



# Sustainability Transformation: Leadership, Innovation, and Strategic Flexibility Improve Sustainability Performance

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## Abstract

This study investigates how sustainability leadership impacts sustainability performance through strategic flexibility and sustainability innovation, which function as the mediators. This study collected data from 200 respondents using purposive sampling and 6-point Likert scale questionnaires. The data were subsequently analyzed using PLS-SEM. The findings confirm that sustainability leadership significantly and positively impacts sustainability performance through strategic flexibility and innovation. Additionally, data analysis revealed that sustainability leadership has a positive and significant impact on strategic flexibility and sustainability innovation. This study highlights the unique aspect of the Indonesian mining sector. It has not received extensive examination regarding sustainability and sustainability leadership as systems thinking that requires the perspective of interdependent structures and adaptability to changes. Strategic flexibility, as an organization's capability to adapt to changes reactively and proactively, is crucial to the organization's effort to create sustainability innovation to ensure sustainability performance.

## Keywords:

Sustainability Leadership;  
Strategic Flexibility;  
Sustainability Innovation;  
Sustainability Performance;  
Sustainable Development Goals (SDGs).

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## 1- Introduction

Sustainability is a major global issue due to climate change and resource overuse [1]. Enhancing sustainability performance should significantly advance all Sustainable Development Goals (SDGs), as superior outcomes in corporate sustainability practices will mitigate environmental consequences, improve social welfare, and foster responsible business models [2-4]. Following the seminal papers *The Limits to Growth* (1972) and *Our Common Future* (1987), the global community has increasingly acknowledged the necessity for development that prioritizes economic expansion, ecological constraints, and social sustainability. *Our Common Future* defined sustainable development as meeting present needs without hindering future generations from meeting theirs [5]. Numerous international forums, including the Paris Agreement [6], have underscored this urgency by establishing a goal of restricting global temperature rises to below 2°C relative to pre-industrial levels. The United Nations Sustainable Development Goals (SDGs) provide a framework for all nations to attain equilibrium among social, economic, and environmental requirements by 2030 [7]. Nonetheless, executing this sustainability agenda encounters significant obstacles, particularly within the corporate sector, frequently as the predominant source of emissions and environmental degradation [8]. The mining industry, for instance, is a sector facing difficulty [9]. This industry supplies crucial raw resources for technical and economic advancement, although it also imposes a considerable ecological and social impact. Indonesia, the fifth largest emitter globally, is responsible for ensuring its mining sector adheres to sustainable norms.

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PT. Vale Indonesia, a nickel mining company that is part of Vale Canada Limited, one of the world's largest mining companies, is a state-owned mining holding entity that has implemented an Environmental, Social, and Governance (ESG) framework centered on six principal pillars: climate change, intelligent operations management, product stewardship, community welfare, economic advancement, and corporate governance. This initiative demonstrates PT Vale's dedication to harmonizing social and environmental accountability with commercial viability. The effective execution of this agenda is significantly reliant on sustainability leadership, which is essential for methodically coordinating organizational resources [10]. To achieve the Sustainable Development Goals (SDGs), we need strong and innovative leadership with caring concern about sustainability that will encourage businesses to act in ways that are responsible, open, and include everyone [11]. The studies on sustainability leadership have expanded dramatically, encompassing diverse aspects such as its influence on organizational performance and the advancement of sustainability innovation. Basu & Mukherjee (2020) emphasize that sustainable leadership fosters an organizational culture conducive to achieving sustainability by incorporating social and ecological values into decision-making processes [12]. Studies by Burawat (2019) and Fatoki (2021) indicate that sustainability leadership markedly enhances sustainability performance, particularly among industrial firms [13, 14]. Iqbal et al. (2020) confirmed that a higher level of psychological empowerment would result in a higher indirect effect of sustainable leadership on sustainable performance through organizational learning [15]. Eustachio et al. (2023) underscored the significance of sustainability-oriented innovation as a mediator between leadership and sustainability performance [16]. While the studies on sustainability in the mining industry from developing countries reveal that, most companies still consider sustainability as meeting the technical aspects of a framework or regulation enforced by associations or authorities [17-19]. The study by Cacciuttolo & Atencio (2022) in Chile also indicated that sustainability initiatives in the mining industry remain nascent, facing significant obstacles in the implementation of eco-friendly technologies and the engagement of local populations [20].

