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Strengthening the Circular Economy through the Transformation of Indonesia's Recycling Industry: The Role of Green Innovation and Corporate Social Responsibility

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ABSTRACT

Purpose: This research investigates the mediating role of company's ability in the relationship between CSR and green innovation.
Research Design/Methodology: Data from structured online questionnaire (distributed digitally) comprising 151 recycling firms from 13 regions in Indonesia was used in this quantitative study. PLS-SEM was performed with SmartPLS to test the mediating role of company capabilities in the CSR-to-green innovation relationship. Analyses included confirmatory factor analysis (CFA), correlation analysis, multicollinearity tests, reliability analysis, predictive relevance (Q^2) for the model, common method bias tests, and structural model (bootstrapped path coefficients) tests.
Findings: Findings confirm that company's ability serves as an essential mediation for CSR and green innovation relationships in the recycling sector in Indonesia. These findings underscore the urgent need for long-term commitment and strategic alignment to tackle the high upfront costs and barriers to changes in sustainable practices among recycling firms in developing economies, particularly Indonesia.
Originality/Value: This research highlights the urgent call for firms to play a strategic role in managing these resources to achieve green innovation within the global climate emergency. It incorporates offerings from companies, environmental initiatives, and green innovation into a comprehensive plan often lacking within the recycling sector in developing nations such as Indonesia. While providing novel insights into how to support sustainable value creation, the study provides a rich set of actionable recommendations for practitioners and policymakers with the company's ability being the main mediator. In addition, it supports the acceleration of green innovation uptake and company's ability in developing-country recycling companies, therefore reinforcing circular economy and ESG efforts.

1.Introduction

Real-time innovations in operation, finance, competitiveness and product are necessary for modern businesses, all while minimizing detrimental environmental externalities. At present, environmental

imperatives have moored global economic narratives on sustainability for longevity (Rajak et al., 2022). According to the Triple Bottom Line model, growth that satisfies current needs without "compromising the ability of future generations to meet their own needs" strikes a balance between the three dimensions of sustainability of economic viability, equity, and ecological integrity (Giddings et al., 2002). Some manufacturing firms have incorporated sustainable practices in strategic actions. Individual acts of participation in sustainability initiatives are deeply impacted by personal sustainability mindfulness and attitudes (Rosati et al., 2018). It embeds the CSR efforts in corporate responsibility to promote the wellness of society and progressive growth (Han et al., 2025). Green innovation is an evolutionary stage ending corporate social responsibility as the most important strategic lever for sustained sustainability (driven by product, process, and governance innovation) (Wu & Tham, 2023). In particular, recycling plays an essential role in reducing resource use and environmental damage (Korhonen et al., 2018).

According to stakeholder theory, businesses have an obligation to consider the interests of a variety of stakeholders: consumers, workers, communities, the environment (Freeman et al., 2010). Corporate competencies are shown in the setting of CSR the most direct indicator of good corporate behavior playing a central role in this domain of Indonesia recycling industry (Almasyhari et al., 2025). Sustainable organizational practices along with green innovation reinforce sustainable stakeholder relationships and company's ability (Liu et al., 2022), which in turn leads to superior compnay's ability (Ahmed et al., 2020). Indonesia reaffirmed its commitment on green innovation programmes during its presentation at the 40th session of the UNESCO General Conference in 2019. In fact, according to the Ministry of Industry and the Indonesian Recycling Association, this sector can process waste 2.54 million tons/year and produces 3 million jobs (Waluyo, 2024). However, the National Waste Management Information System records the total waste generation, which approaches 33 million tons each year with 40.06% left unhandled (Gutama & Iresha, 2023). These statistics indicate continuing issues with national waste management and comprehensive social responsibility practices.

The Influence of CSR on Green Innovation via Company Ability as a Mediator: A Study of Recycling Industry in Indonesia. This study explores the role of Company Ability as a mediator in the interaction between CSR and Green Innovation within the framework of the recycling industry in Indonesia. Eco-sustainability practices have been widely explored in diverse contexts including firms listed on the Pakistan Stock Exchange (C. Ma et al., 2023), Pakistani manufacturers (Faraz et al., 2025), manufacturing firms in Ecuador (Padilla-Lozano & Collazzo, 2022), and firms awarded CSR ratings on the Indonesia Stock Exchange (Novitasari & Agustia, 2023). Other studies consider Indonesian SMEs (Sabihaini et al., 2024) and service enterprises in the Maldives and Morocco (Simmou et al., 2023). However, most of these studies mainly focus on the sustainability benefits on Company Ability, CSR, and green innovation, but pay less attention to the social dimension. This research the recycling sector in Indonesia to fill literature gaps using a comprehensive sustainability viewpoint.

Previous studies have investigated the interrelationships between CSR, Company's Ability, and green innovation in various contexts, such as industrial enterprises in Pakistan and Ecuador and service firms in the Maldives and Morocco. However, most of these research are still contextual and have

not built theoretical processes to explain how CSR is converted into business skills to subsequently generate green innovation. This study fills the gap by combining the stakeholder theory and the dynamic capabilities view to explain the mediating role of Company's ability in the relationship between CSR and green innovation in the recycling industry in Indonesia. The fundamental contribution of this research is to define the theoretical path from social responsibility to internal capacities and sustainable innovation, which enriches the strategic management literature within the framework of developing countries.

The next part provides a detailed description of the theoretical background and evolution of the theory. The detailed exposition of the research methodology and the data collection methods is then given. Then, a detailed thematic analysis is presented to explain the main findings. The last section discusses the limitations of the investigations, theoretical and practical implications and recommendations for future research.

2. Literature Review and Hypotheses Development

According to the stakeholder theory, firms have obligations to contribute to the satisfaction and needs of diverse groups customers, employees, communities and the ecosystem (Freeman et al., 2010). This study uses CSR as a tangible expression of corporate responsibility towards these stakeholders, especially on recycling in Indonesia (Sidharta et al., 2025) and by implementing sustainability principles and green innovation, companies are able to enhance stakeholder relations and internal ability (Faraz et al., 2025). This contribution then enhances company ability because satisfied stakeholders and secure environments ensure the continuity of operations and the effective realization of corporate objectives (SUJARTO & CHARIRI, 2025).

Stakeholder theory requires that firms take into account the expectations of all stakeholders in the decision-making processes, including CSR implementation (Freeman et al., 2010). Amidst the global climate crisis, Company's Ability play a vital mediating role between CSR and green innovation. Strong capabilities drive firms to respond to stakeholder pressures effectively, which in turn facilitates sustainable green innovations and creates value for all stakeholders (V. K. Singh et al., 2024);(M. A. Hossain et al., 2025).

CSR has a good impact on Company's ability since CSR practices contribute to the development of internal ability thru organizational learning, improved reputation, and increased stakeholder relationships (Hael et al., 2025). Firms that actively participate in CSR tend to generate superior management, operational, and technical competences that boost their innovation capacity and strategic adaptability (Islam et al., 2026). Empirical data suggests that CSR engagement correlates with enhanced dynamic capacities, such as the ability to integrate, build, and restructure internal resources to response to changes in the business environment (Ghasemzadeh et al., 2021). When considering the recycling business, legal challenges and social expectations push firms to embrace CSR strategies to improve internal capabilities foundations (Sidharta et al., 2026).

