# Factors affecting the implementation of environmental management accounting - A study of manufacturing enterprises

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**Abstract:** Environmental Management Accounting (EMA) plays a crucial role in helping businesses manage and reduce the environmental impacts of their production activities. The aim of this study is to measure and analyze the factors influencing the implementation of EMA in manufacturing enterprises in Hanoi City, Vietnam. We use both qualitative and quantitative research methods. The research sample consisted of 163 accountants, chief accountants, and other related personnel in manufacturing enterprises (MEs) in Hanoi. Based on contingency theory, institutional theory, and stakeholder theory, the study evaluates the impact of business size, regulatory pressure, stakeholder pressure, the competency of accounting staff, and managerial awareness on the adoption of EMA. The results show that business size, regulatory pressure, and managerial awareness positively affect the implementation of EMA. Larger enterprises, with more financial and human resources, are more likely to implement EMA effectively. Additionally, the study reveals that pressure from stakeholders and difficulties in collecting environmental data are significant factors. These findings provide valuable insights for businesses and policymakers in promoting environmental accounting in Vietnam.

**Keywords:** Accounting, Business size, Environmental Management Accounting (EMA), Manufacturing enterprises, Regulatory pressure, Stakeholder pressure.

## 1. Introduction

The concept of "green economy" was first introduced by environmental economists in 1989 and was officially recognized at the United Nations Conference on Sustainable Development in 2012. According to the United Nations Environment Programme (UNEP), a green economy is one that promotes economic and social prosperity while minimizing negative environmental impacts. In Vietnam, this concept was incorporated into the National Green Growth Strategy in 2012, reflecting the commitment to sustainable development.

With global economic integration, Vietnam is facing the challenge of restructuring its economy toward sustainability. The manufacturing sector, which significantly contributes to the national GDP, is also confronted with the need to optimize resource use and reduce pollution. Studies show that over 70% of wastewater from industrial zones remains untreated, leading to severe environmental pollution.

In this context, environmental management accounting (EMA) has become a vital tool for enterprises to make economic decisions based on environmental data, thereby promoting a green economy. However, in practice, particularly in Hanoi, the application of EMA remains limited. Many enterprises have not prioritized environmental accounting and non-financial environmental information, leading to inaccurate assessments of environmental performance.

Although some studies on environmental accounting have been conducted in Vietnam, they are mainly qualitative or focus on specific industries, lacking a systematic approach and failing to survey a broad range of manufacturing enterprises in Hanoi. Therefore, research on the factors influencing the adoption of environmental management accounting in manufacturing enterprises in Hanoi is essential to improve the environmental accounting system in the context of sustainable development.

## 2. Theoretical Framework and Underlying Theories

### 2.1. Theoretical Basis of Environmental Accounting

#### 2.1.1. Concept of Environmental Accounting

Environmental accounting is a subfield of corporate accounting that focuses on managing and reporting information related to environmental issues in business operations. Environmental accounting in businesses is an information system designed to collect and analyze data on environmental costs and risks, thereby supporting decision-making, performance evaluation, and accountability. This is closely integrated with financial accounting and management accounting, serving as an extension to more accurately reflect environmental factors in business activities.

The U.S. Environmental Protection Agency [1] classifies environmental accounting into three types: (1) natural resource accounting, (2) environmental financial accounting, and (3) environmental management accounting. Environmental financial accounting focuses on recording environmental costs and obligations in financial statements based on generally accepted accounting principles. On the other hand, environmental management accounting aims to provide detailed information on environmental impacts in business decisions and assists companies in managing environmental costs throughout their production processes and operations.

According to the International Federation of Accountants [2] environmental accounting involves developing and implementing appropriate accounting systems to efficiently manage environmental factors within economic activities. Environmental management accounting is a crucial component in implementing a company's environmental strategy, related to accounting for material flows, total costs, as well as evaluating benefits and planning strategies to improve environmental performance.

Pearce, et al. [3] argue that environmental accounting involves providing information on environmental resources and their value, helping stakeholders within an organization better understand the impacts of business activities on the environment.

Based on these definitions, in this study, environmental accounting is understood as the process of collecting, processing, and reporting both financial and non-financial information related to the environment within both financial accounting and management accounting. Its purpose is to provide information for internal and external stakeholders, thereby supporting decision-making and assessing the environmental performance of businesses.

#### 2.1.2. Contents of Environmental Accounting

Environmental accounting is an integral part of a business's accounting system. Therefore, the scope of environmental accounting encompasses all assets, capital, business processes, and economic and legal relations arising from the business's operations [4]. Several international organizations have issued guidelines related to environmental accounting, regarding environmental assets and environmental liabilities, or [2] concerning environmental income and costs. The main components of environmental accounting include:

Environmental Assets: Environmental assets refer to environmental costs that are capitalized when these costs provide future economic benefits to the business. These costs can include investments in environmental protection equipment or expenses aimed at reducing environmental impacts, with the goal of maintaining or increasing long-term economic benefits [5].

Environmental Liabilities: Environmental liabilities are obligations related to environmental costs that businesses must incur to remedy damages or comply with environmental regulations. According to

IAS 37, businesses must set aside provisions for such costs when there is a legal obligation or the possibility of depleting assets to settle environmental liabilities (IAS 37- [5].

Environmental Income: Environmental income refers to income derived from activities that protect or improve the environment, such as income from selling scrap materials, recycling waste, or compensation from environmental insurance [2]. Although environmental income may not represent a large proportion of total income, it demonstrates a company's social responsibility toward environmental protection.

Environmental Costs: Environmental costs include expenses incurred in managing and minimizing the environmental impacts of a business, including costs for prevention, waste disposal, environmental protection, and restoration [1]. These costs may include both direct and indirect costs, such as R&D expenses for environmentally friendly products or costs for complying with environmental protection regulations.

Environmental Cost Estimation: Environmental cost estimation is the process of planning and forecasting the costs of environmental protection to assess the economic effectiveness of these measures and achieve long-term cost savings [1] This process helps businesses compare various investment options, including environmental protection projects, to make decisions that align with environmental protection goals and economic benefits.

Environmental Reporting: Environmental reporting involves providing data and reports on environmental costs, liabilities, and other environmental issues, to help stakeholders assess the business's environmental responsibility and risks [5]. Environmental reporting also promotes transparency in environmental protection activities, demonstrating the company's commitment to sustainable development.