Moreover, studies on sustainability leadership frequently overlook the influence of organizational components such as strategic flexibility. Eisenhardt & Martin (2000) emphasized strategic flexibility as the organizational dynamic capability to reactively and proactively respond to changes [21]. Sanchez (1995) argued that strategic flexibility is a dynamic capability that overlaps with learning capability in how firms reconfigure resources based on acquired knowledge [22]. Senge (2008) and Porter & Córdoba (2009) assert that organizational learning is essential in developing organizational systems that promote sustainability [23, 24]. Studies on strategic flexibility by Yang et al. (2015), Nwachukwu & Vu (2020), and Dwikat et al. (2023) have not put the variable as a crucial factor for sustainability leadership [25-27]. This work provides novel contributions in multiple facets. The emphasis on Indonesia's mining sector, which is economically vital yet poses considerable environmental and social repercussions, offers a particular backdrop that remains underexplored. This study examines the function of sustainability leadership in coordinating intricate organizational components such as strategic flexibility, which stimulates sustainability innovation, and in the end, helps mining companies to attain sustainability performance. Consequently, this study offers novel insights into how companies within the mining sector may spearhead the transition to sustainability via system-oriented leadership, innovation, and collaboration among stakeholders. This paper provides pertinent strategic ideas for implementing sustainability in the Indonesian mining sector through a case study of PT. Vale Indonesia.

## 2- Literature Review

### 2-1-Sustainability Performance

Schaltegger & Wagner (2006) define sustainability performance as the effectiveness of an organization across all dimensions and factors of corporate sustainability [28]. Damtoft et al. (2024) state that sustainability performance is the ability of an organization to contribute to the Triple Bottom Line of environmental stewardship, social responsibility, and economic viability [29]. Sustainability performance refers to an organization's effectiveness in fulfilling social responsibility and environmental preservation while achieving economic profitability. The history of sustainability performance originates from Elkington's (1995) introduction of the Triple Bottom Line concept, which urged companies to document their financial profits and initiatives to foster environmental and social sustainability as part of their sustainability obligations [30]. A concept that is later popularly known as people, planet, and profit. Organizations like GRI, UNGC, and CDP offer widely accepted frameworks for corporate sustainability reporting. Multiple studies on sustainability performance, including those by Burawat (2019), Fatoki (2021), and Ibrahim et al. (2020), concluded that sustainable leadership influences sustainability performance [13, 14, 31]. Akhimien & Adekunle (2023) discovered that technological knowledge and its application (innovation) influence sustainable performance [32]. Sustainability performance refers to an organization's effectiveness in fulfilling social responsibility and environmental preservation while achieving economic gains.

### 2-2-Sustainability Leadership

Beehner (2020) defines sustainability leadership as leadership that has roots in the natural structure of the environment so it can transcend boundaries and barriers, engage multiple stakeholders vertically and horizontally, see the big picture, and influence the entire system [33]. Liao (2022) articulates that sustainable leadership encompasses leadership activities integrated throughout the organization, creating a self-reinforcing system via pertinent practices, enabling enterprises to sustain economic, social, and environmental equilibrium throughout their entire life cycle while facilitating long-term

sustainable development [34]. Meanwhile, Sajjad et al. (2024) views sustainability leadership as a dynamic and complex process in which leaders with sustainability orientation participate in sophisticated psycho-cognitive and socio-cognitive processes to generate long-term sustainable outcomes for business and society [35]. This definition suggests that sustainability leadership is a systemic leadership model based on the natural environment that seeks to realize sustainability by understanding and influencing systems (organizations/businesses, social, environment) by adaptively collaborating to involve stakeholders across boundaries to create the desired future. Senge (2008) argued that sustainability should be viewed from a systems perspective, where every part of an ecosystem is interdependent [23]. Thus, sustainability leadership is a systems thinking paradigm that includes dimensions of seeing systems, collaboration, and creating.

