

# Exploring Sustainability-Oriented Innovation in Thai Technology-Driven Enterprises: A Multiple-Case Study

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## Abstract

This study investigates how Thai technology-driven enterprises perceive and implement Sustainability-Oriented Innovation (SOI), with a focus on the economic, social, and environmental dimensions. Addressing the limited empirical evidence on SOI among SMEs in emerging economies, the study examines sectoral variations and contextual influences shaping sustainability adoption. A qualitative multiple-case study was conducted with twelve enterprises across diverse sectors, including healthcare, agriculture, food, digital services, and engineering systems. Data were collected through semi-structured interviews with founders and senior executives and analyzed using thematic coding, supplemented by secondary documentation.

Findings reveal that economic considerations dominate SOI adoption, with firms prioritizing market survival, financial stability, and competitive product or process innovation. Social initiatives are emerging but often instrumental, focusing on community engagement, health, and capacity building. Environmental practices are limited and usually pursued opportunistically or when aligned with product differentiation. Contextual factors, including founder generational experience, shape sustainability orientation and decision-making. Sectoral and stage-specific differences further influence SOI implementation, with agri-food and health enterprises demonstrating higher social and environmental engagement.

The study contributes to theory by highlighting how technology-driven enterprises in emerging economies selectively adopt SOI, emphasizing the interplay of technological capability, sector, development stage, and cultural context. Practical implications suggest the need for targeted policy support, entrepreneurial training, and ecosystem development to enhance comprehensive adoption of sustainability practices. These insights provide guidance for entrepreneurs, policymakers, and investors seeking to foster innovation that integrates economic, social, and environmental value.

**Keywords:** Sustainability-Oriented Innovation (SOI); Technology-Driven Enterprises; Multiple-Case Study

## 1. Introduction

Sustainability-oriented innovation (SOI) has emerged as a critical concept in the discourse on innovation and entrepreneurship. It refers to the integration of environmental, social, and economic dimensions into innovation processes with the goal of creating long-term value for both business and society. Scholars increasingly emphasize that SOI is not merely about developing environmentally friendly products or socially responsible services but about embedding sustainability principles into the strategic intent and operational practices of firms [1],[2].

Although SOI has gained momentum globally, research indicates that adoption remains uneven across regions and sectors, particularly in emerging economies where resource constraints, institutional gaps, and capability limitations persist. In Thailand, awareness and practical implementation of sustainability within innovation-driven enterprises are still in their early stages. Northern Thailand, including the Chiang Mai region, has witnessed a growing ecosystem of technology-driven SMEs and start-ups engaging in digital transformation and commercialization activities. Yet adoption of sustainability practices varies widely, reflecting differences in firm capability, sectoral conditions, and ecosystem support mechanisms [3].

This study focuses on Thai technology-driven enterprises, encompassing early-stage start-ups and

small- and medium-sized enterprises (SMEs) that develop and commercialize innovations in sectors such as healthcare, agriculture, food, and digital services. These enterprises are often promoted as engines of economic growth and innovation, yet their engagement with sustainability is not well understood. Technological capability, digital readiness, and innovation management have been identified as critical enablers for such enterprises to integrate sustainability into their operations [3]. At the same time, universities and incubation programs play an important role in shaping start-ups' sustainability trajectories, as collaboration with academic institutions can provide critical technological, knowledge, and human resource support [4]. However, empirical evidence on how such enterprises perceive, interpret, and integrate sustainability into innovation strategies in the Thai context remains limited. To address this gap, this study investigates how Thai technology-driven enterprises understand sustainability and how they implement or selectively ignore its economic, social, and environmental dimensions.

The analysis is based on qualitative interviews with twelve technology-driven enterprises, representing different stages of development and diverse sectors. Each of the enterprises has been incubated or supported by Chiang Mai University, reflecting the broader role of university-industry collaboration in shaping innovation and sustainability pathways.

Accordingly, this paper aims to explore how Thai technology-driven enterprises perceive and implement SOI, highlighting the economic, social, and environmental dimensions as well as contextual influences. The study also seeks to identify challenges and opportunities in aligning technological innovation with sustainability imperatives in the Thai entrepreneurial context.

The remainder of the paper is structured as follows: Section 2 reviews relevant literature on SOI, and cultural and contextual influences in Thailand. Section 3 presents the research methodology, including case selection, data collection, and analysis procedures. Section 4 reports the findings, while Section 5 discusses the implications considering existing theory and practice. Finally, Section 6 concludes with theoretical contributions, practical implications, and suggestions for future research.

## 2. Literature Review

### 2.1 Sustainability-Oriented Innovation (SOI)

SOI is defined as innovation that simultaneously addresses the economic, social, and environmental dimensions of sustainability, often referred to as the “triple bottom line” [5]. Unlike conventional innovation, which is primarily oriented toward competitiveness and profitability, SOI aims to create value that extends beyond the firm, contributing to broader societal and ecological goals [2],[6]. Research suggests that SOI can take multiple forms: product innovation (e.g., eco-friendly goods), process innovation (e.g., resource efficiency), organizational innovation (e.g., new governance models), and business model innovation (e.g., circular economy strategies) [7].

