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Environmental Strategy and Environmental Management Accounting as Contributors to Environmental and Financial Performance: The Case of Manufacturing Firms in Vietnam for the Sustainable Development Goals (SDGS)

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Abstract

This study aims to examine the interrelationships among environmental strategy, environmental management accounting (EMA), environmental performance, and financial performance within manufacturing firms in Vietnam, a topic rarely addressed in previous research. Specifically, the research investigates the role of EMA use and environmental performance in mediating the relationship between environmental strategy and financial performance. Drawing on stakeholder theory, contingency theory, and the natural resource-based view theory, this study develops and tests a serial mediation model to explain how EMA use and environmental performance link environmental strategy to improved financial performance Data were collected from 198 manufacturing firms in Vietnam. The research employed partial least squares structural equation modeling (PLS-SEM) with SmartPLS software for data analysis. The findings reveal that environmental strategy positively influences both EMA use and environmental performance. Moreover, EMA and environmental performance act as significant mediators, positively influencing financial performance. This study focuses on manufacturing firms in Vietnam, an emerging market, which may limit the generalizability of the findings to other geographic contexts. Cultural differences, variations in environmental standards, and different levels of economic development across countries may influence the relationship between environmental strategies and performance outcomes, suggesting that the results may not be universally applicable. This research is the first to explore the interconnections between environmental strategy, EMA use, environmental performance, and financial performance in manufacturing firms in Vietnam. It provides valuable theoretical and practical insights for managers and policymakers, highlighting the importance of integrating environmental strategies into business operations.

Keywords: *Environmental Strategy, Environmental Management Accounting, Environmental Performance, Financial Performance, Sustainable Development Goals (Sdgs).*

Introduction

Environmental strategy is defined as a set of initiatives aimed at reducing the impact of business activities on the natural environment through a company's products, processes, and policies. These initiatives include reducing energy consumption and waste, utilizing sustainable green resources, and implementing environmental management systems (Bansal & Roth, 2000). Managers' focus on environmental issues enhances their ability to establish environmental strategies (Gunarathne *et al.*, 2023), and businesses with such strategies can improve their environmental performance (Rodrigue *et al.*, 2013). Environmental management accounting (EMA) has emerged as an effective tool to assist businesses in recording and evaluating the benefits, costs, and effectiveness of activities related to environmental management (Jasch, 2003). Integrating environmental considerations into accounting practices has become increasingly urgent (Trinh Huu Luc & Le Huynh Nhu, 2024). The use of EMA enables businesses to meet their environmental responsibilities while identifying economic benefits through improved financial and environmental performance (Ong *et al.*, 2023). Moreover, EMA serves as an approach to corporate environmental disclosure, enhancing transparency with stakeholders and helping businesses achieve better financial and environmental outcomes (Zhou *et al.*, 2017).

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Using the contingency theory, many researchers have found a positive relationship between environmental strategy and the application of EMA (Solovida *et al.*, 2017; Latan *et al.*, 2018; Gunarathne *et al.*, 2023). This relationship has garnered significant scholarly attention, contributing to a comprehensive understanding of environmental strategy and EMA application. However, the mechanisms through which environmental strategy translate into improved environmental and financial performance via EMA remain underexplored, particularly in emerging markets where environmental challenges persist (Christine *et al.,* 2019). Addressing this gap is essential to provide meaningful implications for enterprises in emerging markets, enabling them to maximize the impact of environmental strategies on both environmental and financial performance through the application of EMA (Latan *et al.*, 2018).

Furthermore, while previous studies have investigated the relationship between environmental and financial performance (Horváthová, 2010; Marrucci *et al., 2022*), limited empirical research has examined the linkage between environmental performance and financial performance from the perspective of environmental strategy and EMA application. Consequently, exploring the simultaneous impacts of environmental strategy and EMA usage on both environmental and financial performance addresses a significant gap in existing literature.

This study focuses on the context of manufacturing enterprises in Vietnam, an emerging market facing severe environmental pollution. The adoption of EMA is crucial to contribute to environmental protection in Vietnam (Liem & Hien, 2024). Latan *et al.* (2018) noted that most prior studies on EMA and its impact on environmental and financial performance have primarily focused on developed countries. Different national contexts, influenced by varying environmental priorities of governments and organizations, may lead to divergent research outcomes (Cadman *et al.,* 2016).

The structure of this paper is as follows: the next section outlines the theoretical background and research model, along with the corresponding hypotheses; the following section details the data collection process, research design, and sampling methods; the results are then presented and discussed; and the paper concludes with a discussion of the theoretical and managerial implications, followed by the overall conclusions.

Theoretical Framework

Research Concepts

Environmental Strategy: Juan Alberto Aragón-Correa & Rubio-Lopez (2007) define environmental strategy as "systematic voluntary practice patterns that go beyond regulatory requirements," including initiatives such as waste minimization and pollution prevention at the source. Various typologies and classifications have been proposed, outlining different levels of environmental strategy proactivity—from slightly exceeding legal requirements to achieving environmental excellence. Environmental strategy ensures that human activities do not harm land, air and water resources (Bansal & Pratima, 2005). Businesses adopt environmental management strategies to reduce their ecological footprint by integrating environmental considerations into operational processes (Steurer *et al.*, 2005; Torugsa *et al.*, 2013).