The company's ability has a beneficial influence on Green Innovation. The internal capabilities are robust, which allows companies to recognize, absorb and use new knowledge to produce environmentally friendly solutions (Albort-Morant et al., 2016). Companies with adequate

managerial, technical and operational capabilities are better positioned to allocate funds to research and development of green products and to efficient and sustainable processes of production (Baernklau, 2025). Empirical research reveals that dynamic capacities like learning and assimilating external knowledge considerably boost green innovation intensity in manufacturing and recycling enterprises (Borah et al., 2025). In Indonesia's recycling business, regulatory pressures and market needs encourage firms to exploit their own resources to develop competitive green technologies (Sidharta et al., 2026).

Green Innovation describes the ability of the business to incorporate social, economic, and environmental dimensions into green innovation evaluation (Dwikat et al., 2023). The main components of sustainability for the company are environmental performance, which is reflected in the reduction of the consumption of natural resources in production processes as well as in the usage of renewable resources (Sarfraz et al., 2023), (Kanan et al., 2023). Economic execution is examined by total compensation development, piece of the pie, and clients development (Khan et al., 2024), in the mean time social execution is connected to commitments to local area prosperity, representative prosperity, and offering safe and healthy work environment (Elshaer et al., 2023). CSR embodies a moral obligation towards green innovation, environmental sustainability, and social welfare (WBCSD, 1999), (Elkington, 1997). CSR programs address environment, social and product issues (S. K. Singh et al., 2020). In addition, superior company's ability can be achieved when firm relatively utilizes a strategy of cost leadership, differentiation or market focus (Porter, 2008).

CSR implementation was found to benefit green innovation (Sabihaini et al., 2024). Growing implements that the increase of extended financial increase through online systems device now not solely promoting efficient utilization of resources, lowering emissions, and minimization of waste however it is additionally a essential dimension of CSR (Hamdi et al., 2025). According to (Laily et al., 2025) Complementing the efforts of ability strategies applied in firms, competition is based on abiity strategies featuring cost leadership, product differentiation, and innovative approaches to create a sustainable competitive advantage beyond simply addressing the fast-growing challenges simultaneously (Zhou et al., 2020), (Sabihaini et al., 2024) dynamic market characterized by crises (Kumar & Sharma, 2021). Such approaches not only open up new market opportunities, but also enhance company reputation and brand image (Sabihaini et al., 2024), (Covaci & Szolga, 2022). In addition, they contribute to increased financial returns and aggregate competitiveness at the national and global level (Goworek et al., 2020), (Wang et al., 2023). For firms, this means that incorporating CSR into successful competitive strategies must be a priority to ensure sustainable development and long-term competitive advantage in a rapidly changing business environment (Silva et al., 2021), (Cao et al., 2022).

The effectiveness of implementation of CSR positively affects green innovation (Galletta & Mazzù, 2023), (Xin & Xie, 2023). This is because CSR facilitates waste minimization, resource conservation, and environmental technology which reduce costs and enhance business productivity (Regmi et al., 2023). Nonetheless, CSR might not have a direct impact on green innovation without the mediating role of the Company's Ability (Asante-Darko & Osei, 2024). It allows the companies to convert green innovation benefits to get additional value in competitive markets (AlKhars et al., 2024). Companies

can use this capability to embed CSR more deeply into their operations to deepen cost cutting to increase the bottom line and attract higher market share (Barforoush et al., 2021). Therefore, the mediating role and the positive economic effect of the relationship between CSR, and green innovation is strengthened by the skills owned by the company ability (Ullah et al., 2024).

This mediation model is anchored in the stakeholder theory, which suggests that enterprises should take numerous stakeholders' interests into account when making strategic decisions (Freeman et al., 2010). Company Ability acts as a mediator to help organizations meet stakeholder expectations adequately, and it plays an important role in the relationship between CSR and green innovation success (Jones et al., 2018). Hence, Company Ability serves as a strategic link for CSR to generate value for green innovation(Weerakoon & McMurray, 2024). The study draws on this framework and formulates the following hypotheses.

H1: CSR has a positive influence on CA

H2: CA have a positive impact on GI

H3: CSR has a positive impact on GI

H4: CSR positively impacts GI through the mediating role of CA.

The created conceptual framework is used based on the synthesis of stakeholder theory and empirical evidence by evaluating four hypotheses using SmartPLS algorithm outputs. Figure below shows the whole model. The research result suggests that Corporate Social Responsibility influences Green Innovation mediated by Company Ability in Recycling Companies in Indonesia. PLS-SEM analysis results demonstrate substantial path coefficients and validate the mediating influence of Company Ability for the three essential relationships. Therefore, the research framework can be presented as follows:

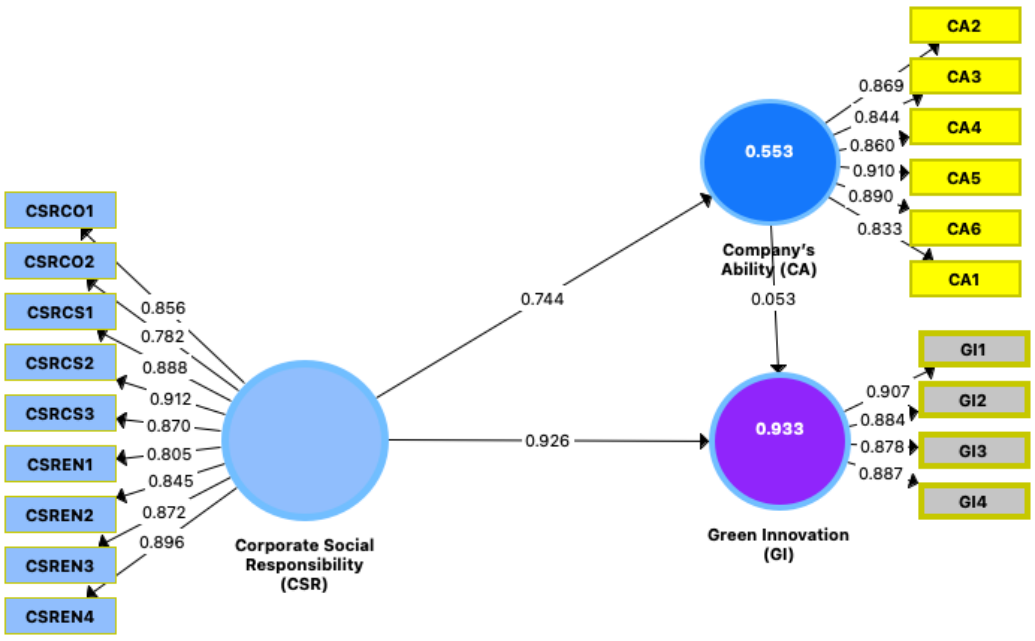

Figure 1: *Research Model Framework [Source: The author's own using SmartPLS].*

3. Methodology

The present study adopts a quantitative approach to explore the mediating effect of Company Ability (CA) on the link of corporate social responsibility (CSR) and green innovation (GI). Data were analyzed by utilizing Structural Equation Modeling-Partial Least Square (SEM-PLS) with Smart PLS software. The path coefficients were confirmed by bootstrapping process (5,000 resamples). This technique increases the reliability of the data and clarifies the interactions between variables in the study. Figure 1. Outputs of the SmartPLS algorithm as the basis of the research model framework.

