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Circular Economy Practices, Environmental Cost and Economic Performance: Empirical Evidence from Traditional Craft Villages in Vietnam

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ABSTRACT: Sustainable development in traditional craft villages in Vietnam is increasingly challenged by resource inefficiencies, waste generation, and environmental pressures, highlighting the urgent need for strategies that balance economic and environmental outcomes. Based on the Natural Resource-Based View by Hart (1995), this study investigates how circular economy practices including resource efficiency, reuse and recycling, cleaner production and eco-innovation, and industrial symbiosis affect perceived environmental costs and economic performance in these small-scale, resource-constrained production settings. Data were collected from 317 firms, and analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) and ANOVA to test the proposed hypotheses. Results show that all CE practices significantly increase perceived environmental costs, which in turn positively influence economic performance. Firm age positively affects performance, whereas firm size has a negative impact. The findings provide actionable insights for firms and policymakers to enhance sustainability and economic efficiency in traditional craft villages.

KEYWORDS: Circular economy practices; economic performance; natural resource-based view; perceived environmental cost; traditional craft villages.

I. INTRODUCTION

Industrial modernization has generated substantial ecological pressures, including carbon emissions, hazardous chemical leakages, and environmental pollution. Growing awareness of the environmental consequences of manufacturing activities has increased pressure on producers in both emerging and developed economies to adopt more sustainable practices. At the same time, firms are still expected to contribute continuously to national economic growth, creating a tension between economic development and environmental protection (Fernandez et al., 2021). Consequently, there is a broad consensus that management practices must balance commercial performance with environmental responsibility, particularly as manufacturing industries are predicted to maintain rapid growth over the next decade. Against this background, the circular economy (CE) has emerged as a promising paradigm to address intertwined economic and environmental challenges (Ghisellini et al., 2016). The 21st century has been characterised by multiple economic, environmental and social crises, highlighting that organisations operate in a volatile, uncertain, complex and ambiguous. Meanwhile, the Intergovernmental Panel on Climate Change warns of future existential risks if radical operational and strategic changes are not implemented by both public and private actors . With its dual orientation toward sustainability and economic growth, the CE is regarded as a restorative and regenerative system by design, aiming to keep products, components and materials at their highest utility and value, in contrast to the traditional linear "take–make–waste" model (Halog et al., 2021).

In a circular economy, the value of products and materials is maintained for as long as possible, waste generation and resource consumption are minimised, and materials are retained within the economic system after a product reaches the end of its life (Kristoffersen et al., 2021). Firms reconfigure and coordinate organisational functions such as marketing, production, logistics, finance and customer service within and across firm boundaries to close material and energy loops and reduce resource input and emission leakage, which in turn can enhance firm performance. Despite the conceptual appeal of the CE, empirical evidence on its economic outcomes remains inconclusive. On the one hand, Lo (2013) found that CE implementation did not lead to financial growth for Chinese industrial firms, as early-stage adoption required substantial investments that increased operating costs and reduced profitability. On the other hand, more recent studies report a positive relationship

between CE practices and financial performance. These mixed findings indicate that the performance implications of CE practices are context-dependent and require further empirical investigation. Moreover, although CE practices are often assumed to reduce environmental burdens, limited attention has been paid to their direct association with environmental costs, such as waste treatment expenses, pollution control investments and regulatory compliance costs (Medina-Mijangos et al., 2021).

In developing economies, these issues are particularly salient in small-scale and traditional production systems. In Vietnam, traditional craft villages play a vital role in local employment, cultural preservation and rural economic development, yet they are also significant sources of environmental pollution due to outdated technologies, inefficient resource use and weak waste management systems. While CE practices offer potential solutions for improving resource efficiency and reducing environmental damage in these villages, there is insufficient empirical evidence on whether such practices actually lower environmental costs and enhance economic performance in this specific context. Furthermore, CE transformation requires organisational capabilities, collaboration with supply chain partners and supportive institutional conditions, which many small producers lack (Mangla et al., 2018). Therefore, this study aims to provide empirical evidence on the relationship between circular economy practices, environmental cost and economic performance in traditional craft villages in Vietnam. By integrating insights from the Circular economy perspective and performance literature, this research seeks to address the gap concerning how CE practices translate into both environmental and economic outcomes in small-scale manufacturing settings. Specifically, it examines whether the adoption of CE practices contributes to reducing environmental costs and improving economic performance, and how these relationships interact in a developing country context. In doing so, this study contributes to the growing body of CE literature by extending empirical analysis beyond large industrial firms and developed economies, and offers practical implications for policymakers and practitioners seeking to promote sustainable development in traditional craft villages. The study is divide into 5 part inluding (1) Introduction; (2) Literature review and hypothesis development; (3) Methodology; (4) Results and discussion; and (5) Implications and conclusion.

II. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Circular Economy and Its Practices

Although the circular economy has been widely studied, its definition remains diverse. This study adopts the definition of Kirchherr et al. (2017), who reviewed 114 definitions and conceptualised CE as an economic system that replaces the “end-of-life” concept by emphasising reducing, reusing, recycling, and recovering materials across production, distribution, and consumption processes to achieve sustainable development. This approach aims to generate benefits for present and future generations by simultaneously improving environmental quality, economic performance, and social equity, enabled by innovative business models and responsible consumers. CE operates at multiple levels including micro (products, firms, consumers), meso (eco-industrial parks), and macro levels (cities, regions and countries). However, in the context of Vietnam, this definition may not fully capture existing social inequalities, which should be considered in the analysis. In addition, recent studies highlight the importance of addressing system leakages in CE implementation (Velenturf et al., 2019). In Vietnam, the concept of the circular economy has been formally institutionalized in national legislation. According to Clause 1, Article 142 of the Environmental Protection Law No. 72/2020/QH14, a circular economy is defined as an economic model in which activities related to design, production, consumption, and service aim to reduce the extraction of raw materials, extend product life cycles, limit waste generation and minimize negative environmental impacts. This legal definition provides an important framework for promoting the CE model in Vietnam and reflects the government’s commitment to sustainable development goals. From an overall perspective, the CE can be understood as a closed-loop operating system in which output products and wastes are reintegrated into production processes as secondary inputs. Such a system contributes to reducing dependence on virgin resources, saving energy and materials, mitigating adverse environmental impacts and protecting ecosystems and human health.

In the reality, circular economy activities in Vietnam have been most visibly manifested in recycling sectors, particularly in traditional craft villages. Plastic recycling is a typical example of production within scrap recycling craft villages, where discarded plastic items such as bottles and containers are collected and processed into raw materials for new products. Plastic recycling craft villages in northern Vietnam are widespread and usually operate at small and household scales with long-standing production traditions. However, production technologies remain largely manual, and input materials are mostly uncleaned scrap. Most facilities lack effective pollution control measures, waste treatment systems, and adequate labor protection (Nguyen, 2020). As a result, although production volumes are relatively small, these craft villages have generated serious environmental problems.

