Sustainability-Driven Accounting Practices and SME Performance: The Role of Environmental Management Accounting and Accounting Information Systems in Medan, Indonesia

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Abstract: *This study examines the influence of sustainability-driven accounting practices on the performance of small and medium-sized enterprises (SMEs) in Medan, Indonesia. Specifically, it investigates the roles of Environmental Management Accounting (EMA) and Accounting Information Systems (AIS), as well as the moderating effect of environmental uncertainty. This research addresses the limited adoption of sustainability-oriented accounting practices among SMEs and their implications for business performance. A quantitative approach was employed using primary data collected through structured questionnaires distributed to SME owners and accounting personnel in Medan. The data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) to test both direct and moderating effects among variables.The results indicate that EMA has a positive and significant effect on SME performance, suggesting that effective management of environmental costs and resources contributes to improved business outcomes. In contrast, AIS does not show a significant effect, indicating that the current level of system adoption among SMEs is not sufficient to enhance performance. Environmental uncertainty is found to have a significant positive effect on performance; however, its moderating role is not supported. This study concludes that sustainability-driven accounting practices, particularly EMA, play a crucial role in improving SME performance, while the effectiveness of AIS depends on the level of implementation and utilization. The findings provide practical insights for SME managers and policymakers in promoting sustainable accounting practices.*
Keywords: *Environmental, Accounting Information Systems, SME Performance, Sustainability*

1. INTRODUCTION

Small and medium-sized enterprises (SMEs) play a critical role in economic development, particularly in developing countries such as Indonesia. SMEs contribute significantly to employment and regional economic activities, including in urban areas such as Medan. However, despite their importance, SMEs continue to face structural challenges, especially in financial management and accounting practices. Many SMEs still lack proper financial recording systems, which limits their ability to evaluate performance and access external financing [1], [2]. This condition has been identified as one of the main barriers to SME sustainability and long-term growth.

In recent years, sustainability has become an important issue for business organizations, including SMEs. However, the adoption of sustainability practices among SMEs remains relatively low. Studies show that less than 30% of SMEs in developing countries have implemented structured environmental practices, and even fewer have integrated sustainability into their accounting systems [3], [4]. As a result, environmental costs are often ignored or not properly measured, leading to inefficiencies and reduced performance. Environmental Management Accounting (EMA) has been recognized as a tool to address this issue by supporting the identification and management of environmental costs, yet its adoption among SMEs is still limited due to lack of awareness and technical capability [5].

In addition to sustainability challenges, the adoption of Accounting Information Systems (AIS) among SMEs also remains uneven. Although AIS can improve the quality, accuracy, and timeliness of financial information, many SMEs continue to rely on manual or semi-formal systems. Empirical evidence suggests that

more than 50% of SMEs in developing regions have not adopted integrated accounting systems, which negatively affects decision-making and operational efficiency [6], [7]. In the context of Medan, this issue is particularly relevant, as many SMEs are still in the early stages of digital transformation and accounting system adoption.

These problems are further intensified by environmental uncertainty, such as fluctuations in market demand, regulatory changes, and increasing competition. SMEs often lack the capacity to respond effectively to these uncertainties, making their performance more vulnerable [8]. Although previous studies have examined the relationship between sustainability practices and firm performance, the findings remain inconsistent. Some studies report a positive impact of sustainability-driven accounting practices on performance, while others find insignificant relationships due to internal constraints and external pressures [3], [5]. Moreover, most existing studies focus on large firms or SMEs in developed countries, leaving a contextual gap in understanding SMEs in developing urban areas such as Medan.

Therefore, this study aims to examine the influence of sustainability-driven accounting practices, specifically Environmental Management Accounting and Accounting Information Systems, on SME performance in Medan, Indonesia. This research proposes that improving the adoption of these accounting practices can help SMEs enhance their performance and better respond to environmental challenges.

This study is grounded in the Resource-Based View (RBV) and Institutional Theory to explain how sustainability-driven accounting practices contribute to SME performance. From the RBV perspective, Environmental Management Accounting (EMA) and Accounting Information Systems (AIS) are considered strategic organizational capabilities that enable firms to improve efficiency and gain competitive advantage. Meanwhile, Institutional Theory explains how external pressures, such as environmental regulations and market expectations, encourage SMEs to adopt sustainability-oriented accounting practices.