3.2 Procedures and Data Collection

The core data was collected utilizing a structured questionnaire (Google Forms) by administering a web-based survey. The companies were identified by contact details taken from their websites and social media profile pages. Interrelationships across factors established in past research were identified using multi-item measures based on a five-point Likert scale. The variables of the study are derived from the previous studies and are include Company Ability (CA) consisting of six items, corporate social responsibility (CSR) consisting of nine items and green innovation (GI) consisting of four items. The measurement items were created meticulously to enhance the response reliability and minimize the bias using the approaches used in the previous research by (Sidharta et al., 2026).

3.3 Population and samples

The unit of analysis in this study are enterprises in the recycling sector of Indonesia that manage waste bank systems and transform waste materials (plastic, paper, textile, wood) into high economic value outputs (furniture, organic fertilizer, handicraft). This industry was selected since there were no previous research in recycling environments. It is also vigorously supporting sustainability projects and creative alternative solutions for environmental issues having a tremendous potential to expand in Indonesia.

3.4. Method of Data Analysis

This study applies descriptive statistics to profile the respondents and describe the features of recycling firms. The current study attempts to assess and evaluate the mediating effect of Company Ability (CA) in the relationship between corporate social responsibility (CSR) and green innovation (GI). The data were analyzed using the SEM-PLS technique with the help of SmartPLS software (Ringle et al., 2020). The model was developed in multiple stages using the SmartPLS software output. The analyzes comprised confirmatory factor analysis (CFA), correlation, multicollinearity, reliability, model predictive relevance (Q2), common method bias tests, and structural model testing (path coefficients with 5,000 bootstrapping resamples).

4. Research results and Discussion

4.1 Research Respondent Data

Data were gathered thru 241 questionnaires disseminated to Indonesian recycling firms, yielding 151 valid replies (62.7% response rate). In Figure 2, the profile of the responder is illustrated, encompassing their gender, educational background, and occupational role, which serve as the

foundation for a more in-depth exploration in the subsequent paragraphs. Attributes of the firm, including the type of recycled materials, duration of operation, and condition of disrepair, are elaborated upon in Figure 3. Findings: These descriptive evaluations provide comprehensive insights into the features of the study sample including participant demographics and organizational attributes.

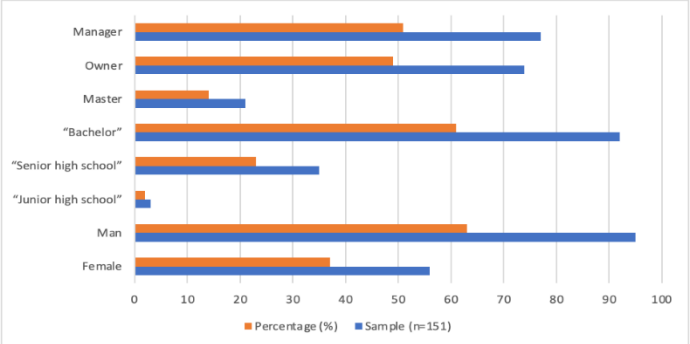

Figure 2. Characteristics of the respondents [Source: The author's own work]

Figure 2 indicates that the majority of respondents are male, at 63%, whereas females represent merely 37%. The most prevalent educational attainment is among individuals with bachelor's degrees (61%), succeeded by those with high school diplomas (23%), master's degrees (14%), and junior high school certificates (2%). Respondents are about equally divided between business proprietors (49%) and managers (51%). These results suggest that the analyzed industry is predominantly comprised of males and highly educated individuals, aligning with current research on formal sector business participants.

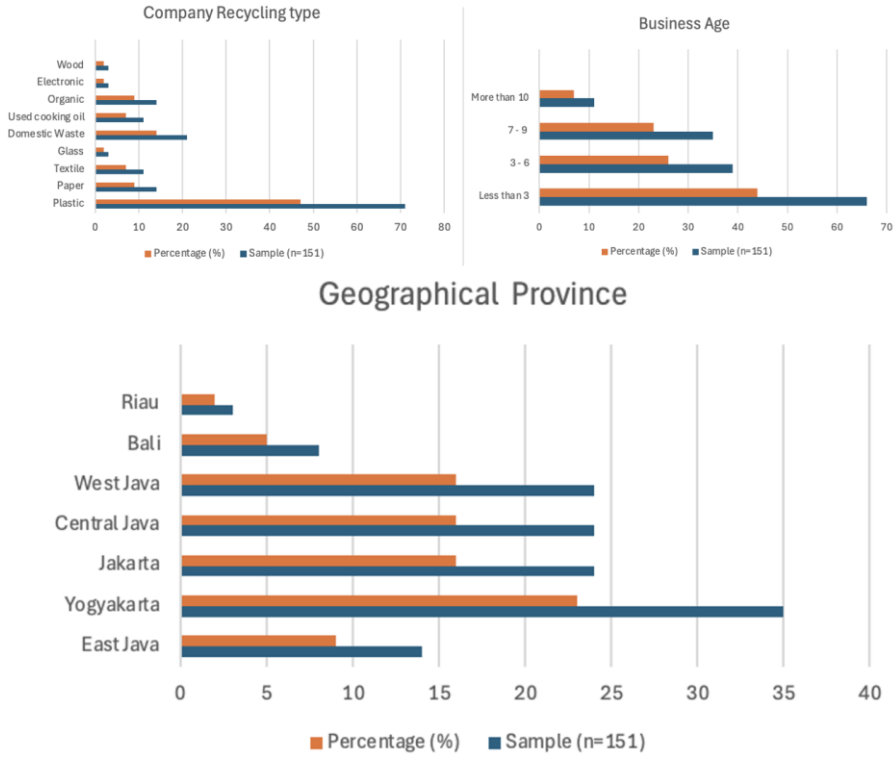

Figure 3. Company characteristics [Source: The author's own work].

. The information shown in Figure 3 indicates that most enterprises engage in plastic recycling (47%), succeeded by domestic garbage (14%), paper and organic waste (both 9%), and used cooking oil and textiles (each 7%), along with glass, electronics, and wood (each 2%). This indicates that plastic remains the primary focus of waste management efforts in Indonesia, aligning with national statistics that reveal plastic waste constitutes the greatest portion of urban refuse. The business experience is constrained, since 44% of firms have been in operation for three years or less, suggesting that the recycling sector is rapidly evolving yet remains nascent for numerous participants. The others have been engaged in the industry for various durations: 26% have been active for 3-6 years, 23% for 7-9 years, and merely 7% for over 10 years. In terms of firm distribution, 23% are situated in Yogyakarta, 16% in Jakarta, Central Java, and West Java, 9% in East Java, 5% in Bali, and 2% in Riau. The data indicate that recycling operations are mostly led by Java, consistent with other research on the concentration of the waste management sector in Indonesia.

4.2. Measurement Model And Confirmatory Factor Analysis (CFA)

The present study followed the two-step approach recommended by (Gerbing, 1988) and statistical analysis was conducted in steps to ensure a comprehensive assessment of model quality. The measurement model was validated in the first stage by applying confirmatory factor analysis (CFA) with Smart PLS-SEM and assessing indicator validity and reliability. The next step examined structural links among the latent constructs in an effort to obtain meaningful causal insights. This technique, to be undertaken before the analysis of the model for its structure, is in line with the latest guidelines for PLS-SEM (Sarstedt et al., 2021). The confirmatory factor analysis (CFA) results and the measurement features are presented in Table 1.

