

# Exploring the impacts of greenwashing on green business model innovation: the mediating effect of green organizational identity and opportunism

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## Abstract

**Purpose** – Green business model innovation (GBMI) has become an essential strategy for companies seeking to balance profitability with environmental sustainability. Nevertheless, implementing GBMI is difficult and demands significant organizational investments. Rather than making substantial changes, many companies greenwash to boost their public image. While greenwashing is widely recognized as a common practice, there is limited understanding of its impact on GBMI's effectiveness. Thus, this study aims to explore the relationship between greenwashing and GBMI, focusing on the construction sector.

**Design/methodology/approach** – The research hypotheses were formulated based on the theoretical foundations of organizational learning and organizational culture theories. A questionnaire was developed to collect data from 142 Vietnamese construction practitioners, and Partial Least Squares Structural Equation Modeling (PLS-SEM) was used to test the proposed hypotheses.

**Findings** – The results indicated that greenwashing negatively affects GBMI, with this relationship being partially mediated by opportunism and green organizational identity.

**Originality/value** – This study underscores the urgent need for construction firms to focus on genuine environmental practices rather than greenwashing. For policymakers, the findings emphasize the importance of reinforcing regulations and enforcement to combat greenwashing and promote authentic sustainability in the construction sector.

**Keywords** Greenwashing, Green business model innovation, Green organizational identity, Opportunism, PLS-SEM

**Paper type** Research paper

## 1. Introduction

Construction firms worldwide are increasingly encouraged to adopt green business model innovation (GBMI) to address environmental challenges and meet the growing expectations of stakeholders (Lan *et al.*, 2025). GBMI enables construction firms to rethink how they create, deliver and capture value, reducing environmental impact while remaining competitive. For instance, firms may integrate sustainable materials (Nguyen, 2024), optimize energy efficiency in building designs, or implement waste reduction strategies. Such innovations contribute to global sustainability goals, help firms meet green certification standards (Hung, 2024), improve their reputations and attract environmentally conscious



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clients (Lan *et al.*, 2025). GBMI can offer tangible benefits, including long-term cost savings (Onubi *et al.*, 2020), enhanced brand image and access to new market opportunities that favor sustainable practices (Abdullah *et al.*, 2016).

However, despite these benefits, GBMI is not easy for construction firms. It often requires significant investment in new technologies (Wu and Li, 2020), changes in organizational culture (Lijauco *et al.*, 2020) and collaboration with various stakeholders across the value chain (Lloyd-walker *et al.*, 2014). Many firms face financial constraints (Abdullah *et al.*, 2016), a lack of expertise (McAdam *et al.*, 2004) or resistance to change (Tatum, 2018), making it difficult to fully implement sustainable innovations. As a result, some companies may engage in greenwashing, whether intentionally or unintentionally (Overgård *et al.*, 2022). However, greenwashing carries risks, such as reputational damage and loss of stakeholder trust (Kim and Lyon, 2015). In contrast, firms that commit to authentic GBMI may face initial challenges but can build stronger, more sustainable business models in the long run (Ziolo *et al.*, 2024).

Greenwashing may serve as a temporary strategy to satisfy market demands for sustainable development. Over time, these firms might learn, adapt and eventually succeed in genuine GBMI efforts. However, the widespread use of greenwashing (Lan *et al.*, 2025) raises significant concerns about its actual impact on the long-term success of GBMI. While greenwashing may offer short-term benefits, it risks undermining trust and delaying real innovation (He *et al.*, 2020). Despite the significance of this issue, there remains a lack of research exploring the relationship between greenwashing and GBMI. It is unclear whether greenwashing supports firms in transitioning toward successful GBMI or hinders the process.

Greenwashing is often associated with opportunism (Nygard, 2023; Wang *et al.*, 2023). Um and Kim (2018) defined opportunism as “lack of candor or honesty in transactions, to include self-interest seeking with guile”. This opportunistic behavior raises important questions about its influence on GBMI. Understanding how opportunism affects GBMI is crucial, as it may hinder or support the transition toward sustainable practices. In contrast, green organizational identity (GOI), which reflects a firm’s true environmental values and culture, is often considered a key driver of successful sustainability initiatives (Ma *et al.*, 2023). Firms with a strong GOI are more likely to engage in authentic green practices and commit to long-term environmental goals. Moreover, opportunistic firms may seek to project or acquire a green identity to satisfy stakeholder expectations. From a practical standpoint, one purpose of opportunistic behavior is to build or simulate a GOI. However, there is little understanding of these relationships. Existing research has not addressed whether opportunism and GOI ultimately support or hinder GBMI.

Thus, this study aims to clarify whether greenwashing ultimately supports or hinders GBMI development. Indeed, this study will investigate how opportunism and GOI interact within the greenwashing-GBMI relationship. It seeks to clarify whether opportunism fosters or reduces GOI and how GOI, in turn, affects GBMI success in the presence of greenwashing. By integrating organizational learning and organizational culture theories, this study advances theoretical understanding of sustainability-driven innovation. The findings offer practical insights for construction firms seeking authentic environmental transformation. In addition, the study provides policy implications for strengthening governance mechanisms against greenwashing practices in the construction sector.

## 2. Literature review and hypothesis development

### 2.1 Green business model innovation and greenwashing

Green business model innovation (GBMI) refers to the process by which companies redesign or transform their business models to integrate environmental sustainability into their core

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operations (Lan *et al.*, 2025). GBMI focuses on economic performance, minimizing environmental impacts and delivering value to society and the environment. GBMI can involve using eco-friendly materials (Nguyen, 2024), adopting energy-efficient building designs (Wang *et al.*, 2019) or incorporating green certifications such as LEED or BREEAM into projects (Thach *et al.*, 2025). GBMI can enhance brand reputation, attract new clients and open market opportunities (Prajapati *et al.*, 2024). Firms that adopt GBMI can also reduce operational costs by improving energy efficiency, minimizing waste and optimizing resource use. Moreover, adopting GBMI helps firms stay ahead of tightening environmental regulations and positions them as leaders in sustainable development (Han and Zhang, 2022). However, GBMI also presents several challenges. Implementing new technologies and processes often requires significant financial investment and organizational change (Abdullah *et al.*, 2016). Firms may face resistance from employees or stakeholders who are reluctant to shift from traditional methods (Tatum, 2018). Additionally, uncertainty about the return on investment (Yannan *et al.*, 2021) for green innovations can discourage firms from committing to these initiatives.

Due to the complexities and challenges of implementing GBMI, some firms may engage in greenwashing practices. However, some companies may unintentionally resort to greenwashing due to limited understanding or capability rather than deliberate misrepresentation. This highlights the need to interpret greenwashing as a context-dependent phenomenon rather than a uniformly deliberate act. Overgård *et al.* (2022) noted that greenwashing “is often used to describe companies claiming that their products are environmentally friendly but have no clear documentation.” Wang *et al.* (2023) argued that greenwashing is the practice of exaggerating or misrepresenting environmental efforts to appear more sustainable than they actually are (Ninan and Clegg, 2024).

Greenwashing carries serious long-term risks and negative consequences. For firms, exposure to greenwashing can lead to reputational damage, legal penalties and a loss of trust from clients, investors and the public (Kim and Lyon, 2015). Employees within these firms may also experience decreased morale and ethical conflicts, knowing that the company’s environmental claims are misleading. This can affect employee engagement, retention and organizational culture. For society, greenwashing slows real progress toward environmental sustainability. It creates a false sense of achievement, making it difficult for genuinely green firms to differentiate themselves and for consumers to make informed choices.

