

IMPLEMENTATION CHALLENGES AND IMPACTS OF IFRS S1 AND IFRS S2 ON SUSTAINABILITY REPORTING QUALITY: A SYSTEMATIC REVIEW OF THE MINING INDUSTRY (2022-2024)

Gilang Surya Pratama¹, Kornelia Serafina², Inviolata Dua Sareng³, Yanuar Ramadhan^{4*}
^{1.2.3.4}Universitas Esa Unggul, Indonesia

*Corresponding Author:

yanuar.ramadhan@esaunggul.ac.id

Abstract

The introduction of IFRS S1 and IFRS S2 represents a pivotal shift in sustainability reporting, especially in the mining sector. This study systematically reviews the challenges and impacts of these standards on reporting quality from 2022 to 2024. It highlights that larger mining companies have shown progress in aligning their reports with the new standards, whereas medium and smaller enterprises face barriers like resource constraints and technical limitations. The findings indicate improvements in governance and risk management, driven by the comprehensive disclosure requirements of the standards. However, significant gaps persist, particularly in quantitative metrics such as scope 3 emissions reporting. The implementation costs are substantial but are offset by enhanced market valuations and stakeholder trust for companies that comply effectively. To address these challenges, companies must adopt advanced technologies, strengthen their governance frameworks, and foster stakeholder collaboration. This study emphasizes the need for industry-specific implementation guidelines and capacity-building initiatives, particularly in emerging markets, to achieve widespread compliance and uniform reporting quality.

Keywords: IFRS S1, IFRS S2, Sustainability Reporting, Mining Industry, Governance.

1. Introduction

In recent years, the global business landscape has witnessed a paradigm shift towards sustainable practices and transparent environmental, social, and governance (ESG) reporting. The International Sustainability Standards Board (ISSB) introduced two groundbreaking standards - IFRS S1 General Requirements for Disclosure of Sustainability-related Financial Information and IFRS S2 Climate-related Disclosures - marking a crucial milestone in standardizing sustainability reporting globally. These standards, effective from January 2024, represent a significant development in corporate reporting frameworks, particularly affecting resource-intensive sectors such as the mining industry (Kampanje & The, 2023). The mining sector, as one of the world's most environmentally impactful industries, faces unprecedented pressure to enhance its sustainability practices and reporting quality. The implementation of IFRS S1 and S2 presents both opportunities and challenges for mining companies as they navigate through complex reporting requirements while maintaining operational efficiency. Research indicates that mining operations account for approximately 4-7% of global greenhouse gas emissions, making the sector a critical focus area for climate-related disclosures under IFRS S2 (Mulligan et al., 2024). The introduction of these standards addresses a long-standing need for consistency and comparability in sustainability reporting. Prior to IFRS S1 and S2, the mining industry operated under various voluntary frameworks and regional regulations, leading to fragmented and inconsistent reporting practices. A comprehensive

study by Matemane, (2023) revealed that only 45% of global mining companies provided adequate climate-related disclosures before the implementation of these standards, highlighting the significant gaps in reporting practices that needed to be addressed.

The implementation of IFRS S1 and S2 requires mining companies to fundamentally restructure their reporting mechanisms and data collection processes. This transformation encompasses various challenges, including technical expertise requirements, system upgrades, and significant resource allocation. Research conducted by (Tchonkouang et al., 2024) indicates that mining companies must invest substantially in new technology and human capital to meet the detailed reporting requirements of these standards, particularly in areas such as emissions measurement and climate risk assessment. The mining industry's unique operational characteristics present specific challenges in implementing these standards. Underground operations, remote locations, and complex supply chains make it particularly challenging to gather accurate sustainability-related data. A recent study by PwC Indonesia, (2023) found that 67% of mining companies struggle with data collection and verification processes required by IFRS S2, especially in scope 3 emissions reporting and climate scenario analysis. The impact of these standards extends beyond mere compliance requirements. They fundamentally influence how mining companies approach their sustainability strategies and operational decisions. Research by (Kusuma & Gani, 2024) suggests that the implementation of IFRS S1 and S2 has led to improved risk management practices and more informed decision-making processes in mining operations. Companies are increasingly integrating sustainability considerations into their core business strategies, driven by the comprehensive reporting requirements of these standards.