Table 1: Measurement Model and Confirmatory Factor Analysis

Constructs and the sources of the measures	VIF Value	Standardized Loadings	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Company's Ability (CA)			0.934	0.937	0.948	0.753
CA1	2.741	0.833				
CA2	3.235	0.869				
CA3	3.588	0.844				
CA4	3.289	0.860				

CA5	3.012	0.910				
CA6	3.566	0.890				
Corporate Social Responsibility (CSR)			0.956	0.957	0.962	0.739
CSRCO1	3.431	0.856				
CSRCO2	3.503	0.782				
CSRCS1	3.323	0.888				
CSRCS2	3.205	0.912				
CSRCS3	3.520	0.870				
CSREN1	3.382	0.805				
CSREN2	2.994	0.845				
CSREN3	3.573	0.872				
CSREN4	2.614	0.896				
Green Innovation (GI)			0.912	0.913	0.938	0.790
GI1	3.151	0.907				
GI2	2.709	0.884				
GI3	2.622	0.878				
GI4	2.755	0.887				

Source: The author's own using SmartPLS

The table 1 Measurement Model results indicate that all constructs have adequate measurement quality. All standardized loadings for the items for Company's Ability, Corporate Social Responsibility, and Green Innovation exceed 0.70, meeting the CFA indicator validity threshold. The values of Cronbach's alpha, rho_A, and composite reliability are also higher than 0.70, satisfying the criterion of adequate internal consistency. Additionally, convergent validity is confirmed, as the AVEs for each construct exceed 0.50. The issue of multicollinearity in the indicators of any variable is not apparent from the VIF table, which shows that all values are below 3.5. Thus, as per current SEM guidelines (Sarstedt et al., 2021), the measurement model is deemed acceptable and sufficient to proceed with the structural analysis.

4.3 Correlation, Multicollinearity, Reliability

The correlation analysis reveals coefficients substantially below the conservative limits for finding multicollinearity. The inter-variable correlations were varied, and the inter-construct Variance Inflation Factor (VIF) results were below the recommended thresholds, demonstrating that no structural collinearity issues are present in this analysis (Sarstedt et al., 2021). Table 2 presents the Fornell–Larcker criterion and HTMT ratios to test construct discriminant validity.

Table 2: Correlation, Multicollinearity, Reliability

Variable	Mean	Standard Deviation	CA	CSR	GI
Fornell-Larcker					
Company's Ability	3.841	0.900	0.768		
Corporate Social Responsibility	3.927	0.914	0.744	0.760	
Green Innovation	3.887	0.987	0.742	0.765	0.789
Heterotrait-Monotrait Ratio					
Company's Ability	3.841	0.900			
Corporate Social Responsibility	3.927	0.914	0.783		
Green Innovation	3.887	0.987	0.801	0.734	

Source: The author's own using SmartPLS

The results of correlation, multicollinearity and reliability tests are shown in Table 2. The square root of AVE for Company Ability (0.768), Corporate Social Responsibility (0.760), and Green Innovation (0.789) exceeds the inter-construct correlations, which indicates good discriminant validity (Sarstedt et al., 2021). The HTMT ratios (0.734–0.801) below 0.90 further validate this finding. The inter-construct correlations vary from 0.742 to 0.765, suggesting strong positive associations and no problems with multicollinearity. The mean values (3.841–3.927) and standard deviations (0.900–0.987) indicate consistent responses and reasonable variability among respondents.

4.4. Model Predictive Accuracy

The model predictive accuracy was evaluated with R^2 (Coefficient of Determination), Q^2 (Predictive Relevance), and f^2 (Effect Size). These assess the model's ability to explain endogenous variance and predict out-of-sample, as described in the accompanying table. This assessment follows that of conventional PLS-SEM guidelines for evaluating explanatory power and predictive utility (Sarstedt et al., 2021).

Table 3: R^2 and adjusted R^2; Q^2 and effect size

Variable	R^2	Adjusted R^2	Q^2 predict	RMSE	MAE	Effect Size
Company's Ability (CA)	0.553	0.550	0.547	0.681	0.518	Medium
Green Innovation (GI)	0.933	0.932	0.931	0.266	0.211	Large

Source: The author's own using SmartPLS

Table 3 a stable structural model in green entrepreneurship literature. For the Companys Ability variable: R^2 = 0.553 Adjusted R^2 = 0.550), Q^2_predict = 0.547, RMSE = 0.681, MAE = 0.518 and medium effct size have demonstrated moderate predictive relevance for the endogenous variable. On the other hand, it obtains exceptionally high R^2 (0.933; adjusted R^2 = 0.932), Q^2_predict = 0.931, RMSE = 0.266, MAE = 0.211 i.e. large effect size which means that it also exhibits high predictive relevance and high effect size (Hair et al., 2021).

Table 4: f^2 Values.

Variable	Company's Ability	Green Innovation
Company's Ability		0.219
Corporate Social Responsibility	0.238	0.348

Source: The author's own using SmartPLS

The f^2 values assess the effect sizes among constructs and are shown in Table 4. The value of f^2 equal to 0.238 suggests that CSR has a medium effect on Company Ability, but the value of 0.348 indicates that CSR has a bigger effect on Green Innovation. Furthermore, Company Ability has a medium effect on Green Innovation with a f^2 = 0.219. Based on Cohen's recommendations (Hair et al., 2021), f^2 values of > 0.02, 0.15, and 0.35 are indicative of minor, medium and large impacts, respectively. The results are consistent with the argument that CSR and Company Ability are important determinants of the variance in Green Innovation.

4.5 Common Method Bias Assessment

However, with self-reported survey data analytical integrity should be preserved by conducting thorough common method bias (CMB) tests (Podsakoff et al., 2012). Multi-method procedures were used: Harman's single-factor test explained 40.07% of variance (below the 50% threshold) indicating no significant CMB. As additional validation responding to validity critiques of Harman's (Hair Jr et al.,

2020) test the latent variable approach produced inner VIF <3. 3, confirming lack of common method bias (Kock, 2015).

4.6 Structural Model Testing

The structural model was tested using partial least squares structural equation modeling (PLS-SEM) including path analysis through bootstrapping procedures, confirmatory factor analysis and examination of measurement properties as described in the subsequent table. Bootstrapping is a nonparametric method for assessing the statistical significance of path coefficients and other PLS-SEM estimates, in accordance with recent guidelines on inference in variance-based SEM. This is in line with recent trends regarding reporting standards for PLS-SEM and follows previous logic of first confirming hypothesized relationships, then measurement invariance and model fit.

Table 5: Results of hypotheses testing [path coefficients bootstrapping]

Relationships	Original Sample	Sample Mean	Standard Deviation	T Statistics	P Values	Decetion
Direct						
H1_CSR -> CA	0.744	0.740	0.045	16.436	0.000***	Sopport
H2_CA -> GI	0.053	0.052	0.029	1.824	0.069*	Sopport
H3_ CSR -> GI	0.926	0.927	0.022	41.996	0.000***	Sopport
Indirect Mediating						
H4_ CSR -> CA -> GI	0.039	0.038	0.021	1.873	0.062*	Sopport

*Note: Corporate Social Responsibility [CSR]; Company's Ability [CA]; Green Innovation [GI]; ***sig<0,01 (1%), **sig<0,05 (5%), *sig<0,1(10%)*

Source: The author's own using SmartPLS

The table 5 structural model of green entrepreneurship based on PLS-SEM, the bootstrapping results presented in Table 5 provide empirical evidence for all hypotheses. Finally, the CSR to Companys Ability significant path is indicated by Hypothesis H1 suggesting a strong influence of CSR to CA (Zheng et al., 2025), with a path coefficient of 0.744 (M = 0.740; STDEV = 0.045), T-statistic = 16.436, p = 0.000*** (Sarstedt et al., 2021). Although weak, H2 (M = 0.052; STDEV = 0.029) supports the relationship between CA and GI at the 0.053 level of significance (T= 1.824, p = 0.069*), consistent with evidence that internal capabilities slightly spur green innovation (Sarstedt et al., 2021).

