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Symbiotic Entrepreneurship in the Global South: ANT and Posthumanism Insights from Thai Waste-Based SMEs

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Abstract

This study challenges anthropocentric views of SME innovation by exploring how waste and non-human entities shape business models—an aspect often ignored in traditional industrial symbiosis (IS) research. Using Actor-Network Theory (ANT) and posthumanism, we analyze 15 Thai IS business plans through thematic analysis. Findings reveal that waste streams act as active agents in value creation, while SMEs blend capitalist goals with posthumanist ethics emphasizing multispecies care. The study proposes a sympoietic business framework for regenerative entrepreneurship in Thailand, highlighting Global South ecological ontologies as drivers of innovation. Guided by Resource Dependence Theory, the analysis shows how SMEs form strategic partnerships with waste suppliers, regulators, and technology providers to ensure material flows and reduce risk. These collaborations enable both human and non-human actors—like compost systems and microbes—to co-create value, redefining business ecosystems as dynamic networks of interdependent relationships.

Keywords: *Actor-Network Theory, posthumanism, Industrial Symbiosis, Regenerative Entrepreneurship, Thailand.*

Introduction

This research utilizes core theories, including Resource Dependence Theory, Transaction Cost Economics, and Stakeholder Theory, to analyze the engagement of Thai SMEs in industrial symbiosis (IS) within the agri-food and light manufacturing sectors. The examined symbiosis types encompass waste-to-energy conversions and by-product reutilization frameworks. The research utilizes a posthumanism perspective and Actor-Network Theory (ANT) to reconceptualize business models as dynamic, multi-species assemblages influenced by ecological interconnections, technological capabilities, and sociopolitical frameworks (Hamam et al., 2023).

Traditional frameworks for small and medium enterprise (SME) development are firmly rooted in anthropocentrism, conceptualizing innovation as a human-centered reaction to market demands (Schaltegger et al., 2016). In this framework, non-human creatures, waste streams, ecosystems, and technology are diminished to just passive inputs, overlooking their active involvement in value co-creation (Latour, 2005). Although IS literature recognizes material flows (Chertow, 2000), it seldom examines how more-than-human agency influences SME business models, especially in emerging economies such as Thailand (refer to Pongpiachan, 2020 for institutional eco-industrial policy frameworks in Thailand).

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This study addresses this gap by examining 15 Thai SME IS business plans through a posthumanist perspective, utilizing Actor-Network Theory (ANT) to elucidate how human and non-human actors (e.g., waste metabolisms, local ecologies, policies) collaboratively shape economies that rejuvenate and sustain ecological and social systems. Posthumanism reconceptualizes business innovation as a pluriversal entanglement (Escobar, 2018), wherein SMEs implement information systems not alone for profit but as ethical ontologies promoting multispecies flourishing (Haraway, 2016; Tsing, 2015). This study examines the subsequent specific research inquiries: (i) In what manner do Thai SMEs utilize circular business models (Lüdeke-Freund et al., 2018) to promote the implementation of IS networks within the agri-food and light manufacturing sectors? (ii) How do non-human entities (e.g., waste streams, ecosystems, technology) influence the reciprocal development of business models through a posthumanist perspective? (iii) How can these SMEs reconcile economic viability with posthumanist ethical commitments while using IS principles?

This research provides three significant contributions through the application of ANT within the Thai IS context. Initially, it proposes a non-anthropocentric framework for conceptualizing SME innovation, contesting traditional business model paradigms. Secondly, it offers empirical insights into localized waste-human interactions, highlighting the unique dynamics of industrial ecosystems in the Global South. Third, it delineates concepts for regenerative business design, integrating posthumanism theory with contextual SME practices.

The subsequent part examines theoretical underpinnings from Actor-Network Theory, Information Systems, and Capability-Based Management literatures. A comparative examination of BMC frameworks is next presented, along with a debate on circular logics. The document further delineates its approach and delivers conclusions from 15 Thai SME business plans.