Previous studies have identified both socio-economic benefits and environmental risks associated with plastic recycling craft villages (Thai et al., 2011). On the one hand, these villages contribute to local employment, income generation, and waste

recovery. On the other hand, their activities pose significant threats to environmental quality due to inefficient resource use, uncontrolled emissions, and untreated wastewater. To improve environmental performance, enhance recycling efficiency, and reduce energy consumption, a transition toward circular economy practices is considered essential for plastic businesses operating in these areas. Evaluating the current level of CE implementation is therefore necessary to support this transition, identify areas for improvement, and exploit potential opportunities for more sustainable production. The circular economy has attracted increasing scholarly attention in Vietnam. Existing studies mainly focus on international experiences and policy implications for Vietnam, CE models for the plastic industry (Nhat et al., 2025) , and the development of CE practices in Vietnamese enterprises . These works provide a valuable scientific and theoretical basis for CE implementation, particularly in the plastic sector. Nevertheless, prior research has not sufficiently examined the actual status and potential of CE practices in plastic recycling businesses located in traditional craft villages. In this study, circular economy (practices are conceptualised as a set of environmental protection-oriented production activities that contribute to both economic and ecological performance. The novelty of this approach lies in its ability to provide a systematic and verifiable mapping of how circular practices are integrated into production processes to achieve sustainable performance. Existing evidence suggests that the relationship between CE practices and sustainable performance is not uniform but varies according to contextual factors such as industry type, enterprise size, and national conditions, which act as moderating variables.

Circular Economy Practices in The Context of Traditional Craft Villages in Vietnam

In Vietnam, the transition toward circular economy practices has been increasingly emphasised within national policy frameworks and development strategies. The Constitution of 2013 explicitly states that everyone has the right to live in a fresh environment and must protect the environment (IDEA, 2013), which reflects the government's commitment to sustainable development. In recent years, policymakers have paid greater attention to CE implementation, as highlighted by Deputy Minister of Natural Resources and Environment, who stated that transforming the current economic model toward a circular economy is essential for achieving sustainable development goals. In addition, international cooperation has played a crucial role in accelerating CE adoption, such as collaborations between the Vietnam Association for Conservation of Nature and Environment (VACNE) and the Korea Environmental Industry Association (KEIA), as well as training initiatives supported by the Netherlands to enhance CE capacity among Vietnamese officials (Vietnamplus, 2019).

At the policy level, Vietnam has incorporated sustainability principles into national development agendas. The government adopted "Agenda 21 Vietnam" for the period 2004–2015 to promote sustainable economic growth, green industry, and environmental protection (Nguyen, 2019). Furthermore, the adoption of the 3Rs (reduce, reuse, recycle) approach has been identified as a key strategy to address environmental challenges and climate change. Notably, the "3R-HN" project implemented in Hanoi and Ho Chi Minh City, in collaboration with URENCO and JICA, aimed to develop a recycling-oriented community through waste separation, public awareness campaigns and composting initiatives, which contribute to a 30% reduction in organic waste compared to 2003 levels.

Despite these policy efforts, the implementation of CE practices at the local level, particularly in traditional craft villages, remains limited and uneven. In Vietnam, culture plays a significant role in sustainable national development. More specifically, traditional craft villages help create jobs while preserving cultural values. According to the Ministry of Agriculture and Rural Development, Vietnam currently has over 5,400 craft villages, providing stable employment for more than 1.5 million rural residents annually and contributing nearly 10% of the total industrial and handicraft production value. However, most craft villages still operate using traditional production methods, employing outdated technology, wasting resources, and putting further pressure on the environment. A recent survey by the Environmental Protection Agency (Hanoi Department of Agriculture and Environment) found that 79% of 292 craft villages were polluted due to the limited number of villages implementing green transformation initiatives. Besides, recycling craft villages represent a unique and significant component of Vietnam's informal economy, with approximately 4,000 villages engaged in waste collection and recycling activities . Among them, plastic recycling is one of the most common practices, involving the collection and processing of discarded plastic materials such as bottles and containers to produce secondary raw materials. These villages are typically small-scale, household-based, and characterised by long-standing production traditions. However, production technologies are largely manual, and input materials are often uncleaned scrap, while most facilities lack adequate pollution control systems, waste treatment infrastructure, and labour protection measures (Nguyen et al., 2020). As a result, although plastic recycling craft villages contribute positively to resource recovery and local economic development, they also generate significant environmental challenges, including air, water, and soil pollution. Previous studies have highlighted both the socio-economic benefits and environmental risks associated with these activities (Thai et al., 2011) . This duality underscores the need for a transition toward more structured and efficient CE practices

to enhance recycling efficiency, reduce energy consumption, and minimise environmental impacts. Evaluating the current level of CE implementation in these villages is therefore essential to identify gaps, improve performance, and support sustainable transformation.

Circular Economy Practices and Environmental Cost

The present study is primarily grounded in the Natural Resource-Based View (NRBV), which extends the traditional resource-based view by emphasising the role of environmental capabilities in achieving sustainable competitive advantage. According to Hart (1995), firms that develop capabilities in pollution prevention, product stewardship and sustainable development are better positioned to enhance both environmental and economic performance. Within this perspective, CE practices such as resource efficiency, reuse and recycling, cleaner production, and industrial symbiosis can be viewed as strategic capabilities that enable firms to more effectively manage resource flows and environmental impacts. Importantly, NRBV suggests that improving environmental management does not merely reduce environmental harm but also enhances firms' ability to identify inefficiencies and hidden costs associated with waste generation, energy use, and pollution. As a result, the adoption of CE practices may increase firms' awareness and perception of environmental costs, which in turn can stimulate more efficient resource utilisation and operational improvements. This argument is consistent with prior research indicating that proactive environmental strategies can generate cost savings, improve productivity, and contribute to superior economic performance (Hart, 1995; Porter & van der Linde, 1995).

Resource efficiency practices, particularly those related to process and equipment improvements, play a critical role in enhancing environmental performance within production systems. Efficient processes such as error-proof equipment, reduced setup time, and flexible manufacturing systems contribute to a more stable and consistent production flow, thereby minimising waste generation and operational inefficiencies (Wang et al., 2022). In contrast, over-processing and incorrect processing lead to material waste, defects, and unnecessary resource consumption, which increase environmental burdens . Furthermore, inefficient processing equipment can generate harmful emissions, increase water consumption, and waste energy, thereby raising environmental pressures. Improving process and equipment efficiency can reduce deficiencies, lower energy consumption, and enhance coordination within production environments, while also enabling firms to detect leakages and inefficiencies more quickly. As a result, such practices contribute to reducing resource usage, waste generation, and environmental damage. Prior studies have also demonstrated that minimising material and energy consumption, as well as waste production, can significantly improve both environmental and organisational performance (Aray et al., 2021). In the context of traditional craft villages in Vietnam, where production is often small-scale and resource-inefficient, the adoption of resource efficiency practices is expected to influence how environmental costs such as waste treatment, pollution control, and resource losses are perceived and managed.

