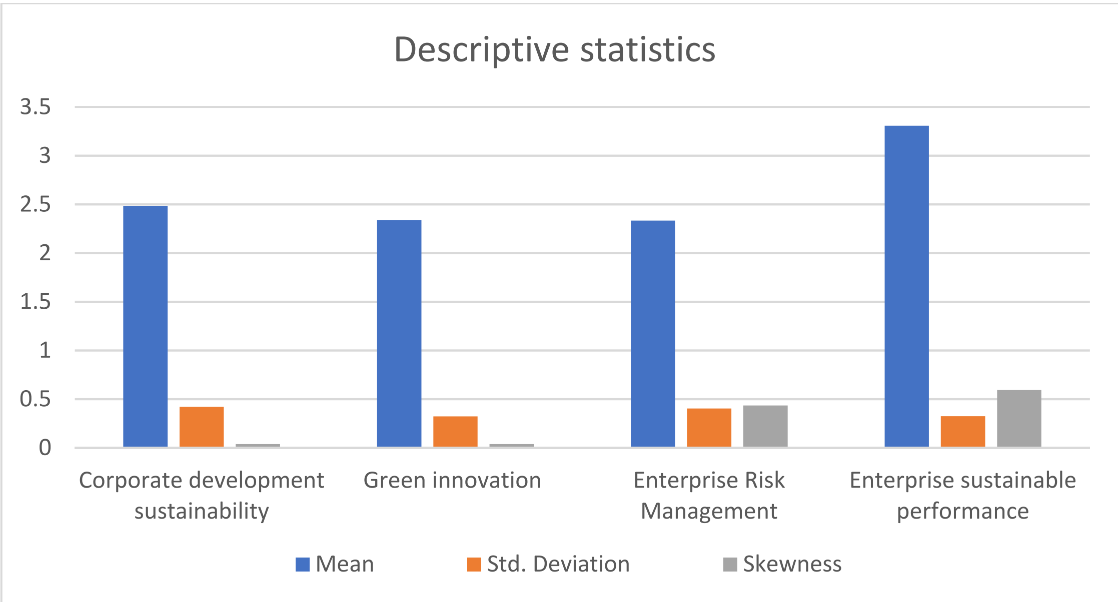

Figure 2. Descriptive statistics.

Table 2. Descriptive statistics.

	Mean	Std. Deviation	Skewness	Kurtosis
Corporate development sustainability	2.4834	0.42098	0.038	−1.004
Green innovation	2.3391	0.32290	0.038	−0.791
Enterprise risk management	2.3322	0.40429	0.435	−1.017
Enterprise sustainable performance	3.3052	0.32448	0.594	−0.099

5.2. Correlation Coefficients

This study used a Pearson correlation analysis (see Table 3) to examine the intricate relationships among the main constructs of the study. The correlation matrix demonstrated that corporate development sustainability significantly positively related to green process innovation (r = 0.835, $p < 0.01$), green organizational innovation (r = 0.590, $p < 0.01$), green product innovation (r = 0.889, $p < 0.01$), green technological innovation (r = 0.939, $p < 0.01$), and enterprise risk management (r = 0.673, $p < 0.01$). Similarly, green process innovation (r = 0.607, $p < 0.01$), green organizational innovation (r = 0.927, $p < 0.01$), green product innovation (r = 0.564, $p < 0.01$), and green technological innovation (r = 0.853, $p < 0.01$) were significantly associated with enterprise risk management.

Table 3. Correlation matrix.

	1	2	3	4	5	6	7	8	9	10	11	12
1. Business type	1											
2. Company age	0.211 *	1										
3. Product range	0.393 **	0.845 **	1									
4. No. of employees	0.408 **	0.862 **	0.823 **	1								
5. Green process innovation	−0.469 **	−0.721 **	−0.780 **	−0.814 **	1							
6. Green organizational innovation	0.161	−0.653 **	−0.545 **	−0.545 **	0.643 **	1						
7. Green product innovation	−0.696 **	−0.566 **	−0.720 **	−0.630 **	0.812 **	0.469 **	1					
8. Green technological innovation	−0.253 *	−0.786 **	−0.791 **	−0.753 **	0.856 **	0.800 **	0.815 **	1				
9. Corporate development sustainability	−0.498 **	−0.756 **	−0.811 **	−0.753 **	0.835 **	0.590 **	0.889 **	0.929 **	1			
10. Enterprise risk management	0.114	−0.622 **	−0.572 **	−0.460 **	0.607 **	0.927 **	0.564 **	0.853 **	0.673 **	1		
11. Financial performance	0.169	0.821 **	0.772 **	0.683 **	−0.730 **	−0.742 **	−0.714 **	−0.931 **	−0.874 **	−0.825 **	1	
12. Non-financial performance	0.561 **	0.583 **	0.685 **	0.650 **	−0.636 **	−0.531 **	−0.718 **	−0.593 **	−0.618 **	−0.507 **	0.507 **	1