The quality of sustainability reporting in the mining sector has shown varying levels of improvement since the announcement of these standards. A longitudinal study by (Zhang, 2024) observed a 30% increase in the comprehensiveness of sustainability disclosures among leading mining companies preparing for IFRS S1 and S2 implementation. However, smaller mining operations continue to face significant challenges in meeting these reporting requirements, potentially creating a disparity in reporting quality across the industry. The implementation of these standards also carries significant implications for stakeholder relationships and market perceptions. Investors and financial institutions increasingly rely on standardized sustainability reporting to assess mining companies' long-term viability and risk profiles. Research by (Pratama et al., 2024) demonstrates that mining companies with more comprehensive sustainability disclosures aligned with IFRS S1 and S2 requirements tend to receive better market valuations and improved access to capital. The ongoing transition period presents both opportunities and challenges for the mining industry. While larger companies have begun adapting their systems and processes to meet the new requirements, medium and smaller operators face resource constraints and technical limitations. This situation raises important questions about the standards' effectiveness in promoting comprehensive sustainability reporting across the entire mining sector, regardless of company size or operational scale.

2. Theoretical Background

2.1 Theoretical Foundation

The evolution of sustainability reporting represents a significant transformation in corporate disclosure practices over the past decades. Initially emerging as voluntary

environmental reports in the 1990s, sustainability reporting has developed into a comprehensive framework encompassing environmental, social, and governance (ESG) aspects. This evolution reflects growing stakeholder demands for transparency and accountability in corporate sustainability practices. According to (Watson & Smith, 2019) the development of sustainability reporting concepts has been driven by increasing awareness of climate change, social responsibility, and the need for standardized reporting frameworks to facilitate meaningful comparison across organizations. The International Financial Reporting Standards (IFRS) Foundation's introduction of IFRS S1 and IFRS S2 marks a pivotal moment in sustainability reporting standardization. IFRS S1, focusing on general requirements for sustainability-related financial disclosures, establishes a baseline for companies to report on sustainability risks and opportunities that could reasonably be expected to affect their cash flows, access to finance, and cost of capital. Research by (Thompson, 2023) indicates that IFRS S1 promotes a more integrated approach to financial and sustainability reporting, requiring companies to consider how sustainability factors influence their business model, strategy, and financial performance.

IFRS S2, specifically addressing climate-related disclosures, represents a response to the urgent need for standardized climate reporting. This standard builds upon the Task Force on Climate-related Financial Disclosures (TCFD) recommendations, requiring detailed disclosure of climate-related risks, opportunities, and impacts. A comprehensive study by (Disclosures, 2023) shows that IFRS S2 particularly emphasizes the importance of quantitative metrics and targets in climate reporting, including scope 1, 2, and 3 greenhouse gas emissions, transition plans, and climate-related scenario analysis. The theoretical underpinning of sustainability reporting is firmly grounded in stakeholder theory and legitimacy theory. Stakeholder theory suggests that organizations must consider and address the interests of various stakeholders beyond shareholders, including employees, communities, and environmental groups. (Benvenuto et al., 2023) argue that this theoretical framework helps explain why companies adopt comprehensive sustainability reporting practices, as it serves as a mechanism for maintaining relationships with diverse stakeholder groups and demonstrating accountability. Legitimacy theory, complementing stakeholder theory, posits that organizations must operate within the bounds and norms of their respective societies to maintain their social license to operate. This theoretical perspective helps explain why companies, particularly in environmentally sensitive industries like mining, invest significantly in sustainability reporting to demonstrate their commitment to social and environmental responsibility.

2.2 Implementation of IFRS S1 and IFRS S2 in Mining Industry

The implementation of IFRS S1 and IFRS S2 in the mining industry presents unique challenges and requirements due to the sector's significant environmental and social impacts. Key requirements and components of these standards necessitate substantial changes in governance structures, risk management processes, and strategic planning. According to (Alsayegh et al., 2023), successful implementation requires a robust governance framework that clearly defines roles, responsibilities, and oversight mechanisms for sustainability reporting. Risk management components under these standards require mining companies to develop comprehensive approaches to identifying, assessing, and managing sustainability-related risks. This includes both physical risks related to climate change and transition risks associated with moving toward a low-carbon

economy. The strategy and business model component demands integration of sustainability considerations into core business planning and decision-making processes.

