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Learning for Eco-Innovation: Institutional Pressures and Absorptive Capacity in Vietnamese Manufacturing SMEs

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Abstract

Eco-innovation is important for manufacturing SMEs facing environmental pressures and sustainability transitions. Drawing on institutional theory and absorptive capacity, this study examines how coercive, mimetic, and normative isomorphism influence eco-innovation in Vietnamese manufacturing SMEs. Absorptive capacity is positioned as an internal learning mechanism and conceptualised as a higher-order construct reflected by acquisition, assimilation, transformation, and exploitation, while eco-innovation is reflected by eco-process, eco-product, and eco-organisational innovation. Using 182 valid survey responses and PLS-SEM, the findings show that coercive isomorphism has both direct and indirect effects on eco-innovation through absorptive capacity. Mimetic isomorphism directly influences eco-innovation, but its indirect effect is not significant. Normative isomorphism affects eco-innovation only indirectly through absorptive capacity. Absorptive capacity also positively influences eco-innovation. The study highlights workplace-based sustainability learning as a mechanism through which SMEs translate institutional pressures into green transformation.

Keywords absorptive capacity, eco-innovation, institutional pressure, manufacturing SMEs, sustainability learning

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INTRODUCTION

Sustainable futures depend not only on environmental policies and technological solutions but also on the capacity of organisations to learn, adapt, and act on sustainability-related knowledge (UNESCO, 2020; Wals, 2011). Education for Sustainable Development emphasises the development of knowledge, skills, values, and attitudes that enable responsible action for environmental integrity, economic viability, and social well-being (UNESCO, 2020). Although this agenda is often associated with formal education, sustainability learning also takes place in workplaces, professional networks, and organisational settings where actors interpret external demands and translate them into changed practices (Feeney et al., 2023; Wals, 2011). This perspective is particularly relevant for manufacturing small and medium-sized enterprises (SMEs), because sustainability transitions require firms not only to face external environmental pressures but also to develop the internal capacity to recognise, absorb, and apply environmental knowledge in business practice (Cohen & Levinthal, 1990; Zahra & George, 2002).

Within firms, eco-innovation provides an important pathway through which sustainability-related learning is translated into environmental and organisational change. It refers to the development, adoption, or use of products, processes, services, or organisational methods that are new to the organisation and reduce environmental risks, pollution, and resource use compared with relevant alternatives (Kemp & Pearson, 2007). Prior research shows that eco-innovation can improve resource efficiency, reduce emissions, and support both environmental and economic performance, particularly when it is embedded across product, process, and organisational dimensions (Adams et al., 2016; Horbach et al., 2012; Zhang et al., 2019). However, eco-innovation is not merely a technical response to environmental problems. It also requires firms to interpret regulatory and market signals, learn from external actors, reorganise internal knowledge, and apply that knowledge in operational and strategic decisions (Cohen & Levinthal, 1990; Delmas & Toffel, 2008; Zahra & George, 2002). In this sense, eco-innovation can be understood as a practical outcome of organisational learning for sustainable development (Adams et al., 2016; Rennings, 2000; Wals, 2011).

Institutional theory offers a useful explanation for why firms are exposed to sustainability expectations, as organisations are shaped by rules, norms, and shared beliefs in their institutional environments (DiMaggio & Powell, 1983; Meyer & Rowan, 1977; Scott, 2008). In environmental management research, coercive pressures from regulations, mimetic pressures from peer imitation, and normative pressures from professional and social expectations have been shown to influence firms' environmental practices and innovation decisions (Berrone et al., 2013; Delmas & Toffel, 2008; Hoffman, 1999). Yet institutional pressures do not automatically lead to substantive eco-innovation. Firms may respond to external demands symbolically, minimally, or through meaningful changes in products, processes, and organisational systems, depending on their internal capabilities (Berrone et al., 2013; Delmas & Toffel, 2008). This suggests that institutional pressure alone is insufficient to explain how sustainability expectations are transformed into eco-innovation.

Absorptive capacity provides a learning-based mechanism for addressing this limitation. Cohen and Levinthal (1990) define absorptive capacity as a firm's ability to recognise the value of new external knowledge, assimilate it, and apply it to commercial ends. Zahra and George (2002) further conceptualise it as a set of routines and processes through which firms acquire, assimilate, transform, and exploit knowledge. This capability is particularly relevant to sustainability transitions because environmental knowledge is often complex, externally generated, and distributed across regulators, customers, suppliers, competitors, professional associations, and technical experts (Aboelmaged & Hashem, 2019; Del Río et al., 2016; Liao, 2018b). Firms exposed to similar environmental pressures may therefore differ in their eco-innovation responses because they differ in their ability to acquire, interpret, combine, and apply sustainability-related knowledge (Del Río et al., 2016; Lane et al., 2006; Zahra & George, 2002). From this perspective, absorptive capacity helps connect institutional theory with the broader concern of education for sustainable futures by explaining how external sustainability pressures can become organisational learning processes that support eco-innovation (Cohen & Levinthal, 1990; Wals, 2011; Zahra & George, 2002).

This issue is especially important in Vietnamese manufacturing SMEs. SMEs account for more than 97% of enterprises in Vietnam and play an important role in national economic development (General Statistics Office of Vietnam, 2024; Viet Nam Government Portal, 2023). Manufacturing firms are also closely connected to environmental concerns because production activities may generate emissions, wastewater, solid waste, and resource consumption pressures (Lee & Klassen, 2016; Wang et al., 2018). At the same time, Vietnamese firms are increasingly exposed to environmental regulations, export-market sustainability requirements, supply-chain expectations, and social demands for greener production (Ngo, 2023; Wang et al., 2018). These conditions create a dual challenge because institutional pressures push SMEs towards environmental responsibility, while limited financial, technological, and managerial resources may constrain their ability to convert such pressures into substantive eco-innovation (Del Río et al., 2016; OECD, 2021). Vietnam therefore provides a meaningful emerging economy context for examining how institutional pressures and absorptive capacity jointly shape eco-innovation.