**: Correlation is significant at the 0.01 level (2-tailed). *: Correlation is significant at the 0.05 level (2-tailed).

5.3. Multi-Collinearity Statistics: Assessing Model

In partial least squares structural equation modeling (PLS-SEM), assessing multi-collinearity is crucial for ensuring the stability and reliability of the model. The Variance Inflation Factor (VIF) is a widely accepted metric for evaluating the degree of collinearity among predictor variables (Hair et al. 2019). This study employed the VIF analysis to examine the potential presence of multi-collinearity in the PLS-SEM model. Hair et al. (2019) suggests that VIF values of five or greater indicate potential collinearity concerns. This threshold is widely accepted in the field of management research. It is important to note that VIF is calculated as the reciprocal of tolerance (1/Tolerance), implying that VIF values are always greater than or equal to 1. The absence of multi-collinearity would result in a VIF value of one, while increasing values indicate higher degrees of collinearity. The maximum VIF (see Table 4) value observed in the model was 4.969, which falls below the commonly accepted threshold of 5 proposed by (Hair et al. 2019). This indicates that multi-collinearity was not a significant concern in the model, supporting the statistical validity of the PLS-SEM analysis.

Table 4. Multi-collinearity statistics.

	1	2	3	4	5	6
Corporate development sustainability		4.969	4.969		1.000	
Enterprise sustainable performance				1.000		1.000
Enterprises risk management						
Financial performance						
Green innovation		4.969	4.969			
Non-financial performance						

Note: 1 = corporate development sustainability, 2 = enterprise sustainable performance, 3 = enterprise risk management, 4 = financial performance, 5 = green innovation, 6 = non-financial performance.

5.4. Validity and Reliability Analysis

Convergent Validity

To assess the validity and reliability of the constructs, a series of analyses were conducted using the partial least squares structural equation modeling (PLS-SEM) algorithm technique with 5000 subsamples. Validity refers to the extent to which a scale accurately measures the intended construct (Hair et al. 2022). Construct validity encompasses both convergent and discriminant validity, which can be evaluated using established threshold values (Sarstedt et al. 2022). Convergent validity, a crucial aspect of construct validity, assesses the degree to which multiple measures of the same construct are in agreement (Henseler et al. 2015). In PLS-SEM, convergent validity is typically evaluated using two key criteria: factor loadings and average variance extracted (AVE). According to the recent literature, acceptable thresholds for these criteria are factor loadings >0.70 and AVE > 0.50 (Henseler et al. 2015). To achieve satisfactory factor loadings, multiple iterations of the PLS algorithm were performed. This process resulted in the removal of several items due to factor loadings below the 0.70 threshold: Corporate development sustainability (CDS): three items removed (CDS3 = 0.317, CDS6 = 0.663, CDS9 = 0.674). The removal of items with low factor loadings is a common practice in PLS-SEM to improve model fit and construct validity (Hair et al. 2022). However, it is important to note that the removal of items should be done cautiously, considering both statistical criteria and theoretical implications (Ringle et al. 2020). After removing these items, the PLS algorithm was re-run, resulting in factor loadings for the remaining items meeting or exceeding the 0.70 threshold, as shown in Table 5.

Table 5. Factor loadings.

	Corporate Development Sustainability	Enterprises Risk Management	Financial Performance	Green Innovation	Non-Financial Performance
CDS1	0.858				
CDS2	0.890				
CDS4	0.901				
CDS5	0.867				
CDS7	0.896				
CDS8	0.769				
ERM2		0.890			
ERM3		0.824			
ERM4		0.855			
ERM5		0.846			
ERM7		0.744			
ERM8		0.729			
ERM9		0.872			
ERN6		0.856			
FP1			0.722		
FP2			0.920		
FP3			0.792		
FP6			0.911		

Table 5. *Cont.*

	Corporate Development Sustainability	Enterprises Risk Management	Financial Performance	Green Innovation	Non-Financial Performance
GOI2				0.707	
GOI3				0.782	
GOI5				0.723	
GOI6				0.761	
GPI1				0.837	
GPI2				0.866	
GPI3				0.727	
GPI8				0.725	
GPPI1				0.874	
GPPI2				0.754	
GPPI3				0.782	
GPPI4				0.749	
GPPI6				0.827	
GPPI8				0.884	
GTI1				0.723	
GTI2				0.771	
GTI3				0.728	
GTI4				0.778	
GTI5				0.775	
GTI7				0.793	
GTI9				0.811	
NFP1					0.844
NFP2					0.755
NFP3					0.821
NFP4					0.861

GOI9 = 0.265.

The second critical component of convergent validity is the average variance extracted (AVE) (Hair et al. 2022; Schaltegger et al. 2022). The AVE represents the amount of variance captured by a construct in relation to the variance due to measurement error (Fornell and Larcker 1981). According to established guidelines, the AVE for each latent construct should exceed 0.50 to demonstrate adequate convergent validity. Table 6 presents the AVE values for all latent constructs in the study. The results indicate that all constructs met or exceeded the recommended threshold of 0.50, providing strong evidence of convergent validity. Specifically, the AVE values for each construct were as shown in Table 6.

Table 6. Average variance extracted (AVE).