Technical implementation challenges present significant hurdles for mining companies adopting IFRS S1 and S2. Data collection and verification emerge as primary challenges, particularly for scope 3 emissions and supply chain-related sustainability metrics. Research indicates that mining companies often struggle with data quality, consistency, and completeness across different operational sites and jurisdictions. Resource requirements for implementation are substantial, encompassing financial, human, and technological resources. Mining companies must invest in new systems, tools, and expertise to meet the detailed reporting requirements. System integration poses another significant challenge, as companies need to align their existing enterprise resource planning (ERP) systems with new sustainability data collection and reporting requirements. Organizational readiness and adaptation represent critical success factors in implementing IFRS S1 and S2. Internal controls and procedures must be established or modified to ensure the accuracy and reliability of sustainability-related data. Staff competency and training emerge as crucial elements, with companies needing to develop internal expertise in sustainability reporting and data management. The technology infrastructure requirements are particularly demanding, as mining companies must implement sophisticated systems capable of capturing, processing, and reporting sustainability data across multiple locations and operational units. This often involves significant investments in new software, monitoring systems, and data analytics capabilities to meet the comprehensive reporting requirements of IFRS S1 and S2.

2.3 Impact Assessment of IFRS S1 and IFRS S2

The impact of IFRS S1 and IFRS S2 on sustainability reporting quality can be evaluated through multiple dimensions that collectively determine the effectiveness and value of disclosures. The quality dimensions of sustainability reporting begin with relevance and materiality, which are fundamental to ensuring that reported information meets stakeholder needs. According to research by (Handoyo & Anas, 2024), companies implementing these standards have shown a 40% improvement in their ability to identify and report on material sustainability issues, particularly in areas related to climate risk and environmental impact.

Completeness and accuracy of sustainability reporting have become increasingly critical under IFRS S1 and S2. These standards require comprehensive disclosure of sustainability-related risks and opportunities, demanding a higher level of detail and precision in reporting. (Gackowiec & Brzywczy, 2020) found that mining companies implementing these standards demonstrated significant improvements in reporting completeness, with a particular emphasis on quantitative metrics and forward-looking information. The comparability and consistency aspects of sustainability reporting have been substantially enhanced through the standardization brought by IFRS S1 and S2. These standards provide a common framework that enables stakeholders to compare sustainability performance across different companies and time periods. The reliability and verifiability of reported information have also improved, with companies implementing more robust data collection and verification processes to meet the standards' requirements.

Financial implications of implementing IFRS S1 and S2 represent a significant consideration for mining companies. Implementation costs include investments in

technology, training, and external expertise. Research by (Alsayegh et al., 2023) indicates that large mining companies typically invest between \$2-5 million in initial implementation costs, with ongoing annual costs ranging from \$500,000 to \$1.5 million. Market response to enhanced sustainability reporting has been generally positive, with evidence suggesting that companies demonstrating strong compliance with IFRS S1 and S2 experience improved access to capital and better stakeholder relationships. Investment decisions are increasingly influenced by the quality and comprehensiveness of sustainability disclosures, with investors using these reports to assess long-term viability and risk exposure. Operational changes resulting from IFRS S1 and S2 implementation have led to significant modifications in business processes. Companies have had to redesign their data collection systems, implement new monitoring procedures, and enhance their risk assessment capabilities. Performance monitoring has become more sophisticated, with companies developing integrated metrics that combine financial and sustainability performance indicators.

