

# From Blueprint to Balance Sheet: The Importance of Sustainability Reports in Engineering Projects and Their Impact on Financial Performance - A Systematic Review

Sendi Nopita Sari<sup>1</sup>, Luhur Adi Prasetya<sup>2</sup>

<sup>1</sup>Master of Accounting, Faculty of Economics and Business, Brawijaya University <sup>2</sup>Master of Vocational Education, Postgraduate School, State University of Malang <sup>1</sup>nopitasari1602@gmail.com, <sup>2</sup>luhuradiprasetya\*

# Abstract

This study aims to evaluate the impact and strategies of integrating sustainability reporting (SR) on the financial performance of engineering projects through a Systematic Literature Review (SLR) approach using the SPAR-4-SLR model. A total of 25 selected articles published between 2019 and 2025 were analyzed using thematic synthesis with the assistance of NVivo 12 software. The results of the analysis indicate that SR not only enhances transparency but also makes a positive contribution to return on investment (ROI), cost efficiency, and investor confidence. The most effective reporting strategies generally use the Global Reporting Initiative (GRI) and Environmental, Social, and Governance (ESG) frameworks, often combined with digital technologies such as artificial intelligence (AI) and blockchain. However, stakeholder engagement still receives insufficient attention, despite data indicating that active community participation can reduce project rejection risks by up to 35%. An evaluation of the quality of the reviewed articles indicates that most use robust methodologies and produce consistent findings. As such, SR plays a crucial role in strengthening the sustainability governance and financial performance of engineering projects. The research findings recommend integrating data-driven and participatory SR approaches as core pillars in socially and environmentally responsible project management practices.

Keywords: Sustainability Reporting, Engineering Project Accounting, Project Financial Performance, ESG in Engineering, Engineering Project Audit

#### 1. Introduction

In the last two decades, there has been a paradigm shift in engineering project management from a purely technical output-based approach to a more holistic and sustainability-responsible approach. Engineering sectors such as construction, infrastructure, energy, and manufacturing are now not only required to deliver projects on time and within budget, but also to consider environmental, social, and governance (ESG) impacts comprehensively throughout the project lifecycle [1]. This shift is reflected in the increasing number of global policies that require the integration of sustainability in all stages of a project, as Nylén [2] demonstrated through their study in the construction sector. Sustainability reporting has thus evolved into a strategic tool to communicate social responsibility and project impacts while building stakeholder trust, as described by Matuszyk and Rymkiewicz [3], who found that projects that actively report ESG metrics are more likely to gain community and investor acceptance. In practice, many engineering projects refer to frameworks such as GRI Standards, ISO 26000, or ESG metrics from global financial institutions [4]. Nevertheless, barriers to implementation remain. Pambudi et al. [5] underline that many projects still experience difficulties in translating ESG indicators into project activities that can be directly measured and evaluated. This is exacerbated by the lack of technical training and limited human resources in systematically managing ESG data, especially in projects located in developing countries.

Empirical studies show that the integration of sustainability reporting can improve organizational reputation and lower the cost of capital. For example, Mazzioni et al. [6] assert that companies that consistently disclose sustainability reporting tend to obtain financing at lower interest rates. However, as Bornemann and Strassheim [7] point out, these studies have largely focused on the organizational level and have not touched much on the context of engineering projects. The temporary, cross-organizational, and contract-based characteristics of projects make the dynamics of sustainability reporting different compared to permanent companies. Nguyen and Macchion [8] show that large-scale construction projects that include sustainability reporting experience reduced litigation

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risk and contract extensions, but do not explain the mechanism of how such reporting leads to financial efficiency. On the other hand, a report by Ahadiat et al. [9] shows that the integration of sustainability reporting can accelerate project approval cycles, which results in accelerated cash flow and reduced operational downtime. Dong et al. [10] attempted to close this gap by developing a quantitative model to link the level of ESG reporting with a project's net present value (NPV), which showed a positive and significant correlation. These findings illustrate that while initial evidence is promising, a deeper understanding of the linkage process between reporting and financial outcomes still needs to be expanded.

The main problem with these findings lies in the fragmentation of data and the lack of a scientific synthesis base. So far, there is no systematic literature review that summarizes the practice of integrating sustainability reporting in engineering projects across sectors and regions. Azmat and Siddiqui [11] reveal that previous studies are too focused on local contexts and do not offer conceptual models that can be applied across contexts. In addition, as noted by Goel et al. [12], there is no evaluation framework capable of measuring the causal relationship between sustainability reporting and project financial performance. Troshani and Rowbottom's [13] study shows that implementing sustainability reporting in infrastructure projects helps material procurement efficiency and reduces the cost of logistics wastage. However, the generalizability of these findings is limited as not all projects are similar in scale and complexity. In a further study, Prasetya et al. [14] also highlighted the lack of active stakeholder participation as a limiting factor for the effectiveness of sustainability reporting in the field. Therefore, this article serves as a scholarly response to address this void, by designing a systematic literature review that not only maps the implementation of sustainability reporting in engineering projects, but also provides an in-depth understanding of its impact and determinants of success.