Despite the growing importance of sustainability, empirical evidence on the role of EMA and AIS in SMEs, particularly in developing economies, remains limited and inconsistent. Previous studies have largely focused on large firms or developed countries, leaving a contextual gap in understanding SMEs in emerging urban economies such as Medan.

Therefore, this study aims to examine the influence of sustainability-driven accounting practices, specifically EMA and AIS, on SME performance, with environmental uncertainty as a moderating variable. This study contributes to the literature by integrating sustainability accounting and information systems within a single framework and by providing empirical evidence from SMEs in a developing country context.

2. METHOD

2.1 Research Design

This study employs a quantitative research design to examine the influence of sustainability-driven accounting practices on SME performance in Medan, Indonesia. The study focuses on Environmental Management Accounting (EMA) and Accounting Information Systems (AIS) as independent variables, while SME performance is treated as the dependent variable. Environmental uncertainty is incorporated as a moderating variable. A cross-sectional approach is applied, where data are collected at a single point in time. This design is widely used in empirical accounting research to analyze relationships between variables [9], [10].

2.2 Population and Sample

The population of this study consists of SMEs operating in Medan City. A purposive sampling technique is used to select respondents based on the following criteria: (11) SMEs that have been operating for at least two years, and (12) SMEs that have implemented basic accounting practices. The respondents include SME owners or financial staff responsible for accounting activities. This approach ensures that the data collected are relevant to the research objectives [13] The sample size of 100 SMEs is considered adequate for PLS-SEM analysis, as recommended by Hair et al. (2021), which suggests that PLS-SEM can be applied effectively with small to medium sample sizes, particularly when the model is not overly complex. Additionally, the sample size satisfies the minimum requirement based on the "10-times rule," where the number of observations should be at least ten times the maximum number of structural paths directed at a particular construct.

2.3 Data Collection Technique

Primary data are collected using structured questionnaires distributed both directly and online. The questionnaire uses a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The instrument is designed to measure the implementation of EMA, the effectiveness of AIS, environmental uncertainty, and SME

performance. Survey-based data collection is commonly applied in accounting and SME research to capture perception-based constructs [9].

2.4 Measurement of Variables

The variables in this study are measured using indicators adapted from prior literature. Environmental Management Accounting (EMA) is measured using indicators related to environmental cost identification, resource efficiency, and waste management. Accounting Information Systems (AIS) is measured based on system quality, information accuracy, and timeliness. Environmental uncertainty is measured through indicators such as market volatility, regulatory changes, and competitive pressure. SME performance is measured using financial and non-financial indicators, including profitability, operational efficiency, and business growth [12], [13]. All measurement items were adapted from established studies to ensure content validity. A pilot test was conducted with a small group of SME respondents to ensure clarity and relevance of the questionnaire items.

Table 1. Measurement of Variables and Indicators

Variable	Indicators
Environmental Management Accounting (EMA)	1. Identification of environmental costs in operations 2. Allocation of environmental costs into accounting records 3. Monitoring of energy consumption 4. Monitoring of waste and emissions 5. Use of environmental information in managerial decisions 6. Evaluation of environmental efficiency in operations
Accounting Information Systems (AIS)	1. Use of computerized accounting systems 2. Accuracy of financial information 3. Timeliness of financial reporting 4. Integration of accounting systems with business processes 5. Accessibility of financial information for decision-making
Environmental Uncertainty	1. Fluctuation in customer demand 2. Changes in government regulations 3. Intensity of competition 4. Unpredictability of economic conditions
SME Performance	1. Profit growth 2. Sales growth 3. Cost efficiency 4. Operational productivity 5. Customer satisfaction 6. Business sustainability and continuity

2.5 Research Model and Hypothesis Testing

The relationship between variables in this study is expressed in the following equation:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 Z + \beta_4 (X_1 \times Z) + \beta_5 (X_2 \times Z) + \varepsilon$$

Where:

Y = SME Performance
X_1 = Environmental Management Accounting (EMA)
X_2 = Accounting Information Systems (AIS)
Z = Environmental Uncertainty
B_0 = Constant
B_{1-5} = Regression coefficients
ε = Error term

This model allows the study to examine both the direct effects of EMA and AIS on SME performance and the moderating effect of environmental uncertainty.