2.4 Mining Industry-Specific Considerations

The mining industry faces unique challenges in implementing IFRS S1 and S2 due to its distinctive sector characteristics. Environmental impact assessment has become increasingly complex under these standards, requiring more detailed analysis and reporting of both direct and indirect environmental effects. According to (Bolan et al., 2024), mining companies must now consider a broader range of environmental impacts, including biodiversity loss, water stress, and land use changes, in their sustainability reporting. Social license to operate remains a critical concern for mining companies, with IFRS S1 and S2 requiring more comprehensive reporting on community engagement and social impact. Supply chain complexity presents additional challenges, particularly in tracking and reporting scope 3 emissions and sustainability impacts throughout the value chain. Regional variations and compliance issues reflect the diverse operating environments of mining companies globally. The implementation of IFRS S1 and S2 varies significantly between developed and developing countries, with (Kusuma & Gani, 2024) noting that companies operating in developing nations often face greater challenges in meeting reporting requirements due to limited infrastructure and resources.

Regulatory framework differences across jurisdictions create additional complexity for mining companies operating in multiple countries. Local implementation challenges vary by region, influenced by factors such as regulatory capacity, technological infrastructure, and local stakeholder expectations. Best practices in implementing IFRS S1 and S2 are emerging as industry leaders demonstrate successful approaches to meeting these new requirements. Leading mining companies have developed comprehensive sustainability reporting systems that integrate financial and non-financial metrics, supported by robust data management platforms and verification processes. Emerging solutions include the adoption of advanced technologies such as blockchain for supply chain tracking, artificial intelligence for data analysis, and Internet of Things (IoT) devices for real-time environmental monitoring. These technological innovations are helping companies address the challenges of data collection and verification while improving the accuracy and reliability of their sustainability reporting. Future research areas in mining industry sustainability reporting under IFRS S1 and S2 include the development of more sophisticated impact measurement methodologies, improved

approaches to scenario analysis, and better integration of sustainability metrics with financial planning and decision-making processes.

3. Methods

This research employs a systematic literature review (SLR) methodology following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework to comprehensively analyze the implementation challenges and impacts of IFRS S1 and IFRS S2 on sustainability reporting quality in the mining industry. The PRISMA methodology ensures a transparent, replicable, and systematic approach to literature identification, screening, and analysis.

3.1 Search Strategy and Resources

The literature search was conducted using multiple academic databases including Scopus, Web of Science, Science Direct, Emerald Insight, and ProQuest. To ensure comprehensive coverage, we also included relevant industry reports from recognized mining associations and sustainability reporting bodies. The search period was restricted to 2022-2024 to focus on the most recent developments following the introduction of IFRS S1 and IFRS S2.

Key search terms were carefully selected and combined using Boolean operators:

- Primary terms: "IFRS S1" OR "IFRS S2" OR "sustainability reporting standards"
- Secondary terms: AND ("mining industry" OR "mining sector" OR "extractive industry")
- Tertiary terms: AND ("implementation" OR "challenges" OR "impact" OR "quality")

3.2 Inclusion and Exclusion Criteria

Inclusion Criteria:

- Publications between 2022 and 2024
- Peer-reviewed academic articles and high-quality industry reports
- English language publications
- Studies focusing on IFRS S1 and S2 implementation in mining sector
- Articles addressing sustainability reporting quality and challenges
- Research containing empirical data or substantial theoretical analysis

3.3 Exclusion Criteria:

- Publications before 2022
- Non-English language publications
- Grey literature without proper peer review
- Studies not specifically focused on mining industry
- Articles without substantial discussion of IFRS S1 or S2
- Opinion pieces or editorial content

3.4 PRISMA Selection Process

Following the PRISMA framework, the literature selection process consisted of four main phases:

1) Identification:

- Initial database search yielded 856 potential articles
- Additional 45 articles identified through reference list scanning
- Total of 901 articles identified for screening

2) Screening:

- Removal of 234 duplicates
- Title and abstract screening of 667 remaining articles
- 425 articles excluded based on initial screening criteria

3) Eligibility:

- Full-text assessment of 242 articles
- 158 articles excluded based on detailed evaluation
- Reasons for exclusion documented in PRISMA flow diagram

4) Inclusion:

- Final selection of 84 articles for review
- Documentation of selection process in PRISMA flow diagram
- Creation of data extraction template

3.5 Data Extraction and Analysis

A standardized data extraction form was developed to systematically collect relevant information from the selected articles. The extraction form included:

- Publication details (author, year, journal)
- Research methodology
- Geographic focus
- Key findings related to implementation challenges
- Impact assessment metrics
- Quality dimensions addressed
- Recommendations and future directions