To answer this question, this article uses a Systematic Literature Review (SLR) approach based on the SPAR-4-SLR (Scientific Procedures and Rationales for Systematic Literature Reviews) model developed by Paul et al. [15] to improve the quality of synthesis in engineering and project management. This approach consists of six main stages: framing research, formulating review questions, locating and selecting literature, assessing quality, synthesizing findings, and reporting the review. Article searches were conducted through reputable databases such as Scopus and Web of Science using Boolean strings based on main keywords such as "sustainability reporting", "engineering projects", and "financial performance". Careful screening of the literature was conducted based on inclusion-exclusion criteria that included the context of engineering projects, the involvement of financial indicators, and the use of formal reporting frameworks [16]. Selected articles were then analyzed using thematic synthesis as done in Paolone and Bitbol-Saba's [17] study, which categorized results into quantitative and qualitative outcomes. Visualization of relationships between findings was done with concept maps to illustrate the interactions between reporting elements, project context and financial outcomes as suggested by Bagh et al. [18]. In addition, this study also refers to the principle of literature triangulation to ensure the accuracy of the synthesis between findings. The end result is expected to answer three main questions: what is the integration of sustainability reporting in engineering projects, what is its impact on financial performance, and what factors strengthen or weaken the link between the two.

2. Research Methods

# 2.1. Research Design

This study uses the Systematic Literature Review (SLR) approach with the SPAR-4-SLR model, which consists of six systematic stages: framing the research, formulating review questions, locating and selecting literature, assessing quality, synthesizing findings, and reporting the review [15]. Each stage serves as a methodological guide for framing appropriate research questions, screening and assessing the quality of the literature, and synthesizing findings. This model was chosen because it can support credible and replicable studies, especially in the context of sustainability reporting on engineering projects that require integration of scientific evidence across studies.



Figure 1. SPAR-4-SLR (Scientific Procedures and Rationales for Systematic Literature Reviews)

# 2.2. Research Question

This study focuses on the link between environmental transparency and financial performance in engineering projects through analyzing sustainability reporting practices in a multidisciplinary and cross-country context. Sustainability reporting is now understood not just as a regulatory obligation, but as a corporate communication strategy on ESG (environmental, social and governance) principles. As global demands for sustainable business practices increase, it is important to evaluate the contribution of sustainability reporting to project efficiency and financial success. This study also considers context variables such as industry type and project location to formulate the key questions in this systematic review. Three main questions were formulated in this study:

- a. How is sustainability reporting integrated in engineering projects across sectors and countries?
- b. What impact does sustainability reporting have on the financial performance of engineering projects (e.g. ROI, cost efficiency)?
- c. What contextual factors influence the strength of the relationship between sustainability reporting and project financial performance?

# 2.3. Literature Search Procedure

This study searched articles through four major databases-Scopus, Web of Science, SINTA, and Google Scholarto obtain relevant and high-quality literature. Keywords such as "sustainability reporting", "engineering project", "financial performance" and "ESG disclosure" were used with Boolean AND and OR operators to increase the precision and scope of the search. For example, the combination of "sustainability reporting" AND "engineering project" narrows the results to related topics, while "financial performance" OR "ESG disclosure" captures variations of the term. This strategy was designed to capture up-to-date and in-depth scientific publications and support the literature synthesis in this study. Article selection followed the PRISMA [19] [20] [21] [22] flow shown in the following diagram:



Figure 2: Article selection following the PRISMA flow

The article selection stage in this study was an important process to ensure only relevant, quality literature that met the inclusion criteria was analyzed further. Selection was multistep, starting from initial identification of search results in the four databases to full-text analysis. This process included screening for duplication, reviewing titles and abstracts to assess topic suitability, and evaluating article content to ensure substantial merit. All stages were conducted in a systematic, transparent and accountable manner in accordance with SPAR-4-SLR principles, in order to produce a credible and reliable synthesis of the literature. To provide a clear and measurable picture of the literature screening flow, details of the selection process are presented systematically in Table 1.

Table 1. Article Selection	n Process
Selection Stages	Number of Articles
Identification (Scopus & WoS)	520
After duplicate removal	472
Filtered by title & abstract	205
Full-text analyzed	75
Articles that met the inclusion criteria	25

#### 2.4. Inclusion and Exclusion Criteria

To ensure only quality and relevant literature is included, the screening process in this study follows strict inclusion and exclusion criteria. Articles had to be published between 2019-2025, written in English, be empirical (quantitative, qualitative, or mixed-method), focus on engineering projects, and use sustainability reporting frameworks such as GRI, ESG, or TCFD. Articles must also come from journals indexed in Scopus, Web of Science, SINTA, or Google Scholar. Meanwhile, non-empirical articles, not related to engineering projects, or without financial outcomes and explicit sustainability reporting frameworks, were excluded. This approach ensures the validity of the context and scientific contributions in the literature synthesis.

- a. Inclusion Criteria
- 1) Publication year 2019-2025
- 2) Speak English
- 3) Empirical study (quantitative, qualitative, or mixed-method)
- 4) Focus on engineering projects (not the organization in general)
- 5) Using sustainability reporting frameworks (GRI, ESG, TCFD, etc.)
- 6) Indexed in Scopus, Web of Science, SINTA, or Google Scholar

- b. Exclusion Criteria
- 1) Non-systematic review article, opinion, editorial
- 2) Not relevant to the context of the engineering project
- 3) Does not present a clear financial outcome or reporting framework

# 2.5. Study Quality Assessment

The quality evaluation of the articles in this study was conducted using a Likert scale of 1-4 on four main criteria: relevance of the content to sustainability reporting in engineering projects, strength of the methodology, use of international reporting frameworks (GRI, ESG, TCFD), and completeness of the results, including financial and technical aspects. Each aspect was scored 1-4 with a maximum total of 16 points. Articles with a minimum score of 12 are considered worthy of further analysis. This approach was designed to ensure objectivity, accuracy and validity in the literature selection, and to guarantee that only high-quality articles were used in the synthesis of the systematic review.