### 2-3-Strategic Flexibility

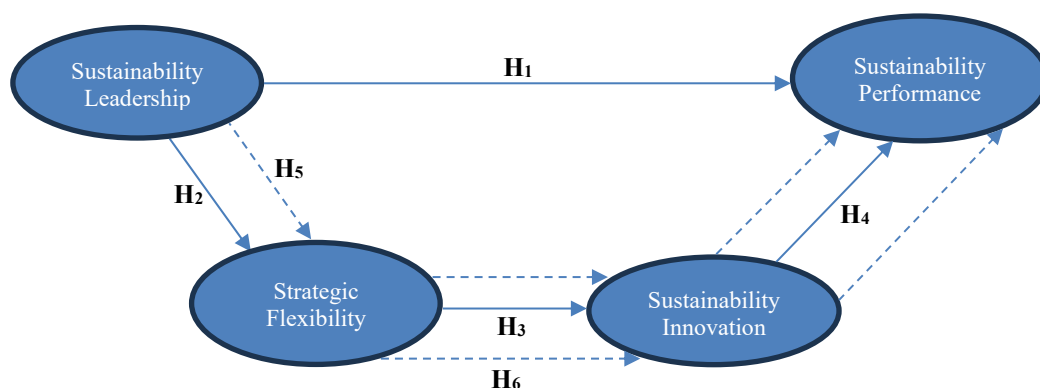
Sanchez (1995) characterizes strategic flexibility as a company's capacity to adapt to diverse requirements from fluctuating competitive landscapes. The development of this capacity is in line with how firms reconfigure resources based on acquired knowledge [22]. Hitt et al. (1998) define strategic flexibility as a firm's ability to proactively or reactively adjust to evolving competitive situations, thereby establishing and/or sustaining a competitive advantage [36]. Agostini et al. (2023) define strategic flexibility as an organization's capacity to modify and adapt its utilization of resources by swiftly and efficiently reconfiguring and reallocating its flexible assets and capabilities to establish and sustain alternative courses of action or varied portfolios of strategic options that can be employed to respond, either proactively or reactively, to recognized environmental opportunities and/or threats [37]. Strategic flexibility is an organization's dynamic capability to react to changes, either reactively or proactively, by adjusting strategy and resource allocations to maintain competitive advantage. This capability develops through organizational learning and drives innovation initiatives.

### 2-4-Sustainability Innovation

Charter & Clark (2007) characterize sustainability innovation as a process that incorporates sustainability factors such as environmental, social, and economic (ESG) into corporate systems from ideation to study and development (R&D) to commercialization [38]. This pertains to products, services, technologies, and innovative business and organizational models. Hermundsdottir & Aspelund (2021) describe sustainability innovations as inventions that consider all elements of sustainability, namely environmental, social, and economic, throughout the innovation process [39]. Zotov (2024) asserts that sustainability innovation encompasses the deliberate endeavors of organizations to promote stakeholder interests by balancing economic, social, and environmental advantages [40]. Innovations in sustainability consequently enhance corporate competitiveness and advance sustainability efforts. Afeltra et al. (2022) asserted that sustainable innovation involves introducing novel ideas, capabilities, processes, and products that mitigate or prevent environmental harm for the community's benefit while aiming for profitability, enhancing the firm's sustainable competitive advantage [41]. Sustainability innovation is an invention that integrates social, ecological, and economic aspects into an organization's management system for the benefit of all stakeholders, hence ensuring sustainable performance.

### 2-5-Theoretical Framework

This study's framework examines the correlation among the specified variables. Sustainability Leadership is evaluated based on the dimensions of seeing systems, collaboration, and creating. Strategic flexibility is assessed based on its dimension of reactive and proactive abilities. Sustainability innovation is assessed on economic, environmental, and social dimensions. Sustainability performance is assessed on financial, ecological, and social dimensions, similar to sustainability innovation. The concept posits that sustainability leadership impacts sustainability performance through strategic flexibility and sustainability innovation as the mediating variables. Figure 1 depicts the structure employed to fulfill the objectives of this study.