Despite growing research on institutional drivers of eco-innovation, the learning process through which SMEs convert external sustainability pressures into eco-innovation remains insufficiently explained. First, existing research has often emphasised external drivers of eco-innovation while paying less attention to the internal learning mechanism through which firms absorb and use sustainability-related knowledge (Berrone et al., 2013; Delmas & Toffel, 2008). Second, although absorptive capacity is well established in innovation research, its role in connecting institutional pressures with eco-innovation remains insufficiently examined in SME and emerging economy contexts (Del Río et al., 2016; Lane et al., 2006; Volberda et al., 2010). Third, many studies treat eco-innovation as a general construct, whereas firms may pursue eco-process, eco-product, and eco-organisational innovation in different ways (Horbach et al., 2012; OECD, 2009; Triguero et al., 2013). Addressing these limitations is important for understanding not only whether institutional pressures influence eco-innovation but also how SMEs learn from external sustainability demands and convert them into concrete innovation practices.

To address these gaps, this study examines how coercive, mimetic, and normative institutional pressures influence absorptive capacity and eco-innovation in Vietnamese manufacturing SMEs. It further investigates whether absorptive capacity mediates the relationships between institutional pressures and eco-innovation. By integrating institutional theory with absorptive capacity, this study advances a learning-based explanation of eco-innovation in which external sustainability pressures are converted into organisational knowledge processes and then into eco-innovation outcomes. The study contributes to education for sustainable futures by extending sustainability learning beyond formal education and showing how workplace-based learning capacity can support green transformation in SMEs. It also contributes to institutional and eco-innovation research by clarifying the role of absorptive capacity as an internal mechanism linking external pressures with multidimensional eco-innovation.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Literature Review

Institutional pressures and sustainability-oriented organisational learning

Institutional theory explains how organisations are shaped by the social, regulatory, and professional environments in which they operate (DiMaggio & Powell, 1983; Meyer & Rowan, 1977; Scott, 2008). From this perspective, firms do not make strategic decisions only on the basis of internal efficiency but also respond to external expectations to maintain legitimacy, reduce uncertainty, and conform to accepted norms (DiMaggio & Powell, 1983; Scott, 2008). In sustainability contexts, institutional pressures may encourage firms to adopt environmental practices, improve management systems, and pursue eco-innovation as a response to regulatory, market, and social expectations (Berrone et al., 2013; Delmas & Toffel, 2008; Hoffman, 1999).

Institutional pressures are commonly categorised into coercive, mimetic, and normative pressures (DiMaggio & Powell, 1983). Coercive pressure refers to formal and informal pressures exerted by powerful actors, particularly governments, regulators, and other organisations on which firms depend (DiMaggio & Powell, 1983). In environmental management, coercive pressure often appears through regulations, compliance requirements, penalties, and mandatory environmental standards that require firms to adjust their operations (Berrone et al., 2013; Delmas & Toffel, 2008). Mimetic pressure arises under uncertainty, when organisations imitate firms perceived as successful, legitimate, or advanced in the same field (DiMaggio & Powell, 1983). For SMEs with limited resources and incomplete technical knowledge, observing and adapting the environmental practices of leading firms can reduce uncertainty and provide practical models for change (Bansal, 2005; DiMaggio & Powell, 1983). Normative pressure is rooted in professionalisation, industry norms, training systems, and shared expectations about appropriate organizational behaviour (DiMaggio & Powell, 1983; Scott, 2008). In the sustainability domain, such pressure may be transmitted through professional associations, industry networks, customer expectations, and environmental standards that define what responsible business practice should look like (Delmas & Toffel, 2008; Hoffman, 1999).

Although these institutional pressures can push firms toward environmental responsibility, they do not automatically result in substantive eco-innovation. Firms may respond to external expectations through symbolic compliance, limited adjustment, or meaningful organisational change, depending on their internal capabilities (Berrone et al., 2013; Delmas & Toffel, 2008). This distinction is important for a learning-based explanation of eco-innovation. Coercive, mimetic, and normative pressures may provide external signals and sustainability-related knowledge, but firms still need the capacity to recognise, absorb, interpret, and apply such knowledge in practice (Cohen & Levinthal, 1990; Zahra & George, 2002). Therefore, institutional pressures are treated in this study not only as external drivers of eco-innovation but also as triggers of sustainability-oriented organisational learning.

Absorptive capacity

Absorptive capacity is a central concept in organisational learning and innovation research. Cohen and Levinthal (1990) define it as a firm's ability to recognise the value of new external knowledge, assimilate it, and apply it to commercial ends. Zahra and George (2002) later reconceptualised absorptive capacity as a set of organisational routines and processes through which firms acquire, assimilate, transform, and exploit knowledge. Acquisition refers to identifying and obtaining externally generated knowledge; assimilation involves analysing and understanding that knowledge; transformation reflects the ability to combine new knowledge with existing knowledge; and exploitation refers to applying knowledge to create new operations, products, processes, or organisational practices (Zahra & George, 2002).