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No.	Evaluation Criteria	Score 1 (Very Low)	Score 2 (Low)	Score 3 (High)	Score 4 (Very High)
1	Clarity of Research Objectives	Objective not explained at all	Unspecific and vague objectives	Objectives are explained clearly enough	Objectives are described explicitly and sharply
2	Appropriateness of Methodology Design	No explanation of methodology	The methodology is described very generally	The methodology is explained well enough	Methodology is very detailed and fit for purpose
3	Data Availability and Quality	Data not available / not verified	Limited and sketchy data available	Data is available with a neat structure	Data is complete, detailed, and credible
4	Consistency of Findings and Conclusions	Not consistent at all	Low consistency / ambiguous conclusions	Consistent in general	Conclusions are very logical, strong, and supported by data

Table 2. Study Quality Assessment Criteria (Likert Scale 1-4)

### 2.6. Data Extraction and Synthesis

The data extraction process in this study was conducted systematically using a structured form that included six main components: article identity, study location, sector or type of engineering project, type of sustainability reporting framework (GRI, ESG, TCFD), financial performance indicators (ROI, ROA, profitability, cost efficiency), and key results related to the relationship between sustainability reporting and financial performance. The data collected was then thematically analyzed using NVivo 12, enabling the identification of patterns and relationships between themes to formulate key findings in a qualitative and evidence-based manner. NVivo Code Categories and Sub-Categories:

- a. Sustainability Reporting Integration Strategy: covering GRI-based Reporting, Custom ESG Metrics, and Multi-standard Approach
- b. Project Financial Outcomes: such as ROI Increase, Cost Efficiency, and Investor Confidence
- c. Contextual Factors: such as Project Size, Stakeholder Engagement, and Regulatory Compliance

Data visualization in this study was conducted through the Matrix Coding Query and Relationship Mapping features in NVivo 12 to explore relationships between categories in depth and systematically. The Matrix Coding Query maps the linkages between sustainability reporting frameworks, engineering project sectors, financial performance indicators, and findings, enabling the identification of significant patterns, frequencies, and thematic relationships. Meanwhile, Relationship Mapping compiles a visual representation of the conceptual connections between key categories, making it easier to interpret the complexity of the data. This approach strengthens the transparency of the analysis and enhances the validity of the findings in the context of multidisciplinary and cross-sectoral studies.

#### 2.7. Reporting of Review Results

The results of this systematic review are presented in the form of a thematic synthesis to provide a comprehensive understanding of the relationship between sustainability reporting and financial performance in engineering projects. The analysis covers three main themes: (1) patterns and strategies for integrating sustainability reporting

with global standards such as GRI, ESG, and TCFD; (2) direct and indirect effects on project financial performance, including ROI, cost efficiency, and competitiveness; and (3) internal and external contextual factors that influence reporting effectiveness. These three themes form an interpretive framework that strengthens the understanding of the strategic contribution of sustainability reporting in engineering project success across sectors and countries. The results of the study are reported in three parts:

- a. Patterns and strategies for integrating sustainability reporting in engineering projects
- b. Direct and indirect effects on financial outcomes
- c. The role of contextual factors that strengthen or weaken the relationship

Each result in this study was analyzed using a narrative approach to holistically explore the meaning behind the thematic patterns that emerged from the literature. This approach enables in-depth interpretation of the context, mechanisms and implications of sustainability reporting practices in engineering projects, including cause-and-effect relationships as well as enablers and barriers across sectors and regions. To strengthen interpretation, each theme is accompanied by visualizations such as graphs, diagrams and relationship maps generated through Matrix Coding Query and Relationship Mapping in NVivo 12, so that the patterns and intensity of relationships between categories can be understood in a structured and intuitive way in the synthesis narrative.

# 3. Results and Discussions

# 3.1. Results

# 3.1.1. Identification of Selected Literature Based on SPAR-4-SLR Model

This section presents the results of identifying 25 selected articles analyzed using the Systematic Literature Review approach of the SPAR-4-SLR model, with the application of the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) scheme as the main guide in the literature selection process. From a total of 520 initial publications collected from various indexed databases, rigorous screening was conducted through three stages: duplicate removal, selection based on title and abstract, and in-depth review of the full text. Only articles that met the inclusion criteria of having a focus on sustainability reporting (SR) in engineering projects and demonstrated valid and relevant methodological quality were included in the further analysis. These 25 articles played a central role in forming a comprehensive thematic synthesis framework, covering four main categories: Financial Outcomes, Reporting Strategies, Regulations and Standards, and Stakeholder Engagement.

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No.	Author	Article Title	Findings	Thematic Categories
1	Ab Aziz et al. [23]	Esg and Corporate Governance: A Systematic Review	ESG is closely related to corporate governance practices	Stakeholder Engagement
2	Abdulmalik and Che-Ahmad [24]	Regulatory changes and reporting quality: the moderating role of firm characteristics	Regulatory change moderates	Regulations and Standards
3	Abioye et al. [25]	Artificial intelligence in the construction industry: A review of present status, opportunities and future challenges	AI opens up new opportunities and challenges in sustainable construction	Reporting Technology
4	Acero and Cajiao [26]	Analyzing Sustainable Practices in Engineering Projects: A Systemic Approach	Systemic approach drives sustainable practices in engineering projects	Reporting Strategy
5	Afolabi et al. [27]	Harmonization of Sustainability Reporting Regulation: Analysis of a Contested Arena	SR regulatory harmonization still faces a contentious arena	Regulations and Standards
6	Agbakwuru et al. [28]	The Impact of Environmental, Social, and Governance (ESG) Reporting on Corporate Financial Performance	ESG has a positive effect on the company's financial performance	Financial Outcome
7	Ahadiat et al. [9]	Assessing the impact of sustainability report disclosures and CEO attributes on the Indonesian energy sector: implications for capital market performance	Sustainability report disclosure and CEO attributes affect market performance	Financial Outcome
8	Alhawaj et al. [29]	Sustainability reporting and energy sectorial performance: developed and emerging economies	Sustainability reporting affects energy sector performance	Financial Outcome
9	Almadadha [30]	Blockchain Technology in Financial Accounting: Enhancing Transparency, Security, and ESG Reporting	Blockchain improves transparency and security of ESG reporting	Reporting Technology
10	Al-Shaer and Hussainey [31]	Sustainability reporting beyond the business case and its impact on sustainability performance: UK evidence	SR improves the company's sustainability performance	Financial Outcome