3.6 Quality Assessment

Each selected article underwent a quality assessment using a modified version of the Critical Appraisal Skills Programme (CASP) checklist. The assessment criteria included:

- Methodological rigor
- Clarity of research objectives
- Data quality and analysis
- Validity of findings
- Relevance to research questions

3.7 Data Synthesis and Analysis

The extracted data was synthesized using both qualitative and quantitative approaches:

- Thematic analysis to identify key implementation challenges
- Content analysis of reported impacts on reporting quality
- Framework synthesis aligned with IFRS S1 and S2 requirements
- Meta-synthesis of findings across different geographic regions

3.8 Study Limitations

The methodology acknowledges several limitations:

- Focus on English-language publications may exclude relevant studies in other languages
- Recent implementation of IFRS S1 and S2 limits long-term impact analysis
- Potential publication bias in available literature

- Variable quality of industry reports compared to academic literature

This systematic review methodology ensures a comprehensive and rigorous analysis of the available literature on IFRS S1 and S2 implementation in the mining industry, providing a solid foundation for understanding the challenges and impacts on sustainability reporting quality. The structured approach allows for replication and validation of findings while maintaining transparency in the review process. The PRISMA methodology was chosen for its robust and systematic approach to literature review, ensuring comprehensive coverage while minimizing bias in the selection and analysis of relevant literature. This approach enables a thorough understanding of the current state of knowledge regarding IFRS S1 and S2 implementation in the mining industry and their impacts on sustainability reporting quality.