The strongest is H3, CSR and GI 0.926 (M = 0.927; STDEV = 0.022), T = 41.996, p = 0.000*** as CSR as the first important predictor of sustainable innovation. This is corroborated by H4 (CSR → CA → GI) indicating partial mediation (0.039) (M = 0.038; STDEV = 0.021), T = 1.873, p 0.062*, where CA operates as a partial mediator as expected based on the resource-based view of AI in sustainability (Richter et al., 2022).

In essence, the model highlights the importance of CSR in improving firm level and innovation in green categories, and 1%, 5% and 10% significance levels. These results are in line with PLS-SEM developments that lately have highlighted that bootstrapping provides inference robustness in PLS-SEM (Sarstedt et al., 2021). Original sentence Future research may indicate moderators such as government regulations. The path diagram illustrating outer loadings, path coefficients, and bootstrapping p-values is presented in the following figure:

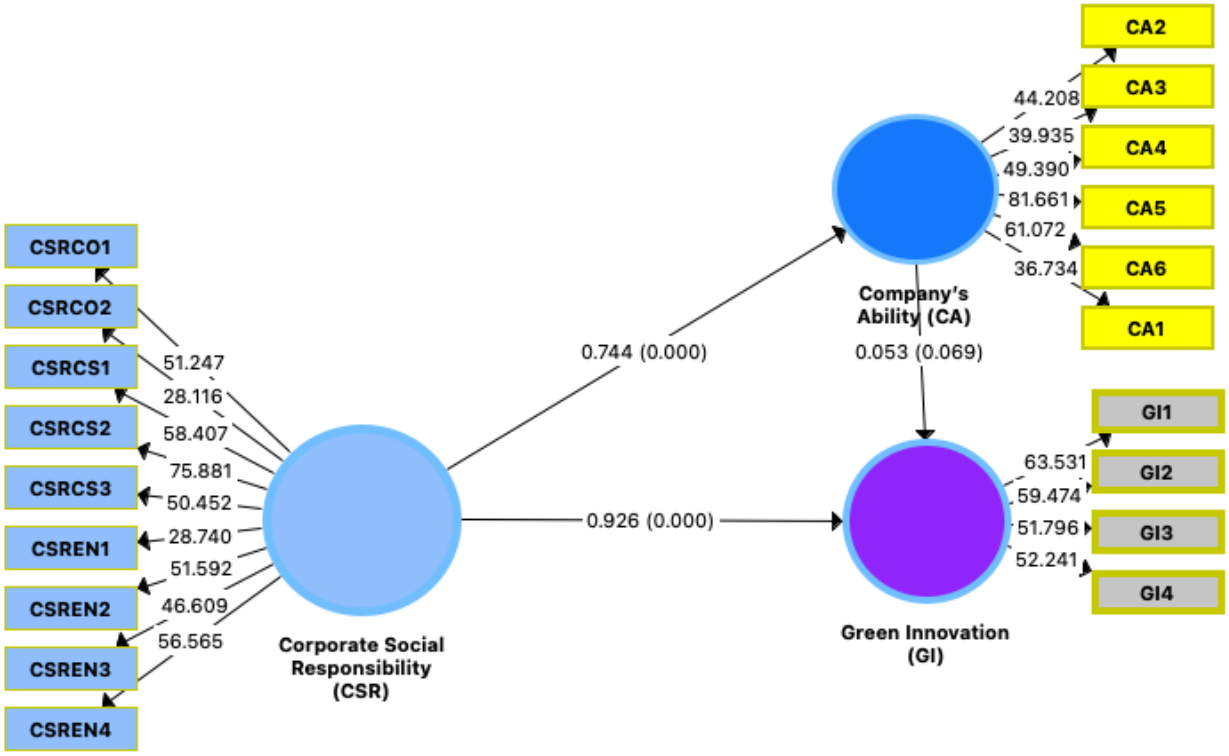

Figure 4: Path diagram Bootstrapping *[Source of the author's own using SmartPLS]*

5. Discussion

This study sheds light on the various challenges that hinder the recycling ecosystem for green innovation, especially based on the Indonesian context (I. Hossain et al., 2026). In addition, it studies the mediating effect of organizational capabilities during the process of CSR drives green innovation (Xiao et al., 2024). Green innovation is more directly under the influence of customer- or community- or green-related CSR initiatives. However, without synergistic integration of green innovation strategies, they will bring limited results on other CSR dimensions (Dewi et al., 2024).

CSR principles can guide the efficient and fair use of corporate resources towards achieving better CSR outcomes (Putra et al., 2023). CSR practices can play an important role not only in conserving the ecosystem but also strengthening the bounty of social relations with the surrounding community (Lestari & Suyanto, 2024). In addition, CSR adoption and promotion has been significantly positively correlated with a firms pursuit of excellence, leading to an increase of green innovation (S. Ma et al., 2022). But the mediating effect of this ability has some limitations, also proving that the positive effect of CSR on green innovation is still in its infancy (Peng, 2024). Hence, better strategic alignment

and higher investment are needed in order to optimise the long-term positive impacts derived from CSR implementation (Shao et al., 2024).

The company ability is an important strategic resource that will have a significant influence on all aspects of green innovation, also plays a significant mediating role in the relationship of green innovation and corporate social responsibility (Ameen et al., 2023). This has facilitated firms to optimally complement their resources and core competencies, consequently creating sustainable value for company's ability (Ameen et al., 2023). However, organizations adopting CSR together with the environmentally friendly process innovation are more able to repeat their capabilities in the recycling industry (Xu et al., 2023). The translation of CSR into unique business strategies that are not easy to copy by competitors is therefore imperative for recycling firms (Ullah et al., 2024). Green innovation, process efficiency and product differentiation are among the approach that can enable. (Saqib & Satar, 2021), they are also critical in endeavining to meet market challanges and in turn assisting the accomplishment of the firm capability goals). Accordingly, a firm's capability is a critical firm strength and plays an important role in driving green innovation (Ameen et al., 2023).

This study emphasizes that sustainability is not just driven by CSR within the recycling industry but by CSR, Company's Ability, and green innovation (Waheed & Zhang, 2022). integrated framework. This sustainability is based on an interconnected CSR, green innovation, and company's ability (Dionisio & Paula, 2024). In the context of Indonesia, the recycling sector is a new and immature industry, and while some companies may seem promising, it is still uncertain how they can overcome regional economic inequalities (Herrador & Van, 2024). So, future studies should study older industries as well as regional inequities of stakeholders in the adoption and survival of CSR practices (Kurniawan et al., 2024). Further studies must also identify CSR drivers and develop plans to maintain competitiveness within markets that are more sensitive to green innovation (Bataineh et al., 2024).

6. Conclusions

The It proves that CSR has a positive and significant effect on green innovation. In addition, corporate capabilities act as mediators between CSR and green innovation These capabilities embody an essential aspect of its economic underpinning resource endowment that firms can actually use to better access environmentally sound innovations. To remain competitive in a fast-changing market scene, recycling firms should implement integrated approaches with green innovation, operational efficiency, and product differentiation working in tandem. The paper calls for future studies on the impacts of digital technologies and the circular economy on sustainable performance. We believe that our findings call for more research on how firms adapt their business strategies to meet climate change as well as other strict environmental regulations in a way that maximizes the achievement of sustainable development goal and their overall competitiveness.