In the context of sustainable development, absorptive capacity is especially relevant because environmental knowledge is often complex, externally generated, and dependent on firms' ability to acquire, process, and apply knowledge from institutional and market environments (Aboelmaged & Hashem, 2019; Liao, 2018b). Firms may need to learn from government regulations, technical standards, suppliers, customers, competitors, consultants, and professional networks before they can implement meaningful environmental innovation (Liao, 2018b; Mady et al., 2022). For manufacturing SMEs, this learning process is particularly important because resource limitations may restrict their ability to independently develop environmental knowledge and technological solutions (Aboelmaged & Hashem, 2019; Mady et al., 2022). Absorptive capacity therefore helps explain why firms exposed to similar institutional pressures may differ in their eco-innovation responses. Firms with stronger absorptive capacity are more likely to understand sustainability requirements, transform external information into internal knowledge, and apply that knowledge in environmental innovation activities (Aboelmaged & Hashem, 2019; Cohen & Levinthal, 1990; Zahra & George, 2002).

Eco-innovation

Eco-innovation refers to the development, adoption, or use of new or significantly improved products, processes, services, or organisational methods that reduce environmental risks, pollution, and resource use compared with relevant alternatives (Kemp & Pearson, 2007; OECD, 2009). Rennings (2000) emphasises that eco-innovation includes technological, social, and institutional forms of innovation directed toward sustainable development. This broader view is important because environmental improvement does not depend only on cleaner technologies but also on changes in organisational routines, managerial systems, and business practices (Adams et al., 2016; Rennings, 2000).

In this study, eco-innovation is conceptualised as a multidimensional construct comprising eco-process innovation, eco-product innovation, and eco-organisational innovation. Eco-process innovation involves cleaner production methods, energy-saving solutions, waste reduction, and improved resource efficiency in production and delivery activities (Horbach et al., 2012; OECD/Eurostat, 2005). Eco-product innovation refers to the development or improvement of products and services that reduce environmental harm during production, use, or disposal (Kemp & Pearson, 2007; OECD, 2009). Eco-organisational innovation reflects changes in management systems, organisational structures, workplace routines, and external relations that support environmental objectives (OECD/Eurostat, 2005; Rennings, 2000). Treating eco-innovation as multidimensional allows the study to capture the different ways in which firms translate sustainability-related learning into concrete innovation practices (Horbach et al., 2012; Triguero et al., 2013).

Hypotheses Development

Institutional pressures and absorptive capacity

Institutional pressures can stimulate absorptive capacity because they expose firms to new knowledge, standards, and expectations that require interpretation and internal learning (Liao, 2018b; Mady et al., 2022). Coercive pressure from environmental regulations and compliance requirements can force firms to search for technical information, understand legal standards, and develop internal routines for meeting environmental obligations (Delmas & Toffel, 2008; Liao, 2018b). In this sense, coercive pressure may activate learning processes by making environmental knowledge necessary for continued operation and legitimacy. For manufacturing SMEs, regulatory pressure can encourage managers to acquire and assimilate knowledge about cleaner production, emissions control, waste management, and resource efficiency. Therefore, coercive pressure is expected to strengthen absorptive capacity.

H1a. Coercive isomorphism positively influences absorptive capacity.

Mimetic pressure can also enhance absorptive capacity by encouraging firms to learn from competitors, industry leaders, and successful peers. When environmental technologies and sustainability practices are uncertain, firms may observe organisations that have already implemented eco-innovation and use them as models for learning (Bansal, 2005; DiMaggio & Powell, 1983). This process is not only imitation but also knowledge acquisition and adaptation, because firms must understand which practices are transferable and how they can be adjusted to their own operations. SMEs with limited internal resources may rely especially on such peer-based learning to identify feasible environmental solutions. Therefore, mimetic pressure is expected to promote absorptive capacity.

H1b. Mimetic isomorphism positively influences absorptive capacity.

Normative pressure may strengthen absorptive capacity through professional norms, industry standards, training systems, and network-based knowledge exchange. Professional associations, consultants, industry groups, and customer networks may communicate sustainability expectations and provide firms with technical and managerial knowledge about environmental practices (DiMaggio & Powell, 1983; Mady et al., 2022; Scott, 2008). These normative channels can help firms understand what is considered appropriate and responsible within their sector. They may also create opportunities for knowledge sharing, training, and collective learning. Therefore, normative pressure is expected to enhance firms' absorptive capacity.

H1c. Normative isomorphism positively influences absorptive capacity.

Absorptive capacity and eco-innovation

Absorptive capacity can promote eco-innovation because it enables firms to convert external sustainability-related knowledge into practical innovation outcomes. Eco-innovation often requires firms to identify environmental problems, understand cleaner technologies, interpret sustainability standards, and integrate new knowledge into production, product design, and organisational routines (Horbach et al., 2012; Kemp & Pearson, 2007; Rennings, 2000). Firms with strong absorptive capacity are better able to acquire environmental knowledge from external actors, assimilate it into their existing knowledge base, transform it into context-specific solutions, and exploit it through process, product, and organisational innovation (Cohen & Levinthal, 1990; Zahra & George, 2002).

Prior research also suggests that absorptive capacity is important for green innovation because it helps firms use external environmental knowledge more effectively and adopt green innovation practices (Aboelmaged & Hashem, 2019; Qi et al., 2021). Therefore, absorptive capacity is expected to positively influence eco-innovation.

H2. Absorptive capacity positively influences eco-innovation.