## 2.2. Related Theories
### 2.2.1. Contingency Theory

The contingency theory, developed by Lawrence and Lorsch [6] explains the relationship between various factors affecting the outcomes of an organization, with changes in situational factors. According to this theory, elements such as environment, technology, size, and experience influence the operational effectiveness of a business. Subsequent studies have shown that organizations need to have structures aligned with these factors to maintain stability and growth. The contingency theory is also applied to analyze the impact of environmental factors on the implementation of environmental management accounting (EMA), with factors such as business size and the competency of accounting staff playing a critical role in EMA adoption. The larger the enterprise, the greater the environmental pressures and the need for EMA implementation.

### 2.2.2. Institutional Theory

The institutional theory, proposed by [7], focuses on the impact of institutional forces (such as government, industry standards, and social organizations) on organizational behavior. The theory identifies three types of institutional pressures: coercive, normative, and mimetic. Organizations must comply with regulations and social norms to maintain legitimacy and reduce risks. In the face of uncertainty, businesses tend to imitate successful organizations in their industry to minimize risks and costs.

This theory explains why manufacturing enterprises in Hanoi need to respond to the requirements of the government, regulatory bodies, and the community regarding environmental protection, thereby driving the effective implementation of environmental management accounting.

### 2.2.3. Useful Information Theory

According to Godfrey, et al. [8] the useful information theory posits that the objective of financial reporting is to provide useful and relevant information that helps users make informed economic decisions. For environmental accounting, this theory emphasizes the importance of providing detailed

and accurate information about environmental costs, helping managers make strategic decisions regarding the management and control of environmental impacts. The study by Chang and Deegan [9] indicates that managerial awareness of the benefits of environmental accounting can accelerate the implementation of management accounting practices for the environment. Thus, an understanding of the costs and benefits of environmental accounting plays a vital role in the decision-making process for implementing environmental accounting in manufacturing enterprises.

### 2.2.4. Stakeholder Theory

Developed by Freeman [10] stakeholder theory highlights that businesses must balance the interests of various stakeholders, including shareholders, customers, suppliers, employees, and the community. These stakeholders can significantly influence the strategies and operations of a business. In the environmental context, these groups demand that companies protect the environment and provide transparent information about their environmental impacts. This theory explains why manufacturing enterprises in Hanoi must respond to the pressures from stakeholders, particularly the environmental protection demands from the government, customers, and the local community, in order to maintain good relationships and build a sustainable corporate image.

### 2.3. Factors Affecting the Implementation of Environmental Management Accounting in Manufacturing Enterprises
### 2.3.1. Business Size

Larger enterprises tend to focus more on environmental accounting than smaller ones, as they face greater pressure from stakeholders and have to comply with environmental regulations.

### 2.3.2. Regulatory Pressure

Government regulations and institutional pressures significantly influence the adoption of environmental accounting. Businesses need to comply with waste management and environmental protection regulations to avoid penalties and maintain their reputation.

### 2.3.3. Pressure from Stakeholders

Groups such as customers, investors, regulatory bodies, and the community require businesses to disclose their environmental responsibilities, thereby pushing enterprises to implement environmental accounting.

### 2.3.4. Competency of Accounting Staff

The expertise of accounting staff is crucial in implementing environmental accounting. A lack of knowledge and skills can be a significant barrier to effectively implementing an environmental accounting system.

### 2.3.5. Managerial Awareness

The support of business leaders for environmental accounting can drive its implementation. Leaders who recognize the importance of environmental protection will help the business meet environmental and sustainability requirements.

### 2.4. Difficulties in Implementing Environmental Management Accounting

Financial Barriers: High costs and unclear financial benefits may discourage businesses from investing in environmental management accounting systems.

Information Barriers: Companies face difficulties in collecting, allocating, and analyzing environmental costs, leading to inefficient management and reporting of environmental data.

Lack of Guidance: The absence of detailed guidelines and standardized materials on environmental accounting is one of the key obstacles in the effective implementation of environmental accounting.

## 3. Research Model and Methodology

*3.1. Overview of Environmental Accounting Research and Factors Influencing the Adoption of Environmental Accounting in Businesses*

Environmental accounting (EA), particularly Environmental Management Accounting (EMA) and Environmental Cost Management Accounting (ECMA), has been researched since the late 20th century. At this time, researchers began integrating environmental factors into accounting, and environmental accounting gradually became distinct from social accounting. In the 1990s, EMA was primarily applied in developed countries such as the United States, Europe, and Japan, and later spread to developing countries. International organizations such as the Nations [1] and IFAC [2] published guidelines on environmental accounting to assist businesses in implementing EMA, aiming to control environmental costs and improve environmental performance in business management. Environmental accounting was first introduced in Vietnam through the project "Environmental Management Accounting for SMEs in Southeast Asia" (EMA-SEA), which aimed to help enterprises and organizations develop and promote their business activities in a sustainable manner and facilitate better trade integration with the world by transferring knowledge and skills on environmental accounting. This project was implemented in four countries: Thailand, the Philippines, Indonesia, and Vietnam, and ran from November 2003 to August 2007 in Ho Chi Minh City. Research on environmental accounting and environmental cost management accounting in Vietnam began mainly in the early 21st century. These studies focused primarily on clarifying the theoretical basis of ECMA, drawing from the development of guidelines by IFAC [2]. Several authors, including Ngoc [11] and Long [12] have studied the factors influencing the adoption of environmental accounting in manufacturing enterprises (MEs) in Vietnam and drawn lessons from developed countries such as Japan, the United States, Germany, and South Korea.

*$H_1$: Business size positively affects the adoption of environmental accounting in manufacturing enterprises in Hanoi*

Numerous studies have shown that business size has a positive influence on the adoption of environmental accounting [13]. Larger enterprises typically have stronger financial and human resources, making it easier for them to invest in environmental accounting systems and implement environmental protection measures. Therefore, large enterprises are more likely to implement EMA effectively compared to smaller enterprises. In Vietnam, the study by Ngoc [11] also found that large enterprises tend to adopt environmental accounting more comprehensively and effectively. This is because larger businesses often have the ability to invest in infrastructure and new technologies, facilitating the implementation of EMA.

*$H_2$: Regulatory pressure positively affects the adoption of environmental accounting in manufacturing enterprises in Hanoi*

Environmental regulatory pressure is a crucial factor driving enterprises to adopt EMA. Studies have shown that in countries with stringent environmental legal systems, businesses are required to comply with environmental protection regulations, and environmental accounting becomes an important tool to meet these requirements [13]. Regulatory pressure can motivate enterprises to invest in the implementation of environmental accounting to ensure compliance with environmental standards.