While SOI has gained momentum in Europe and North America, where policy frameworks and consumer demand often drive sustainability agendas, its diffusion in developing and emerging economies faces structural challenges. These include limited resources, lack of regulatory enforcement, and insufficient awareness among entrepreneurs [8],[9].

### 2.2 SOI in Emerging Economies and SMEs

Small- and medium-sized enterprises (SMEs) and early-stage start-ups play a critical role in innovation ecosystems, particularly in emerging economies. These firms often exhibit agility, technological specialization, and the potential for rapid market adaptation [10]. However, their approach to SOI differs markedly from larger firms. SMEs are often resource-constrained and oriented toward survival, prioritizing economic viability over environmental or social outcomes [11].

Technology-driven enterprises, defined here as SMEs or start-ups with a core focus on developing and commercializing innovations based on technology platforms, occupy a unique position. They combine the agility of small firms with advanced technological capabilities, which can facilitate certain forms of SOI. Rather, strategic intent, organizational learning capability, and ecosystem alignment shape whether and how firms adopt SOI [8]. This calls for a more

contextual understanding of SOI trajectories in emerging economies where institutional pressures and support structures vary significantly.

Recent studies from Southeast Asia similarly emphasize heterogeneous, context-dependent sustainability orientations among SMEs. Qualitative work in Indonesia illustrates how sustainability innovation emerges through local sourcing, community empowerment, and waste reduction practices, reflecting embedded cultural and resource conditions [12]. Likewise, Singgih and Famiola identify sustainable innovation values among Indonesian SMEs that position sustainability as integral to business decision-making rather than as a peripheral add-on [13]. Evidence from Malaysia highlights how organizational culture and employee engagement shape progress toward sustainability-aligned SDGs [14], while analyses from Vietnam indicate that globalization pressures can reinforce economic innovation priorities at the expense of social and environmental dimensions [15]. Collectively, these studies reveal a broader ASEAN pattern: SMEs’ sustainability adoption remains uneven, shaped by sectoral conditions, access to resources, national policy frameworks, and cultural values.

Moreover, the role of universities as incubators and facilitators of entrepreneurial activity is increasingly recognized in emerging economies. University-industry collaboration provides not only technical and business development support but also influences the values and priorities embedded in innovation processes. Jirapong et al. highlight how university incubation programs can act as critical enablers in shaping start-ups’ approaches to sustainability, even though challenges remain in aligning academic objectives with market realities [4].

In the context of Northern Thailand, studies have highlighted that SMEs’ technological capabilities and digital readiness are essential enablers for adopting innovations, though barriers related to resources, expertise, and strategic alignment remain [3].

### 2.3 Cultural and Contextual Influences

SOI in Thailand is shaped not only by global sustainability frameworks but also by local cultural and institutional factors. One of the most widely recognized influences is the Sufficiency Economy Philosophy (SEP), which emphasizes moderation, responsible consumption, and resilience [16]. SEP provides a guiding principle for entrepreneurs to balance economic, social, and environmental considerations in decision-making, even if its application is often more implicit than formal in business practices.

Empirical studies on Thai SMEs highlight culturally grounded approaches to sustainability that influence business behavior. For example, Suriyankietkaew and Avery demonstrate that sustainable leadership practices in Thai SMEs positively affect financial performance, reflecting how economic sustainability is intertwined with leadership behaviors [17]. Winit and Kantabutra emphasize the importance of perceived benefits and employee happiness in sustaining SMEs, suggesting that social well-being and stakeholder satisfaction are

central concerns for Thai enterprises [18]. Kantabutra further provides a framework for measuring corporate sustainability tailored to Thai business contexts, capturing economic, social, and environmental dimensions in ways that reflect local realities [16]. His study also finds that Thai firms often prioritize long-term resilience, ethical practices, and moderation in growth. Moreover, organizational culture, leadership commitment, and stakeholder engagement are critical enablers of sustainability practices, illustrating that the adoption of sustainable practices is closely linked to culturally grounded values rather than formal regulatory requirements.

Integrating these cultural and contextual insights helps explain why Thai technology-driven enterprises often emphasize economic and social dimensions of sustainability, while environmental concerns and holistic SOI adoption remain less prominent. The combination of culturally and leadership practices embedded values shapes how entrepreneurs interpret and implement SOI in practice.

#### 2.4 Linking SOI to Innovation Capability

Finally, the literature emphasizes that the ability to implement SOI is closely linked to overall innovation capability, including technological proficiency, market knowledge, and organizational capacity [6]. Firms with advanced technological capabilities, strong networks, and flexible organizational structures are better positioned to integrate sustainability holistically. However, the Thai technology-driven enterprises in this study illustrate that while individual innovations may have social or environmental impact, comprehensive SOI adoption remains fragmented. This underscores the need for research that investigates how SMEs can systematically translate technological innovation into sustainability-oriented outcomes.