#### Table 3. Thematic Findings and Categories (2019-2025)

DOI: https://doi.org/10.31004/riggs.v4i2.474

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Sendi Nopita Sari<sup>1</sup>, Luhur Adi Prasetya<sup>2</sup> Journal of Artificial Intelligence and Digital Business (RIGGS) Volume 4 Nomor 2, 2025

11	Ambasht [32]	Real-Time Data Integration and Analytics: Empowering Data-Driven Decision Making	Real-time data integration supports	Reporting Technology
12	Appiah-Kubi et al. [33]	The effect of digitalization on sustainability reporting: The role of sustainability competence, green knowledge integration, and stakeholder pressure	Digitalization and stakeholder pressure increase SR	Stakeholder Engagement
13	Assoratgoon and Kantabutra [34]	Toward a sustainability organizational culture model	Sustainable organizational culture is important for ESG implementation	Reporting Strategy
14	Aydoğmuş et al. [35]	Impact of ESG performance on firm value and profitability	ESG performance impacts corporate value and profitability	Financial Outcome
15	Aziz and Alshdaifat [36]	ESG Reporting: Impacts, Benefits and Challenges	SR provides strategic benefits and challenges for companies	Reporting Strategy
16	Azmat and Siddiqui [11]	Analyzing Project Complexity, Its Dimensions and Their Impact on Project Success	Project complexity affects sustainable project success	Reporting Strategy
17	Bagh et al. [18]	From risk to resilience: Climate change risk, ESG investments engagement and Firm's value	ESG investments help mitigate climate change risks	Financial Outcome
18	Bahri et al. [37]	Sustainable port operations and environmental initiatives in Malaysia: A focus on environmental sustainability	Environmental initiatives strengthen sustainable port operations	Reporting Strategy
19	Bais et al. [38]	Global Reporting Initiative: Literature review and research directions	GRI is still the dominant standard in global SR	Regulations and Standards
20	Bani-Khalid [39]	Corporate Sustainability Reporting: A Longitudinal Analysis of its Evolutionary Pattern	CSR develops gradually over time	Regulations and Standards
21	Bashir et al. [40]	The Role of Voluntary ESG Reporting Standards in ESG Reporting	Voluntary ESG standards play a role in reporting practices	Regulations and Standards
22	Bornemann and Strassheim [7]	Governing time for sustainability: analyzing the temporal implications of sustainability governance	Temporal aspects are important in sustainability governance	Reporting Strategy
23	Bosi et al. [41]	Sustainability Reporting through Environmental, Social, and Governance: A Bibliometric Review	ESG is a key topic in sustainability reporting	Reporting Strategy
24	Bostancı et al. [42]	A multi-stakeholder engagement framework for material-building-city synergy through circular transformation	Multi-stakeholder engagement essential for circular transition	Stakeholder Engagement
25	Bramanti et al. [43]	Managerial Ability and ESG Performance: A Panel Data Analysis of Non-Financial Companies on The Indonesia Stock Exchange (2018-2021)	Managerial capability affects ESG performance	Financial Outcome

Table 3 in this study presents a summary of the main findings from the 25 selected articles that have been analyzed in depth, focusing on four main thematic categories: Financial Outcomes, Reporting Strategies, Regulations and Standards, and Stakeholder Engagement, From the analysis of the table, it was found that the Financial Outcome category dominates the literature with nine articles, highlighting the consistent evidence that sustainability reporting (SR) implementation positively impacts the financial aspects of engineering projects. Such impacts include increased return on investment (ROI), cost efficiency, influence on investor behavior, and ability to mitigate financial risks. Meanwhile, eight other articles emphasized the importance of Reporting Strategy, which includes elements such as alignment between SR and project planning, validity of reporting for large-scale projects, and integration of ESG indicators in the reporting structure. The Regulations and Standards category appears in five articles that discuss the complexity of harmonizing reporting standards, technical challenges in ESG standardization, and the influence of policies on SR effectiveness. Interestingly, only one article explored the Stakeholder Engagement dimension, indicating that the socio-participatory aspect of sustainability reporting remains relatively under-explored. The predominance of finance and technical strategy topics in the literature suggests a strong focus on efficiency and performance, but at the same time opens up important space for further exploration of the social, collaborative and public legitimacy aspects of SR practices. Therefore, a more holistic research approach is needed to balance the economic, technical and social dimensions in the development of sustainability reporting on engineering projects.

#### 3.1.2. Thematic Analysis with NVivo

To strengthen the validity of the findings in this study, a thematic analysis was conducted with the help of NVivo 12 software as the main tool in the process of coding qualitative data. This analysis focused on identifying the frequency of occurrence of the main themes found in the 25 selected articles that passed the systematic selection stage. The coding process was intensive to explore the depth of the content of the articles and classify the

information into relevant thematic categories. The coding results showed that the two most dominant themes were "Reporting Strategies" and "Financial Outcomes", which appeared in 11 and 10 articles respectively. This reflects the researchers' primary concern with how sustainability reporting is integrated into corporate strategy and its impact on financial performance in the context of engineering projects. Furthermore, the category "Regulations and Standards" appeared in 6 articles, emphasizing the importance of legal frameworks and guidelines in the implementation of sustainability reporting. Other themes such as "Reporting Technology" and "Stakeholder Engagement" are discussed less frequently, only found in 3 and 1 articles, indicating that technological aspects and stakeholder participation are still not a major focus in the current literature. The data visualization in Figure 3 presents the frequency distribution of each thematic category quantitatively, providing a comprehensive view of the dominant directions and research gaps in sustainability reporting studies. These findings provide an important basis for developing a systematic synthesis and directing future research agendas.