The study by Tuyen [14] showed that pressure from government agencies plays a vital role in the adoption of environmental accounting in mining enterprises in Binh Dinh. Similarly, Thi [15] research confirmed that clear policies and regulations from the government and regulatory agencies are crucial in promoting the adoption of environmental accounting in Vietnam.

*$H_3$: Stakeholder pressure positively affects the adoption of environmental accounting in manufacturing enterprises in Hanoi*

Stakeholders, including customers, shareholders, communities, and environmental organizations, significantly influence the decision to adopt environmental accounting in businesses. The research by Jalaludin, et al. [16] showed that when stakeholders demand businesses to provide environmental information or implement environmental protection measures, enterprises are compelled to adopt EMA to meet these demands. Therefore, pressure from stakeholders plays an essential role in increasing the

adoption of environmental accounting in businesses. The study by Nguyen and Nguyen [17] on environmental accounting disclosure in listed beverage manufacturing enterprises in Vietnam also indicates that pressure from stakeholders such as investors, regulatory bodies, and customers positively influences the disclosure of environmental information. This reflects the critical role of stakeholders in promoting the adoption of EMA in businesses.

*H₄: The competency of accounting staff positively affects the adoption of environmental accounting in manufacturing enterprises in Hanoi*

The competency of accounting staff is a crucial factor in the implementation of environmental accounting. Studies by Setthasakko [18] and Chang and Deegan [9] suggest that if accounting staff possess the knowledge and professional skills in environmental accounting, they will be more effective in applying environmental accounting methods in their work. The competency of accounting staff helps identify and allocate environmental costs, as well as perform environmental cost forecasting and use environmental information in strategic decision-making. In Vietnam, the study by Thi [15] found that the competency and awareness of accountants, particularly in the steel industry, significantly influence the adoption of environmental accounting. Accountants with expertise and understanding of environmental accounting are more likely to implement EMA effectively.

*H₅: Managerial awareness positively affects the adoption of environmental accounting in manufacturing enterprises in Hanoi*

Managerial awareness of the importance of environmental accounting has a significant influence on its adoption in enterprises. Studies by Christ and Burritt [13] have shown that managers who understand the benefits of environmental accounting are more likely to proactively implement environmental accounting methods in their businesses. This indicates that managerial awareness is a key factor in determining the level of adoption of environmental accounting in enterprises. Research by Thi [19] emphasizes that managerial awareness of environmental issues is a critical factor in the adoption of environmental accounting in manufacturing enterprises in Vietnam. Enterprises with managers who are well-aware of environmental concerns are more likely to successfully implement effective environmental accounting systems.

*H₆: Difficulties in implementing environmental accounting negatively affect the adoption of environmental accounting in manufacturing enterprises in Hanoi.*

Difficulties in implementing environmental accounting may be a significant barrier to EMA adoption in enterprises. These difficulties could include the lack of accurate environmental data, high costs in setting up environmental accounting systems, or a lack of specialized knowledge in environmental accounting methods [18]. If businesses face these challenges, they are less likely to implement environmental accounting, thus reducing the level of EMA adoption. The study by Nguyen [20] showed that textile enterprises face many difficulties in adopting environmental accounting, primarily due to a lack of financial resources and environmental accounting expertise. Consequently, these challenges reduce the likelihood of EMA implementation in these businesses.

*3.2. Research Model*

The research model proposed by the author consists of one dependent variable and six independent factor groups as follows:

$$EMA = \beta_0 + \beta_1 * BS + \beta_2 * RP + \beta_3 * SP + \beta_4 * CA + \beta_5 * NTQL + \beta_6 * DI + \varepsilon$$

Where:

Dependent variable: EMA: Level of adoption of Environmental Management Accounting (EMA)

Independent variables: BS: Business Size, RP: Regulatory Pressure, SP: Stakeholder Pressure, CA: Competency of Accounting Staff, MA: Managerial Awareness, DI: Difficulties in Implementing EMA

$\beta_0$\beta_0$\beta_0$: Constant

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6$: Regression coefficients

ε: Error term

Below are the observed variables and the detailed measurement scales for each factor in the model (see Table 1).

**Table 1.**
Scales for each factor in the model.

| No | Code | Measurement Scale | Basis for Developing the Measurement Scale |
|---|---|---|---|
| Business Size | | | |
| 1 | BS1 | Business revenue is large (over 300 billion VND) | Nguyen [20] |
| 2 | BS2 | Total assets of the enterprise are large (over 100 billion VND) | |
| 3 | BS3 | Number of employees is large (over 200 people) | |
| 4 | BS4 | Number of machines, equipment, and production facilities is large | |
| Regulatory Pressure | | | |
| 1 | RP1 | Our environmental activities are influenced by regulations on waste management, raw material, and fuel use | Christ and Burritt [13] |
| 2 | RP2 | Our environmental activities are influenced by environmental penalty regulations | |
| 3 | RP3 | Our environmental activities are influenced by environmental reporting regulations | |
| 4 | RP4 | Our environmental activities are influenced by environmental standards for products and production processes (GAP, HACCP, ISO, etc.) | |
| Stakeholder Pressure | | | |
| 1 | SP1 | Our environmental activities are influenced by shareholders/owners of the enterprise | Jalaludin, et al. [16] |
| 2 | SP2 | Our environmental activities are influenced by customers of the enterprise | |
| 3 | SP3 | Our environmental activities are influenced by industry competitors | |
| 4 | SP4 | Our environmental activities are influenced by the local community | Christ and Burritt [13] |
| Competency of Accounting Staff | | | |
| 1 | CA1 | All accounting staff of the enterprise hold at least a bachelor's degree | Ngoc [11] and Nguyen [20] |
| 2 | CA2 | Accounting staff of the enterprise have obtained domestic certifications such as CPA, Chief Accountant certification | |
| 3 | CA3 | Accounting staff of the enterprise have obtained international certifications such as ACCA, ICAEW, CPA Australia, etc. | |
| 4 | CA4 | Accounting staff of the enterprise have at least 5 years of experience in accounting, particularly cost accounting | |
| Managerial Awareness | | | |
| 1 | MA1 | Managers have knowledge of environmental accounting | Chang and Deegan [9] and Setthasakko [18] |
| 2 | MA2 | Managers highly appreciate the usefulness of implementing environmental accounting | |
| 3 | MA3 | Managers have a high demand for using environmental accounting information in decision-making | |