### 3. Methodology

This study adopts a qualitative multiple-case study approach to explore how Thai technology-driven enterprises perceive and implement Sustainability-Oriented Innovation (SOI). Case study methodology is particularly suited for investigating complex phenomena

within real-world contexts, allowing for rich, in-depth understanding of practices and decision-making [19]. By examining multiple cases, the study identifies patterns and variations across sectors, stages of development, and technological domains.

#### 3.1 Case Selection

Twelve Thai technology-driven enterprises were purposefully selected to maximize variation in sector, innovation focus, and stage of development. Following Eisenhardt's (1989) recommendation on theoretical sampling for multiple-case research [20], cases were chosen not for statistical representativeness but to allow comparison across contrasting contexts that illuminate similarities and differences in Sustainability-Oriented Innovation (SOI) adoption. The selection criteria included:

**Technology-driven focus:** Firms that develop or commercialize products/services based on advanced technology, including nanotechnology, AI, plasma processing, or digital platforms.

**Stage of development:** Enterprises across research/prototype, early selling, growing, and stable stages.

**Sectoral diversity:** Representation from healthcare, agriculture, food, digital services, and engineering systems.

Firms were recruited through multiple channels to ensure diversity and relevance: databases and alumni records from university-based incubation and commercialization programs, referrals from technology transfer offices, recommendations through partner networks, and snowball sampling from interviewed executives. This approach enabled access to firms embedded within Thailand's emerging technology commercialization ecosystem and ensured variation in scale, technological sophistication, and sustainability orientation. **Table 1** provides an overview of the case companies.

#### 3.2 Data Collection

Data were collected primarily through semi-structured interviews conducted with twelve founders or senior executives, who are key decision-makers in innovation and business strategy.

**Table 1** Overview of the Case Companies

Company	Product Type	Stage of Development	Technology Used
A	Anti-aging jelly	R&D / Concept Stage	Nanotechnology
B	Vegetable & fruit safety machine	Early Commercialization / Launch Stage	Plasma technology
C	Cream & spray for Myasthenia Gravis	Early Commercialization / Launch Stage	Nanotechnology
D	Agricultural sourcing platform	Early Commercialization / Launch Stage	AI / data analytics
E	Electrical system services	Mature / Stable Stage	Digital / software
F	Migraine monitoring app	Growth / Scaling Stage	Digital / software
G	Multiple applications (carpool, retail, senior citizen, POS, hotel)	Growth / Scaling Stage	Digital / software
H	Accommodation management app	Growth / Scaling Stage	Digital / software
I	Small business management app	Mature / Stable Stage	Digital / software
J	Coffee waste packaging	R&D / Concept Stage	Material innovation
K	Dried fish seasoning	Growth / Scaling Stage	Food processing
L	Cricket-based products	Growth / Scaling Stage	Food processing

The interviews focused on: understanding participants' perception of sustainability and sustainable development, identifying the integration of sustainability principles in products, processes, or business models, exploring challenges, enablers, and priorities in pursuing innovation, and gathering examples of social, environmental, or economic impact in business operations

Interviews lasted between 60–90 minutes and were audio-recorded with participant consent. Supplementary data were gathered from company websites, product descriptions, press releases, and secondary literature to triangulate findings and enhance data reliability.

### 3.3 Data Analysis

The study employed thematic coding to analyze interview transcripts and supplementary materials. The coding process included:

**Open coding:** Initial codes were generated to capture key concepts and ideas mentioned by participants regarding sustainability and innovation practices.

**Axial coding:** Codes were grouped into broader categories aligned with the three dimensions of SOI; economic, social, and environmental, as well as contextual themes such as sufficiency economy philosophy, ecosystem dependence, and stage-specific challenges.

**Cross-case analysis:** Themes were compared across firms to identify common patterns, sectoral differences, and gaps in SOI adoption.

During analysis, data saturation was observed, with later interviews yielding no substantially new conceptual categories or relationships, supporting the adequacy of the sample size for capturing variation across sectors and stages of development.

The analysis was iterative, with codes refined and consolidated to ensure clarity, consistency, and alignment with the research objectives. This approach allows for a nuanced understanding of how technology-driven enterprises interpret and implement SOI across diverse contexts in Thailand.

## 4. Findings

The analysis of twelve Thai technology-driven enterprises revealed patterns in how entrepreneurs perceive and implement Sustainability-Oriented Innovation (SOI). The findings are presented along the three core SOI dimensions, economic, social, and environmental, with additional observations on contextual influences and stage-specific perspectives. **Table 2** illustrates the key themes, codes, and illustrative interview excerpts that emerged from the analysis. **Table 3** summarizes the distribution of economic, social, and environmental dimensions of SOI across the twelve case firms, providing a summary of how different firms interpret and implement SOI