H1: Resource efficiency practices positively influence perceived environmental cost in traditional craft villages in Vietnam.

Reuse and recycling practices are fundamental components of CE and are widely promoted through the 3R (reduce, reuse, recycle) approach. From a sustainability perspective, going green involves more than simply recycling products; it requires continuous efforts from individuals and organisations to protect and maintain the environment. The adoption of green practices, including reuse and recycling, contributes to reducing environmental degradation and conserving natural resources while supporting long-term economic and social development (Zaki, 2021). These practices are increasingly embedded in organisational and educational settings, where sustainability initiatives are implemented through structured programs and institutional commitments. From a behavioural perspective, prior studies suggest that environmental practices are influenced not only by cognitive factors but also by awareness and attitudes toward environmental responsibility . The implementation of reuse and recycling activities enhances individuals' awareness of environmental issues and their associated impacts. However, the effectiveness of such practices depends heavily on supporting conditions such as infrastructure and convenience. Empirical evidence indicates that when recycling facilities are limited or inconvenient, participation decreases, highlighting the perceived effort and cost associated with environmental practices (Latif et al., 2018). Furthermore, despite early environmental education, unsustainable consumption behaviours and a lack of responsibility toward environmental protection remain prevalent. In the context of traditional craft villages in Vietnam, reuse and recycling practices, particularly in plastic recycling, are common but often conducted under informal and resource-constrained conditions. These activities typically require additional labour, time, and effort in waste sorting, cleaning, and processing, thereby increasing the perceived burden associated with environmental management. As a result, greater engagement in reuse and recycling practices is likely to raise awareness of environmental responsibilities and highlight the associated environmental costs, such as waste treatment, pollution control, and resource inefficiencies.

H2: Reuse and recycling practices positively influence perceived environmental cost in traditional craft villages in Vietnam.

Cleaner production and eco-innovation practices are key components of environmental management strategies within the circular economy framework. Cleaner production focuses on eliminating waste and emissions at the source while improving the efficient use of materials and energy throughout the production process. Firms play a central role in implementing cleaner production by identifying sources of pollution, enhancing awareness, and adopting resource-efficient practices to reduce environmental impacts . From a theoretical perspective, cleaner production contributes to sustainable development and strengthens firms' long-term competitiveness by promoting a holistic approach to production, including environmental protection, resource efficiency, and operational improvement (Dyllick & Hockerts, 2002). In addition, cleaner production practices are closely linked with eco-innovation, as they involve the adoption of new technologies and processes to minimise environmental damage. These practices help firms reduce raw material consumption, lower energy use, and minimise waste generation, thereby improving both environmental and operational efficiency. Furthermore, cleaner production enables firms to avoid costs associated with inefficient resource use and waste disposal, while enhancing the benefits derived from recycling and material reuse (Khalili et al., 2015). Empirical evidence also suggests that cleaner production activities positively influence firms' non-financial performance, such as reputation, market share, and stakeholder confidence , and contribute to reduced emissions and improved environmental outcomes at both firm and national levels . Moreover, eco-innovation and green technologies enable firms to meet environmental goals while reducing production costs and emissions , although their environmental impacts are sometimes underexplored (Nasrollahi et al., 2020). In the context of traditional craft villages in Vietnam, where production is typically small-scale and environmentally inefficient, the adoption of cleaner production and eco-innovation practices requires additional investments in technology, process improvement, and environmental management. These efforts increase awareness of environmental impacts and highlight the associated costs related to pollution control, waste treatment, and resource inefficiencies. As a result, firms engaging in cleaner productionand eco-innovation practices are more likely to recognise and perceive environmental costs more clearly.

H3: Cleaner production and eco-innovation practices positively influence perceived environmental cost in traditional craft villages in Vietnam.

Industrial symbiosis is considered a key approach to operationalising circular economy principles at an inter-organisational level. Early circular economy strategies mainly focused on recycling and reuse within individual firms; however, more advanced approaches emphasise cross-sectoral collaboration across supply chains to maximise resource efficiency and sustainability outcomes (Frig et al., 2020). In this context, industrial symbiosis enables firms to exchange by-products, share resources, and utilise waste streams as inputs for other production processes, thereby reducing overall resource consumption and environmental impact. From the theoretical perspective, industrial symbiosis extends circular economy practices beyond firm-level optimisation toward network-level resource integration. To achieve sustainability, firms must collaborate to ensure continuous flows of recovered and reused materials, rather than operating in isolation (Nabavi et al., 2022). Empirical evidence from various sectors including forestry, chemicals, metals, and construction demonstrates that industrial symbiosis improves resource efficiency, supports economic growth, and facilitates the transition to a low-carbon economy. Notable examples include the National Industrial Symbiosis Programme in the United Kingdom, which has been recognised as an effective resource management policy, as well as successful regional and local symbiosis networks in Sweden and Denmark, where firms collaborate to transform environmental challenges into economic opportunities (Sonel et al., 2022). In the context of traditional craft villages in Vietnam, production activities are often fragmented and lack coordination among households and small enterprises. The adoption of industrial symbiosis practices such as sharing materials, exchanging waste streams, and collaborating across production units requires additional coordination, information exchange, and investment in infrastructure. These activities increase awareness of resource flows, waste management responsibilities, and environmental impacts across the production network. As a result, firms engaging in industrial symbiosis are more likely to recognise and perceive environmental costs associated with resource inefficiencies, waste treatment, and pollution control.

H4: Industrial symbiosis practices positively influence perceived environmental cost in traditional craft villages in Vietnam.