Literature Review

The discourse on IS has progressed from initial notions of waste-to-resource cycles to advanced frameworks highlighting systemic transformation and collaborative engagement among multiple stakeholders (Baldassarre et al., 2019). Concurrently, business model theory has evolved from firm-level analysis to include networked, sustainable, and posthumanism perspectives (Burkhart et al., 2011). Researchers have investigated theoretical frameworks, including Actor-Network Theory, circular economy principles, and value chain structures, to facilitate the proliferation of Information Systems. Notwithstanding these developments, obstacles to implementation persist, including legal ambiguity, technological limits, and misalignment among stakeholders (Urbinati et al., 2021) (see also to Pongpiachan et al., 2018 for limitations linked to emission datasets). Evaluation mechanisms remain inadequately established, with limited research providing substantial performance measures to evaluate the enduring effects of information systems on socio-ecological systems (Martin et al., 2012). Santolin et al. (2023) emphasize a continued deficiency of integrative frameworks that can consolidate these varied elements. This study addresses these gaps by integrating theoretical ideas with empirical patterns through a posthumanism perspective and creating a synthesis matrix to compare and analyze information systems literature.

Actor-Network Theory and the Decentering of Human Agency:

Actor-Network Theory (ANT) has transformed organizational studies by decentralizing the human subject and reconceptualizing agency as a relational outcome of both human and non-human actants (Muniesa & Callon, 2007; Law, 2009). Instead of viewing industrial materials as mere inputs, ANT emphasizes the active involvement of substances such as waste, wherein chemical qualities, classifications, or infrastructural frictions collaboratively shape organizational results (Hodson & Marvin, 2010). This perspective corresponds with posthumanist critiques of Cartesian dualisms, indicating that business models operate as socio-material assemblages, with strategy arising from unpredictable interactions among individuals (Doganova & Eyquem-Renault, 2009).

Posthumanism and the Ethics of Entanglement:

Posthumanism theory interrogates the human/nature dichotomy by emphasizing relationality, interconnectedness, and non-human forms of agency. Unlike anthropocentric innovation models, posthumanism perceives business as a domain of ethical coexistence, wherein multispecies entities—including bacteria, infrastructure, and waste—contribute to the creation of value. This viewpoint advocates for a transition from extractive paradigms to care-oriented economies, in accordance with Haraway's (2016) concept of sympoiesis and Tsing's (2015) ethnographic studies of ecological vulnerability.

Industrial Symbiosis as a Multispecies Practice:

Conventional interpretations of IS have been influenced by economic efficiency principles, emphasizing the transformation of waste into resources for cost and energy reduction (Chertow & Park, 2016). Recent interpretations regard IS as a process that transcends human agency, wherein material entities like microbiological organisms or seasonal cycles significantly influence viability and structure (Martin & Upham, 2016). In the context of SMEs in Thailand, information systems frequently develop through ecological improvisation; for example, the biological characteristics of food waste and the unpredictability of monsoon rains affect both infrastructure and strategy (Sueyoshi & Goto, 2019). This viewpoint underscores the necessity for models that incorporate uncertain yet dynamic potential, material responsiveness, and collective influence among human and non-human components (Hodson & Marvin, 2010).

Circular Business Models in Waste-Driven Economies:

Circular economy business models (CBMs) have arisen as essential frameworks for reevaluating value creation beyond linear extraction, production, and disposal methods. In contrast to traditional business models that focus on maximizing throughput, Circular Business Models prioritize resource circularity, prolongation of product lifespan, and value regeneration within ecosystems (Geissdoerfer et al., 2017). These models aim to reduce waste by converting output into reusable inputs, integrating sustainability into the fundamental framework of corporate strategy (Lewandowski, 2016). CBMs manifest in various ways, including product-as-a-service, remanufacturing, upcycling, and IS, each fostering circularity through unique processes (Bocken et al., 2016). Their incorporation into SME contexts is inadequately understood, especially in emerging economies where ingrained local traditions influence innovation pathways (Ranta et al., 2018). This study situates CBM within a posthumanist framework by examining the roles of trash, infrastructure, and biological systems as co-designers of value (Whalen & Whalen, 2022).

The Business Model Canvas as a Human-Centric Framework:

The Business Model Canvas (BMC) is a prevalent instrument in entrepreneurial ecosystems; yet, its design embodies a human-centered perspective that relegates ecological systems to the status of passive resources (Osterwalder et al., 2014; Bocken et al., 2019). Academics have challenged this rigid and modular perspective, contending that actual business models are more dynamic, emergent, and interrelated (Geissdoerfer et al., 2020). Utilizing an ANT perspective illustrates that each canvas block—such as "Key Resources" or "Customer Segments"—can be reconceptualized as contested domains where germs, policy, and environment negotiate value. In Thai contexts, ecological cosmologies that ascribe personhood to rivers or forests challenge Western managerial assumptions and promote more inclusive logics (Lim, 2019).