Institutional pressures and eco-innovation

Institutional pressures may also have direct effects on eco-innovation. Coercive pressure can push firms to adopt cleaner technologies, improve environmental management, and redesign processes or products to comply with regulations and avoid sanctions (Delmas & Toffel, 2008; Horbach et al., 2012; Jin et al., 2024). In regulated manufacturing contexts, environmental requirements can create clear incentives for firms to reduce emissions, improve resource efficiency, and implement cleaner production practices. Therefore, coercive pressure is expected to positively influence eco-innovation.

H3a. Coercive isomorphism positively influences eco-innovation.

Mimetic pressure can positively influence eco-innovation because firms may imitate competitors or leading firms that have successfully implemented environmental practices. Under uncertainty, imitation helps firms reduce perceived risk and gain legitimacy by following practices already accepted in the industry (Bansal, 2005; DiMaggio & Powell, 1983). For SMEs, observing eco-innovation practices adopted by peers may provide practical examples and reduce the uncertainty associated with green transformation. Prior studies also suggest that mimetic pressure can positively shape firms' green innovation and eco-innovation decisions (Ning et al., 2021; Zhu et al., 2024). Therefore, mimetic pressure is expected to positively influence eco-innovation.

H3b. Mimetic isomorphism positively influences eco-innovation.

Normative pressure can positively influence eco-innovation by encouraging firms to conform to professional standards, industry expectations, and socially accepted environmental responsibilities. Firms may adopt eco-innovation to maintain legitimacy, improve reputation, and align with the expectations of customers, associations, and professional communities (Delmas & Toffel, 2008; Hoffman, 1999). When environmental responsibility becomes a shared norm within an industry, firms are more likely to introduce cleaner processes, greener products, and supportive organisational practices. Prior empirical evidence further indicates that normative pressure can promote eco-innovation by guiding firms toward accepted environmental standards and green innovation strategies (Mady et al., 2022; Ning et al., 2021; Zhu et al., 2024). Therefore, normative pressure is expected to positively influence eco-innovation.

H3c. Normative isomorphism positively influences eco-innovation.

Mediating role of absorptive capacity

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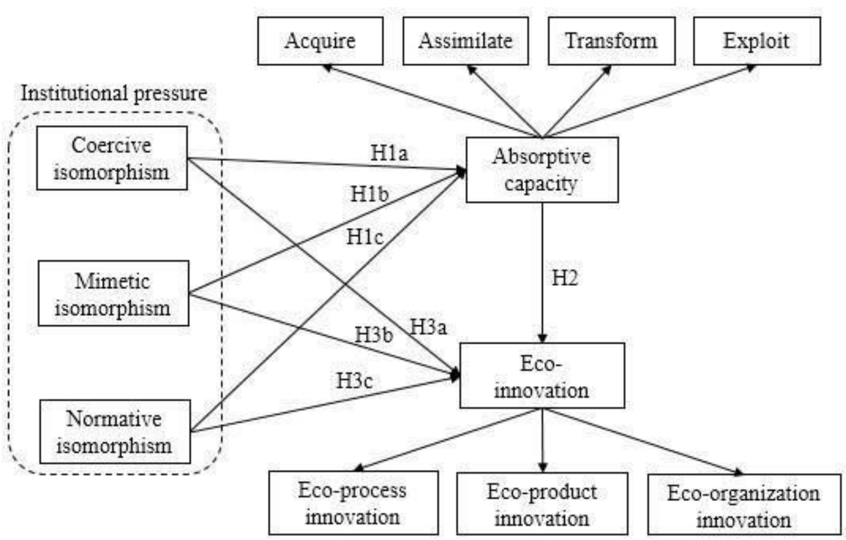
Absorptive capacity is expected to mediate the relationship between institutional pressures and eco-innovation because it explains how external sustainability pressures are converted into internal knowledge processes and innovation outcomes. Institutional pressures may expose firms to environmental requirements, peer examples, and professional expectations, although these pressures are unlikely to produce substantive eco-innovation unless firms can absorb and use the knowledge embedded in them (Cohen & Levinthal, 1990; Liao, 2018b; Zahra & George, 2002). Coercive pressure may lead firms to search for compliance-related knowledge. Mimetic pressure may direct firms towards peer-based learning, while normative pressure may support professional learning through industry standards and networks. Through absorptive capacity, these external signals can be acquired, assimilated, transformed, and exploited as eco-process, eco-product, and eco-organisational innovation. Therefore, absorptive capacity is expected to act as a mediating mechanism linking each type of institutional pressure with eco-innovation.

H4a. Absorptive capacity mediates the relationship between coercive isomorphism and eco-innovation.
H4b. Absorptive capacity mediates the relationship between mimetic isomorphism and eco-innovation.
H4c. Absorptive capacity mediates the relationship between normative isomorphism and eco-innovation.

CONCEPTUAL FRAMEWORK

Figure 1. *Proposed Research Model*



This study integrates institutional theory with absorptive capacity to explain eco-innovation in Vietnamese manufacturing SMEs. Institutional theory explains how coercive, mimetic, and normative pressures shape firm behaviour, while absorptive capacity explains how firms acquire, assimilate, transform, and exploit sustainability-related knowledge (Cohen & Levinthal, 1990; DiMaggio & Powell, 1983; Scott, 2008; Zahra & George, 2002). In this model, absorptive capacity is conceptualised as a higher-order construct reflected by acquisition, assimilation, transformation, and exploitation, whereas eco-innovation is conceptualised as a higher-order construct reflected by eco-process, eco-product, and eco-organisational innovation (Horbach et al., 2012; OECD, 2009; Rennings, 2000). Accordingly, the model assumes that institutional pressures influence eco-innovation both directly and indirectly through absorptive capacity. Figure 1 illustrates the proposed research model.