| 4 | MA4 | Managers are willing to accept the costs incurred due to the implementation of environmental accounting | |
|---|---|---|---|
| Difficulties in Implementing EMA | | | |
| 1 | DI1 | The implementation process faces difficulties in collecting and allocating environmental costs | Setthasakko [18] |
| 2 | DI2 | The implementation process faces difficulties in weighing the benefits and costs of implementation | Setthasakko [18] |
| 3 | DI3 | The implementation process faces difficulties due to a lack of practical experience and guidelines | Setthasakko [18] |
| 4 | DI4 | The implementation process faces difficulties due to a lack of cooperation and information sharing between departments in organizing and operating | Thi [15] |
| Dependent Variable: Environmental Management Accounting (EMA) | | | |
| 1 | EMA1 | Recording assets related to the environment | IFAC [2] |
| 2 | EMA2 | Tracking liabilities related to the environment | |
| 3 | EMA3 | Identifying and classifying environmental costs incurred | [21] |
| 4 | EMA4 | Developing standards and preparing environmental cost estimates | Ismail, et al. [22] |
| 5 | EMA5 | Recording non-financial environmental information (resource consumption; environmental goals and strategies) | Nations [1] |
| 6 | EMA6 | Presenting and disclosing environmental accounting information | |

Data was collected through a survey tool using Google Forms sent to accountants, chief accountants, and other relevant personnel in manufacturing enterprises (MEs) in Hanoi. A total of 180 responses were received, with 163 valid responses included for data analysis.

## 4. Research Results and Discussion

### 4.1. Qualitative Research Results

Hanoi, with its 8 large industrial zones, plays a key role in the national economy and attracts key industries such as electronics, machinery, and textiles. However, this development also faces challenges regarding environmental protection. The qualitative research, based on interviews with accountants, chief accountants, and managers of manufacturing enterprises in Hanoi, revealed several key factors influencing the implementation of Environmental Management Accounting (EMA). The interviewees unanimously agreed that business size is a crucial factor determining the level of EMA adoption, with larger enterprises requiring more detailed and in-depth information to support decision-making. Regulatory pressure and stakeholder pressure, including government and community expectations, also motivate enterprises to implement EMA in order to avoid penalties and protect their reputation. Furthermore, the professional competency of accounting staff and the awareness of management regarding environmental protection are essential factors in successfully implementing EMA. Interviewees emphasized the need to train accounting staff with strong environmental accounting knowledge to ensure the correct and effective application of accounting methods. To collect data, the author distributed 180 survey forms and received 163 valid responses (90.5%). The statistical results regarding the job positions of the respondents are as follows:

**Table 2.**
Descriptive Statistics of Respondent Job Positions.

| Job Position | Number of Responses | Percentage |
|---|---|---|
| CEO | 3 | 1.8% |
| CFO | 4 | 2.5% |
| Chief Accountant | 22 | 13.5% |
| General Accountant | 39 | 23.9% |
| Accountant | 95 | 58.3% |

Descriptive Statistics of Variables in the Model: The statistical indices from the survey data indicate a clear differentiation between enterprises in terms of size, regulatory pressure, stakeholder pressure, and the competency of accounting staff specifically:

Business Size: The indices range from 2.853 to 3.583, indicating a significant variation in business size among the enterprises.

Regulatory Pressure: Enterprises generally perceive a considerable level of regulatory pressure, with the average value ranging from 2.313 to 3.681.

Stakeholder Pressure: The indices range from 2.742 to 3.350, showing that enterprises need to meet the expectations of stakeholders, especially government and local communities.

Competency of Accounting Staff: The competency level of accounting staff ranges from 2.952 to 3.546, indicating a need to enhance the capacity of accounting teams.

Managerial Awareness: The indices for managerial awareness of environmental accounting range from 2.454 to 3.321, reflecting a relatively low level of concern.

Difficulties in Implementing EMA: The indices range from 3.313 to 3.939, indicating various challenges and obstacles in implementing EMA.

Level of EMA Adoption: While enterprises are adopting EMA at a satisfactory level, the adoption is not uniform, with the indices ranging from 3.062 to 3.724.

**Table 3.**
Descriptive Statistics of Variables in the Model.

| Variable | N | Minimum Value | Maximum Value | Mean | Standard Deviation |
|---|---|---|---|---|---|
| Business Size (BS) | 163 | 1.0 | 5.0 | 3.583 | 0.9675 |
| Regulatory Pressure (RP) | 163 | 1.0 | 5.0 | 3.282 | 0.7072 |
| Stakeholder Pressure (SP) | 163 | 1.0 | 5.0 | 2.742 | 0.7079 |
| Competency of Accounting Staff (CA) | 163 | 1.0 | 5.0 | 3.546 | 0.8404 |
| Managerial Awareness (MA) | 163 | 1.0 | 5.0 | 2.906 | 0.8673 |
| Difficulties in Implementing EMA (DI) | 163 | 1.0 | 5.0 | 3.423 | 0.8671 |
| Level of EMA Adoption (EMA) | 163 | 1.0 | 5.0 | 3.351 | 0.8555 |

*4.2. Quantitative Research Results*

*4.2.1. Measurement Model Validation Results*

Reliability Test of Factors (Cronbach's Alpha) (see Table 4). The results of the Cronbach's Alpha test indicate that all measurement scales, including Business Size, Regulatory Pressure, Stakeholder Pressure, Accounting Staff Competency, Managerial Awareness, Difficulties in Implementing Environmental Accounting (EA), and the Adoption of Environmental Accounting, have a Cronbach's Alpha greater than 0.6, demonstrating high reliability and strong internal consistency among the observed variables. The mean and variance values when removing individual variables did not change significantly, suggesting that the variables contribute balanced to the measurement scale. The correlation coefficients between each variable and the total scale range from 0.658 to 0.787, confirming a strong relationship between the variables and the overall measurement scale. The Cronbach's Alpha values when removing individual variables range from 0.542 to 0.902, all of which are considered high, indicating that no variables need to be removed to improve reliability. These results confirm that all measurement scales meet the reliability requirements and are suitable for exploratory factor analysis (EFA).