## 2.2 Research gaps

Although greenwashing has attracted increasing attention in sustainability research (Wang *et al.*, 2024), important knowledge gaps remain. The widespread performance of greenwashing (Wang *et al.*, 2024) raises serious concerns about its long-term influence on sustainability-oriented innovation. Prior studies (Chen *et al.*, 2022; Ferrón-Vílchez *et al.*, 2021; Nygaard, 2023) largely emphasized the negative consequences of greenwashing for stakeholder trust and corporate reputation. Scholars (Hameed *et al.*, 2021; Miller, 2017; Nygaard, 2023) argued that misleading environmental claims damage credibility once the deception is exposed. However, the existing literature rarely examines how greenwashing affects firms’ ability to pursue sustainable innovation strategies (Lan *et al.*, 2025). In particular, little empirical research examines its influence on GBMI. Most studies (Chen *et al.*, 2022; Ferrón-Vílchez *et al.*, 2021; Li *et al.*, 2024; Nygaard, 2023) viewed greenwashing as a purely harmful communication strategy without exploring its deeper organizational consequences. As a result, current knowledge provides a limited understanding of whether greenwashing hinders or indirectly shapes sustainability-driven innovation within firms.

Another gap concerns the lack of attention to the internal organizational mechanisms that link greenwashing to innovation outcomes. Current research focused on external pressures such as regulations (Sun and Zhang, 2019), stakeholder expectations (Muyang Liu *et al.*, 2024) or market demand (Kassinis *et al.*, 2022). However, internal behavioral dynamics receive less systematic examination. Greenwashing may create organizational conditions that influence employee attitudes, collaboration and innovation capabilities. Opportunism is one such behavioral mechanism that may arise in environments that tolerate misleading communication (Nygaard, 2023; Wang *et al.*, 2023). When deceptive practices become normalized, employees may prioritize self-interest over collective environmental goals. Similarly, GOI reflects the extent to which environmental values become embedded in organizational culture. A strong identity can motivate employees to support sustainability initiatives and innovation activities (Ma *et al.*, 2023). Nevertheless, existing research rarely examines how opportunism and GOI jointly shape the consequences of greenwashing. This lack of integrated analysis leaves an important theoretical gap in understanding the internal pathways connecting greenwashing and sustainable innovation.

Furthermore, empirical evidence examining these relationships in the construction sector remains very limited. Construction firms operate within complex project environments that require collaboration among multiple stakeholders (Kim and Nguyen, 2021). Sustainable innovation in this industry often depends on integrated decision-making, resource coordination and long-term environmental commitments (Nguyen, 2024). However, greenwashing may distort information flows and weaken trust among project participants. These conditions can undermine cooperation and reduce the effectiveness of sustainability initiatives (Lan *et al.*, 2025). Despite these risks, research exploring greenwashing and innovation relationships in construction organizations remains scarce. This study addresses these gaps by examining the relationship between greenwashing and GBMI in the construction sector. It investigates the mediating roles of opportunism and green organizational identity to clarify the underlying mechanisms. By integrating organizational identity theory, organizational learning theory and transaction cost economics, the study provides a more comprehensive explanation of how greenwashing shapes innovation outcomes. Consequently, the research contributes new theoretical insights and offers practical implications for promoting authentic sustainability transformation in construction firms.

### 2.3 Theoretical development

Organizational identity theory offers a strong foundation for explaining how greenwashing affects GBMI. Albert and Whetten (1985) argued that organizational identity reflects what members perceive as central, distinctive and enduring about their organization. When firms exaggerate or misrepresent environmental commitments, they create inconsistency between claimed and actual values, weakening this identity. Employees no longer view sustainability as a genuine, defining element of the organization, reducing their willingness to support green strategic changes. Organizational learning theory further explains this decline in innovation (Mu *et al.*, 2021). Learning requires accurate feedback, transparency and reflection. Greenwashing disrupts these conditions by generating distorted environmental information and masking performance gaps. As a result, firms lose opportunities for double-loop learning, limiting their capacity to rethink processes, experiment and adopt GBMI. It is hypothesized as follows:

*H1.* Greenwashing has a negative relationship with green business model innovation.

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Organizational identity theory also provides explanations for the relationship between greenwashing and GOI. [Albert and Whetten \(1985\)](#) argued that identity is formed through what organizational members perceive as central, distinctive and enduring. When a firm claims to be environmentally responsible but behaves inconsistently, employees perceive a discrepancy between espoused values and actual practices. This value–action misalignment erodes the credibility of environmental commitments, making sustainability less central to how members define “who we are” as an organization. Organizational culture theory reinforces this effect ([Ketprapakorn and Kantabutra, 2022](#)). Culture is built on shared assumptions and observable artifacts that must align over time. Greenwashing disrupts this alignment by projecting symbolic green messages while daily practices contradict them. Such inconsistency weakens shared environmental norms, reduces trust in leadership and prevents sustainability from becoming an embedded cultural element. It is hypothesized as follows:

*H2.* Greenwashing has a negative relationship with green organizational identity.

When an organization’s culture is centered around environmental values, these values influence every aspect of its operations ([Nguyen, 2022](#)). This alignment between identity and culture ensures that sustainability is not just an add-on but a core component of the business strategy. [Suto and Takehara \(2022\)](#) noted that employees in such a culture are more likely to engage in innovative activities that align with the organization’s green identity. This commitment to sustainability leads to the development of new business models that integrate environmental considerations. It also fosters innovation that meets market demands and contributes to long-term ecological goals. Furthermore, a GOI fosters an environment that encourages and rewards sustainable innovation. This work environment encourages employees to think creatively about how to make the business more sustainable. Thus, it leads to product, process and service innovations that reflect the organization’s environmental commitment. It is hypothesized as follows:

*H3.* Green organizational identity has a positive relationship with green business model innovation.

Transaction Cost Economics (TCE) provides a strong theoretical basis for understanding the relationship between greenwashing and opportunism. [Williamson \(1989\)](#) defined opportunism as self-interest seeking with guile, which includes deception, withholding information and exploiting information asymmetries. Greenwashing is itself a form of strategic misrepresentation. Such behavior signals that the organization tolerates information manipulation and weak monitoring. When employees observe this pattern, they infer that the organization allows or rewards behavior that exploits informational gaps. This reduces internal trust and increases incentives for individuals to act opportunistically ([Nguyen, 2022](#)). Members also learn that environmental commitments are symbolic rather than real, encouraging private gains over collective goals. Therefore, greenwashing establishes a context in which deceit becomes normalized and opportunistic behavior becomes more likely. It is hypothesized as follows:

*H4.* Greenwashing has a negative relationship with opportunism.