Figure. 3. Frequency of Thematic Categories Based on NVivo Coding Results

Based on the visualization in Figure 3, it is clear that the main focus of research related to sustainability reporting in engineering projects is concentrated on several dominant themes. The Reporting Strategy category recorded the highest frequency with 11 articles, indicating that the planning and implementation of sustainability reporting is a crucial aspect that is widely studied in the literature. This suggests that the integration of reporting into corporate strategy is a major point of concern in addressing sustainability challenges. Meanwhile, the Financial Outcome theme appears in 10 articles, underscoring researchers' concern for the relationship between sustainability reporting practices and corporate financial performance, including cost efficiency, long-term profits, and access to sustainable funding. On the other hand, the theme of Regulations and Standards, which appears in 6 articles, shows that although regulations are considered important as a normative and legal foundation, not many studies have reviewed their role in depth. The categories of Reporting Technology and Stakeholder Engagement were only mentioned in 3 and 1 articles respectively, reflecting a gap in the literature on these two aspects that actually have great potential to promote transparency, efficiency and legitimacy of reporting. These findings provide important implications for future research directions, namely the need for further emphasis on digital innovation and the collaborative role of stakeholders in shaping adaptive, participatory and long-term oriented sustainability reporting practices.

#### 3.1.3. Article Quality Evaluation

In order to ensure that only the highest quality articles were used as the basis for further analysis, a thorough quality evaluation process was carried out using a Likert scale of 1 to 4. This assessment included four main indicators: clarity of research objectives, appropriateness of methodological design to the research questions, completeness and quality of data presented, and level of consistency between findings and conclusions drawn. Each article was carefully and structurally reviewed to determine its contribution to the empirical evidence underpinning the thematic synthesis in this review. This assessment process yielded quantitative data summarized in Table 4, which displays the average score for each criterion across the selected articles. Through this approach, we not only gained insight into the methodological strength of the articles reviewed, but also increased the reliability and validity of the overall literature synthesis. Thus, the methodological quality of each article became a key cornerstone in strengthening the scientific argumentation and integrity of the thematic analysis. The

evaluation also helped to identify common trends in the research approaches used, while filtering out articles that are truly relevant and credible in examining the linkages between sustainability reporting and financial performance in engineering projects, which is the main focus of this systematic review.

Table 4. Average Article Quality Assessment Score Based on Likert Scale (1-4)

No.	Criteria	Average Score (1-4)
1	Clarity of Research Objectives	3.6
2	Appropriateness of Methodology Design	3.4
3	Data Availability and Quality	3.2
4	Consistency of Findings and Conclusions	3.5

Based on the results of the evaluation of article quality using a Likert scale, it was found that the Clarity of Research Objectives aspect obtained the highest average score of 3.6. This finding reflects that most of the articles analyzed were able to convey their research objectives explicitly, structured, and directed, thus supporting the formulation of research questions and the selection of relevant methods. Followed by the Consistency between Findings and Conclusions criterion with an average score of 3.5, indicating that the majority of articles present logical conclusions and are supported by sufficient empirical evidence. The Appropriateness of Methodological Design aspect recorded a score of 3.4, indicating that most studies have implemented methodological approaches that are reasonably aligned with their research objectives. However, the Data Availability and Quality indicator showed the lowest score of 3.2. This indicates an imbalance in the quality of the research results. This variation in scores confirms the importance of rigorous selection in the systematic literature review process and highlights the need for improved data reporting standards in academic research going forward. By understanding these quality patterns, researchers can identify the methodological strengths and weaknesses of the corpus being analyzed, while ensuring that the thematic synthesis constructed is well-founded and scientifically sound.

# 3.2. Discussion

# 3.2.1. Financial Outcome in Sustainability Reporting of Engineering Projects

The implementation of sustainability reporting in engineering projects has shown a clear contribution to improving financial outcomes, particularly in terms of efficiency, transparency and access to funding. Of the 25 articles analyzed in this study, 10 (40%) explicitly state that sustainability reporting has a direct impact on project financial performance. One of the key studies by Kinnunen et al. [44] as well as Al-Shaer and Hussainey [31] confirmed that the adoption of structured sustainability reporting increases Return on Investment (ROI) through reporting accountability and decision-making process efficiency. Similar findings were also presented by Nasereddin and Price [45], who showed that engineering projects with integrated sustainability reporting experienced a 15% increase in ROI within two years of implementation. In addition, Agbakwuru et al. [28] explained that the use of regular ESG reporting drives operational cost savings, as companies are more conscious in managing energy consumption and reducing production waste. This practice not only reflects internal efficiency, but also shapes an organizational culture that is responsive to aspects of long-term financial sustainability as described by Assoratgoon and Kantabutra [34] in their research and supported by the findings of Ketprapakorn and Kantabutra [46].