**Table 4.**
Cronbach's Alpha Test Results for the Variables in the Model.

| Observed Variable | Mean if Item Deleted | Variance if Item Deleted | Item–Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| BS | Cronbach's Alpha = 0.850 | | | |
| BS1 | 9.098 | 6.015 | 0.754 | 0.734 |
| BS2 | 9.528 | 5.658 | 0.787 | 0.757 |
| BS3 | 9.828 | 6.279 | 0.673 | 0.768 |
| BS4 | 9.589 | 6.91 | 0.658 | 0.782 |
| RP | Cronbach's Alpha = 0.863 | | | |
| RP1 | 9.061 | 4.453 | 0.692 | 0.808 |
| RP2 | 8.663 | 4.385 | 0.704 | 0.803 |
| RP3 | 10.031 | 3.302 | 0.743 | 0.797 |
| RP4 | 9.276 | 4.448 | 0.662 | 0.818 |
| SP | Cronbach's Alpha = 0.660 | | | |
| SP1 | 9.288 | 2.762 | 0.568 | 0.697 |
| SP2 | 8.681 | 2.811 | 0.476 | 0.628 |
| SP3 | 8.982 | 2.747 | 0.608 | 0.542 |
| SP4 | 9.141 | 2.628 | 0.504 | 0.613 |
| CA | Cronbach's Alpha = 0.714 | | | |
| CA1 | 6.393 | 3.808 | 0.516 | 0.703 |
| CA2 | 6.81 | 3.513 | 0.681 | 0.668 |
| CA3 | 6.387 | 3.708 | 0.625 | 0.615 |
| CA4 | 6.227 | 3.164 | 0.559 | 0.667 |
| MA | Cronbach's Alpha = 0.821 | | | |
| MA1 | 8.362 | 4.776 | 0.578 | 0.803 |
| MA2 | 7.847 | 4.785 | 0.644 | 0.774 |
| MA3 | 8.38 | 4.509 | 0.689 | 0.752 |
| MA4 | 8.613 | 4.337 | 0.664 | 0.764 |
| DI | Cronbach's Alpha = 0.885 | | | |
| DI1 | 10.908 | 5.405 | 0.794 | 0.833 |
| DI2 | 10.393 | 5.45 | 0.772 | 0.841 |
| DI3 | 10.675 | 5.591 | 0.722 | 0.86 |
| DI4 | 11.018 | 5.426 | 0.705 | 0.869 |
| EMA | Cronbach's Alpha = 0.910 | | | |
| EMA1 | 13.178 | 13.011 | 0.674 | 0.905 |
| EMA2 | 12.693 | 12.449 | 0.772 | 0.891 |
| EMA3 | 12.448 | 12.311 | 0.82 | 0.884 |
| EMA4 | 12.969 | 12.499 | 0.774 | 0.891 |
| EMA5 | 13.939 | 12.539 | 0.768 | 0.892 |
| EMA6 | 14.282 | 13.13 | 0.692 | 0.902 |

### 4.2.2. For the Influential Factors

In this study, the author included all 24 observed variables in the analysis. When these variables exhibit a strong correlation with each other, they will be grouped together into sets of variables and presented as factors influencing environmental accounting in manufacturing enterprises in Hanoi. For the factor analysis, the study set up two hypotheses:

Null Hypothesis (H0): The variables in the dataset are not correlated with each other.
Alternative Hypothesis (H1): The variables in the dataset are correlated with each other.

**Table 5.**
KMO and Bartlett's Test Results for the Factor Analysis of Influential Factors.

| Test | Value |
|---|---|
| Kaiser–Meyer–Olkin (KMO) | 0.864 |
| Bartlett's Test of Sphericity | |
| Chi-Square Value | 3692.368 |
| Degrees of Freedom | 197 |
| Sig (P-value) | 0.000 |

The results show that Bartlett's test yields a significance value (p-value) of 0.000 < 0.05, thus the null hypothesis (H0) is rejected, and we accept the alternative hypothesis (H1), indicating that the variables are correlated with each other. Furthermore, the factor analysis is appropriate for grouping the variables together, and the data is suitable for factor analysis, as indicated by the KMO value of 0.864, which is greater than 0.5.

**Table 6.**
Results of the Total Variance Explained in EFA Analysis.

| Factor | Initial Eigenvalues | Total Squared Loadings Extracted | Factor | Initial Eigenvalues |
|---|---|---|---|---|
| | Total | % of Variance | % Cumulative | Total |
| 1 | 7.686 | 32.024 | 32.024 | 7.686 |
| 2 | 2.916 | 10.983 | 40.007 | 2.916 |
| 3 | 1.639 | 7.830 | 46.837 | 1.639 |
| 4 | 1.358 | 6.680 | 52.496 | 1.358 |
| 5 | 1.299 | 5.413 | 57.909 | 1.299 |
| 6 | 1.095 | 5.162 | 70.471 | 1.095 |

The results of the EFA run for the six independent variables (BA, RP, SP, CA, MA, DI) show that the 24 observed variables were grouped into six factors, confirming that the factor analysis is suitable for the real-world data. The extracted variance of 70.643% indicates that five factors explain 70.471% of the variability in the data, suggesting that the resulting scales are acceptable. The extraction stopped at the sixth factor with an eigenvalue of 1.095. All factor loadings are greater than 0.55, with the lowest factor loading being for the observed variable SP1 with a loading coefficient of 0.578.

**Table 7.**
Factor Loadings in the EFA Analysis of the Influential Factors.

| Observed variable | Factor | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| DI3 | –0.838 | | | | | |
| DI2 | –0.835 | | | | | |
| DI1 | –0.795 | | | | | |
| DI4 | –0.789 | | | | | |
| RP2 | | 0.884 | | | | |
| RP1 | | 0.875 | | | | |
| RP3 | | 0.861 | | | | |
| RP4 | | 0.845 | | | | |
| BS1 | | | 0.836 | | | |
| BS2 | | | 0.827 | | | |
| SB3 | | | 0.791 | | | |
| SB4 | | | 0.780 | | | |
| CA3 | | | | 0.823 | | |
| CA2 | | | | 0.811 | | |
| CA1 | | | | 0.784 | | |
| CA4 | | | | 0.772 | | |
| MA3 | | | | | 0.765 | |
| MA4 | | | | | 0.758 | |
| MA2 | | | | | 0.743 | |

| | | | | | | 0.722 | |
|---|---|---|---|---|---|---|---|
| MA1 | | | | | | 0.722 | |
| SP2 | | | | | | | 0.712 |
| SP4 | | | | | | | 0.678 |
| SP3 | | | | | | | 0.656 |
| SP1 | | | | | | | 0.573 |

For the Dependent Factor

**Table 8**.
KMO and Bartlett's Test Results in EFA for Dependent Factor.

| | **Value** |
|---|---|
| Kaiser-Meyer-Olkin (KMO) | 0.891 |
| Bartlett's Test of Sphericity | Chi-Square |
| | Degrees of Freedom |
| | Sig. (P-value): 0.000 |

The results from Bartlett's test (p-value = 0.000 < 0.05) indicate that there is a significant correlation among the variables in the dataset, thus rejecting the null hypothesis (H0) and accepting the alternative hypothesis (H1). Additionally, the KMO value of 0.891, which is greater than 0.5, confirms that the data is suitable for conducting exploratory factor analysis (EFA).