**Figure 1. Proposed Conceptual Model of Sustainability Performance**

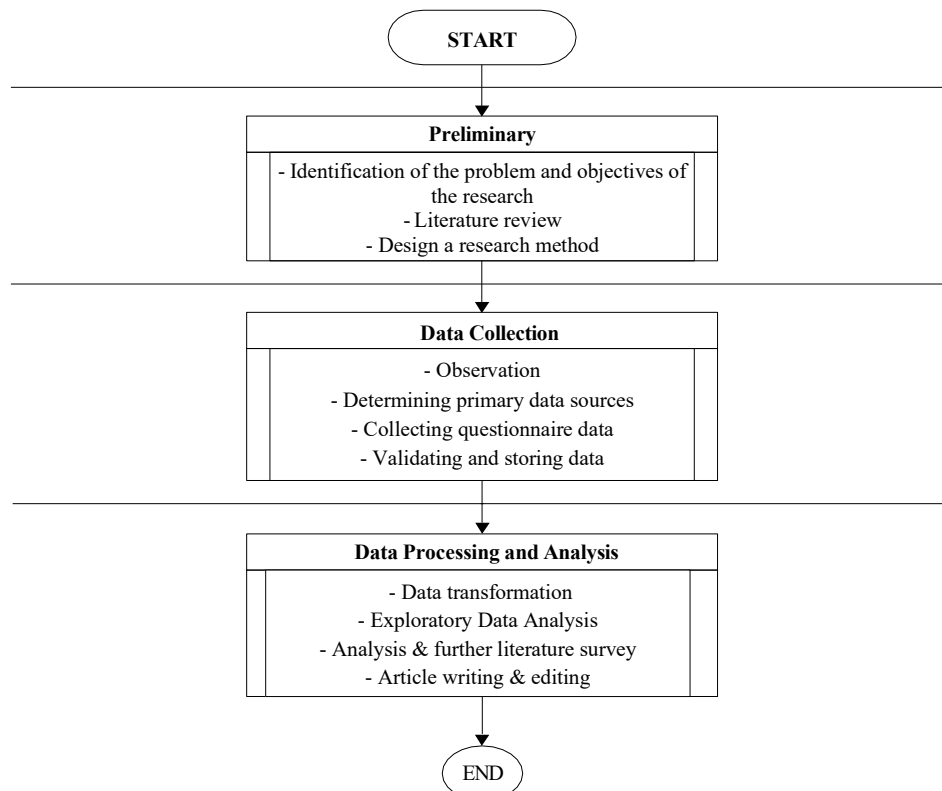
Based on the proposed study framework, the proposed hypotheses of this study are:

- H1:** Sustainability Leadership has a positive impact on Sustainability Performance.
- H2:** Sustainability Leadership has a positive impact on Strategic Flexibility.
- H3:** Strategic Flexibility has a positive impact on Sustainability Innovation.
- H4:** Sustainability Innovation has a positive impact on Sustainability Performance.
- H5:** Sustainability Leadership positively impacts Strategic Flexibility and Sustainability Innovation as a mediating effect of -1 on Sustainability Performance.
- H6:** Strategic Flexibility positively affects Sustainability Innovation as a mediating effect of -2 on Sustainability Performance.