TCE also explains how opportunism affects GBMI. Innovation requires cooperation, transparent information exchange and a willingness to share risks. However, [Williamson \(1989\)](#) argued that opportunism increases transaction costs by prompting parties to protect themselves against deceit, monitor others and avoid risky collaborations. In an organization

with high opportunism, employees focus on safeguarding personal interests rather than supporting long-term innovative initiatives. GBMI depends on cross-functional learning and integrated decision-making. Opportunism weakens these conditions by leading individuals to hoard information, avoid collaboration and prioritize short-term gains. Such behaviors reduce the organization's ability to coordinate green initiatives, explore environmental opportunities and scale sustainable practices. It is hypothesized as follows:

*H5. Opportunism has a negative relationship with green business model innovation.*

[Williamson \(1989\)](#) emphasized that opportunistic environments create pervasive uncertainty because actors cannot rely on stated intentions. When employees act opportunistically, they undermine the authenticity of the organization's environmental commitments. Members perceive that green signals are easily manipulated for personal advantage and are not anchored in genuine environmental values. This reduces confidence that sustainability is central, distinctive and enduring within the organization. As credibility declines, employees detach from the green identity because they no longer believe environmental values are sincerely upheld. Opportunism, therefore, creates identity inconsistency, where the organization's actions conflict with its stated green purpose. This erodes shared meaning around sustainability and weakens the collective belief that the organization is green. These mechanisms provide firm theoretical grounding for *H6*. It is hypothesized as follows:

*H6. Opportunism has a negative relationship with GOI.*

Opportunism can serve as an essential mechanism linking greenwashing and GBMI. Greenwashing signals a tolerance for misleading communication, normalizing deceptive behavior within the organization. This environment encourages employees to prioritize short-term self-interest, consistent with [Williamson \(1989\)](#)'s view of opportunism as self-interest seeking with guile. When opportunism rises, cooperation, information sharing and joint problem-solving decline ([Nguyen, 2022](#)). These behaviors are essential for developing GBMI, which depends on cross-functional collaboration and a shared commitment to environmental goals. As a result, greenwashing indirectly reduces innovative capacity by fostering opportunistic actions that undermine collective green efforts. Moreover, greenwashing may also exert a direct adverse effect on GBMI (*H1*). Therefore, it is hypothesized as follows:

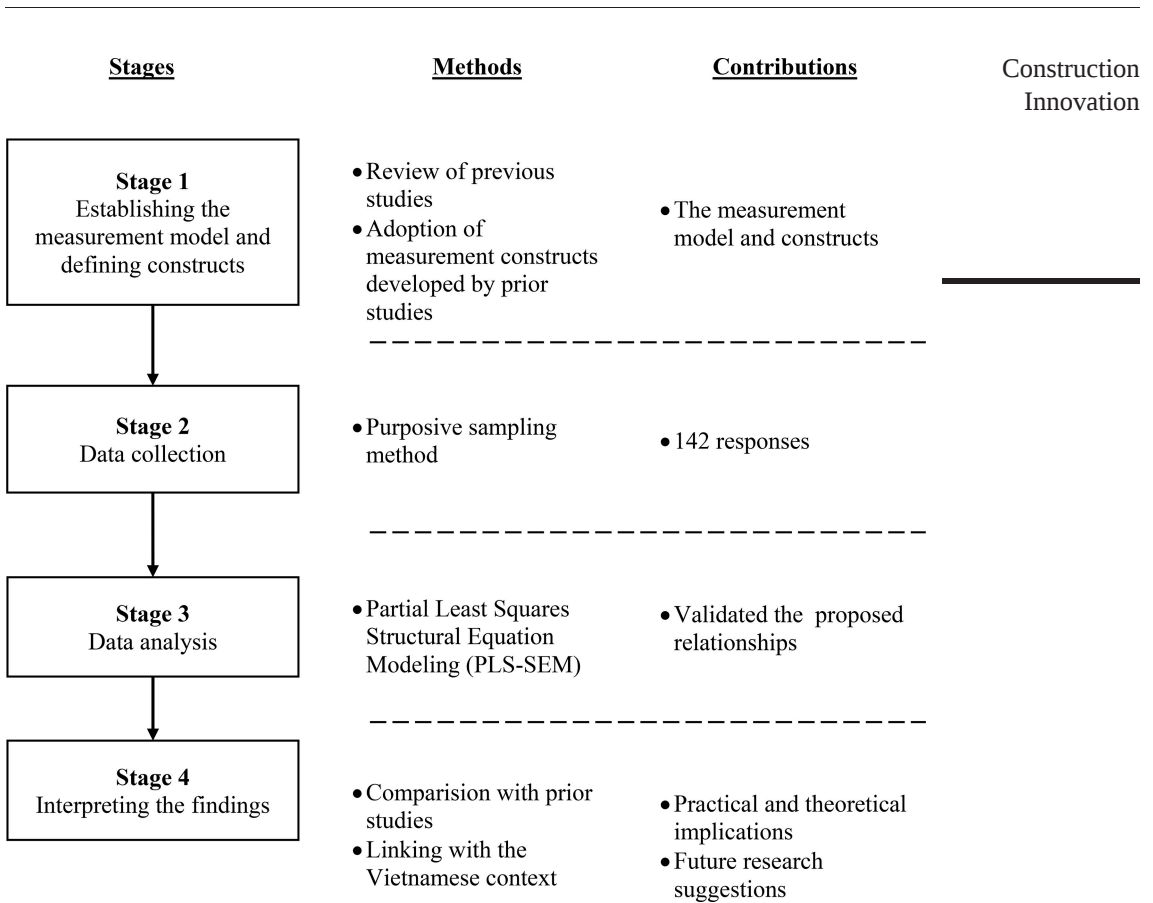
*H7. Opportunism mediates the relationship between greenwashing and GBMI.*

GOI can function as a key mechanism linking greenwashing and GBMI. When firms engage in greenwashing, employees perceive inconsistencies between stated commitments and actual behaviors. These inconsistencies weaken shared environmental beliefs and reduce confidence in the organization's green purpose. As this identity erosion grows, employees become less motivated to support green-oriented initiatives. Reduced identification with environmental values also limits their willingness to contribute to new ideas or collaborative efforts that drive GBMI. Moreover, greenwashing may still exert a direct negative influence on GBMI (*H1*). It is hypothesized that:

*H8. GOI mediates the relationship between greenwashing and GBMI.*

### **3. Research methodology**

A methodological framework is presented in [Figure 1](#). The figure outlines four main stages of the research process:



**Figure 1.** Research plan  
**Source:** Authors' own work

- (1) establishing measurement constructs;
- (2) data collection through purposive sampling;
- (3) data analysis using Partial Least Squares Structural Equation Modeling (PLS-SEM); and
- (4) interpretation of findings.

### 3.1 Stage 1: establishing measurement constructs

The measurement constructs used in this study were adopted from well-established scales in prior literature. This decision was made to ensure conceptual clarity and measurement reliability. These constructs have been previously validated in sustainability and organizational research contexts. Using established scales allows the study to build upon recognized theoretical foundations (Nguyen *et al.*, 2025b). It also improves comparability between findings and previous empirical studies. Developing entirely new constructs could

introduce measurement uncertainty and require extensive validation procedures (Um and Kim, 2018). Therefore, adopting validated instruments strengthens the methodological rigor of the research. This approach has also been widely used in many empirical studies examining sustainability and organizational behavior. Many researchers (Lai *et al.*, 2016; Nguyen *et al.*, 2025b; Um and Kim, 2018) rely on validated constructs to ensure consistency and robustness in data analysis. Additionally, minor wording adjustments were made to reflect the Vietnamese construction context.

In this study, the seven-item scale established by Le and Mohiuddin (2024) was adapted to measure GBMI. Examples of measurement constructs include: “Our business model provides creative offerings through the combination of products and services to improve operational efficiency,” “Our business model actively involves stakeholders (e.g. owners, suppliers, subcontractors) in transactions to enhance efficiency,” “Our business model ensures fair access to project information and opportunities for all relevant parties.”

Moreover, the measurement scale developed by Ferrón-Vílchez *et al.* (2021) was used to measure greenwashing, with four items such as “My company provides vague or seemingly unprovable environmental claims about its environmental performance,” “My company presents a confusing message (using certain words and images) about its environmental behavior,” “My company overstates or exaggerates its environmental behavior,” “My company omits or hides important information about its real environmental behavior.”