Environmental Management Accounting (EMA): Management accounting has evolved significantly over the years, leading to the development of new perspectives and techniques, including EMA (Niap, 2006). EMA is regarded as an extension of management accounting, specifically addressing environmental issues (Le, 2018). Management accountants are trained to enhance the quality of environmental information and utilize it in decision-making processes (Schaltegger & Burritt, 2000). Numerous definitions of EMA exist in the literature, reflecting variations in scope and application boundaries (Chang, 2007). According to the United Nations Division for Sustainable Development (UNDSD, 2001), EMA is defined as "the identification, collection, analysis, and use of two types of information for internal decision-making: Physical information about the use, flow, and disposal of energy, water, and raw materials (including waste), and monetary information about environmental costs, benefits, and savings." Similarly, the International Federation of Accountants (IFAC, 2005) describes EMA as "the management of economic and environmental performance through the development and implementation of appropriate accounting systems and

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practices related to environmental issues." Xiaomei (2004) emphasizes that EMA involves identifying, collecting, estimating, analyzing, internal reporting, and utilizing material and energy flow information, environmental cost data, and other cost-related information to support organizational decision-making. It employs a comprehensive set of methods to enhance material efficiency, reduce environmental impacts, and lower environmental protection costs by processing data from financial accounting, cost accounting, and material flow balancing. EMA is a component of management accounting that provides environmental information for internal management, acting as the intersection of environmental and management accounting. It encompasses both monetary and physical information (Le *et al.*, 2019).

Environmental Efficiency: Environmental performance reflects the extent to which businesses meet stakeholders' expectations regarding environmental responsibility (Carroll, 2000). Albertini (2013) defines environmental performance as "the result of managing an organization's environmental impacts." Similarly, Yang *et al.* (2011) describes it as "the extent to which an organization improves its performance in relation to its environmental responsibilities."

Financial Performance: Financial performance refers to "the extent to which an organization achieves profit-oriented results" (Yang *et al.*, 2011). Managers and investors often evaluate financial performance using profit indicators such as net profit margin (ROS), return on assets (ROA), and return on equity (ROE) (Chau Thi Le Duyen & Huynh Truong Tho, 2015).

Background Theory

Contingency Theory: Developed in the 1960s, contingency theory remains a cornerstone of management accounting research (Mokhtar *et al.*, 2016). The central premise of this theory is that the design and implementation of management accounting systems vary depending on the specific circumstances of each organization (Otley, 1980, 1999). Relevant characteristics influencing the design of these systems include organizational size, environmental uncertainty, production technology, corporate strategy, and market conditions (Chenhall, 2003; Hoque, 2004; Abdel-Kader & Luther, 2008). With increasing pressure to act responsibly toward the environment, businesses must respond quickly and effectively to survive. Since conventional accounting practices fail to provide adequate information for environmental activities (Schaltegger *et al.*, 2003; Burritt *et al.*, 2002; Burritt, 2004), organizations must implement EMA to accurately quantify environmental information for decision-making and reporting purposes. This study systematically examines the influence of organizational characteristics - particularly environmental strategy - on EMA use and how this affects environmental and financial performance.

The Natural Resource Based View Theory – NRBV: Originating with Hart (1995), NRBV posits that an effective environmental strategy can be a source of sustainable competitive advantage if it is valuable, rare, inimitable, and non-substitutable (Hart & Dowell, 2011). Klassen & McLaughlin (1996) argue that environmental strategy influences financial and environmental performance, with financial performance often reflected in profitability and market responses to businesses' sustainable environmental management efforts. Compliance with environmental regulations and strategies for pollution prevention led organizations to adopt systematic approaches that emphasize resource efficiency (Hart, 1995; Hart & Dowell, 2011). These resource optimization efforts enhance environmental performance and, in turn, financial performance (Russo & Fouts, 1997). Solovida *et al.* (2017) applied NRBV to illustrate the link between environmental strategy and environmental performance, emphasizing EMA's mediating role. Building on this, the current study employs NRBV as a theoretical foundation to explain how environmental strategy impacts environmental and financial performance, mediated by EMA use. In essence, NRBV provides a lens through which environmental strategy is aligned with EMA implementation, ultimately driving improvements in environmental and financial outcomes.