	Average Variance Extracted (AVE)
Corporate development sustainability	0.748
Enterprise sustainable performance	0.540
Enterprises risk management	0.687
Financial performance	0.707
Green innovation	0.586
Non-financial performance	0.674

5.5. Discriminant Validity

Discriminant validity is a crucial aspect of construct validity that assesses the extent to which constructs that are theoretically distinct are indeed unrelated in the measurement model (Hair et al. 2022). It ensures that a construct is truly distinct from other constructs by empirical standards, thereby establishing the uniqueness of each construct in capturing phenomena not represented by other constructs in the model. In this study, discriminant validity was evaluated using two primary methods: cross-loadings' examination and the Fornell–Larcker criterion. These methods are widely accepted in the literature and provide complementary evidence of discriminant validity (Henseler et al. 2015).

5.6. Cross-Loadings' Examination

The cross-loading approach posits that an indicator's loading on its assigned construct should be higher than its loadings on all other constructs (Hair and Alamer 2022). Table 7 presents the cross-loadings' matrix, which demonstrates that each indicator loaded most strongly on its associated construct, providing initial evidence of discriminant validity.

For instance, the indicators for corporate development sustainability (CDS1-CDS8) showed consistently higher loadings on their intended construct (ranging from 0.769 to 0.901) compared to their loadings on other constructs. This pattern was observed across all constructs, supporting the discriminant validity of the measurement model.

Table 7. Cross-loadings.

	Corporate Development Sustainability	Enterprise Sustainable Performance	Enterprises Risk Management	Financial Performance	Green Innovation	Non-Financial Performance
CDS1	0.858	−0.646	0.403	−0.655	0.726	−0.471
CDS2	0.890	−0.695	0.420	−0.708	0.703	−0.505
CDS4	0.901	−0.700	0.484	−0.647	0.802	−0.582
CDS5	0.867	−0.751	0.746	−0.822	0.883	−0.478
CDS7	0.896	−0.842	0.668	−0.797	0.840	−0.683
CDS8	0.769	−0.624	0.292	−0.408	0.628	−0.706
ERM2	0.462	−0.677	0.890	−0.639	0.676	−0.558
ERM3	0.453	−0.538	0.824	−0.615	0.749	−0.319
ERM4	0.653	−0.715	0.855	−0.825	0.746	−0.415
ERM5	0.443	−0.552	0.846	−0.556	0.753	−0.409
ERM7	0.402	−0.552	0.744	−0.728	0.584	−0.222
ERM8	0.839	−0.693	0.729	−0.811	0.856	−0.378
ERM9	0.361	−0.674	0.872	−0.668	0.603	−0.527
ERN6	0.399	−0.728	0.856	−0.690	0.622	−0.605
FP1	−0.582	0.735	−0.501	0.722	−0.585	0.584
FP2	−0.672	0.788	−0.790	0.920	−0.741	0.447
FP3	−0.799	0.740	−0.654	0.792	−0.862	0.489
FP6	−0.615	0.762	−0.816	0.911	−0.723	0.409
GOI2	0.469	−0.641	0.657	−0.534	0.707	−0.607
GOI3	0.564	−0.675	0.870	−0.631	0.782	−0.560
GOI5	0.406	−0.526	0.792	−0.520	0.723	−0.401
GOI6	0.676	−0.785	0.758	−0.889	0.761	−0.476
GPI1	0.677	−0.632	0.746	−0.755	0.837	−0.330
GPI2	0.724	−0.695	0.812	−0.751	0.866	−0.459
GPI3	0.510	−0.493	0.669	−0.556	0.727	−0.293
GPI8	0.470	−0.642	0.708	−0.539	0.725	−0.603
GPPI1	0.925	−0.776	0.617	−0.758	0.874	−0.599
GPPI2	0.452	−0.566	0.853	−0.571	0.754	−0.418
GPPI3	0.884	−0.701	0.456	−0.621	0.782	−0.613
GPPI4	0.804	−0.728	0.405	−0.537	0.749	−0.764
GPPI6	0.906	−0.701	0.528	−0.687	0.827	−0.538
GPPI8	0.892	−0.766	0.676	−0.807	0.884	−0.523
GTI1	0.802	−0.744	0.505	−0.775	0.723	−0.527
GTI2	0.867	−0.787	0.559	−0.708	0.771	−0.683
GTI3	0.424	−0.525	0.788	−0.528	0.728	−0.390
GTI4	0.733	−0.705	0.669	−0.784	0.778	−0.436
GTI5	0.887	−0.691	0.495	−0.713	0.775	−0.491
GTI7	0.584	−0.719	0.859	−0.652	0.793	−0.621
GTI9	0.727	−0.678	0.643	−0.782	0.811	−0.391
NFP1	−0.502	0.651	−0.353	0.342	−0.454	0.844
NFP2	−0.449	0.681	−0.376	0.479	−0.464	0.755
NFP3	−0.402	0.755	−0.548	0.545	−0.558	0.821
NFP4	−0.785	0.758	−0.407	0.500	−0.645	0.861

Fornell–Larcker Criterion

The Fornell–Larcker criterion offers a more stringent assessment of discriminant validity (Fornell and Larcker 1981). This approach compares the square root of each construct's average variance extracted (AVE) with its correlations with other constructs. Discriminant validity is established when the square root of a construct's AVE exceeds its correlation with any other construct (Hair and Alamer 2022). Table 8 presents the Fornell–Larcker criterion results. The diagonal elements (in bold) represent the square root of the AVE for each construct, while off-diagonal elements are the correlations between constructs. The results in Table 8 demonstrate that the square root of the AVE for each construct was greater than its correlations with other constructs, further confirming discriminant validity. For example, corporate development sustainability had a $\sqrt{AVE}$ of 0.865, which was higher than its correlations with other constructs (ranging from −0.828 to 0.894 in absolute values).