Environmental Cost and Economic Performance

Environmental cost refers to the expenses associated with managing environmental impacts, including resource consumption, waste treatment, pollution control, and compliance with environmental regulations. From the theoretical perspective grounded in the NRBV, effective environmental management can be considered a strategic capability that enhances firms' efficiency and competitiveness. Firms that recognise and manage environmental costs are more likely to optimise resource utilisation, reduce waste, and improve operational efficiency, thereby contributing to better economic outcomes. (Irfan

et al., 2021). Empirical evidence supports the positive linkage between environmental practices and firm performance. Meta-analysis results indicate that CE practices have a significant positive correlation with overall firm performance including both commercial and ecological aspects. Although the adoption of environmental practices often requires substantial initial investment, cost savings from energy efficiency, waste reduction, and improved operational processes can outweigh these expenditures. Furthermore, collaboration with stakeholders, such as consumers and suppliers, enhances firms' ability to meet demand for environmentally friendly products, improve product quality, and increase financial performance (Yu et al., 2017). In terms of economic outcomes, CE practices have been shown to positively influence sales growth and market share , while also reducing costs related to inventory, assets, and budget control (Chen et al., 2021). Close cooperation with suppliers further reduces unnecessary costs and improves product quality, leading to enhanced commercial benefits. These findings suggest that environmental cost, when properly managed and perceived, is not merely a burden but a driver of efficiency and value creation. In the context of traditional craft villages in Vietnam, where production is often resource-inefficient and environmentally intensive, increased awareness of environmental costs can encourage producers to adopt better resource management practices, reduce hidden inefficiencies, and improve overall economic performance. Thus, perceived environmental cost plays a critical role in linking environmental responsibility with economic benefits.

H5: Perceived environmental cost positively influences economic performance in traditional craft villages in Vietnam.

Firm Characteristics as Control Variables

Firm characteristics, particularly firm size and firm age, are widely acknowledged as critical control variables in studies examining firm performance, as they shape organisational resources, strategic decisions, and operational capabilities. Controlling for these variables helps isolate the effects of the main independent variables and ensures the robustness of the research model. According to Meckling & Jensen (1976), agency costs tend to increase with the proportion of external capital, which is typically higher in larger firms. As a result, larger firms are more likely to adopt structured management practices, formal control systems, and performance monitoring mechanisms to reduce these costs. In addition, from a resource-based view, larger firms possess superior access to financial, technological, and human resources, enabling them to achieve economies of scale, invest in innovation, and improve operational efficiency. These advantages allow larger firms to better manage production processes, reduce inefficiencies, and enhance overall economic performance. Empirical studies have consistently supported the positive role of firm size in influencing organisational practices and performance outcomes (Allegrini & Greco, 2011). Firm age represents another important organisational attribute, reflecting accumulated experience, learning effects, and the development of routines over time. The organisational learning theory by (Argyris & Schon, 1978) suggests that firms improve their efficiency and decision-making capabilities through experience gained over years of operation. Older firms are more likely to have established standardised processes, stable supplier and customer relationships, and a deeper understanding of market dynamics. According to the competition argument, younger firms may be reluctant to fully adopt new practices or disclose strategic information due to competitive pressures and vulnerability in the market, whereas older firms, with established competitive advantages, are less constrained and more capable of leveraging their experience to enhance performance. Empirical evidence generally indicates a positive relationship between firm age and organisational practices and performance, although some studies report mixed findings depending on context and measurement (Jamali et al., 2020). In addition, both firm size and firm age influence firms' ability to adopt new practices, including circular economy initiatives, cleaner production, and environmental management strategies. Larger and older firms are typically more capable of absorbing the costs and risks associated with such practices, while smaller and younger firms may face financial and technological constraints. These differences may lead to variations in efficiency, cost management, and ultimately economic performance.

In the context of traditional craft villages in Vietnam, these differences are particularly pronounced. Production units are often small-scale, household-based, and heterogeneous in terms of size and years of operation. Some firms have operated for decades, accumulating experience and networks, while others are relatively new and resource-constrained. Larger firms within craft villages may benefit from better access to capital, improved production technologies, and broader market connections, enabling them to achieve higher productivity and cost efficiency. Meanwhile, older firms may leverage their long-standing experience and relationships to stabilise production and enhance performance. Consequently, variations in firm size and firm age are likely to result in differences in economic performance across firms. Therefore, controlling for these firm-specific characteristics is essential to accurately assess the relationships proposed in this study.

H6: There is a significant difference in economic performance across firm size group of traditional craft villages in Vietnam.

H7: There is a significant difference in economic performance across firm age group of traditional craft villages in Vietnam.

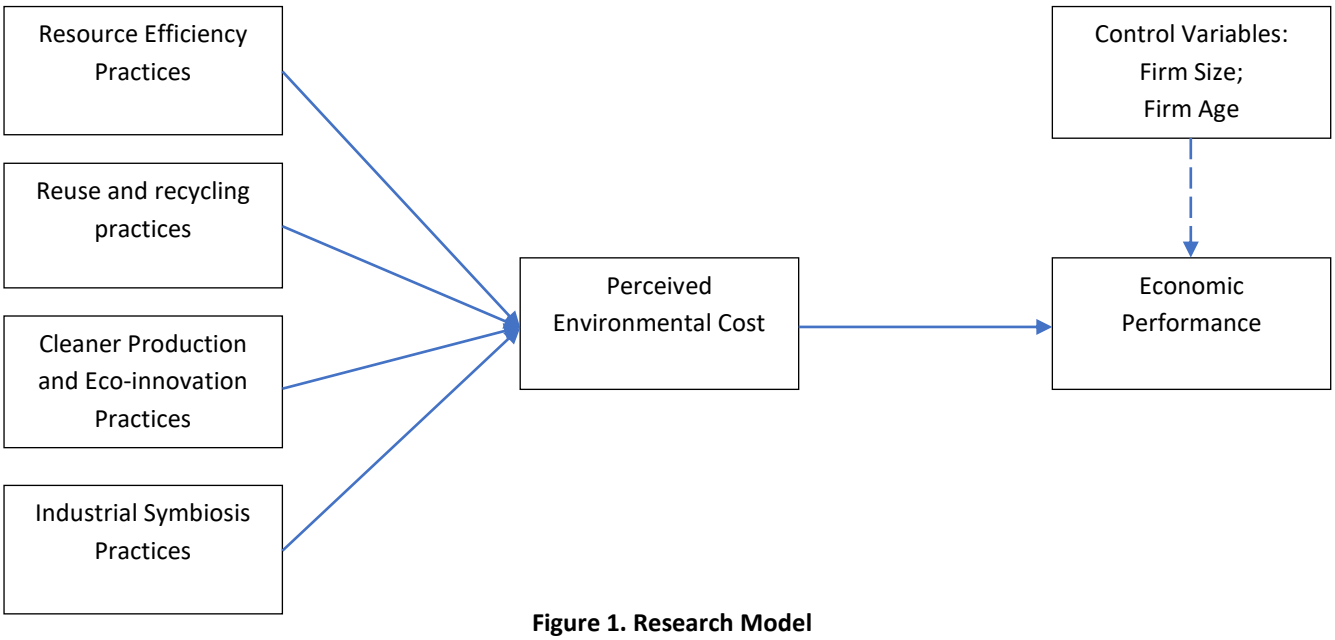


Figure 1. Research Model

III. METHODOLOGY

Measurement and Questionnaire Development

The measurement instrument for this study was developed based on previously validated scales from prior research on circular economy practices, environmental management, and firm performance. The questionnaire included three main constructs: Circular Economy Practices, Perceived Environmental Cost and Economic Performance, along with control variables. All measurement items were adapted and refined to ensure their suitability for the context of traditional craft villages in Vietnam while maintaining their original theoretical meanings. All items were measured using a 5-point Likert scale ranging from 1- "Strongly disagree" to 5- "Strongly agree". Firm size and firm age were included as control variables to account for differences in organizational characteristics that may influence economic performance.