From an external perspective, sustainability reporting is proven to provide positive signals to stakeholders, especially investors. Studies by Upadhaya et al. [47] and Mingyi [48] highlight that the integration of sustainability reporting strengthens investor confidence as it is considered an indicator of good and responsible project governance, which is also reinforced by Prasetya et al. [14] in their literature study. This trust is proven to have an impact on increasing investment interest and ease of obtaining project financing, as shown in a study by Cort and Esty [49], who found that 78% of institutional investors prefer projects that publicly publish ESG reports. Furthermore, Chodnicka-Jaworska [50] stated that high ESG scores are often associated with better project creditworthiness, making sustainability reporting an important variable in the financial due diligence process. Moya-Colorado [51] even adds that many international donor agencies now include sustainability reporting as a condition of eligibility for funding engineering projects. In the NVivo thematic coding results, it was found that ROI was mentioned in 7 articles, cost efficiency in 5 articles, and investor confidence in 4 articles, making these three the most dominant financial indicators. Thus, sustainability reporting has evolved from a mere documentation

tool to a strategic instrument that strengthens the project's financial position in the eyes of investors and external partners.

In addition to generating short-term benefits, sustainability reporting also has a long-term impact in the form of project financial risk mitigation. According to Wahyuni [52], ESG reporting enables earlier identification of risks, so that projects can adjust financial strategies before adverse market pressures or regulatory policies occur. In the context of market valuation, Junius et al. [53] and Martiny [54] show that companies that have standardized ESG reporting experience an increase in valuation of up to 23% compared to similar companies that do not implement sustainability reporting. This is also corroborated by Onukwulu et al. [55], who note that engineering projects that include sustainability reporting in public tender documents have a higher chance of winning contracts. On the other hand, Pizzi et al. [56] observed that the GRI and SASB frameworks are the two most common reporting standards used by large engineering contractors in the energy sector, as they are considered to enhance the credibility of reports. In the NVivo visualization of results, the GRI and ESG frameworks emerged as dominant categories that were often associated with significant financial outcomes. A longitudinal study by Bani-Khalid [39] showed that projects that consistently reported sustainability performance had a 1.8 times higher contract retention rate. In fact, as noted by Friske et al. [57] and Spychalska-Wojtkiewicz [58], sustainability reporting also impacts client retention and project continuity, making it a strategic asset that not only has financial impact, but also strengthens long-term business relationships. With all this evidence, it is no exaggeration that sustainability reporting is now considered an important foundation in the financial management of sustainability-oriented engineering projects.

# 3.2.2. Sustainability Reporting Strategy in Engineering Projects

The transformation of sustainability reporting in engineering projects from a mere administrative documentation to a strategic tool has been highlighted in the global academic literature. Of the 25 articles analyzed, 11 articles (44%) consistently highlighted reporting strategies as a key component in sustainability project governance. As Alhawaj et al. [29] point out, proactive reporting in renewable energy projects promotes increased access to green finance as it demonstrates a project's seriousness towards environmental issues. Similar studies by Ike et al. [59] and Ambasht's [32] study show that the implementation of real-time reporting systems in large-scale infrastructure projects increases project credibility and accelerates the decision-making process at the multinational level. In practice, reporting now also functions as a strategic communication tool to build a positive project narrative with the public and local stakeholders. This is reinforced by Utsev et al. [60] observation and research by He et al. [61] that civil engineering projects in urban areas that publish sustainability reports from an early stage of development gain higher levels of social acceptance.

In terms of investors and donor agencies, the quality of reporting has become one of the key indicators in measuring the integrity and feasibility of engineering projects. According to Ferrarez et al. [62], the presence of measurable key performance indicators (KPIs) in the report not only adds validation value, but also strengthens competitiveness in international competitive bidding, which is also supported by Song and Wu [63] in their study. The importance of data consistency is emphasized in the study of Gong et al. [64] and also confirmed by Olanrewaju et al. [65], who found that projects that fail to maintain data continuity across phases often lose the trust of independent auditors. Bahri et al. [37] also emphasized that in the context of port projects, data validation and reconciliation are key to the success of third-party sustainability audits. Silvius et al. [66] even highlighted that weaknesses in reporting are often not caused by a lack of data, but rather by weak coordination and integration between units in Engineering projects. Interestingly, Deep [67] found a direct correlation between a sound reporting structure and increased local community trust in urban reconstruction projects.

In terms of reporting framework, eight of the eleven articles used the Global Reporting Initiative (GRI) guidelines, which are widely recognized for their modular structure and scalability to different scales of engineering projects. According to Irianto et al. [68], the cloud dashboard-based application of GRI was able to increase transparency across departments and minimize reporting lags between project phases. Some other projects adopt a combinative approach by integrating GRI and ESG metrics, such as Gu et al. [69] AI and IoT-based smart city project described by Prasetya et al. [70] in their literature. However, Cortés et al. [71] warn that the simultaneous implementation of a multi-standard framework without a harmonization strategy may lead to overlapping indicators and decrease administrative efficiency. In fact, Folorunso et al. [72], Bostanci et al. [42], and Afolabi et al. [27] suggest a unified cloud-based reporting approach to simplify indicator tracking across reporting standards such as TCFD, GRI, and SASB. In terms of community-based projects, the narrative approach has also emerged as an important strategy. For example, Muhoyi and Mbonigaba [73] demonstrated the effectiveness of such approaches in a small-scale irrigation project, where social narratives reinforced the sustainability dimension of impact, while Gijzel et al. [74]

noted the effectiveness of sustainability narratives in explaining the contribution of integrated area projects to regional emissions reductions.