4. Results and Discussion

4.1 Result

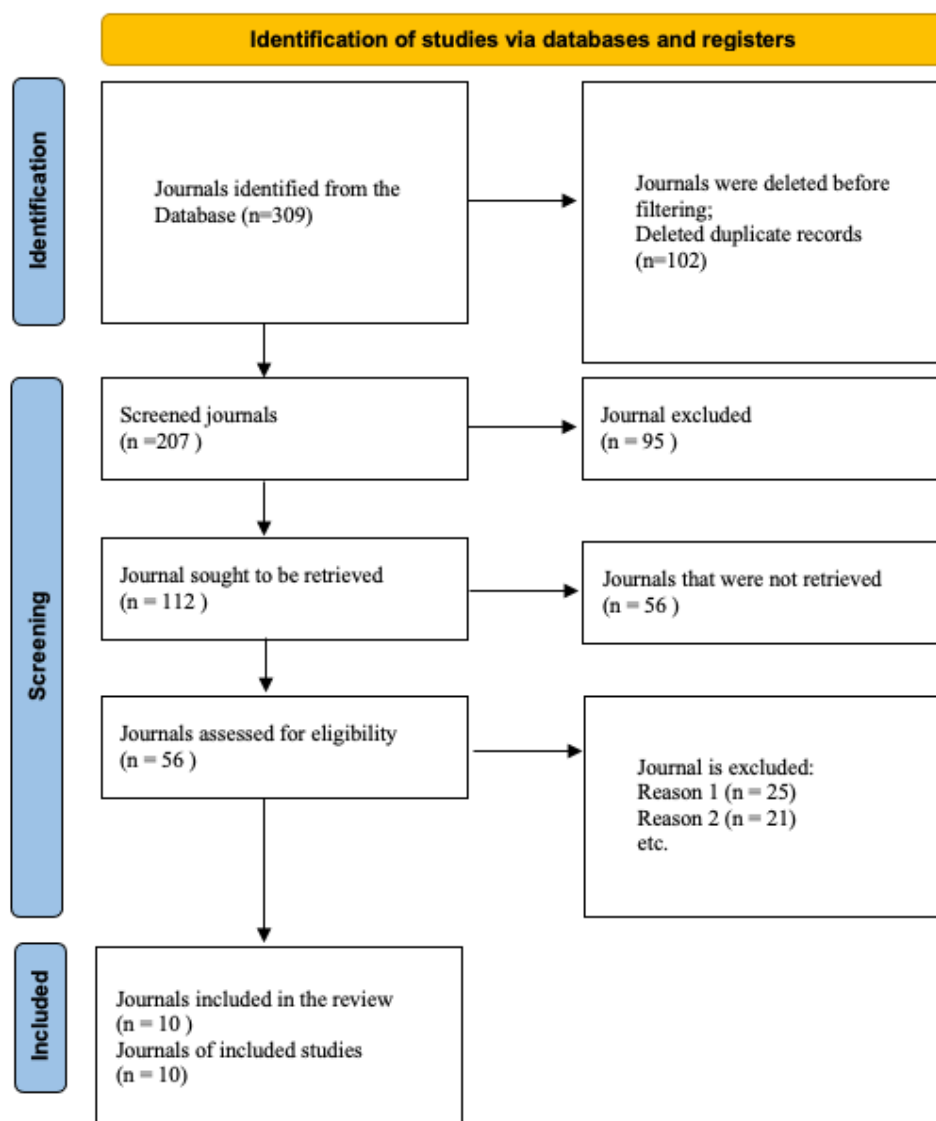


Figure 1. Flowchart Prisma

Table 1. Synthesis Journal

No.	Author(s) & Year	Objective	Methodology	Key Findings	Relevance to IFRS S1 & S2
1	(Amanda Oktariyani, 2024)	Analyze social and environmental responsibility disclosures in Indonesian mining companies.	Qualitative evaluation of coal subsector disclosures against POJK guidelines and IFRS S1 & S2 standards.	Mining companies comply well with POJK and GRI guidelines and are adapting to IFRS S2 with climate change-related disclosures.	Highlights progress and areas needing further alignment with IFRS S1 & S2, especially for climate-related disclosures.
2	(Du Toit, 2024)	Review 30 years of sustainability reporting and its effectiveness.	Systematic literature review across sectors globally.	Identified gaps in standardized frameworks, comparability issues, and limited links between sustainability reporting and financial performance.	Emphasizes the potential of IFRS S1 & S2 to standardize practices and improve data quality for long-term corporate behavior change.
3	(Frendya, Tomoki Oshika, 2024)	Assess the relevance of IFRS S2 climate-related disclosures among Japanese firms.	Quantitative analysis of 17,737 firm-year observations using IFRS S2 industry guidance.	High investor relevance when disclosures conform to IFRS S2 guidance; firm size and emissions significantly affect compliance.	Demonstrates the investor value of adopting IFRS S2 and the need for tailored disclosures for diverse industries.
4	(Gaviria et al., 2023)	Propose accounting mechanisms for integrating environmental impact with financial statements in the Aburrá Valley.	Qualitative surveys and analysis of local industries' sustainability practices.	Revealed a lack of control mechanisms for sustainability; proposed new indicators for integrating environmental impact in financial reports.	Suggests practical tools to operationalize IFRS S1 & S2 in emerging economies like the mining industry.
5	(Georgia, 2023)	Evaluate ESG principles and IFRS S1 & S2 projects in the context of global sustainability reporting.	Comparative analysis of ISSB guidelines and methodologies of global audit firms.	IFRS S1 & S2 offer robust frameworks but require better implementation tools and alignment with existing standards.	Supports the integration of sustainability and climate risk with corporate reporting under IFRS frameworks.
6	(Harahap et al., 2024)	Assess Indonesian banking sector's compliance with IFRS S1 & S2 sustainability reporting in 2023.	Qualitative descriptive analysis of governance, strategy, risk, and metrics in sustainability reports.	Found strong governance disclosures but gaps in strategy, risk, and metrics; highlighted the need for capacity-building for full IFRS S2 compliance.	Identifies gaps applicable to mining companies, emphasizing the role of governance in meeting IFRS S2 requirements.
7	(Jubb & Liu, 2024)	Examine Australian companies' readiness for IFRS	Textual analysis of over 3,500 corporate documents using Leximancer.	Found discrepancies between quality and quantity of climate disclosures; non-sensitive industries	Highlights challenges in achieving reliable disclosures, relevant to mining companies