The significant findings in this mediation model contribute theoretically to the literature by explaining the reinforcement mechanism between CSR and green innovation at the corporate level thru company capabilities. This might be relevant especially when considering the global climate crisis. This study enriches stakeholder theory by highlighting the mediating role of firm capabilities between

CSR and green innovation. This study gives a unique viewpoint on internal organizational capacities for the development of effective CSR strategies to promote sustainable green innovation.

This research only green innovation was considered as mediating variable and the rest of the variables [economic, environmental, technological, etc] were not identified as mediating variables. Cross-sectional data: The design ignores temporal feedback and changes in the relationship between variables. Further research is encouraged to include other internal and external predictors of sustainable performance. An longitudinal approaches would allow for tracking the long-term dynamics of these variables. Expand sampling to different industry sectors for generalizability.

Author contribution

YOL, EAS, NFA, G, IMH, IP,R, INBM, UKO and MM all worked together to write the manuscript, do the research, and make changes to the final version. They made the research hypotheses, built the theoretical framework, and oversaw the whole investigation. They also kept an eye on the study's progress and made sure that the methods were sound. After a thorough review, YOL, EAS, NFA, G, IMH, IP, R, INBM, UKO and MM revised and approved the final manuscript for submission

Declaration of competing interest

The authors declare that they have no known financial or non-financial competing interests in any material discussed in this paper.

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Declaration of use of AI in the writing process

Authors independently selected methods, collected data, and performed PLS-SEM statistical analysis and interpreted the findings in designing, executing, and analyzing this research. We employed ChatGPT solely for cleaning up language, paraphrasing, and en-hancing wording and coherence, while not allowing it to affect the scientific message. The authors bear full responsi-bility for the use of the data and methods and for the paper itself. Independent English language services edited the manuscript professionally to meet the requirements of international journal publication.

References

[1] Ahmed, W., Ashraf, M. S., Khan, S. A., Kusi-Sarpong, S., Arhin, F. K., Kusi-Sarpong, H., & Najmi, A. (2020). Analyzing the impact of environmental collaboration among supply chain stakeholders on a firm's sustainable performance. *Operations Management Research*, *13*, 4–21.

[2] Albort-Morant, G., Leal-Millán, A., & Cepeda-Carrión, G. (2016). The antecedents of green innovation performance: A model of learning and capabilities. *Journal of Business Research*, *69*(11), 4912–4917. https://doi.org/https://doi.org/10.1016/j.jbusres.2016.04.052

[3] AlKhars, M., Masoud, M., AlNasser, A., & Alsubaie, M. (2024). Sustainable practices and firm competitiveness: An empirical analysis of the Saudi Arabian energy sector. *Discover Sustainability*, *5*(1), 146.
[4] Almasyhari, A. K., Rachmadani, W. S., & Sari, Y. P. (2025). Strategic decision-making: Linking corporate choices, social responsibility, and environmental accounting in waste management. *Social Sciences & Humanities Open*, *11*, 101404.
[5] Ameen, N., Papagiannidis, S., Hosany, A. R. S., & Gentina, E. (2023). It's part of the "new normal": Does a global pandemic change employees' perception of teleworking? *Journal of Business Research*, *164*, 113956.
[6] Asante-Darko, D., & Osei, V. (2024). Sustainable supply chain management practices and firm performance: the mediating effect of firm capabilities. *Management of Environmental Quality: An International Journal*, *35*(4), 751–779.
[7] Baernklau, K. (2025). Environmental Innovation: Effect of Capital Expenditure, Operational and Technological Capabilities. *Academy of Management Proceedings*, *2025*(1), 22319.
[8] Barforoush, N., Etebarian, A., Naghsh, A., & Shahin, A. (2021). Green innovation a strategic resource to attain competitive advantage. *International Journal of Innovation Science*, *13*(5), 645–663.
[9] Bataineh, M. J., Sánchez-Sellero, P., & Ayad, F. (2024). Green is the new black: How research and development and green innovation provide businesses a competitive edge. *Business Strategy and the Environment*, *33*(2), 1004–1023.
[10] Borah, P. S., Dogbe, C. S. K., & Marwa, N. (2025). Green dynamic capability and green product innovation for sustainable development: Role of green operations, green transaction, and green technology development capabilities. *Corporate Social Responsibility and Environmental Management*, *32*(1), 911–926.
[11] Cao, C., Tong, X., Chen, Y., & Zhang, Y. (2022). How top management's environmental awareness affect corporate green competitive advantage: evidence from China. *Kybernetes*, *51*(3), 1250–1279.
[12] Covaci, M. A., & Szolga, L. A. (2022). Low-Voltage Plasma Generator Based on Standing Wave Voltage Magnification. *Sustainability*, *14*(5), 2890.
[13] Dewi, V. A. K., Hadiwibowo, I., & Azis, M. T. (2024). Green Innovation as a Mediator between CSR, Ownership Concentration, and Financial Performance. *International Research Journal of Business Studies*, *17*(3), 293–315.
[14] Dionisio, M., & Paula, F. (2024). A systematic review on the interconnectedness of eco-innovations and digital transformation. *Environmental Quality Management*, *34*(1), e22212.
[15] Dwikat, S. Y., Arshad, D., & Mohd Shariff, M. N. (2023). Effect of Competent Human Capital, Strategic Flexibility and Turbulent Environment on Sustainable Performance of SMEs in Manufacturing Industries in Palestine. *Sustainability (Switzerland)*, *15*(6). https://doi.org/10.3390/su15064781
[16] Elkington, J. (1997). The triple bottom line. *Environmental Management: Readings and Cases*, *2*, 49–66.
[17] Elshaer, I. A., Azazz, A. M. S., & Fayyad, S. (2023). Green Management and Sustainable Performance of Small- and Medium-Sized Hospitality Businesses: Moderating the Role of an Employee's Pro-Environmental Behaviour. *International Journal of Environmental Research and Public Health*, *20*(3). https://doi.org/10.3390/ijerph20032244
[18] Faraz, A. Z., Deng, Y., Arshad, S., & Rui, S. (2025). Digital transformation as a catalyst: linking green CSR to sustainable development through environmental strategy and innovation in Pakistani SMEs. *Kybernetes*.
[19] Freeman, R. E., Harrison, J. S., Wicks, A. C., Parmar, B. L., & De Colle, S. (2010). *Stakeholder theory: The state of the art*.
[20] Galletta, S., & Mazzù, S. (2023). ESG controversies and bank risk taking. *Business Strategy and the Environment*, *32*(1), 274–288.
[21] Gerbing, D. W. (1988). Structural equation modeling in practice: A review and recommended two-step approach. *Psychological Bulletin*, *103*(3), 411–423.
[22] Ghasemzadeh, P., Rezayat Sorkhabadi, S. M., Kebriaeezadeh, A., Nazari, J. A., Farzaneh, M., & Mehralian, G. (2021). How does organizational learning contribute to corporate social responsibility and innovation performance? The dynamic capability view. *Journal of Knowledge Management*, *26*(10), 2579–2601. https://doi.org/10.1108/JKM-01-2021-0069
[23] Giddings, B., Hopwood, B., & O'brien, G. (2002). Environment, economy and society: fitting them together into sustainable development. *Sustainable Development*, *10*(4), 187–196.
[24] Goworek, H., Oxborrow, L., Claxton, S., McLaren, A., Cooper, T., & Hill, H. (2020). Managing sustainability in the fashion business: Challenges in product development for clothing longevity in the UK. *Journal of Business Research*, *117*, 629–641.
[25] Gutama, H., & Iresha, F. M. (2023). Evaluation of solid waste management effectiveness in Indonesia from 2019-2021: a geographic information system analysis. *IOP Conference Series: Earth and Environmental Science*, *1263*(1), 12067.
[26] Hael, M., Belhaj, F. A., Hazaea, S. A., Eldaia, M., & Al-dalaien, B. O. (2025). A bibliometric and content analysis of the role of corporate social responsibility in enhancing competitive advantage. *Discover Sustainability*, *6*(1), 1118.
[27] Hair, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M., Danks, N. P., & Ray, S. (2021). *Partial least squares structural*