**Table 9.**
Total Variance Explained in EFA.

| Factor | Eigenvalues (Initial) | Total Sum of Squared Factor Loadings |
|---|---|---|
| | Total | % of Variance |
| 1 | 4.149 | 69.145 |

The results presented above show that the total explained variance reaches 69.145%, which is greater than 50%. This indicates that the factor extracted can explain 69.145% of the variance in the data.

**Table 10.**
Factor Loadings in EFA for the Dependent Factor.

| **Observed Variable** | **Factor 1** |
|---|---|
| EMA3 | 0.841 |
| EMA4 | 0.833 |
| EMA2 | 0.820 |
| EMA5 | 0.803 |
| EMA6 | 0.697 |
| EMA1 | 0.654 |

The factor loadings in the table above show that all the variables from EMA1 to EMA6 have factor loadings greater than 0.5, indicating that the measurement scales are appropriate for the study.

*4.2.3. Results of Multivariate Regression Model Testing*
Model Explanation Test: The general regression model used to illustrate the impact of the factors on the implementation of environmental accounting (EA) in manufacturing enterprises (MEs) in Hanoi is as follows:

$$EMA = \beta_0 + \beta_1 * BS + \beta_2 * RP + \beta_3 * SP + \beta_4 * CA + \beta_5 * NTQL + \beta_6 * DI + \varepsilon$$

The model's goodness-of-fit test involves testing hypotheses to draw conclusions about the model's adequacy:

Null Hypothesis (H0): $\beta_1=\beta_2=\beta_3=\beta_4=\beta_5=\beta_6=0$
Alternative Hypothesis (H1): There exists at least one $\beta_i$ that is different from 0.

If H1 is accepted and H0 is rejected, this indicates that the independent variables in the model explain the changes in the dependent variable, confirming that the model is suitable for the study.

**Table 11.**
R² Coefficient Results in Regression Analysis.

| Model | R | R² | Adjusted R² | Standardized Error of Prediction |
|---|---|---|---|---|
| 1 | 0.784a | 0.681 | 0.673 | 0.43595 |

**Note:** a.Predictors: QDtb, KKtb, QMtb, NTQLtb, TTDNVtb, CBLQtb
b. Dependent variable: KTMTtb.

In the Model Summary table, the Adjusted R Square value is 0.673, meaning that 67.3% of the variance in the implementation of environmental accounting can be explained by the independent variables: Company Size (QM), Regulatory Pressure (QD), Pressure from Stakeholders (CBLQ), Accounting Staff Competence (TDNV), Management Awareness (NTQL), and Challenges in Implementing Environmental Accounting (KK). The remaining 32.7% is attributable to the influence of other unmeasured variables and random errors.
Goodness-of-Fit Test of the Model

**Table 12**.
Results of Goodness-of-Fit Test in Regression Analysis.

| Model | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Regression | 62.961 | 6 | 10.494 | 72.977 | 0 |
| Residual | 17.606 | 156 | 0.113 | | |
| Total | 80.567 | 162 | | | |

**Note:** a. Dependent variable: KTMTtb
b. Predictors: QDtb, KKtb, QMtb, NTQLtb, TTDNVtb, CBLQtb.

The results of the ANOVA test show that the F value is 72.977 with a p-value of 0.000 < 0.05. This indicates that the regression model significantly fits the data. Therefore, the null hypothesis (H0) is rejected, confirming that there is at least one independent variable in the model that is linearly related to the dependent variable.

*4.2.4. Testing the Regression Coefficients*

**Table 13.**
Results of Testing the Regression Coefficients.

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. | Multicollinearity Statistics | |
|---|---|---|---|---|---|---|---|---|
| | | B | Standard Error | Beta | | | Tolerance | VIF |
| 1 | Constant | 0.618 | 0.36 | | 2.827 | 0.005 | | |
| | BStb | 0.171 | 0.041 | 0.197 | 4.206 | 0 | 0.642 | 1.558 |
| | RPtb | 0.302 | 0.063 | 0.284 | 4.776 | 0 | 0.397 | 2.516 |
| | SPtb | 0.028 | 0.066 | 0.021 | 0.453 | 0.651 | 0.582 | 1.533 |
| | CAtb | 0.137 | 0.062 | 0.102 | 2.071 | 0.04 | 0.652 | 1.719 |
| | MAtb | 0.229 | 0.05 | 0.226 | 4.589 | 0 | 0.58 | 1.725 |
| | DItb | -0.267 | 0.048 | -0.29 | -5.599 | 0 | 0.522 | 1.914 |

**Note:** a. Dependent Variable: KTMT.

The results of the t-test for the variable SP show that its Sig. value is greater than 0.05 (specifically, 0.051), indicating that this variable does not have statistical significance in the regression model. On the other hand, the remaining variables - BS, RP, CA, MA, and DI - have Sig. values less than 0.05, meaning these variables significantly influence the dependent variable EMA Implementation (EMA).

The regression coefficients of the independent variables BS, RP, CA, MA, and DI show that BS, RP, CA, and MA have positive coefficients, while DI has a negative coefficient, suggesting that all independent variables are correlated with the dependent variable.

Additionally, the VIF values for all independent variables are less than 2, indicating that there is no multicollinearity problem, meaning that there is no linear relationship among the independent variables.