### 3- Research Methodology

This study is cross-sectional research that examines the impact of sustainability leadership on sustainability performance through a series of mediating variables of strategic flexibility and sustainability innovation. 200 managers and senior staff from PT Vale Indonesia were chosen as respondents using purposive sampling since they are meeting the criteria as respondents, which is has exposure to PT Vale Indonesia management level processes. A 6-point Likert scale questionnaire to measure the variables was adapted from various relevant scales (Baxter & Chipulu, 2023; Miroshnychenko et al., 2020; Afeltra et al., 2022; Ibrahim et al., 2020) and reviewed by two experts on psychometric measurement [31, 41-43]. The decision to use 6-point scale is to avoid the tendency of respondents to choose the middle point, especially for respondents in Asian countries as Ibrahim et al. (2020) suggested [31]. Abdul (2010) also found that the 6-point Likert scale had higher discrimination and reliability [44]. The questionnaire was distributed online. SEM-PLS was chosen as the technique for analyzing the relationship between variables, compared to using Structural Equation Modeling-Covariance Based (SEM-CB), because it is more suitable for predictive modeling and exploration of complex relationships between variables, ideal for theory development, and can be used with smaller sample sizes [45]. Factor loadings and average variance extracted (AVE) assess validity, while Cronbach's alpha and composite reliability measure reliability. The coefficient of determination tests causality. Hypothesis testing involves the examination of path analysis and the evaluation of causality. The results of this study suggest that the distribution of 200 respondents qualifies for the continuation of the study data. The findings showed that 10 senior managers, 38 managers, and 152 senior staff participated as the respondents of this study with each of them having over a decade of experience within the organization. Out of the respondents, 83 individuals possessed a master's degree, whereas 117 individuals held a bachelor's degree.

Figure 2 shows the flowchart of the research methodology through which the objectives of this study were achieved.



**Figure 2. Flow Chart of Methodology Research**

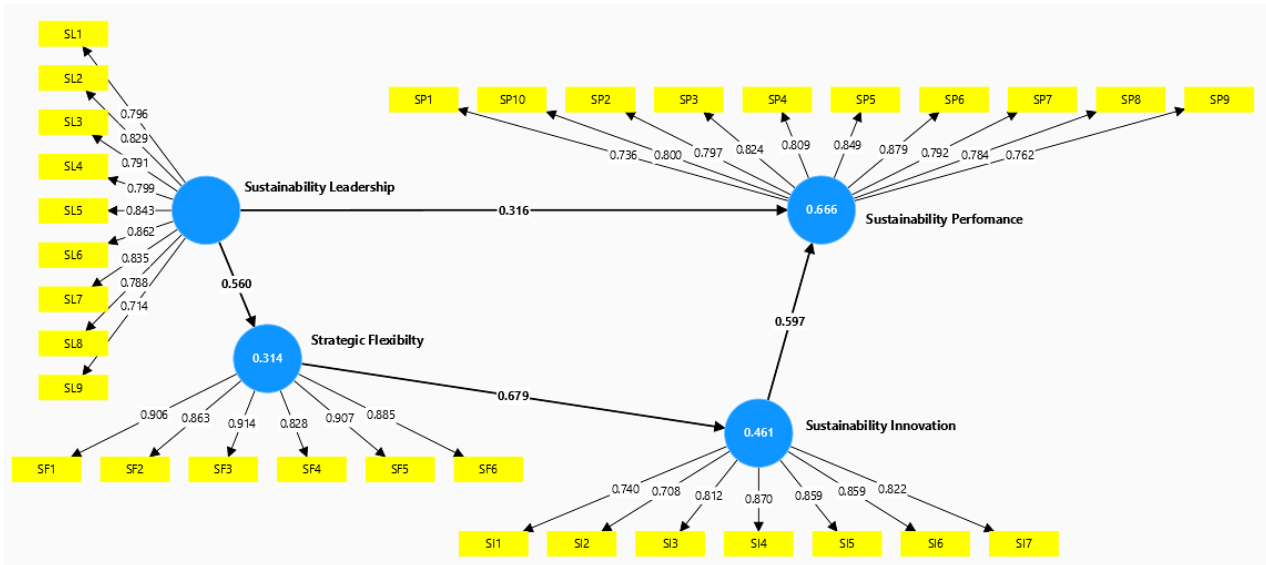
## 4- Results and Discussion

The preliminary phase of this study involved the development of indicators for every dimension of the variables measured. Adapting the work of Baxter & Chipulu (2023), Miroshnychenko et al. (2020), Afeltra et al. (2022), and Ibrahim et al. (2020), the formulation and development of these indicators were carried out [31, 41-43]. Table 1 outlines the variables, dimensions, and indicators of the questionnaire.