Circular Economy Practices were conceptualized as a multidimensional construct. Resource efficiency practices (REP) were measured using 4 items adapted from Wang et al. (2022). Reuse and recycling practices (RRP) were assessed with 4 items based on Zaki (2021). Cleaner production and eco innovation practices (CPP) were measured using 3 items adapted from Nasrollahi et al. (2020), while industrial symbiosis practices (ISP) were measured using 4 items adapted from Sonel et al. (2022). Perceived environmental cost (PEC) was measured using 4 items adapted from Irfan et al. (2021) and Espinoza et al. (2024). Economic performance (EP) was assessed using 5 items derived from Vij & Bedi (2016).

For data analysis, this study employed Partial Least Squares Structural Equation Modeling PLS SEM using SmartPLS3 to assess the reliability and validity of the measurement model and to test the proposed hypotheses. In addition, SPSS 27 software was used to conduct ANOVA analysis to examine differences in economic performance across groups based on firm size and firm age.

Sample, data collection and analysis

The data for this study were collected through a structured questionnaire administered to business owners, managers, and key decision-makers in traditional craft villages in Vietnam to examine the relationships between circular economy practices, environmental cost and economic performance. The questionnaire was distributed through both direct and online channels, including local business networks, craft village associations, and online communities where enterprises actively engage. This approach enabled the study to reach a diverse group of respondents operating in different types of traditional craft villages.

The purposive sampling strategy specifically targeted firms in traditional craft villages, as these enterprises play a crucial role in local economic development while simultaneously facing increasing environmental pressures. To capture the demographic and firm characteristics that may influence environmental and economic outcomes, the questionnaire included several demographic measures such as gender (male, female), age (<25, 26–35, 36–45, >45), education level (primary school, secondary school, high school, college, university or above), and monthly income (<500 USD, 500–1000 USD, 1000–2000 USD, >2000 USD). In addition, respondents were asked to provide information on firm characteristics, including firm size (1–5, 6–10, 11–20, and more than 20 employees) and firm age (less than 5 years, 5–10 years, 11–20 years, more than 20 years). These characteristics

were included as control variables as they may influence firms' economic performance. A total of 317 valid responses were collected and included in the dataset for analysis. The diversity of respondents in terms of demographic profiles and firm characteristics provided a suitable basis for examining the relationships between circular economy practices, environmental cost, and economic performance in traditional craft villages in Vietnam.

IV. RESULTS AND DISCUSSION

Demographics of Respondents

Table 1 summarizes the demographic and firm characteristics of the respondents participating in this study on the relationships between circular economy practices, environmental cost, and economic performance in traditional craft villages in Vietnam.

Table 1. Demographics of Respondents (n = 317)

Demographics		**Frequency**	**Percentage (%)**
Gender	Male	162	51.1
	Female	155	48.9
Age	< 25	48	15.1
	26–35	102	32.2
	36–45	96	30.3
	> 45	71	22.4
Educational Level	Primary school	38	12.0
	Secondary school	67	21.1
	High school	98	30.9
	College	62	19.6
	University or above	52	16.4
Monthly Income	< 500 USD	74	23.3
	500 - 1000 USD	118	37.2
	1000 - 2000 USD	82	25.9
	> 2000 USD	43	13.6
Firm Size	1–5 employees	121	38.2
	6–10 employees	89	28.1
	11–20 employees	63	19.8
	More than 20 employees	44	13.9
Firm Age	Less than 5 years	52	16.4
	5–10 years	79	24.9
	11–20 years	98	30.9
	More than 20 years	88	27.8
Total		**317**	**100**

Among the 317 respondents, males accounted for 162 participants (51.1%), while females represented 155 participants (48.9%). This relatively balanced distribution reflects the participation of both male and female decision-makers in production and business activities within traditional craft villages. Regarding age, the majority of respondents were concentrated in the 26–35 age group (102 respondents, 32.2%) and the 36–45 age group (96 respondents, 30.3%), followed by those aged over 45 (71 respondents, 22.4%) and under 25 (48 respondents, 15.1%). This distribution indicates that most respondents are in their prime working age, which is important for decision-making related to production practices and business performance. In terms of education level, most respondents had completed high school (98 respondents, 30.9%), followed by secondary school (67 respondents, 21.1%) and college education (62 respondents, 19.6%). A smaller proportion of respondents had primary education (38 respondents, 12.0%) or university-level education and above (52 respondents, 16.4%). This structure reflects the typical educational background in traditional craft villages, where practical experience often complements formal education. With respect to monthly income, the largest proportion of respondents reported earning between 500 and 1000 USD (118 respondents, 37.2%), followed by those earning between 1000 and 2000 USD (82 respondents, 25.9%) and those earning less than 500 USD (74 respondents, 23.3%). Only a smaller group reported income above 2000 USD (43 respondents, 13.6%), indicating a moderate income level among respondents.

Regarding firm size, most businesses were small-scale enterprises, with 121 firms (38.2%) employing 1–5 workers and 89 firms (28.1%) employing 6–10 workers. Firms with 11–20 employees accounted for 63 respondents (19.8%), while only 44 firms (13.9%) had more than 20 employees. This distribution highlights the dominance of small and micro enterprises in traditional craft villages. In terms of firm age, a considerable number of firms had been operating for a long period, with 98 firms (30.9%) aged between 11 and 20 years and 88 firms (27.8%) operating for more than 20 years. Meanwhile, 79 firms (24.9%) had been in operation for 5–10 years, and 52 firms (16.4%) had been established for less than 5 years. This indicates the long-standing and stable nature of traditional craft village enterprises. Overall, the diversity of respondents in terms of demographic profiles and firm characteristics provides a solid foundation for examining how circular economy practices influence environmental cost and economic performance in traditional craft villages in Vietnam.

Scale Reliability and Validity Assessment

Table 2 presents the results of construct reliability and convergent validity. The Cronbach's Alpha values for the main constructs, including cleaner production and eco-innovation practices (CPP), economic performance (EP), industrial symbiosis practices (ISP), perceived environmental cost (PEC), resource efficiency practices (REP), and reuse and recycling practices (RRP), range from 0.831 to 0.936, all exceeding the recommended threshold of 0.70, indicating satisfactory internal consistency (Hair et al., 2019). Similarly, the composite reliability values range from 0.890 to 0.954, surpassing the recommended level of 0.70 and further confirming strong construct reliability (Hair et al., 2019).