A Framework for a Posthumanism Business Model:

The integration of concepts from Actor-Network Theory, Information Systems, and posthumanism facilitates the development of novel frameworks that are responsive to ecological interconnections. Soil microbes may constitute a valid "customer segment" for compost-based products, whilst government rules serve as gatekeepers or "obligatory passage points" (Callon, 2021). Yet these points can be rewritten by climate anomalies, invasive species, or infrastructural breakdowns. This study advocates for collaborative and adaptive models of regeneration that involve both human and non-human actors, emerging from dynamic interactions among entrepreneurs, environments, and institutions, rather than a top-down, human-led approach (Haraway, 2016; Barry, 2013). In this perspective, Thai SMEs traversing intricate biological landscapes illustrate how commercial innovation can arise from interspecies interactions.

Table 1. Comparison Between Conventional and posthumanism Business Model Canvas (Thai IS Context)

BMC Component	**Conventional Business Model Canvas**	**Posthumanism Business Model Canvas (PHBMC) (Actor-Network View with Thai Industrial Waste)**
Key Partners	Human stakeholders such as suppliers, government agencies, and waste processors	Includes non-human actors such as microbial ecosystems, waste-treatment infrastructures, composting systems, and regulatory materials
Key Activities	Waste collection, recycling, cost-reduction logistics	Material negotiations and infrastructural choreography involving waste flows, chemical cycles, and ecological actors
Key Resources	Machinery, licenses, financial capital, skilled labor	Waste itself as an *agential resource*—its toxicity, decay cycles, and resistance shape operational limits and innovations
Value Propositions	Providing efficient waste management, turning waste into marketable resources	Co-producing ecological regeneration, building multispecies value, and creating ethical reciprocity with local ecosystems
Customer Segments	Industrial clients, municipalities, and recycling partners	Expands to more-than-human beneficiaries—such as soil microbiomes requiring compost nutrients or future generations depending on ecological stability
Channels	Physical distribution, third-party waste handlers, or digital platforms	Material channels embedded in circular system biogas tanks, microbial pathways, decentralized community networks
Customer	Contracts, service agreements,	Relational accountability through care ethics—

Relationships	and feedback systems	mutual maintenance between businesses, communities, and environmental systems
Revenue Streams	Waste disposal fees, product sales, cost savings	Reconceived as *relational value*, including community trust, ecological resilience, and long-term policy alignment, not just financial income
Cost Structure	Operational costs: energy, technology, logistics	Material and ethical obligations—such as maintaining ecological balance, mitigating runoff, or compensating affected ecosystems

Table 1 illustrates a significant ontological transformation in the how Thai SMEs perceive business models inside IS frameworks. The investigation demonstrates how posthumanism perspectives substantially alter the components of traditional business models when contrasted with conventional viewpoints. The conventional Business Model Canvas (BMC) focuses on human agents and economic value, whereas the posthumanism Business Model Canvas (PHBMC) acknowledges waste streams, ecological systems, and material characteristics as integral contributors to value creation (refer to Pongpiachan et al., 2013 for occupational implications of PCDD/PCDF exposure in information systems contexts). For example, although conventional models regard waste as a passive input, the PHBMC perceives materials such as PIR foam or banana stems as co-designers that actively influence production processes and product design through their chemical qualities and breakdown rates. Likewise, customer segments extend beyond human consumers to encompass soil microbiomes, urban air quality, and future generations. This reorientation embodies a comprehensive posthumanist critique of anthropocentrism in business theory, positioning SMEs as dynamic networks of human and non-human agents negotiating value through material and ecological interactions. The PHBMC provides a theoretical progress by contesting the human exceptionalism included in conventional business tools, as well as a practical framework for creating regenerative firms that implement concepts of multispecies justice and material reciprocity.

Alongside posthumanism critiques of anthropocentric business models, institutional frameworks like the United Nations Industrial Development Organization (UNIDO) provide a systemic articulation of IS. UNIDO delineates IS by five fundamental characteristics: (i) cooperation among various companies; (ii) utilization of by-products or waste as resource inputs; (iii) spatial closeness; (iv) reciprocal economic and environmental advantages; and (v) enduring relationships and trust development (UNIDO, 2018). These criteria underscore that symbiosis encompasses not merely material exchange but also governance, embeddedness, and institutional support. Although UNIDO's model is mostly functional, its focus on closeness, inter-organizational collaboration, and continuity aligns with posthumanist issues of entanglement and multispecies interdependence. This study employs UNIDO’s five-part framework not as a strict template but as an analytical structure to examine how Thai SMEs participate in more-than-human circularity and symbiotic innovation.