Consistent with Nguyen (2022a), this study measured opportunism with five items, which are “On occasion, we lie about certain things to protect our interests,” “We do not always act by our contracts or agreements,” “We sometimes promise to do things without actually doing them later,” “We sometimes take advantage of holes in our contracts or agreements to further our interests,” “We sometimes use unexpected events to extract concessions from the other parties.”

Finally, green organizational identity (GOI) was measured using a six-item scale developed by Chen (2011). The items included “My company has strong records about environmental management and protection,” “We are proud of the company’s environmental goals and missions,” “My company has carved out a significant position concerning environmental management and protection,” “My company has formulated a well-defined set of environmental goals and missions,” “We are knowledgeable about the company’s environmental traditions and cultures,” “We identify strongly with the company’s actions concerning environmental management and protection.”

### 3.2 Stage 2: data collection

Based on the above measurement constructs, a questionnaire was developed. Survey methods are widely used in organizational and management research to collect perceptual and behavioral data from practitioners. This approach is particularly suitable for examining latent constructs such as greenwashing, opportunism and organizational identity, which cannot be directly observed (Um and Kim, 2018). Previous studies recommended questionnaire surveys as an effective method for measuring attitudes, perceptions and organizational practices (Nguyen, 2024; Thach *et al.*, 2025; Um and Kim, 2018). In addition, survey-based approaches are commonly applied in construction management and sustainability research to investigate relationships among organizational variables (Kim and Nguyen, 2021; Nishitani *et al.*, 2021). Therefore, a questionnaire survey was considered an appropriate method for achieving the study’s research objectives.

The survey questionnaire was organized into six distinct sections. The initial section outlined the research’s purpose and provided contact information for further inquiries. Section 2 aimed to collect background information on the participants, including their

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company affiliations, job roles and industry experience. In Section 3, participants evaluated various aspects related to greenwashing. The subsequent sections focused on collecting ratings for opportunism, GOI and GBMI. Within these sections, respondents were asked to express their level of agreement with each measurement item (greenwashing, opportunism, GOI and GBMI) with five options:

- (1) strongly disagree;
- (2) disagree;
- (3) neutral;
- (4) agree; and
- (5) strongly agree.

The [Appendix](#) presents the questionnaire survey.

The questionnaire was validated through discussions with three experienced Vietnamese construction practitioners. The participants included a construction firm director, an HR manager and a business development manager from different companies. Their feedback ensured the questionnaire items were clear, contextually relevant and aligned with the operational realities of Vietnamese construction firms. This process helped refine the wording and focus of the questions in the Vietnamese context.

The required sample size was determined before administering the questionnaire. Previous studies offered guidance on determining an adequate sample for survey studies. For example, [Kyriazos \(2018\)](#) summarized a common recommendation of securing at least 5 participants per measurement item. With 22 measurement items, this guideline implies a minimum of about 110 respondents. [Sapnas and Zeller \(2002\)](#) further argued that samples below 50 are insufficient, around 50 may be marginal and 100 or more are generally acceptable for robust analysis, while very large samples may be unnecessary. These benchmarks support the justification of the chosen sample size for this study.

A purposive sampling method was employed. Purposive sampling is appropriate for obtaining a representative sample when random selection is impractical ([Kim et al., 2020](#)). This approach allows participants to be selected based on specific criteria, such as their willingness to participate, rather than by random choice. It is appropriate when the research needs participants who meet defined criteria rather than a random population. Purposive sampling helps improve data quality because selected respondents have direct experience with greenwashing and sustainability practices. Many surveys in construction management face low response rates, so purposive sampling helps target individuals who are more willing to participate. This approach strengthens the relevance, accuracy and practical value of the findings. To ensure the relevance and quality of the data collected, participants were required to meet the following conditions:

- Respondents had to work in the Vietnamese construction industry at the time of the survey.
- At least three years of professional experience in the construction sector were required.
- Participants needed direct knowledge of their organization's internal processes, particularly project management, procurement, environmental practices, or sustainability strategies. A screening question was applied to confirm this: "Are you directly involved in or knowledgeable about your organization's environmental initiatives, project operations, or decision-making processes?" Only respondents answering "Yes" were included.

- All respondents were required to hold at least a bachelor's degree in construction-related fields.

The questionnaires were initially distributed to respondents with a work or personal connection with the researchers. The researchers then requested these respondents to refer others who met the predefined criteria to participate in the study. Finally, 360 questionnaires were distributed in person to construction professionals in Vietnam, resulting in 156 completed responses. The collected surveys were thoroughly examined, excluding three questionnaires due to substantial non-responses and 11 questionnaires with identical answers. As a result, data from 142 practitioners were included for further analysis.

The respondents in the study had diverse backgrounds in terms of experience, job roles, education and organizational affiliation. Regarding work experience, 18.3% had 3–5 years, 47.2% had 6–10 years, 26.8% had 11–15 years and 7.7% had over 15 years. Job titles among the respondents included 9.2% managers, 7.7% team leaders, 68.3% senior staff and 14.8% junior staff. Educationally, the majority (89.4%) held a bachelor's degree, while 10.6% had a master's degree. The respondents were employed across various organizational types: 58.5% worked for contractors, 22.5% for consulting firms, 10.6% were owners and 8.5% were in government-owned construction companies. This varied respondent profile offers a comprehensive range of perspectives from different roles, experience levels and educational backgrounds within the industry.

### 3.3 Stage 3: Partial Least Squares Structural Equation Modeling

PLS-SEM is a multivariate analysis technique widely used for assessing complex relationships between observed and latent variables (Mu and Lee, 2023). Unlike traditional regression techniques, PLS-SEM can handle complex models with multiple independent and dependent variables, making it highly applicable across various research fields, including strategic management and marketing (Le and Mohiuddin, 2024). PLS-SEM is particularly suitable for exploratory studies aimed at building theory, as it does not require data to meet strict distributional assumptions. It is also advantageous when sample sizes are small, as it uses partial least squares to estimate path models, making it robust to violations of normality (Ma et al., 2023).

In this study, PLS-SEM is an appropriate tool for several reasons. First, the data set includes 142 responses. PLS-SEM is well-suited for small sample sizes, unlike covariance-based SEM, which requires larger samples and normally distributed data (Ma et al., 2023). Second, the study's statistical model consists of four composite variables, a structure that PLS-SEM can efficiently model by allowing latent and directly measurable variables (Le and Mohiuddin, 2024). Third, the research aims to build a theory and examine complex relationships, including two mediating variables (i.e. opportunism and GOI), making PLS-SEM an ideal method.

The analysis follows a two-step approach. In the first step, the measurement model is evaluated to ensure the reliability and validity of the items. In the second step, the structural model is assessed by analyzing the significance of path coefficients and the determination coefficient ( $R^2$ ). This approach uses Smart PLS software to provide comprehensive insights into the relationships between variables in this study.

## 4. Data analysis and results

### 4.1 Measurement model

To examine the possibility of common-method bias, a single-factor confirmatory factor analysis was conducted. The one-factor solution exhibited a poor model fit ( $\chi^2 = 2551.77$ ;

$df = 209$ ;  $\chi^2/df = 12.21$ ;  $GFI = 0.289$ ;  $CFI = 0.448$ ;  $TLI = 0.390$ ), indicating that the data do not fit a unidimensional structure (Phungsoonthorn and Charoensukmongkol, 2020). In addition, an exploratory factor analysis with varimax rotation indicated that no dominant factor accounted for more than half of the total variance (Nguyen *et al.*, 2025c). The questionnaire design also incorporated procedural remedies, including placing items for independent and dependent constructs in separate sections to reduce method-related influences (Phungsoonthorn and Charoensukmongkol, 2020). These findings provide strong assurance that common method bias did not substantially affect the study's results.