Table 2. Construct Reliability and Convergent Validity

Variables	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
CPP	0.831	0.834	0.899	0.747
EP	0.906	0.915	0.930	0.728
ISP	0.936	0.939	0.954	0.839
PEC	0.880	0.881	0.918	0.736
REP	0.836	0.841	0.890	0.670
RRP	0.897	0.907	0.929	0.766

Source: *Data analysis by SmartPLS 3*

The average variance extracted (AVE) values for all constructs range from 0.670 to 0.839, exceeding the minimum recommended value of 0.50 (Fornell & Larcker, 1981). This indicates that each construct explains a substantial portion of the variance of its indicators and demonstrates adequate convergent validity. The control variables, firm size (Fsize) and firm age (Fage), show values of 1.000 for Cronbach's Alpha, composite reliability, and AVE, as they are measured using single-item constructs rather than multiple indicators.

Table 3 presents the discriminant validity results using the Fornell–Larcker criterion. The results show that the square root of the Average Variance Extracted (AVE) for each construct is higher than its correlations with other constructs, satisfying the Fornell–Larcker criterion for discriminant validity (Fornell & Larcker, 1981). The control variables, firm age (Fage) and firm size (Fsize), show values of 1.000 as they are measured using single-item constructs. Overall, the results confirm that the model achieves adequate discriminant validity.

Table 3. Fornell-Larcker Criterion

	CPP	EP	Fage	Fsize	ISP	PEC	REP	RRP
CPP	0.864							
EP	0.568	0.853						
Fage	0.041	0.153	1.000					
Fsize	-0.198	-0.114	0.836	1.000				

ISP	0.518	0.566	0.135	-0.191	0.916			
PEC	0.609	0.757	0.116	-0.117	0.604	0.858		
REP	0.404	0.344	0.294	0.105	0.426	0.454	0.819	
RRP	0.550	0.504	-0.064	-0.286	0.676	0.619	0.438	0.875

Source: *Data analysis by SmartPLS 3*

Table 4 presents the discriminant validity results using the Heterotrait–Monotrait ratio (HTMT). The HTMT values range from 0.091 to 0.840, all of which are below the recommended threshold of 0.85, indicating that discriminant validity is established among the constructs (Ringle et al., 2015; Dijkstra & Henseler, 2015). Although the HTMT value between EP and PEC (0.840) is relatively high, it remains within the acceptable limit. Overall, these results further confirm that the constructs are sufficiently distinct from one another and that the measurement model meets the required criteria for discriminant validity.

Table 4. Heterotrait-Monotrait Ratio (HTMT)

	CPP	**EP**	**Fage**	**Fsize**	**ISP**	**PEC**	**REP**	**RRP**
CPP								
EP	0.650							
Fage	0.114	0.158						
Fsize	0.217	0.120	0.836					
ISP	0.584	0.607	0.139	0.200				
PEC	0.710	0.840	0.124	0.125	0.665			
REP	0.465	0.384	0.331	0.195	0.467	0.523		
RRP	0.633	0.547	0.091	0.305	0.736	0.692	0.486	

Source*: Data analysis by SmartPLS 3*

Research Model Assessment and Discussion

The structural model demonstrates strong explanatory power, with an adjusted R^2 of 0.525 for perceived environmental cost (PEC) and 0.599 for economic performance (EP). This indicates that the proposed model provides a substantial explanation of environmental cost perception and economic performance in traditional craft villages in Vietnam. The relatively high explanatory power suggests that circular economy practices are key drivers of both environmental awareness and economic outcomes in resource-constrained production environments.

Firstly, resource efficiency practices (REP) have a positive and significant effect on perceived environmental cost (PEC) (β = 0.128, p = 0.003), supporting H1. This finding suggests that improving resource efficiency enhances firms' awareness of environmental cost components, such as energy consumption, material waste, and production inefficiencies. In traditional craft villages, where production processes are often informal and inefficient, these practices help reveal hidden environmental costs. This result is consistent with prior research by Wang et al. (2022), which highlights that efficient resource management improves transparency in resource use and reduces waste, thereby increasing awareness of environmental impacts.

Secondly, reuse and recycling practices (RRP) positively influence perceived environmental cost (PEC) (β = 0.240, p = 0.008), supporting H2. This indicates that engaging in reuse and recycling activities increases firms' recognition of environmental costs. Although such practices contribute to sustainability, they often require additional labor, time, and operational effort, especially in small-scale production contexts. This finding aligns with Zaki (2021), who emphasizes that recycling and green practices enhance environmental awareness but also involve practical costs and efforts. Similarly, Latif et al. (2018) suggest that the inconvenience and effort associated with recycling can increase the perceived burden of environmental practices.

Table 5. Structural Equation Modelling Results Estimates

Paths	**Original Sample (O)**	**Sample Mean (M)**	**Standard Deviation (STDEV)**	**T Statistics (|O/STDEV|)**	**P Values**
REP -> PEC	0.128	0.129	0.042	3.020	0.003

RRP -> PEC	0.240	0.246	0.089	2.680	0.008
CPP -> PEC	0.307	0.293	0.074	4.120	0.000
ISP -> PEC	0.229	0.235	0.073	3.126	0.002
PEC -> EP	0.680	0.687	0.055	12.420	0.000
REP -> PEC -> EP	0.087	0.088	0.029	3.024	0.003
RRP -> PEC -> EP	0.163	0.169	0.064	2.529	0.012
CPP -> PEC -> EP	0.209	0.202	0.054	3.836	0.000
ISP -> PEC -> EP	0.156	0.162	0.052	2.997	0.003
Fsize -> EP	-0.319	-0.309	0.095	3.350	0.001
Fage -> EP	0.340	0.330	0.097	3.512	0.000
Adjusted R^2: PEC = 0.525; EP = 0.599					

Source: *Data analysis by SmartPLS 3*

Thirdly, cleaner production and eco-innovation practices (CPP) have a significant positive effect on perceived environmental cost (β = 0.307, p < 0.001), supporting H3. This suggests that firms adopting cleaner production technologies and eco-innovation are more likely to recognize environmental costs. These practices often require investments in new technologies, process improvements, and environmental compliance, thereby increasing cost awareness. This finding is consistent with Nasrollahi et al. (2020), who argue that eco-innovation and cleaner production enhance environmental performance while also making firms more conscious of resource use, emissions, and associated costs.

