

DETERMINANTS OF RESPONSIBLE INNOVATION IN MALAYSIAN SMES: A TOE-BASED PERSPECTIVE

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Abstract

This study investigates the key determinants that drive responsible innovation among small and medium-sized enterprises (SMEs) in Malaysia, drawing on the Technology–Organisation–Environment (TOE) framework. Specifically, it examines how relative advantage, environmental concern and policy orientation influence the adoption of responsible innovation practices. Based on survey data from 277 Malaysian SMEs, the results reveal that all three factors positively influence responsible innovation. Among them, relative advantage exerts the strongest effect, followed by environmental concern, while policy orientation has the least impact. These findings highlight that SMEs are more likely to pursue responsible innovation when they perceive clear business benefits, such as enhanced competitiveness or operational efficiency. Therefore, promoting the tangible advantages of responsible innovation should be a strategic priority. Meanwhile, fostering internal environmental awareness and strengthening alignment with sustainability values can further reinforce responsible innovation. Practical implications include encouraging policymakers to frame regulatory measures in ways that emphasise business incentives and providing support mechanisms for SMEs to recognise the value of responsible innovation. This study contributes empirical evidence from a developing country context, confirming that responsible innovation is not only ethically desirable but also strategically beneficial for SME.

Keywords: Responsible innovation, TOE, SMEs.

Introduction

Small and medium-sized enterprises (SMEs) are widely recognised as vital engines of economic growth, employment generation, and industrial diversification across the globe. In Malaysia, SMEs account for approximately 97.4% of all registered businesses, making them the backbone of the national economy, with notable contributions to GDP and job creation. However, these enterprises are increasingly confronted with intensifying sustainability demands spanning environmental, social, and economic domains. Climate change, natural resource depletion, and mounting stakeholder pressure have collectively elevated sustainability performance to a strategic imperative for SMEs (Ooi, et al., 2025).

Despite their economic importance, SMEs often struggle to implement sustainability initiatives due to structural limitations, such as constrained financial resources, insufficient technological capabilities and a lack of skilled personnel (Memon, et al., 2024; Ooi & Memon, 2025). These challenges hinder their ability to engage in responsible innovation, a form of innovation that integrates ethical reflection, stakeholder inclusion and environmental foresight into the innovation process (Adomako & Nguyen, 2023; Zhang, et al., 2023). Unlike traditional innovation, responsible innovation is particularly salient for SMEs seeking to reconcile business growth with social and environmental considerations (Ooi & Memon, 2025).

Yet, responsible innovation remains underexplored in the SME literature (Ooi & Memon, 2025), which has predominantly focused on large firms with more institutionalised structures and resources (Memon, et al., 2024). This gap is particularly evident in developing

countries like Malaysia, where SMEs operate in dynamic yet resource-constrained environments. External influences such as regulatory requirements, shifting market expectations and stakeholder pressure further complicate their capacity to adopt innovation strategies that are socially and environmentally responsible (Amran, et al., 2012; Wu, et al., 2022). Addressing this gap necessitates a comprehensive framework that captures the relationship between internal capabilities and external drivers. In this regard, Zhang, et al. (2020) highlight the importance of factors such as relative advantage, environmental concern and policy orientation in shaping SMEs' innovation behaviours. These dimensions, spanning perceived technological benefits, organisational commitment to sustainability and responsiveness to external regulatory demands, offer a useful lens to understand how SMEs can effectively embed responsible innovation within their operations.

Overall, this study adopts the Technology–Organisation–Environment (TOE) framework (Zhang, et al., 2020) to examine the key drivers of responsible innovation adoption among Malaysian SMEs. As such, the study not only extends theoretical understanding but also proposes recommendations for policymakers and SME leaders aiming to foster responsible innovation under complex and constrained operating conditions.

Research Objectives

This study examines the factors influencing the adoption of responsible innovation among SMEs in Malaysia, guided by the TOE framework. Specifically, this study aims to:

1. Examine the influence of relative advantage (technological factor) on the adoption of responsible innovation among SMEs.
2. Examine the influence of environmental concern (organisational factor) on the adoption of responsible innovation among SMEs.
3. Examine the influence of policy orientation (environmental factor) on the adoption of responsible innovation among SMEs.

Scope of the Research

Population Scope

This study focuses on SMEs operating in Malaysia, as they constitute the majority of registered businesses and play a central role in national economic development. SMEs are increasingly recognised as key performers in the transition towards sustainable business practices (Ooi, et al., 2025) but often face significant challenges in adopting responsible innovation due to resource constraints and limited institutional support (Ooi & Memon, 2025). Focusing on SMEs allows the study to capture the unique dynamics, decision-making structures and contextual limitations that distinguish them from larger firms.