Factor analysis was then conducted to ensure construct unidimensionality, with a general rule that items with loadings below 0.5 were excluded from further analysis (Hair *et al.*, 2014). As shown in Table 1, the items intended to measure the respective constructs had loadings above 0.5. Additionally, all constructs demonstrated high internal consistency, with Cronbach's alphas exceeding 0.6 (Kim *et al.*, 2020).

The following step used PLS-SEM to evaluate the measurement model's validity and reliability. Reliability refers to the consistency of measurement results, while validity reflects how accurately variables represent their intended constructs. Following Ma *et al.* (2023) recommendation, composite reliability (CR) coefficients should exceed 0.70. In this study, the CRs for all constructs were satisfactory, ranging from 0.79 to 0.91 (Table 1). Convergent validity was assessed using the average variance extracted (AVE), which should be above 0.5 (Fornell and Larcker, 1981). This indicates that the variance explained by the construct

**Table 1.** Measurement of validity and reliability

Variables	Loading	Cronbach's alpha	CR	AVE
Greenwashing		0.953	0.879	0.645
GBMI1	0.795			
GBMI2	0.819			
GBMI3	0.815			
GBMI4	0.784			
Opportunism		0.973	0.864	0.787
OPP1	0.858			
OPP2	0.889			
OPP3	0.892			
OPP4	0.897			
OPP5	0.900			
Green organizational identity		0.948	0.949	0.756
GOI1	0.885			
GOI2	0.877			
GOI3	0.898			
GOI4	0.900			
GOI5	0.837			
GOI6	0.818			
Green business model innovation		0.977	0.898	0.792
GBMI1	0.901			
GBMI2	0.922			
GBMI3	0.913			
GBMI4	0.909			
GBMI5	0.904			
GBMI6	0.858			
GBMI7	0.817			

**Source(s):** Authors' own work

exceeds the measurement error. All constructs had AVE values above 0.5 (Table 1), confirming their convergent validity. Additionally, discriminant validity was established, as the square roots of the AVEs exceeded the off-diagonal correlations. In Table 2, the bold diagonal values represent each construct's square root of its AVE.

In contrast, the off-diagonal elements indicate the correlation coefficients between the constructs. The square roots of the AVEs range from 0.803–0.890, confirming that each construct shares more variance with its indicators than with other constructs. The Fornell–Larcker criterion requires that the square root of each construct's AVE be greater than its correlations with any other constructs in the model (Rahi et al., 2022). Thus, the measurement model's discriminant validity is supported.

4.2 Structural model

The structural model was assessed by examining the coefficient of determination ( $R^2$ ), effect size ( $f^2$ ) and predictive relevance ( $Q^2$ ). The evaluation results are detailed in Table 3 and illustrated in Figures 2 and 3.

The  $R^2$  and  $Q^2$  values were first evaluated. According to Cohen and Arieli (2011),  $R^2$  values are considered substantial at 0.26, moderate at 0.13 and weak at 0.02. Therefore, the  $R^2$  value of 0.338 observed in this study is considered significant, indicating that the model explains 33.8% of the variance in GBMI. A substantial  $R^2$  value was also seen ( $R^2 = 0.477$ ) with opportunism. Moreover, a moderate  $R^2$  value of GOI (0.104) was noticed. After that, the  $Q^2$  value of 0.294 indicated that the model had satisfactory predictive relevance, as it was significantly greater than zero.

Additionally, the explained variance was evaluated using the effect size ( $f^2$ ). According to Nguyen et al. (2024), effect sizes of 0.02, 0.15 and 0.35 are considered small, medium and large, respectively. In this study, greenwashing demonstrated a small impact on GBMI and GOI, with effect sizes of 0.049 and 0.087, respectively. Similarly, opportunism had a small effect ( $f^2 = 0.042$ ) on GBMI. In contrast, greenwashing had a strong effect on opportunism, with an effect size of 0.911.

Table 3 illustrates that all proposed hypotheses were supported except  $H6$ . The results indicated that greenwashing negatively impacts GBMI ( $H1$ ) and GOI ( $H2$ ), with path coefficients of  $-0.259$  and  $-0.322$ , respectively. Similarly, opportunism negatively affects GBMI ( $H5$ ), evidenced by a path coefficient of  $-0.231$ . In contrast, the positive relationships between GOI and GBMI (path coefficient =  $0.264$ ) and between greenwashing and opportunism (path coefficient =  $0.691$ ) are statistically significant ( $p < 0.01$ ), thereby supporting  $H3$  and  $H4$ . In contrast, the greenwashing - GOI relationship is not supported ( $p > 0.05$ ). In addition, the results show that  $H7$  and  $H8$  were supported. The indirect effects

**Table 2.** Discriminant validity (Fornell–Larcker criterion)

Construct	Greenwashing	Opportunism	Green organizational identity	Green business model innovation
Greenwashing	<i>0.803</i>			
Opportunism	0.691	<i>0.887</i>		
Green organizational identity	0.317	0.17	<i>0.870</i>	
Green business model innovation	0.503	0.456	0.378	<i>0.890</i>

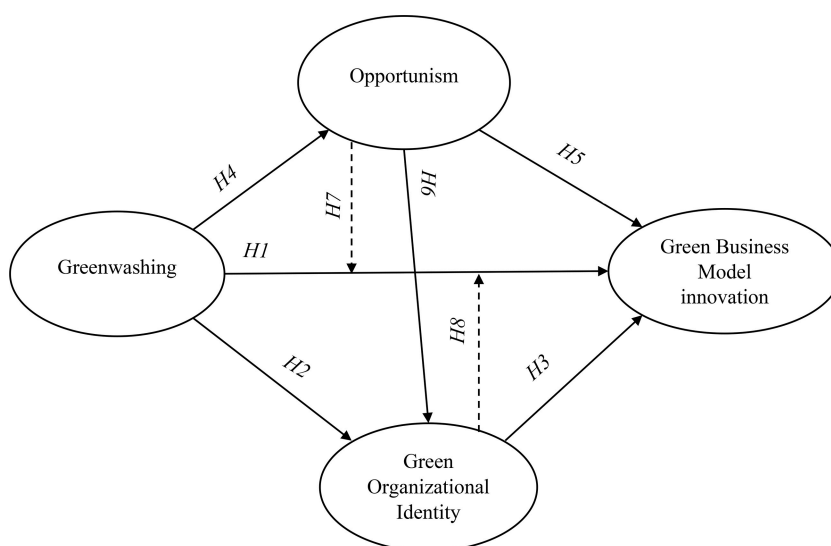
**Note(s):** Italic values provide the square root of AVE values

**Source(s):** Authors' own work

**Table 3.** Results of PLS-SEM

No.	Relationship	Path coefficient	p-value	Effect size (f2)	Result
H1	Greenwashing → GBMI	-0.259	$p < 0.01$	0.049	Supported
H2	Greenwashing → GOI	-0.322	$p < 0.01$	0.087	Supported
H3	GOI → GBMI	0.264	$p < 0.01$	0.094	Supported
H4	Greenwashing → opportunism	0.691	$p < 0.01$	0.911	Supported
H5	Opportunism → GBMI	-0.231	$p < 0.01$	0.042	Supported
H6	Opportunism → GOI	0.091	$p = 0.335$	0.005	Not supported
H7	Greenwashing → opportunism → GBMI	-0.160	$p = 0.014$	-	Supported
H8	Greenwashing → GOI → GBMI	-0.102	$p < 0.01$	-	Supported