Stakeholders Theory: First introduced by Freeman (1984), stakeholder theory highlights the importance of addressing the concerns of stakeholders particularly regarding environmental issues and sustainable development. Pursuing environmental strategies can yield multiple benefits, such as cost savings, improved stakeholder relationships, enhanced eco-innovation, resource efficiency, regulatory compliance, and pollution prevention (Wijethilake, 2017; Gunarathne *et al.*, 2021). Research increasingly suggests that

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environmental strategies contribute to better performance outcomes (Danso *et al.*, 2019; Adomako *et al.*, 2020). Studies have also demonstrated a significant positive relationship between environmental strategies and organizational performance across environmental, economic, and social dimensions (Wijethilake, 2017; Gunarathne *et al.*, 2021). To realize these benefits, organizations often develop environmental accounting systems to support their environmental management activities (Latan *et al.*, 2018). EMA serves as a decision-support tool, aiding businesses in identifying environmental costs and liabilities while providing critical information for decision-makers and stakeholders (Schaltegger *et al.*, 2017). Additionally, EMA systems facilitate the planning, control, monitoring, and evaluation processes necessary to achieve ecological and financial goals (Gunarathne *et al.*, 2021). Drawing on stakeholder theory, this study identifies stakeholder pressure as a driver for adopting environmental strategies. Implementing such strategies necessitates EMA to fulfill information requirements, ensuring successful execution and contributing to improved environmental and financial performance.

Research Hypothesis

Accounting information systems, such as EMA, play a critical role in providing insights into environmental costs and monitoring both financial and environmental performance during the implementation of environmental strategies (Ferreira *et al.*, 2010). Recent trends in sustainable development have heightened businesses' concerns about environmental protection, prompting them to integrate environmental responsibility into their strategies. Consequently, businesses adopt innovative tools like EMA to enhance their corporate image (Tran *et al.*, 2021). Changes in environmental strategy necessitate corresponding adjustments in management accounting systems to deliver relevant environmental information to decision-makers (Le *et al.*, 2019).

Based on contingency theory, Qian & Burritt (2009) argue that environmental strategy influences the adoption and use of EMA in organizations. Guo (2008) further highlights that businesses with varying environmental strategies require tailored management information systems to improve organizational performance. Accounting information systems significantly impact business operations, shaping strategies and contributing to organizational success. For instance, Chang (2007) observes that businesses with proactive environmental strategies often invest in waste treatment technologies to comply with environmental regulations or alleviate stakeholder pressure. Alternatively, these businesses may voluntarily adopt clean technologies to redesign production processes, thereby minimizing environmental impacts. In such cases, management accounting systems must evolve to support the collection, calculation, and dissemination of environmental information. Studies by Al-Mawali *et al.* (2018), Latan *et al.* (2018), Le *et al.* (2019), and Nguyen Thu Hien (2022) confirm that environmental strategy is a significant determinant of EMA use.

From this analysis, the following research hypothesis is proposed:

H1: *Environmental strategy has a positive impact on EMA use.*

Environmental strategies are widely emphasized by businesses and encompass initiatives such as eco-efficiency, pollution prevention, product development, and corporate social responsibility (Solovida & Latan, 2017). The manner in which a business executes its environmental strategy directly influences its environmental performance, with the assessment of this performance underscoring the importance of a robust environmental strategy (Rodrigue *et al.*, 2013). Businesses with environmental strategies consistently demonstrate superior environmental performance compared to those without such strategies (Wagner & Schaltegger, 2004). Furthermore, businesses often disclose their environmental performance to stakeholders as a testament to their commitment to environmental standards and their voluntary compliance with environmental regulations.

Managers' focus on environmental issues significantly affects a business's ability to develop and implement effective environmental strategies (Hart & Dowell, 2011). A well-executed environmental strategy is integral to achieving strong environmental performance (Rodrigue *et al.*, 2013).

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From this analysis, the following research hypothesis is proposed:

H2: *Environmental strategy has a positive impact on environmental performance*

Environmental performance reflects a business's commitment to protecting and maintaining the natural environment (Ong *et al.*, 2023). It is commonly assessed through indicators such as pollution control, waste reduction, emission mitigation, and recycling activities (Solovida & Latan, 2017). EMA addresses the limitations of traditional management accounting systems by enabling more precise cost allocation and product pricing (Kitzman, 2001). Additionally, EMA helps organizations minimize negative environmental impacts and achieve cost savings (Godschalk, 2008). As an essential tool for integrating environmental considerations into project evaluation (Sarker & Burritt, 2008), EMA facilitates the provision of comprehensive environmental data, offering managers valuable insights for decision-making and strategic planning (Wagner, 2005).

The adoption of EMA empowers enterprises to tackle environmental problems effectively by providing actionable information that enables managers to limit environmental impacts, thereby generating environmental benefits (Marrucci *et al.*, 2022; Burritt *et al.*, 2019). Moreover, EMA supports the measurement, control, and disclosure of environmental performance (Solovida & Latan, 2017). Consequently, EMA use positively influences environmental performance (Qian, 2012). Empirical studies, such as those by Lutfi *et al.* (2018), further corroborate the positive impact of EMA on the environmental performance of businesses.

Based on this analysis, the following hypothesis is proposed:

H3*: EMA use has a positive impact on environmental performance*.

According to the natural resource-based view, Qi *et al.* (2014) argue that strong environmental performance enables firms to develop resources that are valuable, rare, inimitable, and non-substitutable (Hart, 1995; Srivastava *et al.*, 1998), thereby improving financial performance. Benefits derived from environmental performance include increased revenues through enhanced environmental reputation and reduced risks associated with environmental disasters, which could otherwise negatively affect financial outcomes (Peloza, 2006). Furthermore, proactive environmental practices reduce compliance costs, enhance employee morale, and boost productivity (Mazzanti & Zoboli, 2009). Enhanced environmental performance also provides an "insurance function" by lowering capital costs and mitigating market and financial risks (Qi *et al.*, 2014).