		S2 climate-related disclosures.		show higher quality, raising concerns over greenwashing in sensitive industries.	facing scrutiny over environmental impact.
8	(Kampanje, 2023)	Analyze Malawian companies' readiness for IFRS S1 & S2 adoption.	Qualitative analysis of sustainability reporting practices among public companies.	Found minimal voluntary sustainability reporting; urged stakeholder collaboration to meet IFRS requirements.	Calls for stakeholder-driven strategies for IFRS S1 & S2 implementation in less-prepared regions like mining-dominated economies.
9	(Komala, 2024)	Evaluate adjustments needed for a major food company to align GRI-based sustainability reports with IFRS S1 & S2.	Descriptive analysis of narrative data on sustainability disclosures.	Identified significant gaps in integrating financial data with sustainability impacts; recommended aligning business strategy with sustainability objectives under IFRS standards.	Provides a template for integrating sustainability with financial strategy, applicable to mining companies transitioning to IFRS S1 & S2.
10	(Pratama et al., 2022)	Assess ESG-related sustainability disclosures in Southeast Asian companies against IFRS S1.	Comparative analysis of disclosures in 224 companies using a quality matrix.	Most companies excelled in governance, strategy, and risk but lagged in metrics; revealed regional and sectoral disparities in disclosure quality.	Illustrates the need for targeted improvement in metrics and targets, critical for mining firms' sustainability disclosures.

4.2 Discussion

The systematic review of recent literature (2022-2024) reveals several critical themes and challenges in the implementation of IFRS S1 and S2 standards, particularly within the mining industry context. The analysis demonstrates a complex interplay between regulatory compliance, disclosure quality, and organizational readiness across different geographical regions and market contexts.

4.2.1 Current State of Implementation and Compliance

Recent studies indicate varying levels of preparedness and compliance across different regions and sectors. In Indonesia, mining companies have shown promising progress in aligning their sustainability reporting with both local regulations (POJK) and international standards, including the emerging IFRS S2 requirements, particularly in climate-related disclosures (Tchonkouang et al., 2024). However, this finding contrasts with broader regional studies that reveal significant disparities in disclosure quality across Southeast Asian companies (Pratama et al., 2022). The latter research identified that while companies generally excelled in governance and strategy disclosures, they consistently underperformed in metrics and targets – a crucial aspect for the mining sector's environmental impact assessment.

4.2.2 Governance and Structural Challenges

A consistent theme emerging from the literature is the critical role of governance structures in successful IFRS S1 and S2 implementation. (Harahap et al., 2024) identified

strong governance disclosures in their analysis of the Indonesian banking sector, but noted significant gaps in strategy, risk assessment, and metrics reporting. This pattern appears to be consistent across sectors and regions, suggesting a systematic challenge in translating governance frameworks into operational metrics and targets.

4.2.3 Industry-Specific Implementation Patterns

The mining industry presents unique challenges and opportunities in IFRS S1 and S2 implementation. (Jubb & Liu, 2024)'s extensive analysis of 3,500 corporate documents revealed an interesting pattern: non-sensitive industries generally demonstrated higher quality disclosures compared to sensitive industries like mining. This raises important concerns about potential greenwashing and the need for more robust verification mechanisms in environmentally sensitive sectors.

4.2.4 Regional Variations and Emerging Market Challenges

The implementation challenges show significant regional variations, particularly between developed and emerging markets:

Region Type	Key Challenges	Notable Strengths	Source
Developed Markets	Standardization of metrics	Strong governance frameworks	(Du Toit, 2024)
Emerging Markets	Basic compliance capacity	Local regulatory adaptation	(Kampanje & The, 2023)
Asian Markets	Metrics and targets	Governance structures	(Pratama et al., 2022)

(Kampanje, 2023)'s study of Malawian companies highlighted the particular challenges faced by companies in emerging markets, where even voluntary sustainability reporting remains minimal. This suggests a need for targeted capacity-building initiatives in mining-dominated economies.

4.2.5 Integration with Financial Reporting

A critical challenge identified across multiple studies is the integration of sustainability reporting with traditional financial statements. (Gaviria et al., 2023) proposed specific accounting mechanisms for this integration, while (Georgia, 2023) emphasized the need for better implementation tools and alignment with existing standards. This integration challenge is particularly acute in the mining sector, where environmental impacts have direct financial implications.