Fourthly, industrial symbiosis practices (ISP) positively influence perceived environmental cost (β = 0.229, p = 0.002), supporting H4. This indicates that collaboration among firms in sharing resources and exchanging waste streams enhances awareness of environmental responsibilities and costs. In traditional craft villages, where production is fragmented, such collaboration requires coordination and infrastructure, making environmental costs more visible. This result supports the findings of Sonel et al. (2022), who highlight that industrial symbiosis improves resource efficiency while increasing firms' awareness of environmental impacts across interconnected production systems.

Fifthly, perceived environmental cost has a strong positive effect on economic performance (β = 0.680, p < 0.001), supporting H5. This result indicates that when firms recognize and manage environmental costs effectively, they can improve operational efficiency and achieve better economic outcomes. Rather than being a burden, environmental cost becomes a driver of value creation by encouraging resource optimization and waste reduction. This finding is consistent with Irfan et al. (2021), who argue that environmental management enhances firm performance, as well as Yin et al. (2023), who demonstrate that circular economy practices positively influence both environmental and economic performance.

Furthermore, the mediation analysis reveals that perceived environmental cost significantly mediates the relationships between circular economy practices and economic performance. Specifically, the indirect effects of CPP (β = 0.209, p < 0.001), ISP (β = 0.156, p = 0.003), REP (β = 0.087, p = 0.003), and RRP (β = 0.163, p = 0.012) on economic performance through perceived environmental cost are all significant. This indicates that circular economy practices enhance economic performance not only directly but also indirectly by increasing firms' awareness and management of environmental costs. This finding reinforces the argument of Yin et al. (2023) that circular economy practices create value through both environmental and economic pathways.

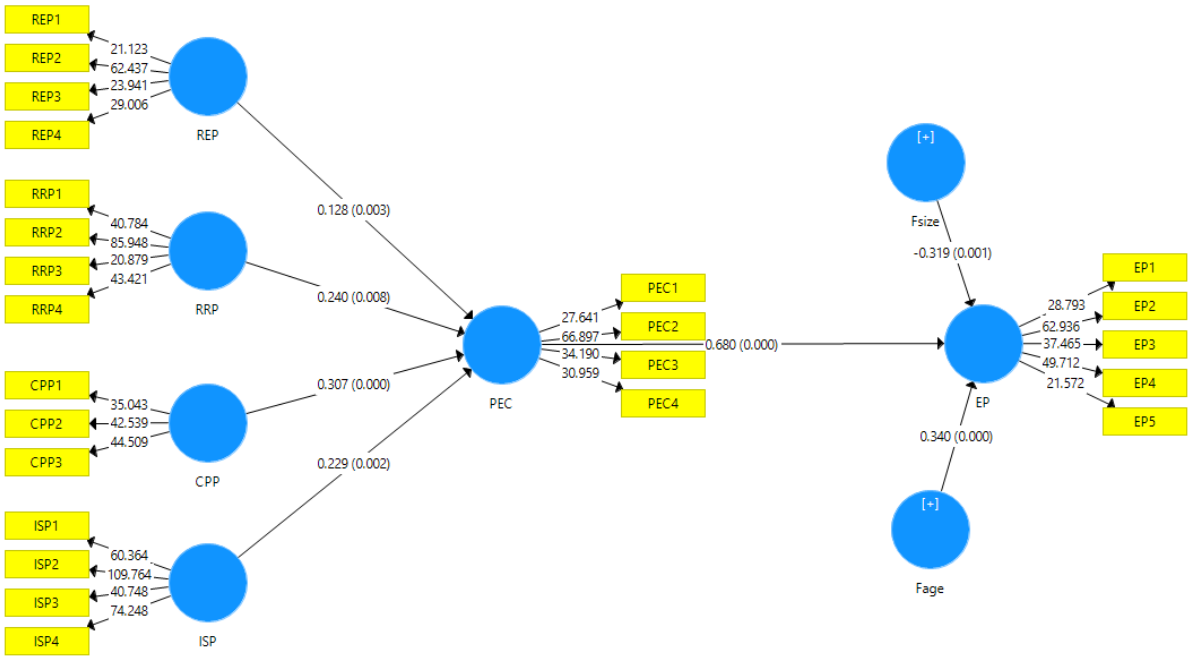


Figure 2. PLS Bootstrapping Model

Source: *Data analysis by SmartPLS 3*

To test hypotheses H6, H7, the study used SPSS 27 with One-way ANOVA technique to assess mean differences between Firm Size and Firm Age groups towards economic performance of traditional craft villages in Vietnam.

Table 6. ANOVA Results for Firm Size and Firm Age

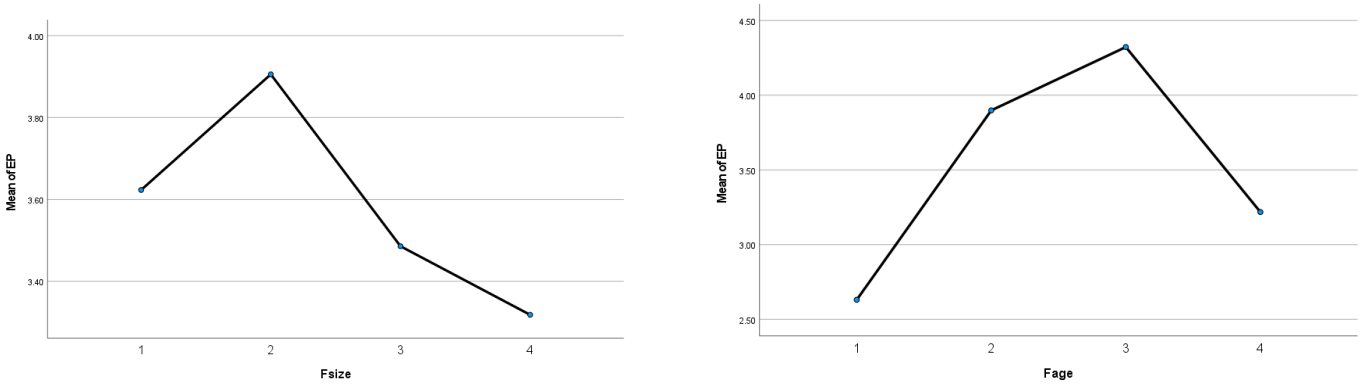
Variables	Test	df	F / Statistic	p-value
Firm Size	Levene's Test (Homogeneity of Variances)	(3, 313)	4.090	0.007
	One-way ANOVA	(3, 313)	4.888	0.002
	Welch Robust Test	(3, 131.480)	3.922	0.010
Firm Age	Levene's Test (Homogeneity of Variances)	(3, 313)	29.255	< 0.001
	One-way ANOVA	(3, 313)	79.680	< 0.001
	Welch Robust Test	(3, 145.561)	64.105	< 0.001

Source: *Data analysis by SPSS 27*

Table 6 presents the ANOVA results for firm characteristics, including firm size and firm age. For both variables, Levene's test is statistically significant ($p < 0.05$), indicating violations of the homogeneity of variances assumption. In line with the recommendation of Hair et al. (2019), the Welch robust test was employed to ensure the reliability of the results under heteroscedasticity. For firm size, both the standard ANOVA ($F(3, 313) = 4.888$, $p = 0.002$) and the Welch test ($F(3, 131.480) = 3.922$, $p = 0.010$) indicate statistically significant differences in economic performance across groups. Similarly, for firm age, the ANOVA ($F(3, 313) = 79.680$, $p < 0.001$) and Welch test ($F(3, 145.561) = 64.105$, $p < 0.001$) both reveal highly significant differences.