Table 8. Fornell–Larcker Criterion.

	1	2	3	4	5	6
Corporate Development Sustainability	0.865					
Enterprise sustainable performance	−0.828	0.735				
Enterprises Risk Management	0.604	−0.769	0.829			
Financial Performance	−0.795	0.903	−0.826	0.841		
Green Innovation	0.894	−0.869	0.849	−0.868	0.766	
Non-Financial performance	−0.656	0.870	−0.517	0.573	−0.652	0.821

Note: 1 = corporate development sustainability, 2 = enterprise sustainable performance, 3 = enterprise risk management, 4 = financial performance, 5 = green innovation, 6 = non-financial performance.

5.7. Construct Reliability

Construct reliability is a crucial aspect of measurement model evaluation, assessing the internal consistency and stability of the measures (Hair and Alamer 2022). In this study, two primary indicators of construct reliability were employed: Cronbach's alpha and composite reliability.

5.7.1. Cronbach's Alpha

Cronbach's alpha is a widely used measure of internal consistency, reflecting the degree to which a set of items consistently measures the same construct. Traditionally, an alpha value greater than 0.70 has been considered acceptable (Hair and Alamer 2022).

5.7.2. Composite Reliability

Composite reliability (CR) offers an alternative measure of internal consistency that addresses some limitations of Cronbach's alpha, particularly its sensitivity to the number of items in the scale (Hair and Alamer 2022). CR values above 0.70 are generally considered acceptable, indicating good internal consistency (Fornell and Larcker 1981). Table 9 presents the Cronbach's alpha and composite reliability values for all constructs in the study. The results demonstrate strong internal consistency across all constructs. Cronbach's alpha values ranged from 0.838 to 0.965, while composite reliability values ranged from 0.892 to 0.968, all exceeding the recommended threshold of 0.70

Table 9. Cronbach's alpha and composite reliability.

	Cronbach's Alpha	Composite Reliability
Corporate development sustainability	0.932	0.947
Enterprise sustainable performance	0.878	0.904
Enterprises risk management	0.934	0.946
Financial performance	0.857	0.905
Green innovation	0.965	0.968
Non-financial performance	0.838	0.892

5.8. Structural Equation Modeling (SEM)

To test the hypothesized relationships among constructs, this study employed partial least squares structural equation modeling (PLS-SEM), a variance-based approach that is particularly suitable for complex models and exploratory research (Hair and Alamer 2022).

The PLS-SEM algorithm was used to estimate the model parameters, followed by a bootstrapping procedure to assess the statistical significance of the path coefficients. The PLS-SEM approach, combined with bootstrapping, offered a robust framework for testing the hypothesized relationships, allowing for a nuanced interpretation of both the statistical and practical significance of the findings.

5.9. Direct Effects

The structural model (see Figure 3) results, presented in Table 10, elucidate the complex interrelationships among corporate development sustainability, enterprise sustainable performance, enterprise risk management, and GI in Jordanian manufacturing industries. These findings offer nuanced insights into the multifaceted nature of sustainability implementation in industrial contexts.