METHODS

This study employed a quantitative cross-sectional survey design to examine the relationships among institutional pressures, absorptive capacity, and eco-innovation in Vietnamese manufacturing SMEs. A structured questionnaire was used because the study aimed to test theoretically derived hypotheses involving latent constructs at the firm level.

The measurement items were adapted from established scales. Coercive, mimetic, and normative pressures were measured based on Colwell and Joshi (2013). Absorptive capacity was measured as a higher-order construct reflected by four lower-order dimensions, namely acquisition, assimilation, transformation, and exploitation, following the absorptive capacity framework of Zahra and George (2002) and the scale development work of Flatten et al. (2011). Eco-innovation was measured based on Liao (2018a) and conceptualised as a higher-order construct reflected by eco-process, eco-product, and eco-organisational innovation. The final questionnaire included 39 observed items, all measured on a five-point Likert scale ranging from 1 = "strongly disagree" to 5 = "strongly agree".

The target population consisted of manufacturing SMEs in Vietnam. Because the study examined firm-level constructs, only one respondent from each enterprise was surveyed. Eligible respondents included owners, directors, managers, and department-level staff with sufficient knowledge of the firm's operations, environmental practices, and strategic decisions. A non-probability sampling approach was applied, combining purposive and snowball sampling. In total, 235 responses were collected. After screening for eligibility, incomplete answers, straight-lining, and failed attention checks, 53 responses were removed, leaving 182 valid responses for analysis.

Data were analysed using Partial Least Squares Structural Equation Modelling (PLS-SEM) with SmartPLS 4.0. The measurement model was evaluated through indicator reliability, internal consistency reliability, convergent validity, and discriminant validity using outer loadings, Cronbach's alpha, composite reliability, average variance extracted, the Fornell-Larcker criterion, and the heterotrait-monotrait ratio. Because both absorptive capacity and eco-innovation were modelled as higher-order constructs, their lower-order and higher-order measurement models were assessed before testing the structural model. The structural model was evaluated using variance inflation factors, path coefficients, R^2, f^2, Q^2, and bootstrapping with 5,000 resamples. The mediating role of absorptive capacity was tested through the indirect effects of institutional pressures on eco-innovation.

RESULTS

Descriptive Statistics

Table 1 shows that the sample consists of 182 valid respondents from manufacturing enterprises in

Vietnam. In terms of workforce size based on social insurance participation, firms with 11 to 100 employees account for the largest proportion (74.2%), followed by those with 1 to 10 employees (14.3%) and 101 to 200 employees (11.5%). Regarding annual revenue, most firms report revenues between VND 3 and 50 billion (46.1%), followed by those with revenues of VND 3 billion or less (28.6%) and those between VND 50 and 200 billion (25.3%). In terms of firm age, enterprises operating for 6 to 10 years represent the largest group (35.2%), followed by those operating for 11 to 20 years (33.0%), 3 to 5 years (19.8%), and more than 20 years (12.0%). With respect to industry sectors, the most represented sectors include metal and mechanical manufacturing (19.8%), textiles and garments (15.9%), plastics and rubber (14.8%), and food processing (13.2%). Regarding ownership type, limited liability companies with two or more members constitute the largest proportion (42.9%), followed by joint-stock companies (31.3%), single-member limited liability companies (15.9%), and private enterprises (8.8%).

Concerning respondents' profiles, the largest group comprises production or operations managers and department heads (29.7%), followed by quality or environmental (HSE) managers (22.0%), technical/R&D/improvement managers (19.2%), and business owners/CEOs/general directors (15.4%). Most respondents had worked at their firms for 2 to 5 years and held a bachelor's degree; male respondents accounted for 69.2% of the sample.

Table 1. *Description of the Sample*

	Characteristics	**Quantity**	**Proportion (%)**
	Firm characteristics		
Workforce size	1-10	26	14.3
	11-100	135	74.2
	101-200	21	11.5
Annual revenue	≤ VND 3 billion	52	28.6
	VND 3-50 billion	84	46.1
	VND 50-200 billion	46	25.3
Firm age	3-5 years	36	19.8
	6-10 years	64	35.2
	11-20 years	60	33.0
	>20 years	22	12.0
Industry sector	Metal & mechanical	36	19.8
	Textile & garment	29	15.9
	Plastics & rubber	27	14.8
	Food processing	24	13.2
	Other industries	66	36.3
Ownership type	Limited liability (≥2 members)	78	42.9
	Joint-stock company	57	31.3
	Single-member LLC	29	15.9
	Private enterprise	16	8.8
	Partnership	2	1.1
	Respondent characteristics		
Position	Production/operations manager	54	29.7
	Quality/environment (HSE) manager	40	22.0
	Technical/R&D manager	35	19.2
	Owner/CEO/director	28	15.4
	Other	25	13.7
Work experience (tenure)	<2 years	21	17.0

	2-5 years	78	42.9
	6-10 years	62	26.9
	>10 years	21	13.2
Education level	High school education or below	7	3.8
College or vocational education		41	22.5
Bachelor's degree		124	68.1
Master's degree		10	5.5
Gender	Male	126	69.2
	Female	56	30.8

Measurement Model Evaluation

This study assessed both first-order and second-order measurement models. The first-order measurement model comprised 10 constructs and 39 observed variables, including three institutional pressure constructs, four absorptive capacity dimensions, and three eco-innovation dimensions. These constructs were evaluated in terms of indicator reliability, internal consistency reliability, convergent validity, and discriminant validity, following the recommended criteria for PLS-SEM assessment (Hair et al., 2019).