Methodology And Data Source For Analysis

This qualitative study employs Thematic Analysis to identify, analyze, and interpret patterns across textual data derived from business planning documents. Thematic Analysis, as outlined by Braun and Clarke (2006), is a flexible yet rigorous method for analyzing qualitative material, particularly suited to studies that seek to synthesize complex organizational frameworks. The analytical framework adopted in this study integrates four theoretical components: (i) the nine elements of the Business Model Canvas (Osterwalder & Pigneur, 2010), (ii) five core elements of Value Chain Management (Porter, 1985), (iii) three structural components of the Circular

Business Model (Geissdoerfer et al., 2020), and (iv) five defining characteristics of IS, as conceptualized by the United Nations Industrial Development Organization (UNIDO, 2018).

The coding process was conducted manually using a deductive-inductive approach. Codes were initially structured from theoretical constructs (BMC, Value Chain, CBM, UNIDO IS), then refined through iterative reading of business plan data. This process aligns with an interpretivist ontology suited to posthumanism inquiry, where themes are not merely categorized but co-constructed with the data context. Coding consistency was ensured through repeated internal validation, though no inter-coder reliability was applied.

The primary data for this study consists of 15 business plans submitted under the sub-project "Capacity Building to Support Business Model Competition and Implementation", a component of the national program "The Application of Industry-Urban Symbiosis and Green Chemistry for Low Emission and Persistent Organic Pollutants-Free Industrial Development in Thailand". This initiative, implemented between August 29, 2022, and October 29, 2023, was jointly led by the Department of Industrial Works (Thailand), UNIDO, and affiliated organizations. It aimed to empower small entrepreneurs, community enterprises, and innovators to create new value from industrial waste and by-products in alignment with the principles of industry–urban symbiosis, while also contributing to the reduction of greenhouse gas emissions.

The selected business plans reflect diverse approaches to waste valorization and symbiotic design and were sourced from across 54 designated eco-industrial zones in 39 provinces nationwide, under the umbrella project "Ploydai ... Pasuk". Thematic Analysis was applied to these documents using a deductive-inductive coding strategy: initial codes were informed by the theoretical components mentioned above, while emergent patterns were allowed to refine the coding scheme. The value chain perspective supported the identification of core–periphery structures, highlighting how symbiotic relations and trust evolved between central actors and peripheral collaborators (Gereffi & Fernandez-Stark, 2016).

Analytical Strategy

Drawing on the three-level coding structure, this study employed comparative mapping across the value chains of 15 SME business models. Patterns were analyzed to identify how circular strategies and posthumanism ethics emerged in each business model block.

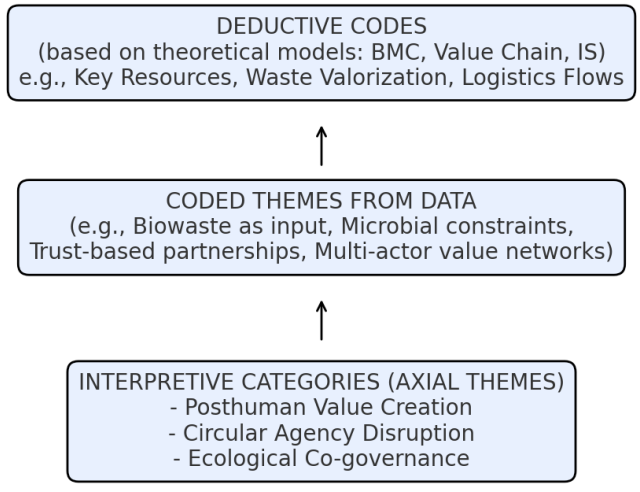

Figure 1. Thematic Coding Strategy Diagram

This study utilizes a thematic analysis constructed through a multi-level coding process that combines deductive and inductive methods. This framework is illustrated in the Thematic Coding Strategy Diagram (refer to Figure 1) and implemented via Table 5 in the Findings section, which collectively delineates the analytical correlation between theoretical constructs and empirical patterns throughout the 15 SME business plans.

At the deductive level, preliminary codes were extracted from four converging theoretical frameworks:

(i) the company Model Canvas (Osterwalder & Pigneur, 2010), emphasizing company structuring principles;

(ii) Value Chain Management (Porter, 1985), highlighting process-oriented value generation.