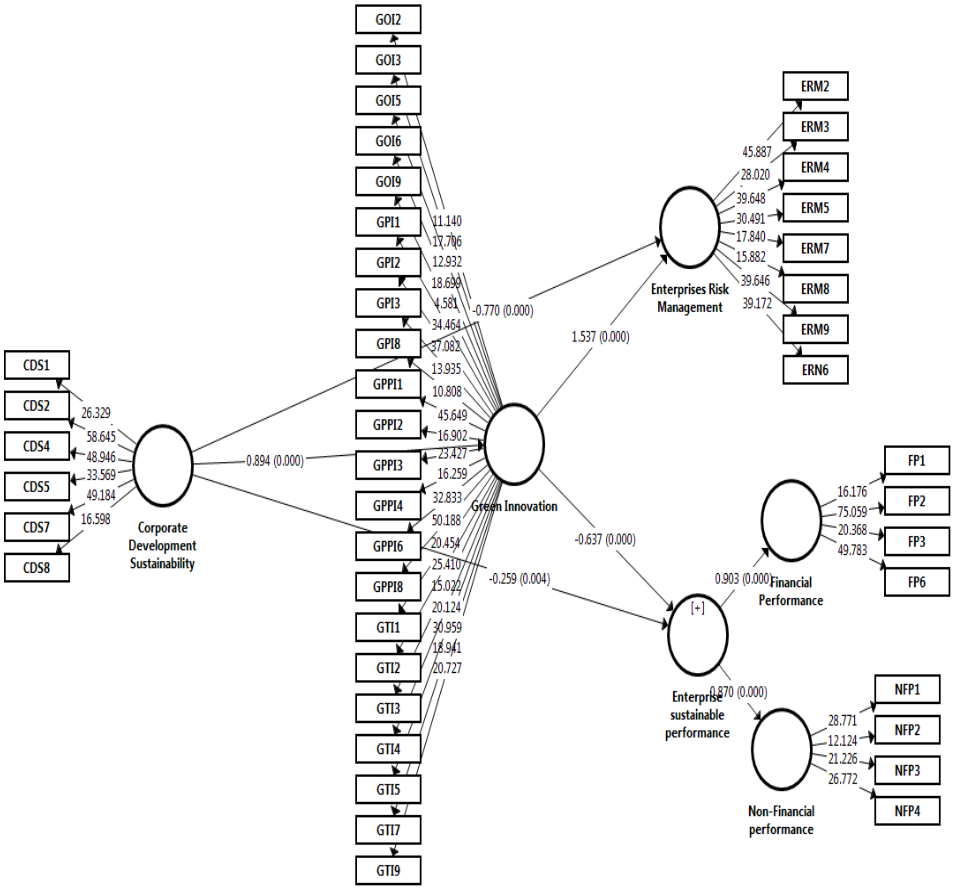

Figure 3. Structural equation modeling (SEM).

5.9.1. Corporate Development Sustainability and Enterprise Sustainable Performance

The analysis revealed a significant negative relationship between corporate development sustainability and enterprise sustainable performance (β = −0.259, $p = 0.004$), supporting Hypothesis 1. This finding aligns with the “sustainability paradox” concept proposed by (Hahn et al. 2017), which posits that firms may experience short-term performance declines as they transition towards more sustainable practices. The negative relationship may be attributed to the initial resource allocation and organizational restructuring required for sustainability initiatives, which can temporarily impact financial metrics (Eccles et al. 2014).

5.9.2. Corporate Development Sustainability and Enterprise Risk Management

A strong negative relationship was observed between corporate development sustainability and enterprise risk management (β = −0.770, $p < 0.001$), supporting Hypothesis 2. This unexpected finding challenges the conventional wisdom that sustainability practices enhance risk management capabilities (Flammer and Ioannou 2021). However, it aligns with recent research by Ortiz-de-Mandojana and Bansal (2016), who argue that sustainability initiatives may initially disrupt established risk management processes, necessitating a reconfiguration of organizational practices. This result underscores the need for a more dynamic and adaptive approach to risk management in the context of sustainability transitions, as proposed by Linnenluecke (2017) in her work on resilience in business and management research.

5.9.3. Corporate Development Sustainability and Green Innovation

Corporate development sustainability demonstrated a strong positive relationship with GI (β = 0.894, $p < 0.001$), supporting Hypothesis 3. This finding corroborates the recent literature on the innovation-driving potential of sustainability initiatives (Klewitz and Hansen 2014; Xie et al. 2019). The strong positive effect suggests that firms investing in corporate development sustainability are more likely to engage in GI activities, potentially creating new market opportunities and competitive advantages.

This relationship aligns with the natural-resource-based view of the firm (Hart and Dowell 2011), which posits that environmentally proactive strategies can lead to the development of valuable organizational capabilities, including innovation capacity.

5.9.4. Green Innovation and Enterprise Sustainable Performance

Interestingly, GI showed a significant negative relationship with enterprise sustainable performance (β = −0.637, $p < 0.001$), supporting Hypothesis 4. While counterintuitive, this finding is consistent with recent research on the "innovation-performance paradox" in the context of sustainability (Maletič et al. 2016). The negative relationship might be attributed to the high initial costs and uncertain returns associated with GI projects, particularly in the short term.

Tang et al. (2018) suggest that this negative relationship may be more pronounced in industries with long product development cycles and high capital intensity, characteristics typical of many manufacturing sectors. This contextual factor could be particularly relevant for Jordanian manufacturing industries.

5.9.5. Green Innovation and Enterprise Risk Management

Finally, GI demonstrated a strong positive relationship with enterprise risk management (β = 1.537, $p < 0.001$), supporting Hypothesis 5. This finding aligns with the recent literature on the risk-mitigating potential of sustainability-driven innovations (Flammer and Bansal 2017; Ortiz-de-Mandojana and Bansal 2016). The strong positive effect suggests that firms engaging in GI are better positioned to identify and manage sustainability-related risks, enhancing their overall resilience. This relationship underscores the potential of GI to serve as a strategic risk management tool, particularly in the face of increasing environmental regulations and stakeholder pressures (Saardchom 2016).

Table 10. Path coefficients.

	β	T-Value	*p*-Value
H1. Corporate development sustainability -> enterprise sustainable performance	−0.259	2.893	0.004
H2. Corporate development sustainability -> enterprise risk management	−0.770	7.807	0.000
H3. Corporate development sustainability -> green innovation	0.894	78.360	0.000
H4. Green innovation -> enterprise sustainable performance	−0.637	7.660	0.000
H5. Green innovation -> enterprise risk management	1.537	19.345	0.000

In conclusion, these findings provide a nuanced understanding of the complex dynamics among corporate development sustainability, enterprise performance, risk management, and GI in the context of Jordanian manufacturing industries. The results highlight the need for a more holistic and long-term perspective when evaluating the impacts of sustainability initiatives on organizational outcomes. Future research could explore the temporal aspects of these relationships, potentially uncovering how they evolve as firms progress in their sustainability journeys and as institutional environments adapt to support.