Variable Scope

This study examines four key constructs: responsible innovation, relative advantage, environmental concern and policy orientation. Responsible innovation refers to an organisation's capacity to develop and introduce new products or services that not only address customer needs but also contribute to social welfare, environmental sustainability, and ethical value creation (Adomako & Nguyen, 2023). It emphasises innovation that is proactive, inclusive and aligned with long-term societal goals (Memon, et al., 2024).

The three independent variables: relative advantage, environmental concern and policy orientation, are adapted from Zhang, et al. (2020). Relative advantage denotes the perceived benefits of adopting technologies for responsible innovation, particularly in terms of enhancing operational efficiency, improving job effectiveness and increasing the quality of products or

services. Meanwhile, environmental concern reflects an organisation's internal commitment to sustainability, demonstrated through cultivating a green culture, integrating environmental protection into daily operations and embedding sustainable development within corporate strategy. Whereas, policy orientation captures an organisation's responsiveness to external regulatory pressures by prioritising adherence to environmental policies, ensuring compliance with environmental regulations and regularly communicating policy updates to employees.

Time Scope

This study adopts a two-wave time-lagged research design (Ooi & Memon, 2025), utilising primary data collected through structured surveys administered to SMEs in Malaysia. The time-lagged approach enhances the robustness of the research by reducing the risk of common method bias and enabling a more accurate assessment of the explanatory relationships. This design also ensures that the findings reflect recent organisational practices and policy environments relevant to responsible innovation. Given the reliance on self-reported data, procedural remedies were implemented to mitigate potential bias and improve response reliability, in line with best practices recommended by Kock, et al. (2021).

Theoretical Framing and Hypotheses Development

This study is anchored in the TOE Framework. The TOE framework systematically classifies the influences on technology adoption into three key domains: technological, organisational, and environmental (Srivastava, et al., 2022). This tripartite lens enables a holistic evaluation of how SMEs make strategic decisions regarding the adoption of responsible innovations, decisions that are shaped not only by internal capabilities but also by evolving external pressures.

Apparently, Loo, et al. (2024) affirms the value of the TOE framework in SME contexts, noting that it provides a structured view of innovation uptake across sectors by capturing firms' sensitivity to factors such as technological compatibility, operational efficiency and environmental responsiveness. In this context, the TOE framework serves as a theoretical support that guides the understanding of the complex interaction between firm-level dynamics and contextual drivers of responsible innovation. Specifically, the framework enables to unpack how SMEs' perceived relative advantage, environmental concern and policy orientation interact to shape their innovation behaviours, particularly in emerging and resource-constrained settings.

Relative advantage refers to the degree to which an innovation is perceived as offering superior value compared to existing practices or technologies. This perceived value can manifest in various forms, operational efficiency, cost savings, enhanced reputation or regulatory compliance. As noted by Zhang, et al. (2020), SMEs are more likely to adopt innovation when the benefits are perceived as clearly outweighing the costs, particularly in contexts where financial prudence is critical. In the Malaysian context, where most SMEs operate under tight cash flow constraints, the perceived clarity and immediacy of returns from adopting responsible innovation become decisive. For instance, improvements in stakeholder trust, better alignment with green consumer values or enhanced visibility in sustainability-driven markets can act as compelling determinants. When firms are able to quantify or visualise these advantages, their likelihood of pursuing responsible innovation strategies increases significantly. As such:

H₁: Relative advantage positively influences the adoption of responsible innovation.

Environmental concern reflects the extent to which a firm integrates ecological responsibility into its strategic and operational decision-making. It denotes a proactive orientation toward sustainability, where ecological values are embedded within the organisational culture. Mokbel Al Koliby, et al. (2024) affirm that a strong internal environmental culture among employees can significantly enhance a firm's readiness for responsible innovation. This view is echoed by Adomako and Nguyen (2023), who argue that internalised green values foster ethically anchored, long-term innovation practices, aligning technological advancement with sustainability imperatives.

Firms characterised by high environmental concern are more likely to engage in anticipatory behaviour, whereby innovation is pursued not merely as a response to regulatory pressures but as a forward-looking commitment to environmental stewardship. Such firms view innovation as instrumental in advancing their broader sustainability agenda, thereby facilitating the integration of responsible practices into their core strategy. In this context, environmental concern acts as an enabler for responsible innovation, particularly in SMEs aiming to reconcile growth with ecological integrity. As such:

H₂: Environmental concern positively influences the adoption of responsible innovation.

Policy orientation refers to the influence of governmental policies, regulatory instruments and institutional support on a firm's innovation behaviour. Well-designed policy frameworks can reduce market and regulatory uncertainty, thereby enhancing the likelihood of innovation uptake. An effective policy instruments not only create favourable conditions for innovation but also accelerate its diffusion by lowering risk and transaction costs. In the Malaysian context, initiatives such as the Green Technology Financing Scheme (GTFS) exemplify how targeted regulatory and financial incentives can lower barriers to business practices (Amran, et al., 2018), particularly for resource-constrained SMEs. By offsetting upfront costs and providing clearer compliance pathways, such policies reduce the perceived risk associated with innovation investments. Zhang, et al. (2020) similarly highlight the role of clear, supportive policies and streamlined compliance mechanisms in motivating SMEs to align with responsible and sustainable innovation agendas. For SMEs, which often lack the scale and slack resources of larger firms, external policy signals serve as vital enablers. These firms depend on institutional frameworks not only to justify the allocation of limited financial and human resources but also to align their practices with broader environmental and social imperatives (Amran, et al., 2012). As such:

H3: Policy orientation positively influences the adoption of responsible innovation.