Based on this analysis, the following hypothesis is proposed:

H4: Environmental performance affects financial performance.

The use of EMA is shaped by environmental strategy, which forms part of a company's broader business strategy. EMA helps enterprises fulfill their environmental responsibilities while identifying economic benefits (Ferreira *et al.*, 2010). It also facilitates information disclosure, enabling firms to achieve superior financial and environmental performance (Zhou *et al.*, 2017). The greater the extent of EMA adoption, the higher the level of control and decision-making efficiency derived from accurate, timely, and integrated information, which is critical for improving environmental performance (Solovida & Latan, 2017).

Empirical studies, such as those conducted by Henri & Journeault (2010), Christ & Burritt (2013), Journeault (2016), Erauskin-Tolosa *et al.* (2020), and Marrucci & Daddi (2022), demonstrate that environmental strategy significantly enhances financial and environmental performance through EMA adoption. However, despite the evidence of these positive effects, empirical research on the interplay between environmental strategy, EMA application, environmental performance, and financial performance is still limited, particularly in developing countries like Vietnam (Lutfi *et al.*, 2023).

Based on this analysis, the following hypothesis is proposed:

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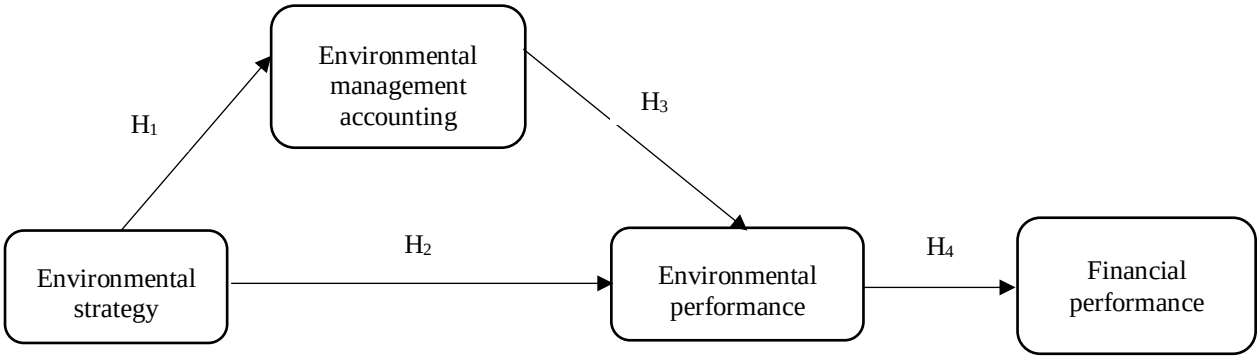
H5: *EMA use and environmental performance play a mediating role in the impact of environmental strategy on financial performance.*

As a result, a conceptual model Figure 1 was established with three constructs showing the relationships among research concepts

Figure 1. Conceptual Framework



H_5: Environmental strategy-> EMA-> Environmental performance -> Financial performance

Source: Author's research

Methodology

Design and Data Collection

This study designed a survey questionnaire to capture four dimensions: environmental strategy, EMA, environmental performance, and financial performance. A pre-examination and adjustment process was conducted to ensure content validity. All factors were assessed using a five-point Likert scale, as developed by Likert (1932), ranging from 1 ("Totally disagree") to 5 ("Totally agree"). The questionnaire was initially designed in English to maintain the integrity of the measurement items and then translated into Vietnamese to facilitate data collection. Part 1 of the survey gathered firm and respondent information, while Part 2 assessed the four research constructs in the proposed model.

The scope of this study was limited to the manufacturing industry. In Vietnam, manufacturing businesses have consistently evolved and adapted to technological advancements and shifting market demands. The industry is now transitioning to a new phase of development that prioritizes sustainability. The target respondents for this study were mid- and top-level managers from manufacturing firms in Vietnam, given their critical roles in driving strategic growth (Thu Hien Nguyen, 2022). These managers were considered suitable respondents as they are well-positioned to provide insights into the performance outcomes (environmental and financial) of organizational strategies.

Data collection was conducted through online surveys. The questionnaire was created using Google Docs and distributed via social media platforms such as Facebook and Zalo. Data collection spanned two months, from August 2024 to September 2024. Upon completion of the data collection process, 198 valid responses were obtained and used for analysis. The demographic information of the respondents is summarized in Table 1.

Content Validation

After proposing the research model, this study analyzed the specific characteristics of manufacturing firms in Vietnam and adapted measurement items for the factors from previous studies. Specifically, four items

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assessing environmental strategy were adapted from Latan *et al.* (2018); six items measuring EMA use were adapted from Chaudhry & Amir (2020); seven items evaluating environmental performance were adapted from Latan *et al.* (2018); and three items assessing financial performance were adapted from Le *et al.* (2019).