(iii) the Circular Business Model framework (Geissdoerfer et al., 2020), emphasizing regeneration product and service cycles; and

(iv) UNIDO's IS standards (UNIDO, 2018), which specify characteristics of waste-based collaboration among stakeholders. These models offered a framework for recognizing essential organizational elements and sustainability mechanisms inherent in the data.

The second level, consisting of coded themes from the business plans, identified recurring terminology, methods, and patterns—such as microbiological limitations in composting systems, biowaste valorization as a form of innovation, and trust-based collaborations with local stakeholders. Themes were coded repeatedly, involving reciprocal refinement between theory and data to ensure contextual relevance.

At the tertiary level, axial categories surfaced via interpretive synthesis. The categories—Posthuman Value Creation, Circular Agency Disruption, and Ecological Co-governance—exemplify a profound theoretical interpretation influenced by posthumanist philosophy and actor-network theory. They emphasize that business models are not only economic frameworks, but socio-material configurations influenced by the collective impact of human and non-human components, including trash, policies, microbiological systems, and human agents.

This multifaceted approach enabled the study to maintain theoretical rigor while being empirically attuned to the intricate interconnections uncovered in the business plans.

The Discovery: Business Model Patterns Informed by Posthumanism

The cross-case analysis of 15 SME business plans included in the IS program indicates a significant shift from anthropocentric principles often linked to business model innovation. A comparison analysis of the Business Model Canvas (BMC) and a modified posthumanism Business Model Canvas (PHBMC) revealed significant themes, as detailed below.

I. Eco-centric and Relational Value Propositions

Most business strategies expressed ecological or regenerative value propositions that transcended human benefit. Offerings such as "Eco Block", "Banana Good Case", and "R-AA-K Biofertilizer" emphasized biocompatibility, biodegradability, or carbon reduction—reframing value as ecological regeneration rather than market differentiation.

II. The Rise of More-than-Human Customer Logics

Numerous programs broadened client groups to include entities outside human customers. For example, "Health to Wealth" focused on schools as ethical ecosystems, while "Chan Rong Thapma" positioned its soap as a solution to environmental problems like PM2. 5. These instances exemplify the conceptual expansion of customerhood to encompass public infrastructure, biophysical systems, and future generations.

III. Waste as a Fundamental Resource and Catalyst

In a minimum of eight initiatives, industrial or biological waste materials functioned not merely as passive inputs but as active limitations and opportunities. The utilization of PIR foam waste by "Eco Block" and the sock loops by "Maliburi" exemplifies how material characteristics influenced product design, manufacturing, and promotion. Waste has become a co-architect of corporate logic.

IV. Conflicts Between Posthumanism and Capitalist Principles

Despite posthumanism tendencies, several cases—such as OEM-targeted ventures or branding-driven products—revealed the persistent influence of market logics. This highlights a hybridity in which SMEs navigate between posthumanist ethics and profit motives.

V. Comparative Analysis of BMC and posthumanism BMC (PHBMC)

The juxtaposition of conventional BMC categories with their posthumanism counterparts revealed key ontological shifts. In the PHBMC, value propositions were redefined as regenerative covenants, key resources included agential waste streams, and customer segments expanded into more-than-human publics. Table 2 summarizes these structural differences.

VI. Analytical Derivation of Posthumanism Framework from Thematic Coding

The emergence of the posthumanism Business Model Canvas was not arbitrary but analytically grounded in a multi-level thematic coding strategy. Figure 1 illustrated this three-tier structure, beginning with deductive codes from BMC, value chain, and circular economy theory, followed by emergent thematic categories and interpretive abstractions.

These interpretive categories—Posthuman Value Creation, Circular Agency Disruption, and Ecological Co-governance—formed the theoretical scaffolding from which the PHBMC framework was derived. Table 2 below presents a crosswalk connecting initial codes, empirical findings, and their corresponding PHBMC components.

Table 2. Comparative Summary of BMC vs posthumanism BMC

BMC Component	**Conventional View (SME Logic)**	**Posthumanism BMC (Actor-Network Lens)**
Key Partners	Suppliers, government agencies, OEM partners	Human-nonhuman alliances (e.g. microbes, policy documents, infrastructure)
Key Activities	Production, marketing, logistics, training	Symbiotic choreography (e.g. waste flow co-ordination, seasonal adaptation)
Key Resources	Labor, machines, raw materials, facilities	Waste as agential input (e.g. behavior of banana stems, foam, manure as actants)