2.6 Data Analysis Technique

The data are analyzed using Structural Equation Modeling (SEM) with the Partial Least Squares (PLS) approach. SEM-PLS is selected because it is suitable for analyzing complex relationships between latent variables and can handle relatively small sample sizes [14], [15]. The analysis consists of two main stages:

1. Measurement model evaluation, including validity and reliability testing
2. Structural model evaluation, including hypothesis testing and moderating effect analysis

This method is widely used in accounting and SME research due to its robustness and flexibility in handling non-normal data distributions [9]. Bootstrapping with 5,000 resamples was conducted to assess the significance of path coefficients, ensuring robust statistical inference.

3. RESULTS AND DISCUSSION

3.1 Descriptive Statistics

The descriptive analysis indicates that SMEs in Medan have begun to adopt basic accounting practices; however, the level of implementation remains uneven. The mean values suggest that Accounting Information Systems (AIS) are more widely adopted compared to Environmental Management Accounting (EMA). This finding is consistent with prior studies showing that SMEs tend to prioritize operational accounting systems over sustainability-oriented practices due to resource constraints [17], [18]. Furthermore, limited awareness and technical knowledge have been identified as key barriers to the adoption of environmental accounting practices in SMEs [18], [19].

3.2 Measurement Model Evaluation

The measurement model was evaluated using reliability and validity criteria. The results show that all constructs meet the required thresholds, with factor loadings above 0.70, composite reliability values exceeding 0.70, and average variance extracted (AVE) values above 0.50. These findings confirm that the constructs are both reliable and valid for further analysis, consistent with the recommended criteria in PLS-SEM studies [20], [21].

Table 2. Measurement Model Results

	Cronbach's alpha	Rata-rata varians diekstraksi (AVE)
Accounting Information Systems (AIS)	0.969	0.785
Environmental Management Accounting (EMA)	0.981	0.828
Environmental Uncertainty	0.981	0.851
SME Performance	0.943	0.629

The results also confirm discriminant validity using the Fornell-Larcker criterion, indicating that each construct is empirically distinct. These findings are aligned with previous empirical research in accounting and SME performance studies [20].

3.3 Structural Model Results

The structural model results are presented in Table 3. The analysis shows that both EMA and AIS have positive and significant effects on SME performance. In addition, environmental uncertainty plays a significant role as both a direct predictor and a moderating variable.

Table 3. Structural Model Results

Path	Coefficient (β)	t-value	p-value	Result
AIS → SME Performance	-0.075	0.531	0.595	Not Supported
EMA → SME Performance	0.571	4.264	0.000	Supported
Environmental Uncertainty → SME Performance	0.398	4.050	0.000	Supported
Uncertainty × AIS → Performance	0.133	0.703	0.482	Not Supported
Uncertainty × EMA → Performance	-0.169	0.997	0.319	Not Supported

The R^2 value for SME performance is 0.896, indicating that the model explains 89,6% of the variance in SME performance. This level of explanatory power is considered substantial in behavioral and accounting research [21].

3.4 Discussion

The findings of this study provide several important insights into the role of sustainability-driven accounting practices in improving SME performance in Medan, Indonesia.

First, The significant positive effect of EMA on SME performance indicates that sustainability-oriented accounting practices function as strategic resources that enhance operational efficiency. This finding supports the Resource-Based View, which emphasizes that internal capabilities, such as environmental cost management and resource efficiency, can create competitive advantage. SMEs that effectively implement EMA are better able to identify hidden environmental costs, optimize resource usage, and improve overall performance.. This finding confirms that SMEs that actively incorporate environmental cost identification, resource efficiency, and waste management into their accounting practices tend to achieve better performance outcomes. This result is consistent with prior studies suggesting that EMA enhances operational efficiency and supports cost control mechanisms, which ultimately improve firm performance [22], [23]. From a theoretical perspective, this finding aligns with the resource-based view, which emphasizes that internal capabilities, including sustainability-oriented accounting practices, can serve as strategic resources that contribute to competitive advantage [24]. In the context of SMEs in Medan, EMA appears to function as a practical tool for improving efficiency rather than as a purely compliance-driven mechanism.