equation modeling (PLS-SEM) using R: A workbook. Springer.
[28] Hair Jr, J. F., Howard, M. C., & Nitzl, C. (2020). Assessing measurement model quality in PLS-SEM using confirmatory composite analysis. *Journal of Business Research*, *109*, 101–110.
[29] Hamdi, F. M., Ganbat, N., Altaee, A., Samal, A. K., Ibrar, I., Zhou, J. L., & Sharif, A. O. (2025). Hybrid and enhanced electrokinetic system for soil remediation from heavy metals and organic matter. *Journal of Environmental Sciences*, *147*, 424–450.
[30] Han, L., Liu, T., Lu, H., & Zhang, W. (2025). Climate risk disclosure, green innovation and enterprise value. *Finance Research Letters*, *72*, 106553.
[31] Herrador, M., & Van, M. L. (2024). Circular economy strategies in the ASEAN region: A comparative study. *Science of the Total Environment*, *908*, 168280.
[32] Hossain, I., Ghosal, I., & Haque, A. K. M. M. (2026). *Green Policies for a Sustainable World*. Springer.
[33] Hossain, M. A., Tat, H. H., & Rahman, A. A. (2025). The Impacts of Environmental Orientation, Social Media, Innovation Capabilities, and Marketing Management on Innovation Performance of Manufacturing SMEs in Bangladesh: A Mediated Moderation Model. *Journal of International Business and Management*, *8*(4), 1–30.
[34] Islam, M. M., Chowdhury, I. H., & Islam, S. (2026). An empirical study of the relationship between corporate social responsibility practices and innovation performance in the Chinese technology industry. *Future Business Journal*, *12*(1), 167. https://doi.org/10.1186/s43093-026-00873-y
[35] Jones, T. M., Harrison, J. S., & Felps, W. (2018). How applying instrumental stakeholder theory can provide sustainable competitive advantage. *Academy of Management Review*, *43*(3), 371–391.
[36] Kanan, M., Taha, B., Saleh, Y., Alsayed, M., Assaf, R., Hassen, M. Ben, Alshaibani, E., Bakir, A., & Tunsi, W. (2023). Green Innovation as a Mediator between Green Human Resource Management Practices and Sustainable Performance in Palestinian Manufacturing Industries. *Sustainability (Switzerland)*, *15*(2). https://doi.org/10.3390/su15021077
[37] Khan, S. A. R., Ahmad, Z., Sheikh, A. A., & Yu, Z. (2024). Green technology adoption paving the way toward sustainable performance in circular economy: a case of Pakistani small and medium enterprises. *International Journal of Innovation Science*, *16*(5), 801–822.
[38] Kock, N. (2015). Common method bias in PLS-SEM: A full collinearity assessment approach. *International Journal of E-Collaboration (Ijec)*, *11*(4), 1–10.
[39] Korhonen, J., Nuur, C., Feldmann, A., & Birkie, S. E. (2018). Circular economy as an essentially contested concept. *Journal of Cleaner Production*, *175*, 544–552.
[40] Kumar, B., & Sharma, A. (2021). Managing the supply chain during disruptions: Developing a framework for decision-making. *Industrial Marketing Management*, *97*, 159–172.
[41] Kurniawan, T. A., Meidiana, C., Goh, H. H., Zhang, D., Othman, M. H. D., Aziz, F., Anouzla, A., Sarangi, P. K., Pasaribu, B., & Ali, I. (2024). Unlocking synergies between waste management and climate change mitigation to accelerate decarbonization through circular-economy digitalization in Indonesia. *Sustainable Production and Consumption*, *46*, 522–542.
[42] Laily, N., Asyik, N. F., Wahyuni, D. U., Sari, J., & Rusdiyanto, R. (2025). The role of Green Business Strategy in mediating the relationship between environmental orientation and SMEs. *The Southern African Journal of Entrepreneurship and Small Business Management*, *17*(1), 13.
[43] Lestari, N., & Suyanto, S. (2024). A systematic literature review about local wisdom and sustainability: Contribution and recommendation to science education. *Eurasia Journal of Mathematics, Science and Technology Education*, *20*(2), em2394.
[44] Liu, Y., Pan, B., Zhu, X., Zhao, X., Sun, H., He, H., & Jiang, W. (2022). Patterns of microbial communities and their relationships with water quality in a large-scale water transfer system. *Journal of Environmental Management*, *319*, 115678.
[45] Ma, C., Chishti, M. F., Durrani, M. K., Bashir, R., Safdar, S., & Hussain, R. T. (2023). The Corporate Social Responsibility and Its Impact on Financial Performance: A Case of Developing Countries. *Sustainability (Switzerland)*, *15*(4). https://doi.org/10.3390/su15043724
[46] Ma, S., Cui, X., Xiao, X., & Zhao, X. (2022). The impact of photo verification service on sales performance in the peer-to-peer economy: Moderating role of customer uncertainty. *Journal of Business Research*, *142*, 45–55.
[47] Novitasari, M., & Agustia, D. (2023). Competitive advantage as a mediating effect in the impact of green innovation and firm performance. *Business: Theory and Practice*, *24*(1), 216–226. https://doi.org/10.3846/btp.2023.15865
[48] Padilla-Lozano, C. P., & Collazzo, P. (2022). Corporate social responsibility, green innovation and competitiveness – causality in manufacturing. *Competitiveness Review*, *32*(7), 21–39. https://doi.org/10.1108/CR-12-2020-0160
[49] Peng, B. (2024). Navigating green horizons: An empirical exploration of business practices aligned with environmental goals in the era of sustainable economy. *Managerial and Decision Economics*, *45*(7), 4732–4752.
[50] Podsakoff, P. M., MacKenzie, S. B., & Podsakoff, N. P. (2012). Sources of Method Bias in Social Science Research and Recommendations on How to Control It. *Annual Review of Psychology*, *63*(Volume 63, 2012), 539–569. https://doi.org/https://doi.org/10.1146/annurev-psych-120710-100452