As shown in Table 2, all outer loadings ranged from 0.732 to 0.926, exceeding the recommended threshold of 0.708. This result indicates satisfactory indicator reliability (Hair et al., 2019). The Cronbach's alpha values ranged from 0.832 to 0.920, while composite reliability values ranged from 0.887 to 0.938, both exceeding the minimum threshold of 0.70. These results confirm good internal consistency reliability (Hair et al., 2019). In addition, all average variance extracted values were above the recommended cutoff of 0.50, ranging from 0.664 to 0.812, thereby supporting convergent validity (Hair et al., 2019).

Discriminant validity was assessed using the Fornell-Larcker criterion and the heterotrait-monotrait ratio, as reported in Table 3. The square root of AVE for each construct was higher than its correlations with other constructs, indicating that the Fornell-Larcker criterion was satisfied (Fornell & Larcker, 1981). The HTMT values ranged from 0.050 to 0.726, below the conservative threshold of 0.85, thereby supporting discriminant validity among the first-order constructs (Hair et al., 2019; Henseler et al., 2015). Overall, the first-order measurement model demonstrated satisfactory reliability and validity and was suitable for further higher-order construct assessment.

Table 2. *Evaluation of the First-Order Model*

Constructs	**Items**	**Outer loadings**	**Cronbach's Alpha**	**CR (rho_c)**	**AVE**
Coercive isomorphism	CI1	0.842	0.832	0.887	0.664
	CI2	0.859			
	CI3	0.821			
	CI4	0.732			
Mimetic isomorphism	MI1	0.926	0.867	0.917	0.787
	MI2	0.830			
	MI3	0.902			
Normative isomorphism	NI1	0.913	0.885	0.928	0.812
	NI2	0.899			
Acquisition	NI3	0.892			

	ACQ1	0.883	0.870	0.920	0.794
	ACQ2	0.892			
Assimilation	ACQ3	0.898			
	ASM1	0.883	0.876	0.924	0.802
	ASM2	0.901			
Transformation	ASM3	0.901			
	TR1	0.854	0.841	0.904	0.758
	TR2	0.891			
Exploitation	TR3	0.867			
	EXP1	0.900	0.883	0.928	0.811
	EXP2	0.909			
Eco-process innovation	EXP3	0.893			
	EPCI1	0.855	0.873	0.913	0.724
	EPCI2	0.851			
	EPCI3	0.870			
Eco-product innovation	EPCI4	0.826			
	EPDI1	0.818	0.916	0.933	0.665
	EPDI2	0.833			
	EPDI3	0.827			
	EPDI4	0.787			
	EPDI5	0.819			
	EPDI6	0.855			
Eco-organization innovation	EPDI7	0.765			
	EOI1	0.880	0.920	0.938	0.716
	EOI2	0.849			
	EOI3	0.847			
	EOI4	0.838			
	EOI5	0.850			
	EOI6	0.811			

Table 3. *The Heterotrait and Monotrait (HTMT) Ratio and Fornell-Larcker Criterion of the First-Order Model*

	CI	NI	MI	TRA	ASM	EXP	EPCI	EPDI	EOI	ACQ
Fornell-Larcker criterion results										
CI	0.786									
NI	0.119	0.895								
MI	-0.512	-0.045	0.836							
TRA	0.102	0.206	0.107	0.871						
ASM	0.122	0.134	0.024	0.349	0.891					
EXP	0.265	0.068	-0.117	0.32	0.326	0.901				
EPCI	0.168	0.076	0.064	0.262	0.194	0.179	0.829			
EPDI	0.227	0.149	0.111	0.311	0.232	0.142	0.483	0.792		
EOI	0.205	0.107	0.175	0.241	0.167	0.257	0.324	0.422	0.835	
ACQ	0.068	0.117	0.151	0.403	0.36	0.424	0.257	0.289	0.29	0.895
The Heterotrait and Monotrait ratio results										
CI										
NI	0.16									
MI	0.726	0.11								
TRA	0.13	0.232	0.141							
ASM	0.153	0.154	0.05	0.405						
EXP	0.322	0.083	0.173	0.371	0.368					
EPCI	0.199	0.099	0.086	0.3	0.217	0.199				

EPDI	0.27	0.165	0.119	0.356	0.258	0.162	0.533		
EOI	0.244	0.123	0.191	0.282	0.186	0.297	0.363	0.47	
ACQ	0.086	0.133	0.149	0.468	0.41	0.481	0.285	0.321	0.331

The second-order measurement model was assessed for absorptive capacity and eco-innovation. As shown in Table 4, the loadings of the lower-order dimensions ranged from 0.670 to 0.829. Although the loadings of assimilation and exploitation were slightly below 0.708, they were retained because the composite reliability and AVE values of absorptive capacity remained acceptable (Hair et al., 2019). The CR values were 0.813 for absorptive capacity and 0.821 for eco-innovation, exceeding the 0.70 threshold, while the AVE values were 0.521 and 0.606, exceeding the 0.50 threshold (Hair et al., 2019). These results indicate acceptable reliability and convergent validity for the higher-order constructs.