**Table 1. Variables, dimensions, and indicators of Sustainability Performance**

Variable	Dimensions	Indicator
Sustainability Leadership [42]	Seeing Systems	<ul style="list-style-type: none"> <li>• Responsibility</li> <li>• Considering</li> <li>• Communication</li> <li>• Organizational</li> </ul>
	Collaboration	<ul style="list-style-type: none"> <li>• Cooperate</li> <li>• Collaborate</li> </ul>
	Creating	<ul style="list-style-type: none"> <li>• Purpose</li> <li>• Vision</li> </ul>
Strategic Flexibility [43]	Reactive Ability	<ul style="list-style-type: none"> <li>• Easily change</li> <li>• Modified</li> <li>• Control</li> </ul>
	Proactive Ability	<ul style="list-style-type: none"> <li>• Necessary practical</li> <li>• Pro-actively develop</li> <li>• Shift projects</li> </ul>
Sustainability Innovation [41]	Economic	<ul style="list-style-type: none"> <li>• Process innovation</li> <li>• Commercialized</li> </ul>
	Environmental	<ul style="list-style-type: none"> <li>• Reduce raw materials.</li> <li>• Less energy</li> <li>• Reduce emission</li> <li>• Reuse and remanufacture</li> <li>• Environmental criteria</li> </ul>
	Societal	<ul style="list-style-type: none"> <li>• Reduce rates of injury,</li> <li>• Decreased consistently</li> <li>• Ergonomic</li> </ul>
Sustainability Performance [31]	Economic	<ul style="list-style-type: none"> <li>• Materials reduction.</li> <li>• Organization Reputation</li> <li>• Reduce energy</li> <li>• Reduce waste</li> <li>• ecological incidents.</li> </ul>
	Environmental	<ul style="list-style-type: none"> <li>• Toxic emissions</li> <li>• Reduced water</li> <li>• Reduced energy</li> <li>• Increase activities</li> <li>• Reduced accidents</li> </ul>
	Societal	<ul style="list-style-type: none"> <li>• Attention to health</li> <li>• Improving safety</li> <li>• Economic activities</li> <li>• Health facilities</li> <li>• Training development</li> <li>• Participation community</li> </ul>

Figure 3 indicates that all loading factors within each dimension exceed 0.7. The minimum loading factors are 0.714 for sustainability leadership, 0.828 for strategic flexibility, 0.708 for sustainability innovation, and 0.736 for sustainability performance. Convergent validity is assessed by checking loading factors and Average Variance Extracted (AVE) values, which should be at least 0.5. Table 2 presents the results of the convergent validity assessment based on the AVE values.



**Figure 3. Loading Factors of Convergent Validity Test**

**Table 2. Convergent Validity Test**

Variable	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
Strategic Flexibility	0.944	0.952	0.956	0.782
Sustainability Innovation	0.913	0.917	0.931	0.659
Sustainability Leadership	0.933	0.936	0.944	0.652
Sustainability Performance	0.939	0.94	0.948	0.647