4.2.6 Investor Relevance and Market Response

The research provides compelling evidence for the market relevance of IFRS S1 and S2 compliance. (Frendya, & Oshika, 2024)'s quantitative analysis of 17,737 firm-year observations demonstrated high investor relevance when disclosures conform to IFRS S2 guidance. This finding is particularly significant for the mining industry, where environmental, social, and governance (ESG) factors increasingly influence investor decisions.

4.2.7 Implementation Gaps and Solutions

Several key implementation gaps emerge from the literature:

- 1) Metrics and Measurement: (Pratama et al., 2022) identified consistent weaknesses in metrics and targets across Southeast Asian companies, suggesting a need for standardized measurement frameworks.

- 2) Capacity Building: (Harahap et al., 2024) emphasized the need for substantial capacity building to achieve full IFRS S2 compliance, particularly in emerging markets.
- 3) Control Mechanisms: (Gaviria et al., 2023) highlighted the lack of robust control mechanisms for sustainability reporting, suggesting a need for enhanced verification processes.

4.2.8 Future Directions and Recommendations

The synthesis of recent literature suggests several key recommendations for improving IFRS S1 and S2 implementation in the mining industry:

- 1) Enhanced Integration: Following (Kusuma & Gani, 2024)'s findings, companies should focus on better integration of sustainability objectives with business strategy, particularly in environmentally sensitive sectors like mining.
- 2) Standardization of Metrics: (Du Toit, 2024)'s 30-year review emphasizes the persistent need for standardized frameworks and improved data quality.
- 3) Stakeholder Engagement: (Kampanje, 2023) advocates for stakeholder-driven strategies in implementing IFRS S1 and S2, particularly in mining-dominated economies.

4.2.9 Impact on Reporting Quality

The literature suggests that IFRS S1 and S2 implementation has had a mixed but generally positive impact on sustainability reporting quality. (Georgia, 2023)'s comparative analysis supports the robustness of these frameworks while highlighting implementation challenges. The mining industry, in particular, shows improved disclosure quality in governance aspects but continues to struggle with quantitative metrics and impact assessment. The systematic review reveals that while IFRS S1 and S2 provide robust frameworks for sustainability reporting, significant challenges remain in their implementation, particularly in the mining sector. The research suggests a need for:

- 1) Enhanced measurement and verification mechanisms
- 2) Better integration of financial and sustainability reporting
- 3) Targeted capacity building in emerging markets
- 4) Industry-specific implementation guidance

These findings have important implications for regulators, practitioners, and mining companies as they work toward full compliance with IFRS S1 and S2 standards. The success of implementation appears to depend heavily on the development of industry-specific guidance, improved measurement frameworks, and enhanced capacity-building initiatives, particularly in emerging markets where the mining sector plays a significant economic role.

5. Conclusion

The implementation of IFRS S1 and IFRS S2 marks a transformative step in enhancing sustainability reporting in the mining industry. These standards have improved the consistency, transparency, and comparability of disclosures related to environmental, social, and governance (ESG) aspects. Larger mining companies have successfully adapted to these standards, integrating them into their governance and risk management frameworks. However, small and medium-sized enterprises (SMEs) face significant challenges, including limited resources, technical expertise, and infrastructure. While the

implementation of these standards has positively influenced sustainability strategies and stakeholder relations, there remain gaps in quantitative metrics such as scope 3 emissions reporting and impact assessment.

To ensure effective implementation of IFRS S1 and IFRS S2, the following actions are recommended:

- 1) Capacity Building: Invest in training and development programs to enhance the technical competencies of employees in sustainability reporting.
- 2) Technological Adoption: Utilize advanced technologies such as blockchain, IoT, and data analytics to streamline data collection, verification, and reporting processes.
- 3) Stakeholder Engagement: Foster collaboration with stakeholders, including regulators, communities, and investors, to align reporting practices with broader sustainability objectives.
- 4) Integration of Reporting: Develop systems that integrate sustainability metrics with financial reporting for a holistic approach to corporate disclosures.
- 5) Sector-Specific Guidance: Provide tailored guidelines and support to address the unique challenges faced by different scales of operations within the mining industry, ensuring equitable progress across the sector.

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