The regression results in Table 5 indicate that firm size and firm age significantly influence economic performance, with firm age showing a positive effect ($\beta = 0.340$, $p < 0.001$) and firm size a negative effect ($\beta = -0.319$, $p = 0.001$). These findings are further supported by the ANOVA results, which reveal significant differences in economic performance across both firm size groups ($F = 4.888$, $p = 0.002$; Welch = 3.922, $p = 0.010$) and firm age groups ($F = 79.680$, $p < 0.001$; Welch = 64.105, $p < 0.001$). Therefore, H6 and H7 are supported. Overall, the results suggest that firm characteristics play a significant role in explaining variations in economic performance. Notably, the stronger F-values observed for firm age indicate that it may have a more

substantial impact compared to firm size, potentially reflecting differences in experience, accumulated resources, and operational capabilities among firms.



a. Firm size b. Firm age

Figure 3: Mean Plots of Firm Size and Firm Age

Source: *Data analysis by SPSS 27*

V. IMPLICATIONS AND CONCLUSION

Theoretical Contributions

This study contributes to the literature by extending the Natural Resource-Based View (NRBV) to the context of traditional craft villages in Vietnam. Circular economy practices including resource efficiency, reuse and recycling, cleaner production, and industrial symbiosis are conceptualized as strategic environmental capabilities that enhance firms' ability to manage resource flows, minimize environmental impact, and improve operational efficiency. In line with NRBV, the adoption of these practices increases awareness and perception of environmental costs, including energy consumption, waste generation, and pollution management. Enhanced recognition of environmental costs, in turn, drives more efficient resource utilization and operational improvements, ultimately contributing to superior economic performance (Hart, 1995; Porter & van der Linde, 1995). The study provides empirical evidence supporting the positive effects of circular economy practices on perceived environmental cost and the significant role of perceived environmental cost as a mediator for economic performance. Regression results demonstrate that resource efficiency, reuse and recycling, cleaner production, and industrial symbiosis significantly enhance awareness of environmental costs, which subsequently improves economic outcomes. These findings confirm the dual environmental–economic pathway proposed by NRBV, showing that environmental capabilities not only reduce ecological impact but also create economic value. Additionally, firm characteristics specifically firm size and firm age emerge as significant moderators of economic performance. Older firms (11 to 20 years) tend to achieve higher economic performance, reflecting accumulated experience, resource capacity, and established operational routines. In contrast, larger firms may encounter coordination challenges and operational complexity, particularly in decentralized, small-scale production contexts. These results underscore the relevance of organizational and contextual factors in shaping the effectiveness of environmental capabilities and CE practices.

Practical Implications

The results of this study offer actionable guidance for managers and practitioners in traditional craft villages in Vietnam, where production is often small-scale, labor-intensive, and resource-constrained. Circular economy practices such as resource efficiency, reuse and recycling, cleaner production, and industrial symbiosis can help these villages manage scarce resources, reduce environmental harm, and simultaneously improve economic outcomes. Recognizing environmental costs, including material waste, energy consumption, and pollution management, enables artisans and small enterprises to optimize production processes and reduce inefficiencies that directly affect profitability. Resource efficiency practices in craft villages such as improving process stability, reducing material waste, and optimizing energy usehelp identify hidden environmental costs while enhancing operational efficiency in workshops that often rely on traditional equipment and informal production methods. Reuse and recycling practices, particularly for plastics, metals, or by-products from traditional crafts, not only reduce waste but also provide low-cost materials that can be reintegrated into production, though they require additional labor and coordination. Cleaner production and eco-innovation initiatives can guide villages in gradually adopting environmentally friendly technologies or improved processes, such as cleaner kilns in pottery or more efficient dyeing methods in textile crafts, reducing emissions and resource consumption. Industrial symbiosis practices, including sharing raw materials or exchanging by-products among

households or small firms within a village, foster collaboration that maximizes resource utilization and lowers collective environmental costs. Firm characteristics influence the adoption and effectiveness of these practices. Older and more experienced craft households are better positioned to implement circular economy practices effectively, while larger or more fragmented production units may face higher coordination challenges. Local governments and village associations can play a crucial role by providing technical support, facilitating resource-sharing networks, and offering incentives for sustainable practices, helping small-scale artisans overcome barriers to environmental management.

To support the sustainable development of traditional craft villages in Vietnam, government agencies and local authorities should implement policies that facilitate the adoption of circular economy practices and enhance both environmental and economic outcomes. Investments in infrastructure for recycling and waste management can reduce the burden of environmental costs for small-scale producers, while technical support programs can provide training on resource efficiency, cleaner production, and eco-innovation tailored to the specific needs of craft villages. Encouraging industrial symbiosis networks within and between villages through cooperative platforms can enable households and small firms to share materials, exchange by-products, and collaboratively manage environmental impacts. Incentives, such as subsidies, low-interest loans, or tax relief, can motivate households and enterprises to invest in sustainable technologies and environmentally friendly production methods. Additionally, government-led initiatives to promote environmental awareness and knowledge-sharing through workshops, demonstration projects, or extension services can increase recognition of hidden environmental costs and strengthen adoption of circular practices. By combining regulatory support, financial incentives, and capacity-building programs, the government can help traditional craft villages achieve a balance between cultural heritage preservation, environmental sustainability, and economic growth.

Limitation and Future Research Directions

This study has several limitations that provide opportunities for future research. First, data were collected from traditional craft villages in Vietnam, which may limit the generalizability of the findings to other industries or regions. Second, the study relied on cross-sectional survey data, preventing causal inferences and long-term assessment of circular economy practices. Third, some constructs, such as perceived environmental cost, were measured using self-reported indicators, which may introduce response bias. Future research could expand the scope by including larger or more diverse samples across multiple regions or industries, employing longitudinal designs to examine changes in environmental and economic outcomes over time. Additionally, qualitative methods or case studies could provide deeper insights into the implementation challenges of circular economy practices in small-scale, resource-constrained production settings. Exploring moderating effects of institutional support, technology adoption, or cultural factors would further enhance understanding of how environmental capabilities translate into economic and sustainability benefits.

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