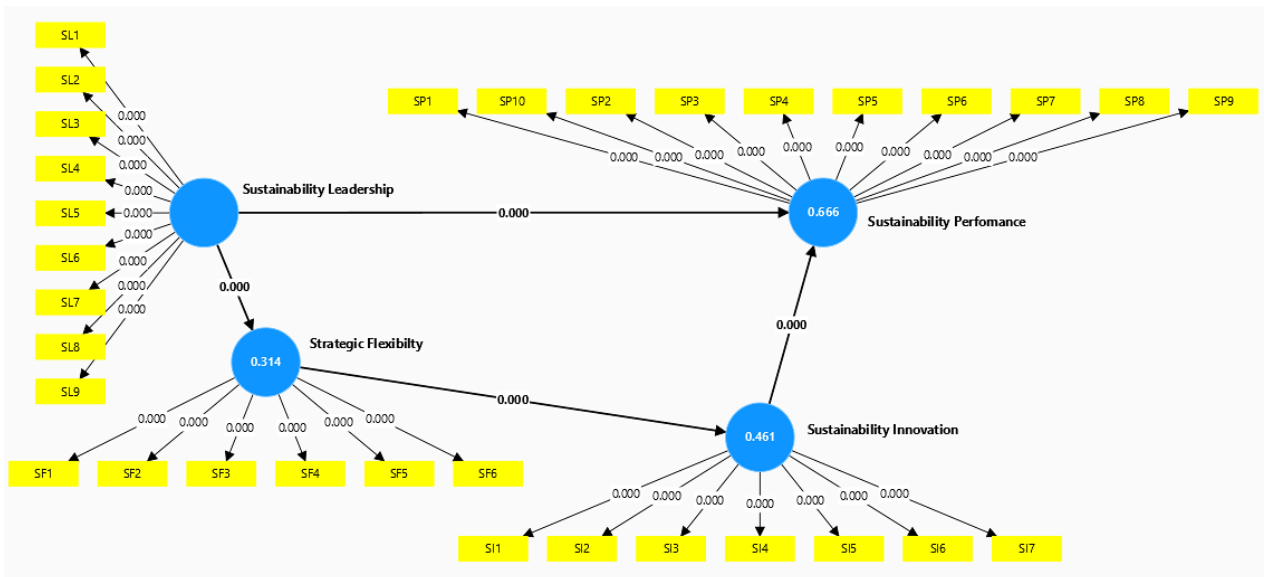
Table 2 shows that the mean values of the average variance extracted (AVE) are all above 0.6, indicating that the data from 200 respondents are valid. Furthermore, the reliability assessment evaluates data quality using Cronbach's Alpha coefficients and composite reliability. Table 2 demonstrates that the Cronbach's Alpha values, and composite reliability values are above 0.6, affirming the data's dependability. To evaluate the feasibility of the study model, the coefficient of determination signifies the extent of the model's practicality. This evaluation uses the  $R^2$  statistic, which varies between 0 and 1. A low  $R^2$  value indicates that the exogenous variables' ability to explain variance in the endogenous variable is minimal, while an  $R^2$  value approaching 1 suggests that the exogenous variables explain nearly all the variance required to predict endogenous variation. The coefficient test results reveal an  $R^2$  value of 0.66, equivalent to 66% of the variance. The exogenous variables—sustainability leadership, strategic flexibility, and sustainability innovation—explain the endogenous variable, sustainability performance, while the remaining 34% of the variance is unexplained. Hypothesis testing employs probability values and t-statistics. The p-values are below 0.05 at a 5% significance level. The t-table value for an alpha of 5% is 1.96, so the criterion for accepting a hypothesis is a t-statistic exceeding 1.96.

Table 3 displays the p-values associated with the three exogenous factors—strategic flexibility, sustainability innovation, and sustainability leadership—relating to the endogenous variable, sustainability performance. For H1, the p-value for sustainability leadership's impact on sustainability performance is below 0.05, and the t-statistic exceeds the critical t-value of 1.96, indicating acceptance of H1 and a significant effect. For H2, the p-value for sustainability leadership's effect on strategic flexibility is below 0.05, and the t-statistic exceeds 1.96, leading to the acceptance of H2, showing a significant effect. For H3, the p-value for strategic flexibility's effect on sustainability performance is below 0.05, and the t-statistic exceeds 1.96, resulting in the acceptance of H3, demonstrating a significant effect. For H4, the p-value for sustainability innovation's effect on sustainability performance is below 0.05, and the t-statistic exceeds 1.96, confirming the acceptance of H4 and a significant effect. For H5, the p-value for sustainability leadership's mediating effect (via strategic flexibility) on sustainability performance is below 0.005, and the t-statistic exceeds 1.96, supporting the acceptance of H5. This indicates that sustainability leadership positively mediates sustainability performance through strategic flexibility. For H6, the p-value for sustainability leadership's mediating effect (via sustainability innovation) on sustainability performance is below 0.005, and the t-statistic exceeds 1.96, leading to the acceptance of H6, affirming a positive mediating effect (see Figure 4).