**Table 2** Key Themes, Codes, and Illustrative Interview Excerpts

SOI Dimension	Theme / Code	Description	Illustrative Interview Excerpt (Company)
Economic	Business survival	Focus on staying in market, maintaining revenue	"Company G shifted from carpool to app development to remain competitive."
Economic	Financial prudence	Managing cash flow, avoiding debt, reinvesting profit	"Company, I prefer organic growth using only company profits."
Economic	Product innovation	Leveraging technology to enhance products	"Company A uses ultrasonic nanotech to improve nutrient absorption."
Social	Community engagement	Supporting local communities or farmers	"Company D helps Thai farmers sell internationally through AI platform."
Social	Health & well-being	Products/services improving health	"Company F's app allows doctors to monitor patients' migraine conditions."
Environmental	Resource efficiency	Reducing environmental impact through technology	"Company J uses coffee waste for packaging to reduce waste."
Environmental	Eco-friendly practices	Sustainable sourcing or process	"Company A uses crop rotation for gooseberry cultivation."
Contextual	Sufficiency Economy	Moderation, long-term planning, risk management	"Company C integrates SEP principles in daily business operations."

### 4.1 Economic Dimension

Economic sustainability was the most salient concern among participants, reflecting a focus on business continuity, financial stability, and market competitiveness. Nine out of twelve enterprises emphasized strategies to maintain revenue, manage risks, and ensure long-term viability.

For example, Company G emphasized the strategic value of flexible business models, transitioning from a carpool prototype to application development in response to market feedback. The firm further diversified its offerings by developing multiple applications, thereby

creating multiple income streams and reducing the risk of market failure. In contrast, Company C and I, led by older founders (over 45 years old), prioritized financial prudence, favoring organic growth and reinvestment of internal profits rather than relying on external financing. This highlights how entrepreneurial experience and firm-specific context influence approaches to economic sustainability and risk management.

In addition to revenue management, several firms stressed product innovation as a driver of economic sustainability. Companies A and C invest in nanotechnology and local herbs to enhance product

efficacy, aiming to secure a competitive edge in niche health markets. Companies D, G, and H leverage digital platforms to improve operational efficiency and enable small business clients to manage sales and inventory effectively. Overall, the economic dimension of SOI is interpreted primarily as market survival, profitability, and business scalability rather than broader sustainability outcomes.

**4.2 Social Dimension**

Social considerations were prominent, though often secondary to economic concerns. Ten of twelve participants associated sustainability with social responsibility, encompassing community development, health improvement, and capacity building.

For instance, Company D’s AI-driven platform supports Thai farmers in accessing international

markets, thereby enhancing livelihoods and fostering local economic inclusion. Company F’s migraine monitoring app enables patients to share health data with doctors, improving care quality and accessibility. Food-related enterprises (Companies K and L) emphasized nutrition and local employment, while Company J explored reusing coffee waste for packaging, indirectly raising awareness of sustainable practices in the local community.

Participants recognized that social impact could reinforce economic outcomes, such as enhancing brand image or customer loyalty. However, these initiatives were largely instrumental, aimed at supporting the core business rather than representing an integrated SOI strategy.

**Table 3** Summary of Sustainability-Oriented Innovation (SOI) Dimensions across the Cases

Company	Economic Dimension	Social Dimension	Environmental Dimension	Contextual Factors
A	Focus on product innovation; strong customer branding	Works with local suppliers; aims to improve healthcare accessibility	Use local economic crops (gooseberry) which use crop rotation practice to grow	Research-based founder
B	Prototype-based revenue; dependent on grants and public R&D funding	Collaboration with university labs to promote food safety	Strong environmental relevance via reduced chemical residues	Research-based founder
C	Self-financed; organic growth model; production planning to reduce inventory	Works with local suppliers; aims to improve healthcare accessibility	Use local crop Cassumunar ginger & Turmeric)	Older founders (>45)
D	Applies AI and technology to optimize production and market expansion	Supports local farmers through ingredient sourcing and international market access	Low environmental relevance	Early-graduated founder
E	Stable business with service and operational innovation; efficiency-driven	Operational efficiency & service innovation; some social impact	Low environmental relevance	Older founders (>45)
F	Non-profit-oriented	Builds community connection through healthcare access; links patients and doctors for preventive care	Low environmental relevance	Older founders (>45)
G	Shifted from prototype to multiple app services; diversified revenue streams	Enhancing transport accessibility; user safety focus	Moderate relevance (reducing carbon emissions indirectly)	Early-graduated founder
H	Growth focus on expanding customer base and service efficiency	Operational efficiency & service innovation; some social impact	Low environmental relevance	Early-graduated founder
I	Self-financed; organic growth model	Operational efficiency & service innovation; some social impact	Low environmental relevance	Older founders (>45)
J	Enhances product and process efficiency to drive sales	Builds community networks through collaboration	Promotes environmental sustainability via waste valorization (coffee waste reuse)	Engineering-based and food-science-based co-founder
K	Enhances product and process efficiency to drive sales	Supports local suppliers and employment; health promotion via nutritious products	Low environmental relevance	Engineering-based founder
L	Enhances product and process efficiency to drive sales	Builds relationships with local suppliers and communities	Low environmental relevance	Engineering-based founder

### 4.3 Environmental Dimension

Environmental considerations were least emphasized. Only three enterprises (Companies A, B, C, and J) reported explicit environmental practices. For example, Company A sourced gooseberries using crop rotation techniques to minimize ecological impact, while Company J explored sustainable packaging from coffee waste. Company B focused on reducing chemical residues in vegetables and fruits, providing both health and environmental benefits.