5.10. Mediation Analysis

The mediation analysis results, presented in Table 11, provide critical insights into the complex interrelationships among corporate development sustainability, GI, enterprise risk management, and enterprise sustainable performance. These findings contribute to the evolving discourse on sustainability-driven organizational outcomes in manufacturing contexts.

Table 11. Path coefficients (mediation analysis).

	β	T-Value	*p*-Value
H6. Corporate development sustainability -> green innovation -> enterprise risk management	1.374	17.376	0.000
H7. Corporate development sustainability -> green innovation -> enterprise sustainable performance	−0.570	7.543	0.000

5.10.1. Green Innovation as a Mediator between Corporate Development Sustainability and Enterprise Risk Management

The analysis revealed that GI significantly and positively mediated the relationship between corporate development sustainability and enterprise risk management (β = 1.374, $p < 0.001$), supporting Hypothesis 6. This finding aligns with the dynamic capabilities framework (Teece 2018) and recent empirical evidence on sustainability-oriented innovation (Bocken and Geradts 2020; Kusi-Sarpong et al. 2019).

The strong positive mediation effect suggests that corporate sustainability initiatives foster GI capabilities, which in turn enhance an organization's capacity to manage risks. This relationship can be understood through the lens of the "shared value" concept proposed by (Kramer and Porter 2011), where sustainability practices lead to innovative solutions that address both environmental concerns and business risks.

Recent work by Flammer and Bansal (2017) provides further support for this finding, demonstrating that firms engaging in long-term-oriented strategies, including sustainability initiatives, exhibit superior risk management capabilities. Moreover, Ortiz-de-Mandojana and Bansal (2016) found that firms practicing social and environmental sustainability displayed greater resilience during economic crises, suggesting enhanced risk management through sustainable practices.

5.10.2. Green Innovation as a Mediator between Corporate Development Sustainability and Enterprise Sustainable Performance

Interestingly, GI significantly and negatively mediated the relationship between corporate development sustainability and enterprise sustainable performance (β = −0.570, $p < 0.001$), supporting Hypothesis 7. While this negative mediation effect may seem counterintuitive, it aligns with the recent literature on the "tensions" and "paradoxes" in corporate sustainability (Hahn et al. 2017). This finding can be interpreted through the lens of instrumental stakeholder theory (Jones et al. 2018), which suggests that firms must balance the interests of various stakeholders, often leading to short-term trade-offs. The negative mediation effect may reflect the initial costs and organizational adjustments associated with GI initiatives, which can temporarily impact performance metrics. Recent empirical work by Maletič et al. (2016) supports this interpretation, demonstrating that the relationship between sustainability-oriented innovation practices and organizational performance is complex and often non-linear. Similarly, Tang et al. (2018) found that the impact of GI on firm performance could vary depending on the type of innovation and the institutional environment.

These mediation results underscore the multifaceted nature of sustainability-driven innovation and its impacts on organizational outcomes. They highlight the need for a more nuanced, context-specific approach when evaluating the effects of GI on risk management and performance.

5.11. Model Explanatory Power

The model's explanatory power was assessed using the coefficient of determination (R^2) for endogenous latent variables, as recommended by (Hair et al. 2019). R^2 values are interpreted as ≥0.25 (weak), ≥0.50 (moderate), and ≥0.75 (substantial) (Henseler et al. 2015). As shown in Table 12, the model demonstrated strong explanatory power. These R^2 values indicated substantial effects, suggesting that the model captured a significant portion of the variance in the endogenous constructs. R^2 values should be considered alongside other model evaluation criteria, such as predictive relevance (Q^2) and effect sizes (f^2), to provide a comprehensive assessment of model quality. Moreover, recent methodological advancements suggest complementing R^2 with the Standardized Root-Mean-Square Residual (SRMR) as a model fit criterion in PLS-SEM (Hair et al. 2017).

Table 12. R square and adjusted R square.

	R Square	R Square Adjusted
Enterprise sustainable performance	0.768	0.763
Enterprises risk management	0.840	0.837
Green innovation	0.799	0.797

6. Discussion

This study provided a nuanced examination of the relationships among corporate CDS, GI, ERM, and ESP within Jordanian manufacturing firms. The findings revealed complex dynamics that both supported and challenged existing theoretical frameworks, contributing significantly to our understanding of sustainable business practices in emerging economies.

To substantiate H0, the findings indicated that CDS had a negative influence on the ESP. These outcomes align with the "sustainability paradox" concept (Hahn et al. 2017) and extend its applicability to emerging economy contexts. This finding suggests that Jordanian manufacturing firms may experience short-term performance declines as they transition towards more sustainable practices. This result is consistent with recent research by (Eccles et al. 2014), who found that sustainability initiatives often required significant initial investments and organizational restructuring, temporarily impacting financial metrics. Further, Ortiz-de-Mandojana and Bansal (2016) argue that sustainability initiatives may initially disrupt established risk management processes, necessitating a reconfiguration of organizational practices. These results collectively suggest that the implementation of sustainability practices in Jordanian manufacturing firms may lead to short-term disruptions in both performance and risk management. However, they also point to the potential for long-term benefits, underscoring the need for a more nuanced, temporal understanding of sustainability impacts.