[51] Porter, M. E. (2008). *Competitive advantage: Creating and sustaining superior performance*. simon and schuster.
[52] Putra, N. R., Yustisia, Y., Heryanto, R. B., Asmaliyah, A., Miswarti, M., Rizkiyah, D. N., Yunus, M. A. C., Irianto, I., Qomariyah, L., & Rohman, G. A. N. (2023). Advancements and challenges in green extraction techniques for Indonesian natural products: A review. *South African Journal of Chemical Engineering*, *46*(1), 88–98.
[53] Rajak, S., Vimal, K. E. K., Arumugam, S., Parthiban, J., Sivaraman, S. K., Kandasamy, J., & Duque, A. A. (2022). Multi-objective mixed-integer linear optimization model for sustainable closed-loop supply chain network: A case study on remanufacturing steering column. *Environment, Development and Sustainability*, *24*(5), 6481–6507.
[54] Regmi, R., Zhang, Z., & Zhang, H. (2023). Entrepreneurship strategy, natural resources management and sustainable performance: A study of an emerging market. *Resources Policy*, *86*, 104202.
[55] Richter, N. F., Hauff, S., Ringle, C. M., & Gudergan, S. P. (2022). The use of partial least squares structural equation modeling and complementary methods in international management research. *Management International Review*, *62*(4), 449–470.
[56] Ringle, C. M., Sarstedt, M., Mitchell, R., & Gudergan, S. P. (2020). Partial least squares structural equation modeling in HRM research. *The International Journal of Human Resource Management*, *31*(12), 1617–1643.
[57] Rosati, F., Costa, R., Calabrese, A., & Pedersen, E. R. G. (2018). Employee attitudes towards corporate social responsibility: A study on gender, age and educational level differences. *Corporate Social Responsibility and Environmental Management*, *25*(6), 1306–1319.
[58] Sabihaini, Kurniawan, A., Eko Prasetio, J., & Rusdiyanto. (2024). Environmental analysis and impact on green business strategy and performance in SMEs post the Covid-19 pandemic. *Cogent Economics & Finance*, *12*(1), 2330428. https://doi.org/10.1080/23322039.2024.2330428
[59] Saqib, N., & Satar, M. S. (2021). Exploring business model innovation for competitive advantage: a lesson from an emerging market. *International Journal of Innovation Science*, *13*(4), 477–491.
[60] Sarfraz, M., Ozturk, I., Yoo, S., Raza, M. A., & Han, H. (2023). Toward a new understanding of environmental and financial performance through corporate social responsibility, green innovation, and sustainable development. *Humanities and Social Sciences Communications*, *10*(1). https://doi.org/10.1057/s41599-023-01799-4
[61] Sarstedt, M., Ringle, C. M., & Hair, J. F. (2021). Partial least squares structural equation modeling. In *Handbook of market research* (pp. 587–632). Springer.
[62] Shao, H., Huang, X., & Wen, H. (2024). Foreign direct investment, development strategy, and green innovation. *Energy & Environment*, *35*(6), 3116–3143.
[63] Sidharta, E. A., Asyik, N. F., Rusdiyanto, R., Burhan, U., & Susilo, H. (2026). Green innovation, company's ability, and corporate social responsibility: Evidence from Indonesia's recycling industry. *Heritage and Sustainable Development*, *8*(1), 17.
[64] Sidharta, E. A., Asyik, N. F., Rusdiyanto, R., Susilo, H., & Mustakim, M. (2025). The Role of Green Innovation in Strengthening CSR to Enhance Sustainable Performance in the Era of the Global Climate Crisis. *Complex Systems Informatics and Modeling Quarterly*, *2025*(44), 66–85. https://doi.org/10.7250/csimq.2025-44.05
[65] Silva, G. M., Gomes, P. J., Carvalho, H., & Geraldes, V. (2021). Sustainable development in small and medium enterprises: The role of entrepreneurial orientation in supply chain management. *Business Strategy and the Environment*, *30*(8), 3804–3820.
[66] Simmou, W., Govindan, K., Sameer, I., Hussainey, K., & Simmou, S. (2023). Doing good to be green and live clean! - Linking corporate social responsibility strategy, green innovation, and environmental performance: Evidence from Maldivian and Moroccan small and medium-sized enterprises. *Journal of Cleaner Production*, *384*. https://doi.org/10.1016/j.jclepro.2022.135265
[67] Singh, S. K., Giudice, M. Del, Chierici, R., & Graziano, D. (2020). Green innovation and environmental performance: The role of green transformational leadership and green human resource management. *Technological Forecasting and Social Change*, *150*. https://doi.org/10.1016/j.techfore.2019.119762
[68] Singh, V. K., Keshari, A., Singh, D., Singh, P. C., & Gautam, A. (2024). Green export strategies and SMEs export performance: mediating roles of innovation, readiness, and activities. *Journal of Innovation and Entrepreneurship*, *13*(1), 87.
[69] SUJARTO, V. N., & CHARIRI, A. (2025). *THE MEDIATION EFFECT OF FINANCIAL DISTRESS ON THE RELATIONSHIP BETWEEN ESG PRACTICES TO FINANCIAL STATEMENT FRAUD*. UNDIP: Fakultas Ekonomika dan Bisnis.
[70] Ullah, R., Ahmad, H., Rizwan, S., & Khattak, M. S. (2024). Financial resource and green business strategy: the mediating role of competitive business strategy. *Journal of Sustainable Finance & Investment*, *14*(2), 410–429.
[71] Waheed, A., & Zhang, Q. (2022). Effect of CSR and ethical practices on sustainable competitive performance: A case of emerging markets from stakeholder theory perspective. *Journal of Business Ethics*, *175*(4), 837–855.
[72] Waluyo, D. (2024). *Ekonomi Sirkular Daur Ulang Sampah*. Portal Informasi Indonesia.
[73] Wang, W., Zhang, D., Wang, H., Zhu, Q., & Morabbi Heravi, H. (2023). How do businesses achieve sustainable success and gain a competitive advantage in the green era? *Kybernetes*, *52*(9), 3241–3260.
[74] WBCSD. (1999). *Corporate Social Responsibility:Meeting Changing Expectations*.
[75] Weerakoon, C., & McMurray, A. J. (2024). Fostering social enterprise innovativeness: the interplay of learning,

market orientation and stakeholder engagement within a capability framework. *Social Enterprise Journal*, *20*(5), 888–920.

[76] Wu, Y., & Tham, J. (2023). The impact of environmental regulation, Environment, Social and Government Performance, and technological innovation on enterprise resilience under a green recovery. *Heliyon*, *9*(10).

[77] Xiao, H., Al Mamun, A., Reza, M. N. H., Lin, X., & Yang, Q. (2024). Modeling the significance of corporate social responsibility on green capabilities and sustainability performance. *Heliyon*, *10*(19).

[78] Xin, N., & Xie, Z. (2023). Financial inclusion and trade adjusted carbon emissions: Evaluating the role of environment related taxes employing non-parametric panel methods. *Sustainable Development*, *31*(1), 78–90.

[79] Xu, L., Wu, X.-Q., Li, C.-Y., Liu, N.-P., An, H.-L., Ju, W.-T., Lu, W., Liu, B., Wang, X.-F., & Wang, Y. (2023). Sonocatalytic degradation of tetracycline by BiOBr/FeWO4 nanomaterials and enhancement of sonocatalytic effect. *Journal of Cleaner Production*, *394*, 136275.

[80] Zheng, H., Dai, J., Li, B., & Shou, Y. (2025). The impact of anticipation of new technologies on operational and environmental performance: a strategy-structure-capabilities-performance perspective. *International Journal of Logistics Research and Applications*, *28*(8), 886–909.

[81] Zhou, C., Xia, W., Feng, T., Jiang, J., & He, Q. (2020). How environmental orientation influences firm performance: The missing link of green supply chain integration. *Sustainable Development*, *28*(4), 685–696.