This tendency reflects several underlying constraints. First, environmental impact initiatives typically require additional investment in technology, certification, or redesign of production systems, which SMEs perceive as financially risky during early development. Second, unlike social benefits that relate directly to customer trust or community legitimacy, environmental outcomes were viewed as less tangible or marketable domestically. Finally, interview responses suggested that founders often framed sustainability through economic survival and local well-being, aligning more closely with cultural notions of social responsibility than ecological stewardship. This pattern aligns with previous studies indicating that SMEs in emerging economies often prioritize economic and social outcomes over ecological concerns [11],[21].

### 4.4 Sectoral Differences in SOI Adoption

Sectoral characteristics influence how firms prioritize sustainability dimensions. Studies suggest that agri-food and bio-based SMEs are more likely to integrate environmental and social considerations due to direct interactions with natural resources and local communities [9]. This aligns with cases such as Company D, which facilitates international market access for Thai farmers, thereby improving local livelihoods while introducing technology-driven efficiencies. Similarly, Companies K and L leverage food innovation (dried fish seasoning, cricket-based products) to contribute to both nutrition and environmental sustainability.

In contrast, digital service firms (e.g., Companies F, G, H, I) often focus on economic and social dimensions, such as convenience, health monitoring, and operational efficiency. Environmental considerations tend to be peripheral unless they are directly tied to market demand. This pattern suggests that sectoral context shapes both the perceived relevance and implementation feasibility of different SOI dimensions.

### 4.5 Contextual Influence: Sufficiency Economy Philosophy and Generational Differences

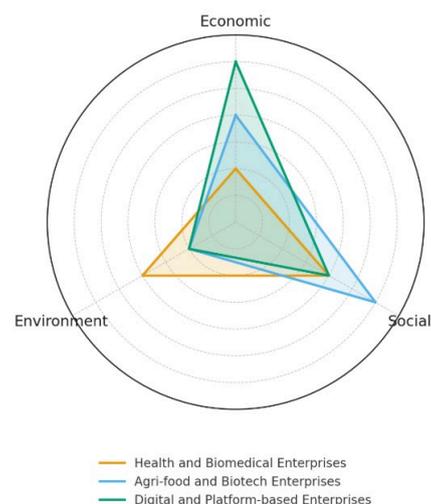
Three participants explicitly referenced the Sufficiency Economy Philosophy (SEP) as guiding their business practices, emphasizing moderation, resilience, and long-term planning. These founders were older (over 45 years old) and more experienced, integrating financial prudence, risk management, and employee development into their sustainability orientation.

Younger entrepreneurs (student and new graduated) tended to focus on market growth and technological performance, with less awareness of holistic sustainability principles. While they implemented practices with social or environmental implications, these were mostly opportunistic or market-driven rather than embedded in a comprehensive SOI framework.

### 4.6 Cross-Case Analysis

Analysis across the twelve enterprises highlights several key insights:

- **Economic** priorities dominate SOI interpretation, with social and environmental dimensions often secondary.
- **Technological capability** enables selective SOI practices, particularly for product innovation (e.g., nanotech, AI, plasma) and process efficiency.
- **Stage of development** affects sustainability integration: early-stage firms focus on survival and market entry, growth-stage firms experiment with social impact, and mature firms have more stable operational capacity to embed sustainability practices.
- **Cultural and generational context** shapes sustainability perspective, with SEP-influenced founders emphasizing moderation and long-term stability.
- **Sectoral differences** influence SOI focus. **Figure 1** illustrates the comparative intensity of SOI dimensions across three sectoral groups, health/biomedical, agri-food/biotech, and digital/platform, enterprises. The visualization highlights distinct sectoral orientations and contextual variations in sustainability focus.



**Figure 1** Comparative Intensity of SOI Dimensions across Three Sectoral Groups

Health and biomedical enterprises (Companies A, B, and C) place strong emphasis on the social dimension, reflecting commitments to community health, accessibility, and well-being, alongside

environmental relevance through the use of natural ingredients and reduced chemical residues.

Agri-food and biotech firms (Companies J, K, and L) exhibit mixed sustainability profiles. Company J demonstrates strong environmental engagement through waste valorization (coffee waste reuse), coupled with community collaboration, while Companies K and L emphasize social sustainability, building long-term relationships with local suppliers, farmers, and communities rather than pursuing explicit environmental initiatives.

In contrast, digital and platform-based firms (Companies D, G, H, and I) display a dominant focus on economic sustainability, driven by operational scalability, market expansion, and service innovation. Their engagement with social and environmental aspects tends to be opportunistic, responding to user or market expectations rather than strategic sustainability intent.