Table 4. *Evaluation of the Second-Order Model*

Higher-order construct	Lower-order dimensions	Outer loadings	Cronbach's Alpha	CR (rho_c)	AVE
Absorptive capacity (AC)	TRA: Transformation	0.755	0.695	0.813	0.521
	ASM: Assimilation	0.670			
	EXP: Exploitation	0.686			
	ACQ: Acquisition	0.772			
Eco-innovation (EI)	EPCI: Eco-process innovation	0.742	0.675	0.821	0.606
	EPDI: Eco-product innovation	0.829			
	EOI: Eco-organizational innovation	0.761			

Structural Model Evaluation

Multicollinearity was assessed using inner VIF values. The results ranged from 1.014 to 1.458, all below the threshold of 3, indicating that multicollinearity was not a concern in the structural model (Hair et al., 2019). Hypothesis testing was conducted using bootstrapping with 5,000 resamples. As shown in Table 5, coercive isomorphism significantly influenced both absorptive capacity ($\beta = 0.271$, $t = 2.698$, $p = 0.007$) and eco-innovation ($\beta = 0.360$, $t = 4.824$, $p < 0.001$), supporting H1a and H3a. Mimetic isomorphism significantly influenced eco-innovation ($\beta = 0.318$, $t = 2.891$, $p = 0.004$), supporting H3b, but its effect on absorptive capacity was not significant ($\beta = 0.212$, $t = 1.818$, $p = 0.069$), so H1b was not supported. Normative isomorphism significantly influenced absorptive capacity ($\beta = 0.166$, $t = 2.512$, $p = 0.012$), supporting H1c, but its effect on eco-innovation was not significant ($\beta = 0.060$, $t = 0.957$, $p = 0.339$), so H3c was not supported. Absorptive capacity significantly influenced eco-innovation ($\beta = 0.328$, $t = 4.666$, $p < 0.001$), supporting H2.

Table 5. *Testing Hypotheses in the Structural Model*

Hypothesis	Path of direct effect	Original Sample (O)	Sample Mean (M)	STDEV	T Statistics (|O/STDEV|)	P Values	Results
H1a	CI → AC	0.271	0.262	0.1	2.698	0.007	Supported
H1b	MI → AC	0.212	0.193	0.117	1.818	0.069	Not supported
H1c	NI → AC	0.166	0.176	0.066	2.512	0.012	Supported
H2	AC → EI	0.328	0.34	0.07	4.666	0.000	Supported
H3a	CI → EI	0.36	0.352	0.075	4.824	0.000	Supported

H3b	MI → EI	0.318	0.3	0.11	2.891	0.004	Supported
H3c	NI → EI	0.06	0.06	0.062	0.957	0.339	Not supported

The indirect-effect results are presented in Table 6. Absorptive capacity significantly mediated the effects of coercive isomorphism (β = 0.089, t = 2.313, p = 0.021) and normative isomorphism (β = 0.055, t = 2.057, p = 0.040) on eco-innovation, supporting H4a and H4c. However, the indirect effect of mimetic isomorphism was not significant (β = 0.070, t = 1.568, p = 0.117), so H4b was not supported.

Table 6. *Testing Mediating Effects*

Hypothesis	Indirect path	Original Sample (O)	Sample Mean (M)	STDEV	T Statistics (|O/STDEV|)	P-Values	Results
H4a	CI → AC → EI	0.089	0.089	0.038	2.313	0.021	Supported
H4b	MI → AC → EI	0.07	0.066	0.044	1.568	0.117	Not supported
H4c	NI → AC → EI	0.055	0.06	0.027	2.057	0.040	Supported

The model explained 28.9% of the variance in eco-innovation and 9.3% of the variance in absorptive capacity, indicating modest explanatory power overall, with stronger explanation for eco-innovation than for absorptive capacity (Hair et al., 2019). The Q^2 values for eco-innovation and absorptive capacity were 0.147 and 0.037, respectively, both above zero, suggesting that the model had predictive relevance for the endogenous constructs (Hair et al., 2019). The f^2 values ranged from 0.005 to 0.137, indicating that the effects were generally small, although the effects of absorptive capacity, coercive isomorphism, and mimetic isomorphism on eco-innovation were relatively more meaningful within the model (Cohen, 1988).

DISCUSSION AND IMPLICATIONS

Discussion

The findings show that institutional pressures influence eco-innovation through different pathways. Coercive isomorphism directly promotes both absorptive capacity and eco-innovation, while absorptive capacity also mediates its effect on eco-innovation. This suggests that regulatory and compliance-related pressures not only push firms to adopt environmental innovations directly, but also stimulate firms to acquire, interpret, and apply sustainability-related knowledge. This finding is consistent with institutional theory, which explains coercive pressure as arising from formal rules and dependence relations, and with prior research showing that environmental regulation can encourage firms to improve environmental practices and pursue eco-innovation (Delmas & Toffel, 2008; DiMaggio & Powell, 1983; Horbach et al., 2012; Jin et al., 2024). In Vietnamese manufacturing SMEs, regulatory pressure may provide clear and enforceable signals that reduce uncertainty and make environmental learning necessary for compliance and legitimacy.

Mimetic isomorphism has a significant direct effect on eco-innovation, but its effect on absorptive capacity and its indirect effect through absorptive capacity are not statistically supported at the 0.05 level. This indicates that imitation mainly works as a direct adoption mechanism in this study. Under uncertainty, firms often imitate organisations perceived as successful or legitimate, especially when they lack clear solutions or internal resources (DiMaggio & Powell, 1983). For Vietnamese manufacturing SMEs, observing competitors or industry leaders may encourage the adoption of visible eco-innovation practices, which is consistent with prior evidence that mimetic pressure can promote green innovation or eco-innovation decisions (Ning et al., 2021; Zhu et al., 2024). However, this peer-oriented pressure does not appear strong enough to explain absorptive capacity in the present model. Thus, mimetic pressure may support the diffusion of eco-innovation practices without necessarily strengthening the internal learning routines needed to absorb and apply sustainability-related knowledge.