To authenticate H1, the findings displayed a strong positive impact of CDS on GI. These outcomes support the natural-resource-based view of the firm (Hart and Dowell 2011) and corroborates the recent literature on the innovation-driving potential of sustainability initiatives. This finding suggests that Jordanian manufacturing firms investing in CDS are more likely to engage in GI activities. Similarly, Bocken and Geradts (2020) examined 42 large corporations and found that sustainability-oriented strategies acted as catalysts for various forms of innovation, including product, process, and business model innovations. Their study revealed that firms integrating sustainability into their core strategies were 3.1 times more likely to develop breakthrough innovations compared to those treating sustainability as a peripheral activity. However, the significant negative relationship between GI and ESP aligns with recent research on the "innovation-performance paradox" in sustainability contexts (Maletič et al. 2016). This result suggests that Jordanian manufacturing firms may experience short-term performance declines due to the high initial costs and uncertain returns associated with GI projects. Additionally, Tang et al. (2018) conducted a longitudinal study of 267 manufacturing firms and found that while green product innovations led to improved financial performance in the long term, there was a significant negative impact on short-term profitability, particularly in the first two years following innovation implementation.

To validate the H2, the findings showed that GI significantly positively contributed to ERM. These outcomes support the recent literature on the risk-mitigating potential of sustainability-driven innovations. This finding suggests that Jordanian manufacturing firms engaging in GI are better positioned to identify and manage sustainability-related risks, enhancing their overall resilience. These results are consistent with Flammer and Bansal (2017), who examined a sample of 3005 publicly listed U.S. companies and found that firms engaging in long-term-oriented environmental strategies, including GI, exhibited superior risk management capabilities and were more resilient to environmental shocks.

To corroborate H3, the findings demonstrated that GI partially mediated the nexus between CDS and ERM. These findings align with the dynamic capabilities' framework (Teece et al. 1997) and recent empirical evidence on sustainability-oriented innovation. This result suggests that in Jordanian manufacturing firms, corporate sustainability initiatives foster GI capabilities, which in turn enhance an organization's capacity to manage risks. These findings are corroborated by Kusi-Sarpong et al. (2019), who conducted a multi-country study of 241 manufacturing firms and found that GI practices mediated the relationship between sustainability orientation and operational risk management, explaining 57% of the variance in this relationship.

Furthermore, the findings also demonstrated that GI partially mediated the relationship between CDS and ESP. These outcomes align with the recent literature on the "tensions" and "paradoxes" in corporate sustainability (Hahn et al. 2017). This finding can be interpreted through the lens of the instrumental stakeholder theory (Jones et al. 2018), suggesting that Jordanian manufacturing firms must balance the interests of various stakeholders, often leading to short-term trade-offs. Additionally, a longitudinal study by Xie et al. (2019) of 209 Chinese manufacturing firms found that while GI negatively mediated the relationship between environmental management practices and short-term financial performance, it positively mediated this relationship when considering a five-year performance window.

In conclusion, these findings provide a nuanced understanding of the complex dynamics among corporate development sustainability, GI, enterprise risk management, and sustainable performance in Jordanian manufacturing industries. They highlight the need for a long-term perspective in sustainability implementation and underscore the critical role of GI in mediating the relationships between sustainability initiatives and organizational outcomes. The results call for more sophisticated theoretical frameworks that can account for the temporal dimensions and contextual factors influencing sustainable business practices in emerging economies.

6.1. Implications Section

Theoretical Implications

This study extends the application of the sustainability paradox concept of Hahn et al. (2017) to the Jordanian manufacturing context, demonstrating its relevance in emerging economies. This finding contributes to the growing body of literature on context-specific sustainability implementation. The findings challenge conventional wisdom regarding the relationship between sustainability practices and risk management, calling for more nuanced theoretical frameworks. This study contributes to the emerging literature on organizational resilience in the face of sustainability challenges. GI is a complex mediator: the study provides empirical support for the natural-resource-based view of the firm (Hart and Dowell 2011) in the context of GI, while also contributing to the literature on the innovation–performance paradox in sustainability contexts (Maletič et al. 2016). The findings on the mediating role of GI extend recent work by Li et al. (2023), advancing our understanding of the mechanisms through which sustainability practices influence firm performance and risk management.

6.2. Practical Implications

This study offers numerous worthwhile implications for top management, decision-makers, and owners. First, the findings demonstrate that CDS has a negative influence on the ESP. These outcomes suggest that managers should adopt a long-term view when implementing sustainability initiatives, preparing stakeholders for potential short-term performance declines. Second, our results show that GI significantly contributes to ERM. These findings recommend that managers of Jordanian manufacturing firms should opt for GI to effectively manage sustainability-related risks and enhance their overall resilience. Third, the findings demonstrate a strong positive relationship between corporate development sustainability and GI, which underscores the importance of viewing sustainability initiatives as drivers of innovation. Therefore, based on these outcomes, it is recommended that managers emphasize sustainability efforts for the effective adoption of GI. Managers should create organizational cultures and structures that support experimentation and learning in sustainability contexts, aligning with recommendations from Bocken and Geradts (2020). Last, the findings demonstrate that CDS is equally important for ERM and ESP, and GI partially mediates the nexus between CDS and ERM, as well as the relationship between CDS and ESP. This study implies that CDS is equally important for GI, ERM, and ESP. Furthermore, these findings recommended that promoting CDS directly and indirectly contributes to ERM and ESP. Given the complex relationships between GI, performance, and risk management, managers should adopt a balanced approach. While recognizing potential short-term costs, they should consider the long-term benefits in terms of risk mitigation and future competitive advantages.