Similarly, the digital health firm (Company F) prioritizes social impact by improving healthcare accessibility and preventive care, while maintaining a modest but balanced emphasis on economic performance and limited environmental initiatives.

An exception within the digital group is Company E, which demonstrates a moderate balance between economic and social dimensions, with some attention to environmental efficiency through service innovation.

Overall, while Thai technology-driven enterprises demonstrate selective engagement with SOI, comprehensive adoption of the triple bottom line remains limited, indicating a significant opportunity for policy, education, and ecosystem support to foster deeper sustainability integration.

## 5. Discussion

The findings of this study provide insights into how Thai technology-driven enterprises perceive and implement Sustainability-Oriented Innovation (SOI), revealing patterns, gaps, and contextual influences. The discussion below links these empirical observations to existing literature and highlights theoretical and practical implications.

### 5.1 Economic Focus as the Primary Driver of SOI

Consistent with prior studies on SMEs and startups in emerging economies [10],[11], the findings indicate that economic considerations dominate SOI interpretation. However, the cases show a stronger dependency on technological capability as a mechanism for economic gain. This suggests that, in resource-constrained ecosystems, SOI adoption is conditional on absorptive capacity rather than normative concerns, echoing Halme & Korpela [8], who argue that technology enables selective adoption of SOI in small firms.

Furthermore, the tension between survival pressures and sustainability aspirations appears structural rather than attitudinal, indicating that expecting proactive sustainability adoption in early-

stage firms may be unrealistic without institutional support. Thus, the finding extends SOI theory by positioning technological innovation not merely as a tool for sustainability but as a filter that determines which sustainability practices are feasible to implement.

### 5.2 Social Dimension: Instrumental yet Emerging

Social considerations were widely recognized, particularly in firms operating in health and agri-food sectors. This aligns with prior research indicating that SMEs often implement socially beneficial initiatives as instrumental strategies to strengthen brand legitimacy or market position [9],[22]. The selective and opportunity-driven nature of these initiatives suggests that social value creation is contingent on market incentives rather than rooted in a fully developed sustainability orientation. Consequently, social SOI in Thai SMEs may evolve incrementally, following trajectories shaped by commercialization and legitimacy pressures.

### 5.3 Environmental Considerations: Limited Integration

Environmental sustainability emerged as the least emphasized dimension, with few firms explicitly addressing ecological impacts unless linked to product differentiation or regulatory compliance. This pattern confirms prior observations in Thai SMEs and emerging economies, where environmental concerns are often subordinated to economic and social priorities [11],[21]. The limited engagement indicates that environmental SOI remains outlying and highlights a systemic weakness in policy and market mechanisms that internalize environmental externalities, reinforcing critiques that institutional conditions shape SOI adoption pathways.

### 5.4 Sectoral and Stage Differences

Sectoral context significantly shapes SOI focus. Agri-food and health enterprises demonstrate higher engagement with social and environmental dimensions, whereas digital service firms primarily emphasize economic sustainability. This supports existing studies suggesting that industry characteristics influence the relevance and feasibility of SOI adoption [9].

Stage of development also matters. Early-stage firms concentrate on market entry and survival, growth-stage firms experiment with social initiatives. This observation aligns with the dynamic capability perspective, indicating that firms' ability to implement SOI evolves as resources, knowledge, and market position develop [23]. These patterns highlight path dependency, suggesting that SOI capabilities are accumulated gradually rather than adopted holistically at the early stage.

### 5.5 Contextual Influence: Culture and Generational Differences

The influence of SEP values and generational differences demonstrates that sustainability orientation is culturally mediated rather than solely economically driven. However, the uneven application of SEP suggests that cultural philosophies alone lack operational mechanisms

for formal SOI implementation. Thus, embedding national values in entrepreneurship support must move beyond discourse to structured capability-building.

Finally, the findings point to the importance of cultivating a culture of shared understanding and continuous learning as a foundation for sustaining innovation pathways. This aligns with broader perspectives on workplace innovation, such as the work of Piyatamrong and Guile [24], who demonstrate how establishing a common technical language for knowledge management can support transformation in complex organizations. Although derived from a global consulting context, these insights underscore the relevance of communication and knowledge alignment in enabling SMEs to pursue SOI.

### 5.6 The Role of Universities and Incubation in SOI Adoption

While the findings reveal that Thai technology-driven enterprises prioritize economic considerations and show limited integration of environmental and social dimensions, this pattern cannot be fully understood without considering the institutional context. All of the case enterprises in this study were incubated or supported by Chiang Mai University, reflecting the university's active role in promoting entrepreneurship and technological development.

As Jirapong et al. [4] argue, university start-up collaborations can serve as critical enablers in shaping enterprises' approaches to sustainability by embedding values, providing resources, and fostering awareness. However, the evidence here suggests that such influence is still uneven: although technical and business development support is widely recognized by entrepreneurs, the translation of sustainability principles into innovation strategies remains weak. This highlights a misalignment between incubation support and the broader ambition of fostering sustainability-oriented innovation and suggests opportunities to realign incubation processes to integrate SOI capability-building more explicitly.