The regression model is written as follows:

EMA = 0,618 + 0,171 * BS + 0,302 * RP + 0,137 * CA + 0,229* MA - 0,226 * DI + ε

Thus, the dependent variable EMA Implementation (EMA) is influenced by the following factors: Company Size (BS) ($\beta$ = 0.171), Pressure from Regulations (RP) ($\beta$ = 0.302), Employee Qualifications (CA) ($\beta$ = 0.137), Management Awareness (MA) ($\beta$ = 0.229), and Difficulties in Implementing EMA (DI) ($\beta$ = -0.267). The factor Pressure from Stakeholders (MA) is not statistically significant, and therefore does not affect EMA Implementation in manufacturing enterprises in Hanoi.

Based on the standardized regression coefficients, the order of influence of the independent variables on the dependent variable is as follows: Pressure from Regulations (RP) ($\beta$ = 0.291), Difficulties in Implementing EMA (DI) ($\beta$ = -0.283), Management Awareness (MA) ($\beta$ = 0.226), Company Size (BS) ($\beta$ = 0.187), and Employee Qualifications (CA) ($\beta$ = 0.12).

The first assumption is that the residuals in the regression must follow a normal distribution. Residuals may not conform to a normal distribution due to reasons such as improper model specification, non-constant variance, or an insufficient number of residuals for analysis. Therefore, it is necessary to conduct several diagnostic checks, with the two most common being the histogram and Normal P-P Plot of the residuals.

The mean value of the residuals is approximately 0, and the standard deviation is 0.981, which is close to 1. This indicates that the residuals' distribution approximates a normal distribution. Therefore, it can be concluded that the assumption of normally distributed residuals is not violated.
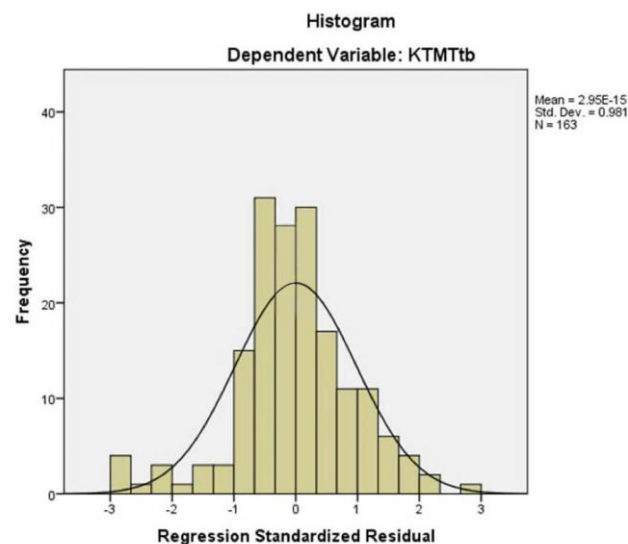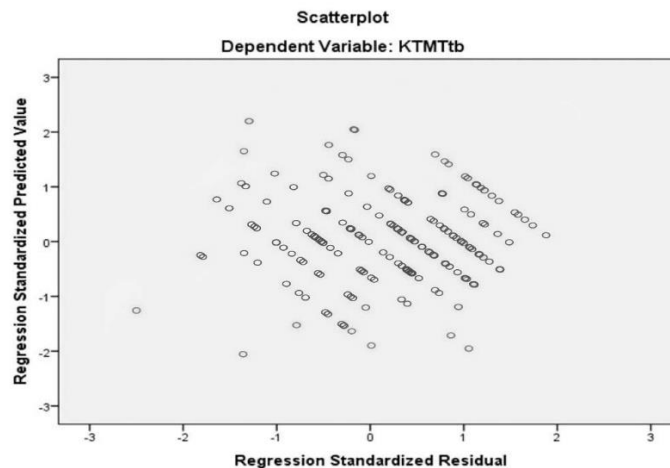


**Figure 1.**
Histogram Test Results.
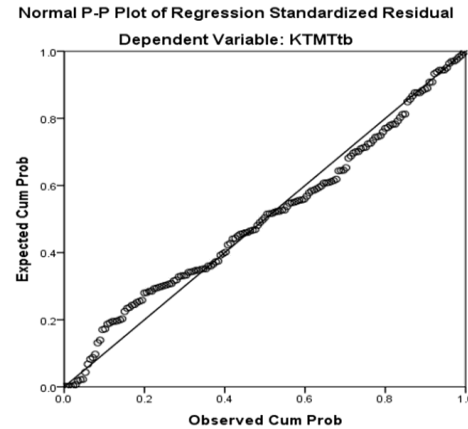
**Figure 2.**
Normal P-P Plot Test Results.

The residuals' quantile points are closely aligned along a diagonal line, indicating that the assumption of normal distribution of residuals is satisfied.

The second assumption is that there must be a linear relationship between the dependent variable and the independent variables. A scatter plot of the standardized residuals against the standardized predicted values can help detect any violations of this linearity assumption.

From the scatter plot, it is observed that the standardized residuals are randomly distributed around the zero horizontal axis, forming a linear pattern. This indicates that the assumption of linearity between the dependent and independent variables is not violated.



**Figure 3.**
Standardized Residual.

### 4.2.5. Hypothesis Testing

Based on the previous diagnostic tests, it can be concluded that the five independent variables – Company Size (BS), Regulatory Pressure (RP), Managerial Awareness (MA), Accounting Staff Expertise (CA) and Environmental Challenges (DI) – all positively affect the dependent variable, Environmental Management Accounting (EMA).

**Table 14.**
Hypothesis Testing Results.

| No. | Hypothesis | Conclusion |
|---|---|---|
| 1 | H1: Company size positively affects the level of environmental management accounting (EMA) implementation in manufacturing enterprises in Hanoi. | Accepted |
| 2 | H2: Regulatory pressure positively affects the level of environmental management accounting (EMA) implementation in manufacturing enterprises in Hanoi. | Accepted |
| 3 | H3: Pressure from stakeholders positively affects the level of environmental management accounting (EMA) implementation in manufacturing enterprises in Hanoi. | Rejected |
| 4 | H4: Accounting staff expertise positively affects the level of environmental management accounting (EMA) implementation in manufacturing enterprises in Hanoi. | Accepted |
| 5 | H5: Managerial awareness of environmental issues positively affects the level of environmental management accounting (EMA) implementation in manufacturing enterprises in Hanoi. | Accepted |
| 6 | H6: Challenges in implementing environmental management accounting negatively affect the level of environmental management accounting (EMA) implementation in manufacturing enterprises in Hanoi. | Accepted |

This section confirms the hypotheses tested in the model and provides the necessary conclusions on the relationships between the independent variables and the dependent variable (EMA implementation) in the context of manufacturing enterprises in Hanoi. The rejected hypothesis (H3) indicates that stakeholder pressure does not have a statistically significant impact on the adoption of environmental management accounting in the given context.