6.3. Policy Implication

Based on the outcomes, this research offers remarkable implications for government officials and policymakers. The findings send an urgent signal to policymakers to promote sustainable development efforts among Jordanian firms; this can enhance GI and positively contribute to the SDGs. This study recommends that government officials and policymakers provide financial and non-financial support to Jordanian firms to practice sustainability initiatives and greener activities effectively. This may include incentives for long-term investments in sustainable technologies, support for GI networks, and the development of nuanced performance evaluation criteria for sustainable businesses. Policymakers should arrange education programs for top management and owners to educate and equip them with the necessary skills to implement sustainability initiatives and GI.

6.4. Conclusions

This study provided a comprehensive examination of the intricate relationships among corporate development sustainability, GI, enterprise risk management, and sustainable performance in Jordanian manufacturing industries. The findings revealed a complex interplay of effects that both supported and challenged existing theoretical frameworks. First, we found that corporate development sustainability initiatives could lead to short-term disruptions in both performance and risk management practices, aligning with the sustainability paradox concept (Hahn et al. 2017). This highlights the need for a long-term perspective in sustainability implementation, particularly in emerging economy contexts. Second, the results underscored the critical role of GI as a mediator between sustainability initiatives and organizational outcomes. While GI enhances risk management capabilities, it may exacerbate short-term performance challenges, supporting recent work on the complex effects of sustainability-oriented innovations. Third, the study contributed to the growing body of literature on the context-specific nature of sustainability implementation in emerging economies. The findings highlighted the unique challenges and opportunities faced by Jordanian manufacturing firms in their sustainability transitions. These results collectively call for a more nuanced and holistic approach to implementing sustainability practices in emerging economy contexts. They emphasize the importance of managing stakeholder expectations, developing adaptive organizational capabilities, and fostering supportive institutional environments to navigate the complexities of sustainable business transitions. By shedding light on both the challenges and opportunities associated with sustainability transitions, this study contributes to the ongoing academic discourse and offers valuable insights for practitioners. It underscores the need for a more sophisticated understanding of the temporal dynamics of sustainability implementations and their varied impacts across different organizational domains. In conclusion, the findings suggest that while the path to sustainable business practices in emerging economies may be fraught with short-term challenges, the potential long-term benefits in terms of innovation, risk management, and competitive advantage make it a journey worth undertaking. Future research should continue to explore these complex dynamics across diverse contexts and longer time horizons to further refine our understanding of sustainable business practices in an increasingly complex global environment.

6.5. Limitations and Future Research Section

While this study provides valuable insights, several limitations offer opportunities for future research. First, the cross-sectional nature of data limits the ability to capture dynamic and potentially non-linear relationships over time. Future research should employ longitudinal designs to examine how relationships between sustainability initiatives, GI, risk management, and performance evolve over different time horizons. Second, the focus on manufacturing industries in Jordan may limit the generalizability of findings to other sectors or countries. Future studies should explore these relationships in diverse industrial and national contexts, allowing for comparative analyses. Cross-country studies, particularly within emerging economies, could illuminate how varying institutional environments influence the examined relationships. Future scholar could study other industries in Jordan (such trading, services sector, etc.) to boost the generalizability of the findings. Third, while the study considered GI as a mediator, it did not differentiate between types of GI (e.g., green product, marketing, process, or organizational). Future research could adopt a more fine-grained approach to examining how different GI types (e.g., green product, green marketing, green process, or green organizational innovation) mediate the relationships between sustainability initiatives and organizational outcomes. Fourth, the reliance on self-reported measures may be subject to social desirability bias. Future studies should incorporate objective measures of sustainability performance and innovation outputs to complement subjective assessments. The integration of archival data on environmental performance, patent data for innovation outputs, and financial metrics could provide a more robust empirical foundation, as suggested by (Xie et al. 2019). Fifth, while this study considered enterprise risk management as an outcome, it did not explore the specific mechanisms through which sustainability initiatives and GI influence risk management practices. Future research could delve deeper into these mechanisms, potentially incorporating qualitative methods to provide richer insights into the organizational processes involved. Sixth, future research could explore potential moderators of the relationships examined in this study. Factors such as firm size, ownership structure, or the presence of sustainability-oriented dynamic capabilities could influence how sustainability initiatives translate into innovation, risk management, and performance outcomes. Seventh, this study primarily focused on organizational-level outcomes. Future research could incorporate multiple stakeholder perspectives to gain a more comprehensive understanding of the impacts of sustainability initiatives. Finally, while this study focuses on the manufacturing sector, future research could explore how industry-specific factors influence the relationships between sustainability, innovation, and performance. Comparative studies across different industries could reveal sector-specific challenges and opportunities in sustainability implementation, building on work by (Xie et al. 2019).

By addressing these limitations and pursuing the suggested research directions, scholars can continue to advance our understanding of sustainable business practices in emerging economy contexts. This will contribute to both theory development and practical guidance for managers and policymakers, ultimately supporting more effective and context-appropriate sustainability transitions in diverse global settings.

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