## 6. Conclusion

This study examined how Thai technology-driven enterprises perceive and implement Sustainability-Oriented Innovation (SOI). Through a multiple-case study of twelve firms across diverse sectors and stages of development, the findings reveal that economic sustainability dominates entrepreneurial focus, with social and environmental dimensions integrated more selectively. Economic priorities drive SOI adoption, as firms emphasize market survival, financial stability, and the pursuit of product or process innovations for competitive advantage. Social initiatives are emerging but are often instrumental in nature, typically linked to customer engagement, community development, or health outcomes. By contrast, environmental considerations remain limited, pursued largely when they align with product differentiation opportunities or regulatory compliance requirements. Contextual influences also play a critical role, with generational

differences among founders shaping sustainability orientation and decision-making. Finally, sectoral and stage-specific factors affect the type and depth of SOI engagement, as agri-food and health enterprises tend to demonstrate a stronger social and environmental focus, while growth-oriented firms are generally better positioned to implement more comprehensive sustainability practices.

### 6.1 Theoretical Contributions

The study makes several contributions to the literature on SOI and technology-driven enterprises:

- It demonstrates that technology-driven SMEs in emerging economies interpret SOI primarily through economic survival, with selective integration of social and environmental practices.
- It highlights the role of technological capability, sector, and business stage in shaping SOI adoption patterns.

### 6.2 Practical Implications

The findings suggest actionable insights for multiple stakeholders:

- **Entrepreneurs:** Integrating sustainability requires intentional strategies beyond economic survival. Training and awareness programs can help firms leverage technology to generate social and environmental value.
- **Policymakers and ecosystem builders:** Support mechanisms, including grants, universities, incubators, and technical assistance, should facilitate social and environmental innovation, especially for early-stage and digital technology-driven enterprises.
- **Investors and partners:** Awareness of selective SOI adoption patterns can guide investment and collaboration strategies, emphasizing firms with technological capacity and willingness to embed sustainability in operations.

### 6.3 Limitations and Future Research

While this study provides rich insights, several limitations should be noted. First, the sample consists of twelve Thai technology-driven enterprises, which constrains generalizability beyond similar sectors or regional ecosystems. The sample size was adequate for conceptual saturation, but it does not capture the full heterogeneity of SMEs in Thailand or other emerging economies. Second, all enterprises were incubated or supported by a university program, reflecting a boundary condition of the research. This institutional context may have influenced entrepreneurs' exposure to innovation practices and shaped their sustainability values in ways that differ from non-incubated firms. Third, data were primarily self-reported via interviews, which could introduce bias or social desirability effects. Finally, environmental sustainability was underrepresented, limiting exploration of ecological innovation practices.

Future research could; expand the sample across multiple emerging economies to compare cultural and policy influences on SOI adoption, explore longitudinal

dynamics to understand how sustainability integration evolves as firms scale, and investigate interventions, training programs, or ecosystem support that enable comprehensive adoption of SOI.