All measurement items were required to ensure reliability (Allen & Yen, 1979) and internal consistency (Nunnally, 1978). Verifying content validity was critical to the study's theoretical examination (Hair *et al.*, 2019). Consequently, preliminary research was conducted by gathering feedback from the target respondents to test the latent variables and revise the items as needed. Once the measurement items met the required standards for validity and content, they were included in the questionnaire.

A pilot study was then conducted with 20 respondents working in manufacturing firms. The results indicated that all factors had Cronbach's alpha values greater than 0.7, demonstrating good reliability (Nunnally & Bernstein, 1994).

Data Analysis

The data analysis technique analyzes a linear structural model based on partial least squares (PLS-SEM). This study uses PLS-SEM because it is consistent with previous studies in leading journals (Lutfi *et al.,* 2023). A systematic procedure for data analysis included analysis of demographic information, evaluation of the measurement model and evaluation of the structural model.

Table 1. Characteristics of Sample Firms and the Respondents (N=198).

Demographics	n	%	Demographics	n	%
Firm size (assets in VND billion)			***Workplace***		
Small (less than 20)	48	24.24	mid-level manager	137	69.19
Medium (from 20 to less than 100)	101	51.01	top-level manager	61	30.81
Large (over 100)	49	24.75	***Working time***		
Firm size (employees)			Less than 5 years	48	24.24
Small (less than 100)	44	22.22	From 5 to less than 10 years	89	44.95
Medium (from 100 to less than 200)	108	54.55	From 10 to less than 20 years	32	16.16
Large (over 200)	46	23.23	Over 20 years	29	14.65
Ownership structure			***Qualifications***		
With foreign capital	44	22.22	Postgraduate level	28	14.14
Without foreign capital	154	77.78	Bachelor's degree	150	75.76
			College degree	20	10.10

Source: Author's research

Research Results and Discussions

Measurement Model Assessment

At first, the measurement model was examined for reliability and validity. As shown in Table 2, the outer loadings and the corresponding t-bootstrap values resulted from the test are acceptable and highly reliable. The outer loadings of all observed variables range from 0.762 to 0.909, exceeding the 0.50 limit, except observed variable "*2.ketoan4*" (Hulland, 2012). In addition, the convergent validity fulfilled expectations because the average variance extracted (AVE) values for all constructions are over the cutoff value of 0.50, within the range of 0.665 and 0.807. The Cronbach's Alpha (CA) of each construct ranges from 0.837 to 0.938 and is above 0.70. The composite reliabilities (CR) of the latent variables range from 0.891 to 0.950 and is above 0.70 for all constructs, surpassing the satisfactory standards for exploratory research (Hair *et al.*, 2019).

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Table 2. Scale Items and Latent Variable Evaluation.

Construct and items	Mean	Outer loading	CA	CR	AVE
1.strategy: Environmental strategy (Latan *et al.*, 2018)					
1.chienluoc1: Key performance indicators (KPIs), which identify four key categories: air, waste, water and energy	3.338	0.820	0.837	0.891	0.672
1.chienluoc2: Investing in research and development environment	3.222	0.791			
1.chienluoc3: ISO Certification	3.636	0.818			
1.chienluoc4: Long-term commitment to the environment	3.581	0.848			
2.ema: Environmental management accounting (Chaudhry & Amir, 2020)					
2.ketoan1: A company's accounting system records all physical inputs and outputs (such as energy, water, materials, waste and emissions).	3.601	0.838	0.874	0.908	0.665
2.ketoan2: The accounting system used by the business has the ability to conduct studies on product inventories, product improvements, and the environmental impact of products.	3.495	0.846			
2.ketoan3: Enterprises use environmental performance targets to measure and manage physical inputs and outputs.	3.576	0.801			
2.ketoan4[a]: An enterprise's accounting system can identify, estimate and classify environmental costs and liabilities.	3.687	-			
2.ketoan5: The enterprise's accounting system has the ability to create and use cost accounts specifically related to the environment.	3.747	0.774			
2.ketoan6: The accounting system used by the enterprise has the ability to allocate environmental-related expenses to different products.	3.758	0.816			
3.envi_per: Environmental performance (Latan *et al.*, 2018)					
3.hieuquamt1: Compliance with environmental regulations	3.586	0.890	0.938	0.950	0.731
3.hieuquamt2: Preventing and mitigating environmental crises	3.237	0.762			
3.hieuquamt3: Explore cost-cutting opportunities	3.273	0.862			
3.hieuquamt4: Limiting environmental impact beyond	3.303	0.879			
3.hieuquamt5: Enhance reputation	3.338	0.886			
3.hieuquamt6: Create social benefits	3.712	0.838			
3.hieuquamt7: Enhance competitive advantage	3.702	0.862			
4.finan_per: Financial performance (Le *et al.*, 2019)					
4.hieuquatc1: Return on assets (ROA)	3.732	0.909	0.880	0.926	0.807
4.hieuquatc2: Return on equity (ROE)	3.707	0.895			
4.hieuquatc3: Return on sales (ROS)	3.692	0.891			

Notes:
a: Items removed because of outer loading < 0.5
CA: Cronbach's Alpha; CR: Composite Reliability; AVE: Average Variance Extracted

Source: Author's research

Discriminant validity was assessed using Fornell & Larcker's (1981) proposed procedure. As stated in Table 3, except for all the control variables, the square roots of AVE of the critical constructs (ranging from 0.815 to 0.898) are all over the equivalent bootstrapped correlation coefficients.