**Table 3. Convergent Validity Test**

Variable	T statistics ( O/STDEV )	P values
Sustainability Leadership → Sustainability Performance	3.656	0.000
Sustainability Leadership → Strategic Flexibility	7.355	0.000
Strategic Flexibility → Sustainability Innovation	12.127	0.000
Sustainability Innovation → Sustainability Performance	6.485	0.000
Sustainability Leadership → Strategic Flexibility → Sustainability Innovation → Sustainability Performance	4.021	0.000
Strategic Flexibility → Sustainability Innovation → Sustainability Performance	5.307	0.000

**Figure 4. Loading Factors of Convergent Validity Test Hypothesis Testing**

The findings of this study indicate that effective sustainability leadership plays a vital role in improving sustainability performance, particularly in the complex mining industry. These findings align with existing studies. Basu & Mukherjee (2020) and Burawat (2019) emphasize that leaders with a sustainability vision cultivate an organizational environment that supports the shift toward sustainability [12, 13]. Fatoki (2021) also illustrates that sustainability leadership fosters a culture supportive of sustainability [14]. This study offers unique insights by focusing on the mining sector, which faces challenges distinct from those in manufacturing or service industries. Given the complex ecological and social impacts of mining, sustainability leadership is essential for driving systemic change within PT Vale Indonesia's operations. These findings further demonstrate that sustainability leadership enhances strategic flexibility within organizations through mechanisms such as promoting innovation, supporting adaptive decision-making, enhancing risk management, and developing a flexible organizational culture. Linnenluecke & Griffiths (2010) indicate that organizations implementing sustainability policies exhibit greater adaptability to external changes, thereby improving strategic flexibility [46]. Wang et al. (2024) emphasize that an adaptable organizational culture significantly enhances strategic flexibility [47]. However, these results contrast with those of Bansal & DesJardins (2014) [48]. Slawinski & Bansal (2015) highlight a conflict between short-term and long-term objectives that impedes rapid strategic flexibility [49]. This study contributes to the mining sector by emphasizing the importance of mediating factors like strategic flexibility and sustainability innovation. The role of strategic flexibility as a mediator is critical, given the ever-changing and unpredictable nature of the mining industry. This finding supports Teece (2017), who emphasizes the role of dynamic capabilities in creating competitive advantage [50]. By focusing on the Indonesian mining sector—often overlooked in sustainability discussions—this study addresses a gap in the literature, which has primarily concentrated on manufacturing or service sectors. Sustainability-focused innovation significantly drives improvements in sustainability performance, consistent with the conclusions of [35].

## 5- Conclusion

This study has significant implications for the mining industry, particularly in Indonesia. The results demonstrate that effective sustainability leadership is vital for enhancing sustainability performance in the complex mining industry. It shows that sustainability leadership improves organizational strategic flexibility through mechanisms such as promoting innovation, facilitating adaptive decision-making, and strengthening risk management. Furthermore, sustainability leadership mediates between strategic flexibility and sustainability innovation. This approach could enhance the

Indonesian mining sector by aligning economic, social, and environmental priorities. Organizations can boost their strategic adaptability by implementing sustainability initiatives and fostering a culture that embraces change. The study illustrates that strategic flexibility serves as a critical mediator in the dynamic and uncertain mining environment. These findings offer innovative insights for the mining sector. Sustainability innovation integrates sustainability goals into corporate strategies, especially in mining, where reducing carbon emissions and mitigating negative social impacts are imperative. This investigation focuses on the mining industry, distinct from manufacturing or services, yielding unique conclusions. Given the complex ecological and social effects of mining activities, sustainability leadership is essential for driving systemic change within PT Vale Indonesia's operations.

## 6- Declarations

### 6-1-Author Contributions

Conceptualization, R.H.; methodology, S.F.W. and F.A.S.; formal analysis, F.A.S. and R.H.; writing—original draft preparation, F.A.S. and R.H.; writing—review and editing, R.H., S.F.W., and F.A.S.; supervision, F.A.S. All authors have read and agreed to the published version of the manuscript.

### 6-2-Data Availability Statement

The data presented in this study are available on request from the corresponding author.

### 6-3-Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

### 6-4-Institutional Review Board Statement

Not applicable.

### 6-5-Informed Consent Statement

Not applicable.

### 6-6-Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been completely observed by the authors.

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