Source(s): Authors' own work



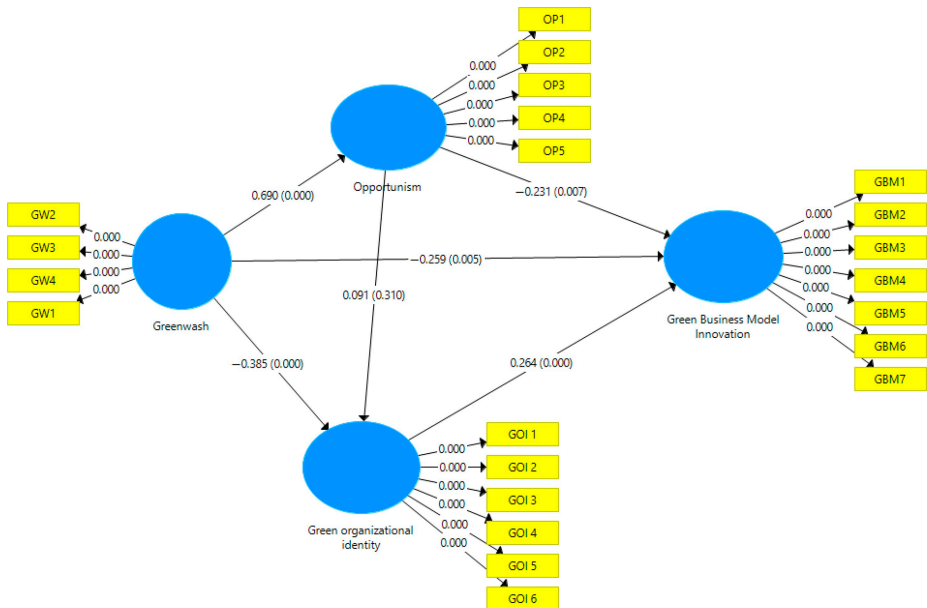
**Figure 2.** Proposed hypothesis  
Source: Authors' own work

through opportunism (H7; path coefficient = -0.160) and green organizational identity (H8; path coefficient = -0.102) were significant, confirming that both constructs mediate the relationship between greenwashing and GBMI. These findings indicate partial mediation in both pathways, as the direct effect of greenwashing on GBMI remained significant.

## 5. Discussions and implications

### 5.1 Comparisons with previous studies

Consistent with Nygaard's (2023) work, this study confirms that greenwashing erodes the company's commitment to sustainability. The findings also support Miller's (2017) observation that greenwashing can divert valuable resources from crucial long-term investments in sustainable technologies and processes. Miller (2017) argued that the firms that implement them may risk themselves in a culture that prizes public perception over



**Figure 3.** PLS-SEM findings  
**Source:** Authors' own work

deep-rooted change. Furthermore, this study bolsters [Hameed et al. \(2021\)](#) findings on the detrimental impact of greenwashing on stakeholder trust. The study of [Hameed et al. \(2021\)](#) revealed that greenwashing organizations may face long-term disadvantages in retaining customer loyalty and achieving sustainable growth. Similarly, the findings support [Miao et al. \(2023\)](#) research, which highlighted the skepticism that greenwashing can generate among employees, ultimately hindering the adoption of genuine green innovations.

The finding also clarifies [Wang et al.'s \(2023\)](#) study regarding the role of opportunism in undermining business model innovation. This study enriches [Wang et al.'s \(2023\)](#) finding by showing that such opportunism further hampers GBMI. This study highlighted the role of opportunism as a mediator in the negative relationship between greenwashing and GBMI. The findings contribute to [Soewarno et al.'s \(2019\)](#) discussion surrounding the influence of corporate identity on environmental strategies. [Soewarno et al. \(2019\)](#) posited that a strong GOI is essential for fostering innovation and sustaining competitive advantage in eco-friendly business practices. This study extends [Soewarno et al. \(2019\)](#) by demonstrating that greenwashing adversely affects GOI, which in turn mediates the relationship between greenwashing and GBMI. Additionally, this study interprets the findings of [Kumar and Kumar \(2013\)](#) in the context of construction. [Kumar and Kumar \(2013\)](#) contended that organizations that employ deceptive marketing tactics ultimately pay a high price for competitive advantage. This study clarifies [Kumar and Kumar's \(2013\)](#) research by demonstrating that greenwashing hinders the success of GBMI by hindering GOI and increasing opportunism.

### 5.2 Theoretical and practical discussions

The findings reinforce that greenwashing weakens a firm's ability to pursue green business model innovation. The supported relationship for *H1* confirms that Organizational Identity

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Theory and Organizational Learning Theory successfully explain this outcome. In construction firms, greenwashing creates a visible gap between public claims and operational actions. This gap undermines identity coherence and reduces employee belief in environmental commitments. As identity becomes unstable, firms struggle to build shared motivation for innovation. The supported mediation through green organizational identity (*H8*) further validates that weakened identity is a significant pathway linking greenwashing and GBMI. Greenwashing reduces transparency and impedes internal learning, making it difficult for construction firms to assess performance gaps or adopt sustainable practices. The significant mediation through opportunism (*H7*) confirms that learning is disrupted when employees prioritize self-interest over collective improvement.

The supported relationship between greenwashing and green organizational identity (*H2*) shows that Organizational Identity Theory and Organizational Culture Theory jointly capture the mechanism behind this decline. In construction firms, employees depend on consistent signals to interpret environmental values. Greenwashing breaks this consistency, reducing trust in leadership and weakening cultural commitment to sustainability. The results confirm that a damaged identity does not remain isolated but directly influences innovation capacity. The mediation effect (*H8*) validates the central role of identity in sustaining collaborative green practices. Construction firms require a strong internal culture to manage complex resources, coordinate teams and integrate sustainable materials or technologies. However, greenwashing disrupts these cultural foundations, making green initiatives appear symbolic rather than authentic. This discourages employee participation and reduces support for long-term sustainability strategies. The empirical results, therefore, confirm that weakened identity and culture are key channels through which greenwashing suppresses GBMI in the construction sector.

The supported findings for *H4*, *H5* and *H7* also demonstrate the strong relevance of Transaction Cost Economics to construction firms. The significant link between greenwashing and opportunism (*H4*) indicates that deceptive communication increases information asymmetry. In construction projects, where coordination and trust are essential, such asymmetry can foster opportunistic behavior. The negative link between opportunism and GBMI (*H5*) confirms that increased transaction costs hinder collaboration, slow decision-making and reduce willingness to invest in green innovations. The mediation effect (*H7*) provides further validation, showing that opportunism is a key behavioral mechanism through which greenwashing harms innovation outcomes. Construction firms rely on integrated project teams to adopt green technologies, improve resource efficiency and meet environmental standards. Opportunism disrupts this collaboration and shifts focus toward short-term benefits.

The findings revealed that the relationship between opportunism and GOI (*H6*) was not supported within the Vietnamese construction context. The findings may be attributed to Vietnamese construction firms' unique cultural and structural characteristics. Vietnamese construction organizations often operate within a highly hierarchical culture, where decisions and strategic directions are predominantly driven by top management (Nguyen *et al.*, 2025a). Thus, employees have limited influence over organizational identity formation. Therefore, employees may be passive, feeling disempowered to critique or internalize organizational values. This top-down dynamic reduces the likelihood that employees will engage critically with environmental narratives. Moreover, in the construction industry, environmental practices may be viewed more as compliance-driven or marketing-oriented initiatives (Loosemore *et al.*, 2018). As a result, employees are not deeply connected to or responsible for shaping green identity elements. This detachment from the identity-forming process may explain why opportunism does not have a measurable

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effect on GOI in this context. Thus, the non-significant relationship underscores the importance of considering cultural and structural factors when examining how internal behaviors influence identity formation.