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Table 3. Fornell-Larcker Criterion.

	1.strategy	2.ema	3.envi_per	4.finan_per
1.strategy	0.819			
2.ema	0.498	0.815		
3.envi_per	0.369	0.464	0.855	
4.finan_per	0.505	0.702	0.489	0.898

Notes: 1. strategy: Environmental strategy; 2.ema: Environmental management accounting; 3. envi_per: Environmental performance; 4. finan_per: Financial performance.

Source: Author's research

The Heterotrait–Montrait (HTMT) test was also used (Henseler *et al.*, 2015). The test results in the HTMT values are within the range of 0.505 and 0.573, which is below 1.00, consequently, stronger supporting the discriminant validity (see Table 4).

Table 4. Heterotrait-Monotrait Ratio (HTMT).

	1.strategy	2.ema	3.envi_per	4.finan_per
1.strategy				
2.ema	0.573			
3.envi_per	0.409	0.505		
4.finan_per	0.584	0.800	0.537	

Notes: 1.strategy: Environmental strategy; 2.ema: Environmental management accounting; 3.envi_per: Environmental performance; 4.finan_per: Financial performance.

Source: Author's research

Hence discriminant validity test does not reveal any serious problem, and this shows that all the latent variables are different from each other.

Structural Model Assessment

Before verifying the research's hypotheses, model fit indices and predictive relevance were estimated. First, the standardized root means square residual (SRMR), and normed fit index (NFI) were satisfactory and below 0,08 for SRMR (Henseler *et al.*, 2015) and below 0,90 for NFI (Lohmöller & Lohmöller, 1989). The results were as follows: SRMR = 0.054 and NFI = 0.889. The predictive relevance (Stone–Geisser's Q^2) was also satisfactory since Stone– Geisser's Q^2 values were higher than 0 (Hair *et al.*, 2019).

Table 5. LV Prediction Summary

	RMSE	MAE	Q^2_predict	R Square	R Square Adjusted
2.ema	0.885	0.658	0.237	0.248	0.245
3.envi_per	0.949	0.731	0.122	0.241	0.233
4.finan_per	0.939	0.715	0.144	0.239	0.235

Source: Author's research

The bootstrapping procedure is used to assess the inner model as a measurement of the significant value of the influence between variables. T-test (T-statistics) is used to test the hypothesis on each direct effect path partially and indirect effect path simultaneously. The results of hypothesis testing are presented in table 2.

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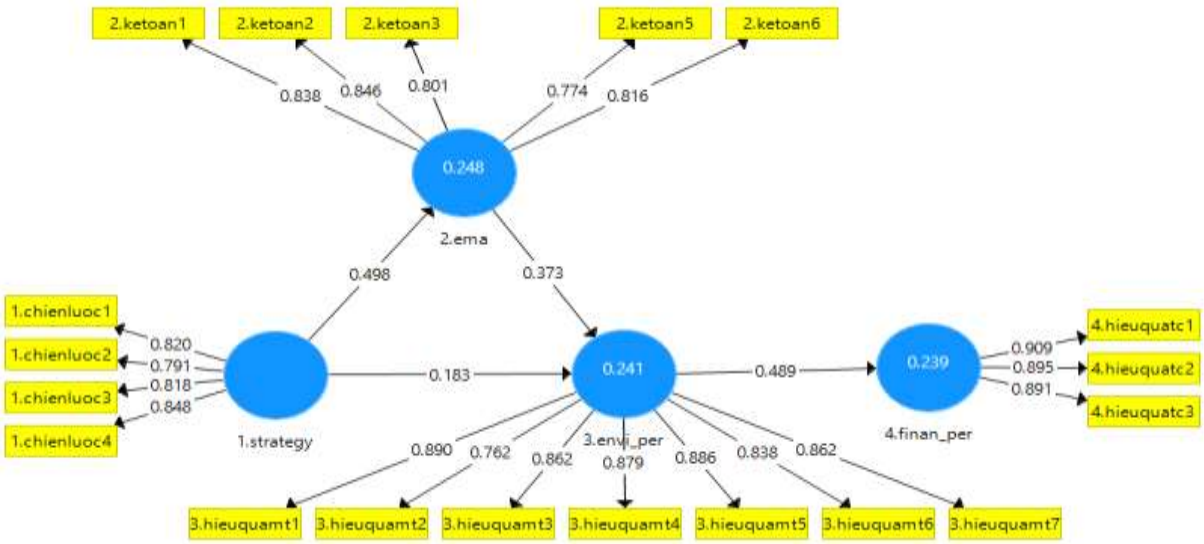
Table 6. Hypothesis Testing Direct and Indirect Relationships