### 4.3. Discussion of Research Findings

The results of our study confirm the factors influencing the implementation of Environmental Management Accounting (EMA) in manufacturing enterprises (MEs) in Hanoi, with statistically significant relationships at a 95% confidence level.

Regulatory pressure is the strongest factor affecting EMA, with a β coefficient of 0.291 (p-value = $0.00 < 0.05$). This finding is consistent with the study by Chang and Deegan [9] which shows that regulations imposed by the government and regulatory authorities play a crucial role in encouraging enterprises to adopt EMA in order to comply with environmental protection requirements. Christ and Burritt [13] also found that pressure from regulations and institutional factors significantly impact corporate environmental behavior. This pressure comes not only from environmental standards but also from penalties, reporting requirements, and product quality standards related to environmental protection.

The difficulty in applying EMA has a negative impact, with a β coefficient of -0.2283 (p-value = $0.00 < 0.05$). The main difficulty arises from the lack of guidance materials and practical experience in collecting and allocating environmental costs. This result aligns with the research of Setthasakko [18] who pointed out that the lack of guidance materials and the lack of practical experience in implementing EMA are significant barriers in developing countries like Thailand. Furthermore, financial constraints and the lack of cooperation between departments within enterprises also play important roles in hindering the implementation of environmental accounting.

Management's awareness of environmental protection and EMA has a positive impact on the implementation of EMA, with a β coefficient of 0.226. This is in line with the study by Thi [19] which indicates that leaders' awareness of the benefits of EMA can drive the adoption of environmental accounting practices, helping enterprises not only reduce costs but also improve environmental management efficiency. When leadership recognizes the importance of environmental protection, they are more likely to implement strategies and policies aimed at enhancing environmental protection in the company's operations.

The size of the enterprise also significantly affects the implementation of EMA (β = 0.187, p-value = $0.00 < 0.05$). Larger enterprises are more likely to successfully implement EMA due to their well-developed accounting systems and strong financial resources. This result is consistent with the study by

Christ and Burritt [13] which suggests that large enterprises have advantages in resources and the ability to implement environmental management methods, including EMA. Large enterprises are better equipped to invest in environmental accounting systems, train employees, and comply with environmental standards, whereas smaller enterprises often face challenges due to financial and resource constraints.

Finally, the professional qualifications of accounting staff have the weakest impact on EMA. While most accountants have received training, the lack of in-depth knowledge of EMA remains a significant limitation. This is similar to the findings of Chen, et al. [23] and Setthasakko [18] which highlight that the lack of specialized knowledge in environmental accounting among accounting staff is one of the major obstacles to implementing EMA. Accounting staff with higher professional qualifications will be more capable of identifying and allocating environmental costs, as well as providing accurate and timely information for managerial decision-making, which helps the company achieve better environmental performance.

## 5. Conclusion and Recommendations

Environmental protection and environmental management accounting (EMA) are current issues and present a significant challenge for enterprises in Vietnam. EMA not only helps businesses meet legal and environmental requirements but also improves business efficiency and enhances competitiveness. The adoption and development of EMA in Vietnam will contribute to cost management, increased profitability, and achieving sustainable development goals.

This study was conducted on 163 accountants and managers from 163 manufacturing enterprises (MEs) in Hanoi, using SPSS 22 software to assess Cronbach's Alpha reliability, exploratory factor analysis (EFA), and regression analysis. The results show that six factors influence the implementation of EMA in MEs in Hanoi. These factors, in order of their impact, are: (1) Regulatory pressure, (2) Difficulties in applying EMA, (3) Management's awareness of EMA, (4) Enterprise size, (5) Accounting staff qualifications, and (6) Accounting staff professional expertise. These factors affect EMA implementation in a descending order.

The results of the study have helped identify the key factors influencing the implementation of EMA in manufacturing enterprises in Hanoi, contributing to the development of effective solutions to enhance the quality of financial information and support decision-making in business.

Based on the research findings, several solutions can help strengthen the implementation of EMA in manufacturing enterprises in Vietnam:

Strengthen legal regulations and provide detailed guidelines on environmental accounting: The current legal regulations on environmental protection are insufficiently detailed, particularly in the area of environmental accounting. The lack of specific guidelines for EMA implementation causes difficulties for businesses. The government should issue more detailed regulations on EMA, including mandatory environmental reporting for all enterprises, not just listed companies. This will not only help businesses easily comply with environmental requirements but also ensure transparency in financial reporting.

Reduce difficulties in applying environmental accounting: Enterprises face many challenges in implementing EMA, including cost classification, balancing benefits and costs, lack of guidelines, and poor coordination between departments. To address these challenges, the Ministry of Finance should issue detailed guidelines and work with professional organizations to develop environmental accounting standards. Additionally, businesses should be supported with tools and software for managing environmental data, making EMA implementation more efficient and effective.

Raise awareness among business leaders about environmental accounting: Business leaders play a key role in the implementation of EMA. The study shows that the awareness of leaders about the importance of EMA directly affects its implementation in enterprises. Therefore, it is necessary to strengthen training programs and workshops to raise awareness among business leaders about the benefits of EMA, particularly in the context of sustainable development and the growing demands from investors and customers.

Encourage large enterprises to implement EMA: The research findings indicate that large enterprises are more likely to successfully implement EMA due to their higher information needs. Therefore, these enterprises should be encouraged to systematically adopt EMA to support decision-making and minimize environmental impacts in production. For small and medium-sized enterprises (SMEs), flexible approaches should be explored to integrate EMA into their traditional accounting systems without incurring excessive costs.

Train and develop environmental accounting human resources: Environmental accounting is still a relatively new field in Vietnam, so training accounting professionals with the knowledge and skills in environmental issues is essential. Universities and training institutions should incorporate environmental accounting into their curriculum and offer specialized training for accounting professionals currently working in businesses. Professional organizations, such as the Vietnam Association of Accountants and Auditors, could collaborate to organize workshops and specialized training on environmental accounting to enhance knowledge among accounting professionals.

Enhance interdepartmental coordination within enterprises: Effective implementation of EMA requires close cooperation between the accounting department and other departments such as production, environmental management, and business operations. Improving communication and information exchange between these departments will help businesses gather comprehensive data on environmental costs and make their EMA systems more effective.

## Transparency:
The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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