The rejection of *H6* can also be explained through institutional theory. Institutional theory explains how organizations respond to external pressures from regulatory, normative and cultural institutions (Tijani *et al.*, 2024). In the Vietnamese construction context, green practices are often implemented not because of internal values but to conform to external demands. These may include government regulations, expectations from international partners, or industry norms. This reflects coercive isomorphism, where organizations adopt certain behaviors to gain legitimacy or access vital resources (Tijani *et al.*, 2024). As a result, green initiatives are often symbolic and driven by compliance, rather than genuine environmental commitment. Employees may recognize this and view environmental actions as formalities. Therefore, when opportunism occurs, it does not strongly influence employees' perceptions of the organization's green identity. These findings suggest that signaling theory may not apply well in this context. Instead, institutional theory provides a more suitable lens for interpreting employee perceptions and organizational identity.

Information collected from discussions with three industry practitioners during the questionnaire validation process is integrated into this section to illustrate how the findings apply to real-world business scenarios. One practitioner shared a case where a construction firm promoted itself as highly experienced in delivering green-certified projects. Despite submitting a higher bid than competitors, the contractor was awarded the project based on its expertise in sustainable construction. The project owner leveraged the contractor's reputation to market the project. However, during construction, the contractor used low-cost, non-sustainable materials that did not meet the promised green standards. Over time, several issues began to surface after the building was put into use. For example, poor ventilation performance and water leakage from balconies into living areas were reported. These problems led to customer complaints directed at the project owner. As a result, the developer's credibility was seriously damaged, as buyers questioned the integrity of the green claims and the quality of construction.

Another case was discussed, illustrating how greenwashing behavior severely damaged stakeholder collaboration. To win a contract for a project, a contractor partnered with a consulting firm to provide emission testing services. During project execution, the contractor pressured the consultant to skip material sampling for specific construction inputs (i.e. insulation and coating materials). However, the contractor required a consulting firm to issue test reports that confirmed compliance with green standards. Despite initial resistance, the consulting firm reluctantly agreed to the arrangement under pressure from both the contractor and the project owner. This situation placed the consulting firm in an ethical dilemma, forcing it to compromise professional standards to maintain the relationship. After the project ended, the consulting firm chose to distance itself from the contractor and the client, refusing to participate in future collaborations.

Another practitioner reported that one firm publicly promoted its commitment to community engagement and safety programs. However, employees recognized these claims were overstated, as funding for the promoted initiatives had been significantly reduced or quietly discontinued. Some safety programs were still listed on the company's website, even though they had been canceled long ago. The gap between external messaging and internal practices became increasingly evident, leading to visible signs of lowered morale. Employees showed less interest in participating in sustainability programs, hesitated to contribute ideas related to green improvements and expressed growing skepticism toward the firm's environmental agenda.

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As trust in leadership declined, aligning employees in this company with green goals became increasingly difficult. For example, when the company organized a volunteer activity to support a local environmental cleanup, only a few employees registered despite prior high participation in similar events. In another case, when a new green procurement policy was introduced to encourage staff to propose adopting sustainable materials, employees remained silent during meetings or submitted minimal input. Some openly questioned whether the policy would be implemented or quietly dropped, as with previous initiatives. These examples show that employees no longer believed their contributions would be valued or acted upon, making it harder for the organization to generate internal momentum toward green business transformation. Without a strong GOI, the firm's ability to implement GBMI was weakened.

### 5.3 Understanding the findings in the Vietnamese context

The specific context of Vietnam is crucial to understanding these findings. The concept of “face” (or “*uy tín*” in Vietnamese) is deeply ingrained in Vietnamese culture (Leshkovich, 2006). It represents an individual's or organization's social standing, reputation and honor. This cultural emphasis on the face can explain the prevalence of greenwashing in Vietnamese construction firms in several ways. Companies may engage in greenwashing to project an image of environmental responsibility, thereby enhancing their “face” in the eyes of other stakeholders (i.e. clients, partners and the government). Demonstrating green credentials can be seen as a way to gain a competitive advantage and maintain social standing. In Vietnam, reputation is paramount. Thus, the pressure to appear environmentally conscious can be immense. This pressure can lead companies to prioritize the appearance of greenness over genuine sustainable practices.

However, the concept of “face” also presents a potential constraint on greenwashing. While companies may initially engage in greenwashing to enhance their image, the risk of exposure can lead to a significant loss of “face.” This fear of reputational damage can act as a deterrent, particularly as public awareness of greenwashing increases in Vietnam. Furthermore, employees who value their “face” and reputation may be reluctant to work for companies known for greenwashing, as it could negatively affect their standing. This can lead to difficulties in attracting and retaining talent, particularly among younger generations who are increasingly environmentally conscious. Therefore, while the desire to maintain “face” can initially drive greenwashing, the fear of losing it can eventually counterforce, encouraging genuine commitment to sustainability.

Vietnam is a rapidly developing middle-income country (News, 2023). Over the past few decades, there has been a significant increase in social awareness regarding environmental issues (Kim *et al.*, 2020). Vietnamese consumers, NGOs and the government are becoming more discerning and critical of corporate environmental claims. Therefore, this growing awareness makes greenwashing less effective and riskier. Consumers are more likely to scrutinize environmental claims (Vietnam, 2024) and are less tolerant of companies that are perceived to be greenwashing (Nishitani *et al.*, 2021). This evolving social landscape explains why this research found that greenwashing is negatively impacting GBMI. As society becomes more aware, companies that engage in greenwashing are likely to face reputational damage, legal challenges and reduced consumer trust, ultimately hindering their ability to innovate genuinely in a sustainable direction.

The socio-economic context of Vietnam also plays a role. The average salary for construction engineers in Vietnam (TopCV, 2025) is relatively low compared to developed countries (Park *et al.*, 2021). This economic reality can create an environment where opportunism is more likely to flourish. When opportunities for personal gain arise,

individuals may be more tempted to seize them. In the context of greenwashing, this can manifest in employees prioritizing short-term gains from deceptive practices over genuine efforts to implement green innovations. Companies engaging in greenwashing can create a culture where such opportunistic behavior is normalized and rewarded, further hindering genuine GBMI. The pressure to meet project deadlines and maximize profits in a competitive market can also contribute to this tendency toward opportunism.

Moreover, the Vietnamese Government has been increasingly promoting green building practices. Initiatives such as the LOTUS certification system and the adoption of LEED standards demonstrate a growing commitment to environmental sustainability within the construction sector. The fact that over 500 projects in Vietnam are green-certified indicates the increasing importance of green building (Hung, 2024). This regulatory push and increasing consumer demand for green buildings create opportunities and challenges for construction firms.

On the one hand, it incentivizes companies to adopt more sustainable practices (Pizzetti *et al.*, 2019). On the other hand, it also creates an environment where companies may be tempted to engage in greenwashing to capitalize on the growing demand without making genuine changes. While necessary, the increasing stringency of environmental regulations can inadvertently pressure companies to appear compliant, even if they lack the resources or commitment to truly embrace sustainability. This can lead companies to prioritize meeting regulatory requirements on paper rather than implementing meaningful operational changes. Therefore, while positive overall, the government's push for green building must be accompanied by strong enforcement mechanisms and public awareness campaigns to prevent greenwashing and encourage genuine GBMI.