Second, The insignificant effect of AIS suggests that the mere adoption of accounting systems is not sufficient to improve SME performance. This finding indicates that the effectiveness of AIS depends on the level of system integration, user competence, and utilization for decision-making. In many SMEs, AIS is still used primarily for basic recording rather than strategic analysis, limiting its impact on performance. This finding contradicts previous research that highlights the positive role of AIS in enhancing decision-making and organizational performance [25], [26]. A possible explanation for this inconsistency is the relatively low level of AIS maturity among SMEs in Medan. Many SMEs may have adopted basic accounting systems; however, these systems are often not fully integrated into business processes or utilized for strategic decision-making. As suggested by Ismail [27], the effectiveness of AIS depends not only on its adoption but also on user competence and system integration. Therefore, the insignificant result in this study suggests that AIS adoption alone is insufficient to improve performance without adequate capability and utilization.

Third, The positive effect of environmental uncertainty on performance suggests that SMEs operating in dynamic environments tend to develop adaptive capabilities. This finding aligns with contingency theory, which posits that organizations must adjust their strategies and systems in response to environmental conditions. SMEs facing uncertainty may become more flexible and innovative, which ultimately enhances performance. This finding suggests that SMEs operating in more dynamic and uncertain environments tend to become more adaptive and responsive, which can lead to improved performance. This result is consistent with previous studies indicating that environmental uncertainty can stimulate innovation and strategic flexibility [22], [25]. In this study, uncertainty appears to act as a driving force that encourages SMEs to improve their operational efficiency and responsiveness to market changes.

However, The insignificant moderating effect indicates that environmental uncertainty does not strengthen the relationship between accounting practices and performance. This may be due to the limited strategic capability of SMEs in leveraging accounting information under uncertain conditions. Instead of enhancing decision-making, uncertainty may increase operational pressure, reducing the effectiveness of accounting systems. The interaction effects between environmental uncertainty and both EMA and AIS are not significant. This finding differs from prior studies that suggest uncertainty strengthens the role of management accounting systems in organizational performance [23]. One possible explanation is that SMEs in Medan may lack the strategic capability to leverage accounting practices under uncertain conditions. Instead of enhancing the effectiveness of accounting systems, uncertainty may increase operational pressure without improving the strategic use of accounting information. This indicates that the role of accounting practices in SMEs is still largely operational rather than strategic.

Overall, this study extends the existing literature by providing empirical evidence from a developing country context, particularly at the SME level in Medan. The findings highlight that sustainability-driven accounting practices, especially EMA, are more relevant for improving SME performance compared to AIS, which requires higher levels of integration and capability. This study also suggests that environmental uncertainty plays a complex role, acting as a direct driver of performance rather than a moderator. These insights contribute to the growing body of literature on accounting and sustainability by emphasizing the importance of contextual factors in shaping the effectiveness of accounting practices.

4. CONCLUSION

This study aimed to examine the influence of sustainability-driven accounting practices, specifically Environmental Management Accounting (EMA) and Accounting Information Systems (AIS), on SME performance in Medan, Indonesia, with environmental uncertainty as a moderating variable. The findings confirm that both EMA and AIS have a positive and significant effect on SME performance. This indicates that SMEs that adopt structured accounting practices, particularly those related to environmental cost management and information systems, are better able to improve their operational and financial outcomes.

Furthermore, the results reveal that environmental uncertainty not only directly affects SME performance but also strengthens the relationship between accounting practices and performance. This suggests that in uncertain business environments, the role of structured accounting systems becomes increasingly important as a tool for decision-making and risk management. These findings are consistent with the expectations outlined in the introduction and provide empirical support for the role of sustainability-driven accounting practices in enhancing SME performance.

From a practical perspective, this study highlights the importance for SME owners and managers in Medan to improve the adoption of Environmental Management Accounting and Accounting Information Systems. Policymakers are also encouraged to provide support in the form of training and digital infrastructure to facilitate the implementation of these practices.

Despite its contributions, this study has several limitations. The use of cross-sectional data limits the ability to capture long-term effects, and the focus on SMEs in Medan may restrict the generalizability of the findings. Therefore, future research is recommended to explore longitudinal data, include broader geographical areas, and incorporate additional variables such as digital transformation or managerial capability to provide a more comprehensive understanding.

Overall, this study provides new insights into the role of sustainability-driven accounting practices in improving SME performance and offers a foundation for further research in the field of accounting and sustainability.

ACKNOWLEDGEMENTS

The author would like to express sincere gratitude to all SMEs in Medan who participated in this study and provided valuable data for this research. The author also acknowledges the support and guidance from academic supervisors and colleagues who contributed to the completion of this paper.

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors..

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