Hypothesized path		Standardized coefficients	Standard Deviation	t-value	P Values	Hypotheses
H1	1.strategy -> 2.ema	0.498	0.059	8.441	0.0000	Supported
H2	1.strategy -> 3.envi_per	0.183	0.090	2.047	0.0410	Supported
H3	2.ema -> 3.envi_per	0.373	0.076	4.887	0.0000	Supported
H4	3.envi_per -> 4.finan_per	0.489	0.059	8.234	0.0000	Supported
H5	1.strategy -> 2.ema -> 3.envi_per -> 4.finan_per	0.091	0.027	3.311	0.0010	Supported
Significance level (5%): t-statistics = 1.96; p-value < 0.05						

Source: Author's research

H1 proposes that environmental strategy positively affects EMA. Our analysis supports this hypothesis as the correlation between 1.strategy and 2.EMA was positive and significant (β = 0.498; t-value = 8.4415; p-Values=0.0000). H2, which conjectures that environmental strategy positively influences environmental performance, was confirmed as the 1.strategy -> 3.envi_per relationship was positive and significant (β = 0.183; t-value = 2.047; p-Values = 0.0410). Our analysis also supports H3, which posits that EMA has a positive effect on environmental performance (β = 0.373; t-value = 4.887; p-Values = 0.0000). H4 on the positive relationship between environmental performance and financial performance was also confirmed (β =0.489; tvalue = 8.234; p-Values=0.0000). To test H5 on the serial mediating effects of EMA and environmental performance in the environmental strategy – financial performance relationship, this study calculated the indirect impact of EMA and environmental performance on the 1.strategy -> 2.ema -> 3.envi_per -> 4.finan_per path. The result shows that the indirect effect was significant (β = 0.091; t-value = 3.311; p-Values= 0.0010), and the confidence interval of the effect does not contain zero (LLCI = 0.046; ULCI = 0.154), supporting H5. Finally, the model explained 23.9% of the variance in financial performance. While this is a significant proportion, there may be other factors not accounted for in the model that influence financial performance. The study provides a valuable contribution to understanding how environmental strategies and EMA use influence both environmental and financial performance.

Figure 2. *Structure of the model*



Source: Author's research

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General Discussion

The first hypothesis proposed that environmental strategy positively affects the use of EMA. Our results confirmed this relationship, with a significant positive correlation ($\beta = 0.498$; $p < 0.01$). This finding is consistent with previous research, such as that by Qian & Burritt (2009) and Guo (2008), which emphasized that the implementation of an environmental strategy encourages companies to adopt more effective accounting systems, like EMA, to quantify and manage their environmental impacts. In the Vietnamese manufacturing context, this is particularly relevant as companies face increasing regulatory pressures and stakeholder expectations. The study by Latan *et al.* (2018) also supports this result, noting that a clear environmental strategy helps companies design management systems that not only meet regulatory requirements but also provide tools for better environmental decision-making. This is crucial for manufacturing firms in Vietnam, where rapid industrialization and increasing environmental concerns demand more systematic management of environmental costs and resources.

The second hypothesis, which proposed that environmental strategy positively influences environmental performance, was also supported ($\beta = 0.183$; $p < 0.05$). This result is in line with earlier studies, such as Wagner & Schaltegger (2004) and Rodrigue *et al.* (2013), which highlighted that businesses with a clear environmental strategy tend to perform better environmentally, demonstrating reduced pollution and more efficient resource management. For Vietnamese manufacturing firms, adopting an environmental strategy is particularly important given the country's rapid industrialization and the government's increasing emphasis on sustainable development. The findings also align with the natural resource-based view (NRBV), which suggests that companies with strong environmental strategies can leverage valuable and rare resources to achieve competitive advantage (Hart, 1995). Vietnamese manufacturers are beginning to recognize that sustainable practices, such as resource efficiency and pollution prevention, are integral to long-term operational success.

The third hypothesis proposed that the use of EMA positively affects environmental performance, which was supported by our findings ($\beta = 0.373$; $p < 0.01$). EMA facilitates the integration of environmental considerations into the decision-making process, helping companies better track and reduce environmental impacts (Schaltegger & Burritt, 2000). This finding is consistent with previous research by Lutfi *et al.* (2018), which showed that EMA systems play a key role in improving the environmental performance of firms by providing accurate data on environmental costs and resource flows. For Vietnamese firms, where environmental awareness is increasing but still developing, EMA serves as a crucial tool for improving resource efficiency, reducing waste, and complying with environmental regulations.

The fourth hypothesis, suggesting that environmental performance positively impacts financial performance, was confirmed ($\beta = 0.489$; $p < 0.01$). This is consistent with the NRBV, which argues that improvements in environmental performance can lead to long-term financial benefits through increased revenue, cost savings, and enhanced reputation (Hart & Dowell, 2011). Our findings echo the work of Peloza (2006) and Qi *et al.* (2014), who noted that strong environmental performance reduces financial risks and enhances profitability. For Vietnamese manufacturing enterprises, where competition is growing and stakeholders are increasingly concerned with sustainability, the ability to demonstrate good environmental performance can enhance a company's reputation, attract investment, and ensure continued market access.