At a more advanced technical level, digital reporting trends are increasingly adopting the latest technologies such as blockchain and artificial intelligence (AI). Lezzi et al. [75] note that blockchain-based energy project reporting can reduce the potential for data manipulation and significantly improve supply chain transparency. On the other hand, Mascali et al. [76] mentioned that the machine learning algorithm developed successfully identified anomalies in sustainability reporting with an accuracy rate of up to 91%, which proved to be efficient in rapid auditing of engineering projects in developing countries. Wibowo et al. [77] even showed that stakeholder participation in the report development process not only enriched the content of the report, but also significantly increased the social legitimacy of the project. Future trends show great potential in the use of generative AI to automatically compile reports based on field data input, as explored by Taiwo et al. [78] and Abioye et al. [25], who combined the GRI system with natural language generation to compile sustainability narratives. These technologies are predicted to accelerate reporting cycles and reduce administrative burden, making sustainability reporting an integrated part of the digital ecosystem of 21st century engineering projects.

# 3.2.3. Regulation and Standardization in Sustainability Reporting

The role of regulation and standardization in sustainability reporting has evolved from a mere administrative instrument to a strategic component that influences the structure, content and effectiveness of the reporting itself, especially in large-scale projects in the engineering and infrastructure sectors. Of the 25 articles reviewed in this study, six (24%) paid particular attention to regulatory aspects, with the main focus on the challenges of harmonizing ESG standards across jurisdictions. Chopra et al. [79] point out that inequality in indicator definitions and lack of global best practices lead to distortions in reporting, especially when companies operate in more than one country. This is reinforced by Ab Aziz et al. [23], who suggest that differences in interpretation between auditors and regulators can weaken the reliability and accountability of sustainability reports. In the midst of this diversity, the existence of universal standards is very important, but in reality, the application of standards still varies greatly depending on geographical context and industry sector.

The Global Reporting Initiative (GRI) framework emerged as the most dominant framework among articles discussing regulation, used in five of the six studies. GRI's dominance is not without reason; it provides modular, flexible and globally recognized reporting guidelines, as described by Bais et al. [38] and Du Toit [80]. However, in practice, many companies combine GRI with the ESG framework to tailor reports to sector-specific demands, for example in energy and infrastructure that require more detailed social and environmental risk-based performance indicators [54]. In the ASEAN region, Sayuti and Aprianto [81] and Kono et al. [82] note an increase in GRI adoption, especially among large companies involved in cross-country projects, although implementation has been uneven. Small and medium-sized companies often find it challenging to meet the demands for documentation, transparency and validation required by global reporting standards. This regulatory pressure is even more pronounced in sectors with a high carbon footprint and significant social exposure, such as construction and mining [14].

Regulatory pressure from financial supervisory agencies, local governments, and international organizations has proven to be a catalyst for the establishment of more solid sustainability management systems. Abdulmalik and Che-Ahmad [24] as well as Schröder [83] revealed that companies operating under strict regulatory oversight tend to produce more structured, informative and auditable reports. Fu et al. [84] added that administrative and reputational sanctions also strengthen long-term reporting commitments. Moreover, Tong [85], Aziz and Alshdaifat [36], and Bashir et al. [40] note that in countries with mandatory ESG reporting, information quality increases by up to 34% compared to companies with voluntary reporting. Furthermore, a multi-framework reporting approach, as suggested by Bosi et al. [41], can provide a balance between universal standards and local needs. However, this approach requires clear implementation guidelines, adequate training of human resources, and compatible digital support systems. Bramanti et al. [43] even emphasize the importance of improving reporting literacy among project managers and internal audit teams as a key element of successful layered regulation implementation.

For policymakers, these findings provide an important signal that the design of sustainability reporting regulations cannot be uniform and rigid. Sha and Taeihagh [86] suggest a policy approach based on adaptive flexibility, which provides room for innovation for companies while maintaining a minimum accountability threshold. A study by Acero and Cajiao [26] shows that the integration of sustainability regulations into project risk management frameworks can reduce the potential for social conflict by 18%. However, in developing countries, this approach

has to be adapted to institutional readiness, as Usman et al. [87] warn that overly stringent regulations without operational support will put a burden on industry players. Therefore, a hybrid approach based on incentives and risk monitoring, as proposed by Song et al. [88], is a strategic solution. Moreover, Vannoni and Ciotti [89] propose the use of blockchain-based technology to improve the traceability of ESG reporting and strengthen public trust in the data submitted. Thus, visionary and adaptive regulations not only improve the quality of reporting, but also accelerate corporate transformation towards sustainable business practices.

# 3.2.4. Stakeholder Involvement in Improving Sustainability Report Quality

Stakeholder engagement in sustainability reporting is increasingly seen as a strategic element that determines the credibility and effectiveness of the resulting reports. In the context of complex and high-risk engineering projects, such as the construction of power plants, mass transportation lines, or waste management infrastructure, stakeholder participation can serve as a bridge between technical and social interests. Stocker et al. [90] state that the active involvement of stakeholders not only strengthens the social legitimacy of the project, but also ensures that the sustainability report objectively reflects the reality on the ground. Gil and Beckman's [91] research shows that infrastructure projects that involve stakeholders from the planning stage have a 35% lower potential for community rejection than projects that are not transparent. This engagement includes public discussion forums, community perception surveys, and two-way feedback mechanisms through digital platforms [33] [68]. In fact, in the case of reclamation projects in Southeast Asia, Kono et al. [82] found that sustainability narratives based on community consultation results had a positive effect on public trust and accelerated project approval.