Figure 1: presents the conceptual framework of the study.

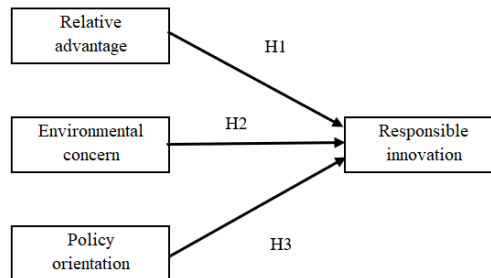


Figure 1: Conceptual Framework

Research Method

This study employed a quantitative, time-lagged survey design to examine the determinants of responsible innovation practices among SMEs in Malaysia. SMEs were selected due to their essential role in driving economic activity while simultaneously facing resource constraints that challenge sustainable innovation efforts (Ooi & Memon, 2025). The unit of analysis was the organisational level, and the target respondents were the SME owners, or senior managers or executives responsible for sustainability, innovation or strategic decision-making.

A purposive sampling strategy was adopted to ensure that participating SMEs were actively involved in innovation activities and had sufficient awareness of environmental or CSR practices. Firms that met the Malaysian SME definition (fewer than 200 full-time employees or an annual turnover of less than RM50 million) and had been operating for at least one year were considered eligible. Data were collected using an online structured questionnaire distributed via email and professional networks. A total of 277 usable responses were obtained for analysis.

Analysis and Findings

This study employed Partial Least Squares Structural Equation Modelling (PLS-SEM) to analyse the data, a method well-suited for examining complex relationships among variables. PLS-SEM is widely used in organisational-level research (Memon, et al., 2024). The findings of the structural model are summarised in Table 1.

Table 1 Results of the Structural Model

Relationship	Path Coefficient	SE	t-value	Effect size	R ²
H1: Relative advantage -> Responsible innovation	0.373	0.040	9.320**	0.260	0.500
H2: Environmental concern -> Responsible innovation	0.315	0.055	5.742**	0.134	
H3: Policy orientation -> Responsible innovation	0.278	0.056	4.997**	0.100	

Note: ** p<0.01

Discussion

Relative advantage emerged as the strongest predictor of responsible innovation ($\beta = 0.373$, $p < 0.01$), indicating that SMEs are more likely to adopt responsible innovation when the perceived advantages, such as improved operational efficiency, brand reputation, regulatory alignment or financial returns, outweigh existing practices. This finding aligns with prior research (Zhang, et al., 2020) suggesting that the clarity of value creation is critical for innovation uptake, particularly for resource-constrained firms. The relatively large effect size and statistical significance highlight the central role of perceived relative advantage in shaping SME innovation behaviour.

Similarly, environmental concern also showed a significant positive effect on responsible innovation adoption ($\beta = 0.315$, $p < 0.01$), reflecting the growing influence of ecological / environmental values in organisational decision-making. This result supports earlier findings by Adomako and Nguyen (2023), who argue that internalised environmental commitments lead to more ethically oriented and sustainability-driven innovation practices. The effect size suggests that SMEs with stronger environmental values are more inclined to pursue innovation as a proactive strategy to maintain ecological integrity rather than merely to comply with external regulations.

Policy orientation was also found to significantly influence responsible innovation adoption ($\beta = 0.278$, $p < 0.01$), affirming the enabling role of institutional support in shaping innovation outcomes. This finding is consistent with Zhang, et al. (2020), who highlight the importance of clear, targeted policies in lowering uncertainty and facilitating the adoption of responsible practices among SMEs. Although the effect size is smaller than that of relative advantage and environmental concern, the statistical significance confirms that supportive policy frameworks remain a critical factor in contexts where firms operate with limited resources. Collectively, the three predictors account for 50.0% of the variance in responsible innovation ($R^2 = 0.500$), indicating substantial explanatory power. This suggests that both internal motivations (relative advantage, environmental concern) and external institutional factor (policy orientation) are jointly critical in driving SMEs' responsible innovation behaviours.

Conclusion

This study provides valuable insights into the determinants of responsible innovation practices among SMEs, highlighting the critical roles of relative advantage, environmental concern and policy orientation. By leveraging internal motivations and responding to external institutional support, SMEs can embed sustainability into their innovation strategies. The findings align with the TOE framework, demonstrating how the interplay of technological benefits, organisational values and policy mechanisms shapes responsible innovation behaviour in resource-constrained contexts.

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