## 7. References

- [1] T. Schiederig, F. Tietze and C. Herstatt, “Green innovation in technology and innovation management—an exploratory literature review,” *R&D Management*, vol. 42, no. 2, pp. 180–192, 2012, doi: 10.1111/j.1467-9310.2011.00672.x.
- [2] R. Adams, S. Jeanrenaud, J. Bessant, D. Denyer and P. Overy, “Sustainability-oriented Innovation: A Systematic Review,” *International Journal of Management Reviews*, vol. 18, no. 2, pp. 180–205, 2015, doi: 10.1111/ijmr.12068.
- [3] C. Boonmee, J. Mangkalakeeree and Y. Jeong, “Towards sustainable digital transformation: AI adoption barriers and enablers among SMEs in Northern Thailand,” *Sustainable Futures*, vol. 10, 2025, Art. no. 101169, doi: 10.1016/j.sfr.2025.101169.
- [4] K. Jirapong, K. Cagarman and L. von Arnim, “Road to Sustainability: University–Start-Up Collaboration,” *Sustainability*, vol. 13, no. 11, 2021, Art. no. 6131, doi: 10.3390/su13116131.
- [5] J. Elkington and I. H. Rowlands, “Cannibals with forks: the triple bottom line of 21st century business,” *Alternatives Journal*, vol. 25, no. 4, pp. 42–43, 1999.
- [6] E. G. Hansen and F. Große-Dunker, “Sustainability-Oriented Innovation,” in *Encyclopedia of Corporate Social Responsibility*, S. O. Idowu, N. Capaldi, L. Zu, and A. Das Gupta, Eds., Berlin, Heidelberg: Springer, 2013, pp. 2407–2417.
- [7] J. Carrillo-Hermosilla, P. Del Río and T. Könnölä, “Diversity of eco-innovations: Reflections from selected case studies,” *Journal of Cleaner Production*, vol. 18, no. 10–11, pp. 1073–1083, 2010, doi: 10.1016/j.jclepro.2010.02.014.
- [8] M. Halme and M. Korpela, “Responsible Innovation Toward Sustainable Development in Small and Medium-Sized Enterprises: a Resource Perspective,” *Business Strategy and the Environment*, vol. 23, no. 8, pp. 547–566, 2014, doi: 10.1002/bse.1801.
- [9] N. M. P. Bocken, S. W. Short, P. Rana and S. Evans, “A literature and practice review to develop sustainable business model archetypes,” *Journal of Cleaner Production*, vol. 65, pp. 42–56, 2014, doi: 10.1016/j.jclepro.2013.11.039.
- [10] H. E. J. Bos-Brouwers, “Corporate sustainability and innovation in SMEs: Evidence of themes and activities in practice,” *Business Strategy and the Environment*, vol. 19, no. 7, pp. 417–435, 2010, doi: 10.1002/bse.652.
- [11] R. Lozano, “A Holistic Perspective on Corporate Sustainability Drivers,” *Corporate Social Responsibility and Environmental Management*, vol. 22, no. 1, pp. 32–44, 2015, doi: 10.1002/csr.1325.
- [12] B. Harsanto, A. Mulyana, Y. A. Faisal, V. M. Shandy and M. Alam, “Sustainability Innovation in Small Medium Enterprises (SMEs): A Qualitative Analysis,” *The Qualitative Report*, vol. 28, no. 11, pp. 3257–3271, 2023, doi: 10.46743/2160-3715/2023.6193.
- [13] G. G. Singgih and M. Famiola, “Core Values of Sustainable Innovation in Indonesian SMEs,” in *Core Values and Decision-Making for Sustainable Business: An International Perspective*, Cham, Switzerland: Springer Nature, 2025, ch. 3 pp. 39–74.
- [14] A. R. A. Arokiasamy, P. Doraisingam, H. N. Krishnasamy, W. Wider, S. F. A. Hossain and D. R. Sawitri, “Greening the dragon: how Malaysian SMEs can achieve SDGs through engaged employees,” *Discover Sustainability*, vol. 5, no. 1, 2024, Art. no. 415, doi: 10.1007/s43621-024-00642-3.
- [15] N. N. T. Vy, T.-Q. Luu and W.-K. Wong, “Impact of Globalisation on Innovation of Small and Medium Enterprises in Vietnam,” *Asian Academy of Management Journal*, vol. 28, no. 1, pp. 81–112, 2023, doi: 10.21315/aamj2023.28.1.4.
- [16] S. Kantabutra, “Measuring corporate sustainability: a Thai approach,” *Measuring Business Excellence*, vol. 18, no. 2, pp. 73–88, 2014, doi: 10.1108/MBE-02-2013-0015.
- [17] S. Suriyankietkaew and G. Avery, “Sustainable leadership practices driving financial performance: Empirical evidence from Thai SMEs,” *sustainability*, vol. 8, no. 4, 2016, Art. no. 327, doi: 10.3390/su8040327.
- [18] W. Winit and S. Kantabutra, “Sustaining Thai SMEs through perceived benefits and happiness,” *Management Research Review*, vol. 40, no. 5, pp. 556–577, 2017, doi: 10.1108/MRR-04-2016-0083.
- [19] R. K. Yin, “Getting Started How to Know Whether and When to Use the Case Study as a Research Method,” in *Case study research and applications: Design and methods*, 6th ed. Thousand Oaks, CA, USA: SAGE Publications, Inc., 2017, ch. 1, pp. 32–61.
- [20] K. M. Eisenhardt, “Building theories from case study research,” *Academy of Management Review*, vol. 14, no. 4, pp. 532–550, 1989, doi: 10.2307/258557.
- [21] F. Halila and J. Rundquist, “The development and market success of eco-innovations: A comparative study of eco-innovations and “other” innovations in Sweden,” *European Journal of Innovation Management*, vol. 14, no. 3, pp. 278–302, 2011, doi: 10.1108/14601061111148807.
- [22] P. Dobers and M. Halme, “Corporate social responsibility and developing countries,” *Corporate Social Responsibility and*

- Environmental Management*, vol. 16, no. 5, pp. 237–249, 2009, doi: 10.1002/csr.212.
- [23] D. J. Teece, G. Pisano and A. Shuen, “Dynamic capabilities and strategic management,” *Strategic Management Journal*, vol. 18, no. 7, pp. 509–533, 1997, doi: 10.1002/(SICI)1097-0266(199708)18:7<509::AID-SMJ882>3.0.CO;2-Z.
- [24] T. Piyatamrong and D. Guile, “Cultivating Workplace Innovation: Establishing a Common Technical Language for Knowledge Management in a Digital Transformation Perspective-A UK-Based Global Consulting Firm Case Study,” in *2024 IEEE International Conference on Technology Management, Operations and Decisions (ICTMOD)*, Sharjah, United Arab Emirates, Nov. 4–6, 2024, pp. 1–7, doi: 10.1109/ICTMOD63116.2024.10878215.