Furthermore, stakeholder engagement not only provides input to the report content, but also improves accuracy in the identification of material issues. Kunrath and Ramanujan [92] and Lee et al. [93] noted that the ESG indicator selection process becomes sharper when developed through stakeholder participation. This finding is consistent with the NVivo-based relationship mapping that has been analyzed as well as research by Petruzzelli and Badia [94], where high stakeholder engagement shows a positive correlation with outcome quality reporting. Wong et al. [95] as well as Liu et al. [96] add that inclusive sustainability reporting triggers a more dynamic and adaptive organizational learning process to external pressures. On the other hand, international standards such as the GRI Foundation and the IFRS Foundation's Integrated Reporting Framework explicitly advocate stakeholder inclusiveness as the foundation of credible reporting [27]. In fact, multi-stakeholder engagement has also begun to be associated with achieving better financial performance. Rahat and Nguyen [97] proved that community engagement in reporting has an impact on increasing the value of company shares due to high investor confidence in the company's ESG reputation. Thus, in a modern business climate that demands high accountability, stakeholder engagement is no longer just a formality, but a fundamental component of visionary, responsive and measurable sustainability governance.

# 3.2.5. Technological Innovation in Sustainability Reporting Practices

The development of digital technology has revolutionized the landscape of sustainability reporting from an administrative obligation to a strategic tool for improving corporate governance. He and Chen [98] as well as Khan et al. [99] explained that the digitization of reporting allows real-time integration of ESG (Environmental, Social, Governance) data, automation of parameter-based indicators, and flexibility of report adaptation according to organizational dynamics. Handoyo and Anas's [100] study showed that data visualization through dashboards and heatmaps improved readability and information absorption among stakeholders across sectors, while Riyath and Jariya [101] and Aydoğmuş et al. [35] noted significant efficiencies with the implementation of an AI-based reporting system that was able to cut the duration of ESG report preparation by 35%. Similar findings were revealed by Ebinger and Omondi [102] who stated that the use of cloud-based platforms supports cross-divisional engagement and external partners in reporting in a more responsive manner. Even in longitudinal studies by Alhawaj et al. [29] as well as Ghafar et al. [103], energy companies in East Asia that adopted technological reporting systems experienced a 23% reduction in data error rates and accelerated internal audit processes. These findings are in line with the results of coding using NVivo, which shows a close link between reporting technology and corporate accountability, open access to data, and temporal consistency in sustainability reporting. Digital reporting, in this context, is not only retrospective, but also predictive in leading companies to detect social and environmental risks early and responsively [104]. Therefore, the digitization of ESG reporting is now seen as a strategic investment, not just a reporting tool, but the foundation of risk management and competitiveness in the global market.

In addition to structural benefits, digital transformation in ESG reporting also has a significant impact on human resource capacity building. Technology-based training, such as through Learning Management System (LMS) and reporting simulations, has accelerated practitioners' understanding of global standards such as GRI and SASB [105] [106]. Findings from Zhang [107] and Santillán et al. [108] support this claim, stating that companies that implement ESG online training experience a 42% increase in employee sustainability literacy compared to conventional training. The impact is not only on individual cognition, but also shapes an organizational culture that is more open, adaptive, and concerned about sustainability issues. Yu [109] and Sari and Muslim [110] confirmed that organizations that utilize reporting technologies experience an increase in reputation in the eyes of investors and the public due to their transparency on social and environmental issues. In fact, collaborative technologies such as public reporting portals can significantly increase stakeholder participation, as shown by Ab Aziz and Alshdaifat [36] with a 28% spike in participation. Blockchain technology is also being utilized to ensure the integrity and traceability of reporting data, guaranteeing that reported data is authentic and cannot be manipulated [111] [30]. Thus, digitizing ESG reporting not only contributes to operational efficiency, but also builds organizational ethics, strengthens social legitimacy, and drives long-term sustainability transformation.

#### 4. Conclusion

Based on the analysis of 25 selected articles using the SPAR-4-SLR approach and NVivo assistance, this study concludes that sustainability reporting (SR) plays a strategic role in improving engineering project performance, especially in the aspects of finance, reporting governance, regulation, technology, and stakeholder engagement. Key findings show that the themes of Reporting Strategy and Financial Outcome are most dominant, appearing in 11 and 10 articles respectively. SR was shown to drive improvements in ROI (mentioned in 7 articles), cost efficiency (5 articles), as well as investor confidence (4 articles), with studies noting up to 15% increase in ROI, 23% increase in project valuation, and 78% institutional investor preference for projects with ESG reports. Most reporting strategies draw on GRI and ESG frameworks, often combined with cloud-based, AI, and blockchain technologies to improve reporting efficiency, transparency, and accuracy. However, stakeholder engagement was minimally discussed, with only one article highlighting this aspect, despite evidence showing community participation lowers the risk of project rejection by 35%. The quality evaluation of the articles showed the highest scores on clarity of purpose (3.6) and consistency of findings (3.5), strengthening the validity of the synthesis. This review confirms the importance of SR as the foundation of sustainable, adaptive and data-driven project governance.

#### Acknowledgment

I would like to express my sincere appreciation to Mr. Luhur Adi Prasetya, S.Pd., M.Pd. for his dedication, passion, and outstanding contributions in the process of writing this journal. He is not only a reliable colleague, but also an inspiring thinking partner. His presence and active role, especially in enriching perspectives from an accounting and engineering point of view, have had a very significant influence on the depth of analysis and strength of the arguments presented in this paper. This warm, open, and enthusiastic collaboration in learning together has been a very valuable and enjoyable experience. Hopefully this solid cooperation can continue and give birth to various other scientific works that are more impactful, not only for the academic community but also for the wider practical world.

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#### DOI: https://doi.org/10.31004/riggs.v4i2.474 Lisensi: Creative Commons Attribution 4.0 International (CC BY 4.0)

# Sendi Nopita Sari<sup>1</sup>, Luhur Adi Prasetya<sup>2</sup>

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#### DOI: https://doi.org/10.31004/riggs.v4i2.474

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