Hypothesis 5 tested the serial mediation of EMA and environmental performance in the relationship between environmental strategy and financial performance. The results showed a significant indirect effect ($\beta = 0.091$; $p < 0.01$), suggesting that EMA use and environmental performance mediate the relationship between environmental strategy and financial performance. This finding supports the stakeholder theory (Freeman, 1984), which posits that firms adopt environmental strategies not only to comply with regulations but also to meet the expectations of stakeholders, ultimately leading to enhanced financial outcomes. This result also reinforces the theoretical framework of NRBV, where firms with strong environmental strategies, supported by EMA systems, create sustainable competitive advantages that improve both environmental and financial performance. For Vietnamese manufacturing enterprises, this is a particularly important insight as firms move toward integrating sustainability into their core operations. The use of

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EMA provides the necessary information for firms to make strategic decisions that positively influence both their environmental performance and financial results.

Conclusions

Theoretical Implications

This study provides several important theoretical contributions that extend and deepen our understanding of the relationships between environmental strategy, EMA use, environmental performance, and financial performance, particularly in the context of the manufacturing sector in Vietnam. It expands the application of contingency theory by demonstrating the role of environmental strategy in shaping EMA use. It enhances the natural resource-based view by showing how environmental strategies, supported by EMA use, contribute to the development of sustainable competitive advantages. Finally, it enriches stakeholder theory by illustrating how companies that adopt environmental strategies and employ EMA systems can effectively manage stakeholder expectations and translate those efforts into financial success. These theoretical contributions provide valuable insights into future research and offer a robust foundation for further exploring the integration of environmental management and business performance.

Practical Implications

The results confirm that all hypothesized relationships in the model are statistically significant at the 5% level, with t-values exceeding 1.96 and p-values below 0.05. These findings underscore the interconnectedness of environmental strategy, EMA, environmental and financial performance, offering valuable insights for manufacturing firms seeking to align sustainability with profitability. To begin, manufacturing firms in Vietnam must establish a clear and actionable environmental strategy that outlines measurable goals, such as reducing greenhouse gas emissions, minimizing waste, improving resource efficiency, or achieving carbon neutrality. This strategy sets the foundation for sustainability initiatives, ensuring that environmental objectives are integrated into core business operations and receive support from leadership across all organizational levels.

The next critical step is implementing EMA, which serves as a practical tool to operationalize environmental strategies. EMA provides detailed insights into the costs and benefits associated with environmental activities, such as waste management, energy consumption, and emissions reduction. By tracking and analyzing these metrics, EMA helps organizations identify inefficiencies, prioritize investments, and make data-driven decisions that align with sustainability goals.

Improved environmental performance, driven by a combination of strategy and EMA, directly contributes to operational efficiencies and cost savings. Actions such as reducing resource consumption, minimizing waste disposal costs, and enhancing energy efficiency lead to measurable financial benefits. Beyond cost reduction, better environmental performance also mitigates risks, such as regulatory fines or reputational damage, and strengthens stakeholder trust. Manufacturing firms with strong environmental track records often gain a competitive advantage by accessing new markets, appealing to environmentally conscious customers, and securing green financing opportunities or government subsidies. Additionally, their sustainability efforts can boost employee morale and attract top talent who value environmentally responsible employers.

Policymakers play a vital role in facilitating this transformation by creating incentives for businesses to adopt sustainable practices. Tax credits, grants, and subsidies for implementing renewable energy, waste reduction technologies, or green supply chain initiatives can encourage organizations to accelerate their sustainability efforts. Regulatory frameworks that mandate transparent reporting on environmental performance and financial impacts can further drive accountability and spur innovation. Moreover, fostering partnerships between governments, businesses, and technology providers can result in scalable solutions, such as industry-wide benchmarks or certifications for sustainability excellence.

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Ultimately, businesses that align environmental strategies with robust EMA systems and continuous improvement in environmental performance are well-positioned to achieve long-term financial success. This approach not only helps organizations reduce costs and risks but also creates opportunities for growth and innovation in a sustainability-driven economy. By embracing sustainability as a core value, manufacturing firms can enhance their reputation, meet growing stakeholder expectations, and ensure resilience in the face of environmental and market challenges, contributing to both economic and societal progress.

Future Research

This study has several limitations that should be considered when interpreting the findings.

First, the data collected from managers may contain subconscious biases, which could potentially affect the results. Managers, due to their positions, may present a biased view that reflects a superficial understanding of the company's environmental practices, potentially overlooking the perspectives of other stakeholders. Future research could explore these relationships from the viewpoints of other stakeholders, such as employees, customers, and external partners, to provide a more comprehensive understanding of how environmental strategies impact both performance outcomes and decision-making processes.

Second, while this study examines the relationships among environmental strategy, EMA, and both environmental and financial performance within manufacturing firms in Vietnam, the sample size was relatively small. This limitation may affect the generalizability of the findings to the broader manufacturing industry. Future studies should consider using a larger and more diverse sample to enhance the external validity of the results and provide a more robust understanding of the dynamics between these variables.

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