#### 5.4 Theoretical implications

This study theoretically explains how greenwashing disrupts the advancement of GBMI. From the organizational learning perspective, the findings highlight that greenwashing obstructs a firm's ability to acquire and apply critical environmental knowledge. By prioritizing superficial "green" claims, companies forego genuine opportunities to learn from real-world practices or stakeholder feedback. This aligns with prior research that underscores the role of accurate feedback loops in stimulating organizational improvements. However, the results extend these insights by showing that deceptive practices diminish the utility of feedback and shape a misplaced perception of success.

From a cultural perspective, this study reveals that greenwashing fosters an environment in which public image is prioritized over authentic alignment with environmental values. Such a culture weakens the GOI because stakeholders observe inconsistencies between stated environmental commitments and actual behavior. The disconnect undermines key elements for successful GBMI, such as trust, collaboration and creative thinking. Thus, the findings add depth to organizational culture theory by suggesting that opportunistic mindsets do more than raise ethical concerns. They systematically derail the mission-driven ethos necessary for holistic sustainability transformation.

Moreover, by demonstrating that opportunism partially mediates the effect of greenwashing on GBMI, this study clarifies a previously underexplored link between deceptive environmental communication and the stifling of innovation. While opportunism often serves short-term goals, it restrains the long-term orientation critical for sustainability-driven innovation. Thus, greenwashing shapes an organizational climate where employees become reluctant to participate in green initiatives.

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### 5.5 Practical implications

The findings suggest that greenwashing risks eroding employee trust, weakening GOI and discouraging the collaborative innovation needed to remain competitive in the Vietnamese construction industry. Thus, Vietnamese construction firms should invest in authentic green initiatives. This can include adopting renewable energy solutions, integrating green materials into design processes and adopting modular or lean construction techniques that reduce waste. Building a robust green organizational identity, anchored in transparent actions, ensures better alignment between management and employees. Internally, this might involve establishing clear sustainability goals, providing relevant staff training and communicating progress transparently. Externally, engaging with stakeholders and forming partnerships with sustainable suppliers or energy providers can reinforce real green credentials.

Moreover, this study underscores the need for stronger regulatory frameworks and more rigorous enforcement in Vietnam's construction sector. Policymakers should consider tightening disclosure requirements around environmental initiatives. This might include compulsory and standardized sustainability reporting, third-party audits for large-scale projects and the creation of public databases to track companies' actual environmental performance. Such measures would discourage deceptive green claims and provide valuable data for shaping future policy.

Moreover, government agencies can foster innovation by incentivizing genuine sustainability efforts. This could involve offering tax breaks, subsidies or streamlined permissions for projects that meet stringent environmental criteria. Encouraging robust collaborations between universities, research institutes and construction enterprises may also further collective knowledge sharing. Coupled with policy support for training and development in green technologies, such measures help ensure that the entire ecosystem (i.e. education, industry and government) pushes the sector toward authentic GBMI.

## 6. Conclusions

GBMI is vital for sustainable development in the construction industry. Despite its importance, several obstacles impede this initiative. This study's findings reveal that greenwashing and opportunism pose significant challenges to GBMI. Conversely, the study highlights that a solid GOI can positively influence GBMI in construction firms.

This study highlights several vital implications for the construction industry. This study underscores the critical need for construction firms to prioritize genuine environmental practices over superficial greenwashing. Firms should focus on building a robust GOI to drive GBMI and achieve sustainable development effectively. Authentic commitment to sustainability will foster innovation, build trust with stakeholders and mitigate the adverse effects of opportunism. For policymakers, the findings highlight the need to strengthen regulations to combat greenwashing and promote transparency. Enhanced enforcement mechanisms and more precise guidelines are essential to ensure that construction firms adhere to genuine green practices. Policymakers should create an environment that incentivizes true sustainability and penalizes misleading claims.

This study has several limitations that should be acknowledged. First, while the analysis provides valuable insights into the Vietnamese construction industry, the findings should be interpreted cautiously. The influence of cultural factors such as reputation management and social harmony may differ across regions or sectors. Therefore, overgeneralization to other cultural or national contexts should be avoided. Future research could explore similar models in different countries or industries to assess the cultural variations in greenwashing, GOI and GBMI relationships.

One notable limitation of this study lies in the unsupported relationship between opportunism and GOI (*H6*). While this result may reflect contextual realities in Vietnam, it also points to potential measurement and methodological limitations. The construct definitions were adopted from established literature to ensure theoretical consistency. However, the measurement instruments may not fully capture opportunism and GOI in Vietnam. Additionally, the relatively low explanatory power of GOI ( $R^2 = 0.104$ ) suggests that other unmeasured factors (i.e. organizational culture, leadership behavior, or institutional norms) may play a more prominent role in shaping identity than opportunism. As the survey had already been administered and the data set finalized, it was not feasible to revise or extend the instrument post hoc. This constraint limits the ability to further explore the non-significant finding through supplementary analysis. Future research should refine the measurement scales to better align with local practices and cultural values. Furthermore, mixed-methods approaches, such as interviews or case studies, could offer richer insights into how opportunism may influence GOI formation across different organizational and national contexts. Another limitation is the potential for response bias in survey data, where participants might underreport greenwashing practices. Further investigation could include qualitative approaches (i.e. interviews or case studies) to gain insights into how greenwashing affects organizational culture and innovation practices.

#### **Declaration of generative AI and AI-assisted technologies in the writing process**

During the preparation of this work, the author(s) used ChatGPT to assist the writing process more naturally. After using this tool, the author(s) reviewed and edited the content as needed.

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**Table A1.** Measurement items of the questionnaire survey

ID	Variables
<i>Green business model innovation</i>	
GBMI1	Our business model provides creative offerings through the combination of products and services to improve operational efficiency
GBMI2	Our business model actively involves stakeholders (e.g. owners, suppliers, subcontractors) in transactions to enhance efficiency
GBMI3	Our business model ensures fair access to project information and opportunities for all relevant parties
GBMI4	Our business model facilitates the firm in generating profit while improving environmental efficiency (e.g. reducing waste, energy use)
GBMI5	Our business model introduces improved operating processes (e.g. project management, procurement) to enhance performance
GBMI6	Our business model reduces the likelihood of information inadequacy or misinformation among project stakeholders
GBMI7	Our business model integrates socially responsible actions and behaviors (e.g. worker safety, community engagement, environmental protection) into daily operations
<i>Greenwashing</i>	
GRW1	My company presents a confusing message (using certain words and images) about its environmental behavior
GRW2	My company provides vague or seemingly unprovable environmental claims about its environmental performance
GRW3	My company overstates or exaggerates its environmental behavior
GRW4	My company omits or hides important information about its real environmental behavior
<i>Opportunism</i>	
OPP1	On occasion, we lie about certain things to protect our interests
OPP2	We do not always act in accordance with our contracts or agreements
OPP3	We sometimes promise to do things without actually doing them later
OPP4	We sometimes take advantage of holes in our contracts or agreements to further our own interests
OPP5	We sometimes use unexpected events to extract concessions from the other parties
<i>Green organizational identity</i>	
GOI1	My company has strong records about environmental management and protection
GOI2	We are proud of the company's environmental goals and missions
GOI3	My company has carved out a significant position with respect to environmental management and protection
GOI4	My company has formulated a well-defined set of environmental goals and missions
GOI5	We are knowledgeable about the company's environmental traditions and cultures
GOI6	We identify strongly with the company's actions with respect to environmental management and protection

**Source(s):** Authors' own work

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