Normative isomorphism presents a different pattern. Its direct effect on eco-innovation is not significant, but it significantly influences absorptive capacity and has a significant indirect effect on eco-innovation through absorptive capacity. This suggests that professional norms, industry expectations, and shared sustainability values may not immediately lead SMEs to implement eco-innovation, but they can strengthen the learning conditions that make eco-innovation possible. Normative pressure is rooted in professionalisation, shared standards, and socially accepted expectations about appropriate organizational behaviour (DiMaggio & Powell, 1983; Scott, 2008). In this study, normative pressure seems to work as a softer, more knowledge-oriented force because it helps firms become more aware of sustainability expectations and improves their ability to process and use environmental knowledge, which then supports eco-innovation through absorptive capacity (Mady et al., 2022; Zahra & George, 2002). This finding reinforces the role of absorptive capacity as a bridge between external sustainability expectations and concrete innovation outcomes (Aboelmaged & Hashem, 2019; Cohen & Levinthal, 1990; Zahra & George, 2002).

Overall, the findings support a learning-based explanation of eco-innovation. External institutional pressures matter, but their effects are not uniform. Coercive pressure operates through both direct compliance and absorptive-capacity pathways. Mimetic pressure directly encourages eco-innovation, while normative pressure contributes to eco-innovation mainly through absorptive capacity. These results suggest that eco-innovation in Vietnamese manufacturing SMEs is shaped not only by external pressure but also by firms' ability to absorb and apply sustainability-related knowledge. This extends institutional explanations of eco-innovation by showing that absorptive capacity is a key internal mechanism through which institutional demands can be translated into sustainable innovation practices (Cohen & Levinthal, 1990; Liao, 2018b; Mady et al., 2022; Zahra & George, 2002).

Implications

Theoretically, this study contributes to research on education for sustainable futures by showing that sustainability learning also occurs in workplace and organisational settings, not only in formal education. By positioning absorptive capacity as a learning mechanism, the study explains how SMEs acquire, interpret, transform, and apply sustainability-related knowledge to support eco-innovation (Cohen & Levinthal, 1990; UNESCO, 2020; Wals, 2011; Zahra & George, 2002). The findings also extend institutional theory by showing that coercive, mimetic, and normative pressures operate through different pathways. Coercive pressure affects eco-innovation both directly and indirectly through absorptive capacity, mimetic pressure mainly encourages direct eco-innovation adoption, and normative pressure contributes to eco-innovation through absorptive capacity. This suggests that institutional pressures do not work uniformly. Their effects depend on whether firms can convert external sustainability demands into internal learning and innovation processes (DiMaggio & Powell, 1983; Liao, 2018b; Mady et al., 2022; Scott, 2008). In this way, the study moves beyond a simple pressure-response explanation and highlights absorptive capacity as an internal mechanism linking institutional pressures with eco-innovation (Aboelmaged & Hashem, 2019; Cohen & Levinthal, 1990; Zahra & George, 2002).

Practically, the findings suggest that policymakers should combine environmental regulations with learning-oriented support, such as technical guidance, training programmes, and advisory services, so that SMEs can translate compliance requirements into eco-innovation rather than treating them only as administrative burdens (Delmas & Toffel, 2008; Horbach et al., 2012). Vocational education institutions, universities, and training providers should design short, practice-based sustainability programmes that help SMEs identify external knowledge, interpret environmental standards, and apply green solutions to products, processes, and organisational routines (UNESCO, 2020; Zahra & George, 2002). Industry associations should strengthen peer-learning forums, best-practice sharing, and sector-specific sustainability guidance because normative expectations appear to influence eco-innovation mainly through absorptive capacity (Mady et al., 2022; Scott, 2008). For SME managers, the results indicate that eco-innovation requires internal learning routines, including monitoring environmental requirements, sharing knowledge across departments, training employees, and integrating sustainability criteria into operational decisions (Aboelmaged & Hashem, 2019; Cohen & Levinthal, 1990).

CONCLUSION

This study shows that institutional pressures shape eco-innovation in Vietnamese manufacturing SMEs through distinct pathways. Coercive isomorphism has both direct and indirect effects through absorptive capacity, mimetic isomorphism directly promotes eco-innovation, and normative isomorphism contributes indirectly through absorptive capacity. These findings highlight absorptive capacity as a key mechanism through which external sustainability pressures are translated into eco-innovation.

From a practical perspective, promoting eco-innovation among manufacturing SMEs requires both institutional support and internal learning capacity. Policymakers should combine environmental regulations with technical guidance and training so that SMEs can convert compliance requirements into practical innovation. Industry associations, vocational education institutions, and professional networks should strengthen peer learning and sector-specific sustainability guidance. SME managers should also develop routines for monitoring environmental requirements, sharing knowledge across departments, and integrating sustainability criteria into operational decisions.

This study has several limitations that suggest directions for future research. First, the cross-sectional design limits the ability to capture changes in institutional pressures, absorptive capacity, and eco-innovation over time. Therefore, longitudinal research could examine how these relationships evolve. Second, the focus on Vietnamese manufacturing SMEs may limit generalisability, so comparative studies across industries or countries could further test the robustness of the proposed model. Third, the use of self-reported survey data may introduce subjective bias. Future studies may also incorporate additional mediating or moderating variables, such as green strategic orientation, managerial commitment, technological readiness, or environmental uncertainty, and use mixedmethods designs to better explain how SMEs acquire, interpret, and apply sustainability-related knowledge in daily operations.

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