Value Proposition	Marketable benefits (e.g. low cost, eco-friendly features)	Value as multispecies flourishing (e.g. soil health, climate resilience, community restoration)
Customer Segments	Demographic groups (urban consumers, farmers, exporters)	More-than-human publics (e.g. schools, forests, future generations)
Customer Relationships	Customer service, loyalty programs, education	Ethical care relationships, ecological feedback, ritualistic ties
Channels	Retail stores, fairs, online platforms	Material flows and biophysical conduits (e.g. compost pathways, water reuse loops)
Revenue Streams	Sales of products/services, OEM contracts	Value beyond price: ecological reciprocity, relational recognition
Cost Structure	Fixed + variable costs (materials, utilities, logistics)	Costs as ethical obligations (e.g. biowaste management, communal upkeep)

The integration of thematic coding with posthumanism theorization ensured analytical transparency and provided empirical legitimacy to the proposed model. It bridges raw data with theoretical advancement, affirming that posthumanism logics in Thai SME contexts are not imposed but emerge organically through socio-material entanglement.

Table 3. Crosswalk: Deductive Codes → Emergent Findings → Interpretive Categories

Deductive Code / Theme	**Emergent Finding**	**Interpretive Category**
Key Resources (BMC)	Waste as Configurational Actor	Circular Agency Disruption
Customer Segments (BMC)	Distributed Customerhood	Ecological Co-governance
Value Proposition (BMC)	Relational Regeneration	Posthuman Value Creation
Waste Valorization (Circularity)	Compost, ash, or foam becoming central actants in innovation	Circular Agency Disruption
Logistics Flows (Value Chain)	Infrastructure and seasonal cycles disrupting distribution	Ecological Co-governance
Trust-based Partnerships	Localized mutuality as condition for ecosystem co-design	Ecological Co-governance

Table 3 delineates the presence and distribution of the five defining elements of IS as specified by UNIDO (2018) across 15 circular business models driven by Thai SMEs. Each row represents an IS principle, indicating its frequency of occurrence across the plans, and offers illustrated examples from particular circumstances. The table illustrates that waste valorization (Characteristic 3) was consistently observed, reinforcing the importance of by-product usage within the IS philosophy. Multi-sectoral collaboration (Characteristic 1) was notably widespread, with numerous initiatives functioning at the convergence of commercial enterprises, governmental entities, and community networks. Geographic proximity (Characteristic 3) and mutual benefit (Characteristic 4) were commonly observed, although long-term trust-building (Characteristic 5) was less consistent, typically arising in models featuring cooperative or instructional elements. These findings indicate that whereas fundamental symbiotic

mechanisms—such as material reutilization and proximity—are firmly established, the more relational and institutional aspects of IS (e.g., enduring relationships) may still be developing within grassroots Thai contexts. Consequently, the table not only substantiates the significance of the UNIDO framework but also emphasizes places where posthumanism symbiosis may intensify through socio-material continuity.

Applying the Value Chain to Industrial Symbiosis Innovation

Table 4. The analysis of the Value Chain to IS Innovation

	Project Name	**Inbound Logistics**	**Operations**	**Outbound Logistics**	**Marketing & Sales**	**Service**	**Support Activities (Selected Examples)**
1	Eco Block	Collection of waste materials (e.g., foam, paper, organic waste)	Foam-based brick manufacturing	Transport to construction sites and local buyers	Eco-benefit storytelling, exhibitions	Workshops and prison reintegration	Training via university and NGO partners
2	Ban Saphan Hin	Banana sheath delivery and rubber procurement	Banana phone case crafting	Eco-packaging and mailing	Product branding as biodegradable lifestyle	Social media customer support	R&D with bioplastic labs
3	Arak Group	Ash and CBD byproducts sourced from factories	Spiritual item molding and finishing	Packed for exhibition and temple delivery	Spiritual meaning and decor aesthetics	Workshop co-design	Collaboration with temples, artisans
4	Chom Muang (Chomruam)	Sock loops sourced from textile waste	Sock loop handcraft production	Market-ready packaging	Social media handcraft community	Artisan demonstration and training	Local women's co-op organization
5	Palang Rak	Pallet and tire pickup from industrial donors	Furniture assembly and design	Furniture shipping via partners	Eco-circular branding and design	Furniture maintenance education	Design input from tourism sector
6	Health to Wealth	Agro-waste (molasses, palm fiber) collected from mills	Biofertilizer composting and blending	Distribution to farm supply shops	Farm demos and soil test promotion	Consulting for fertilizer use	University lab input and government certification
7	Chan Rong Thapma	Natural dye plants and bark from farms	Boiling and extraction of natural dyes	Creative fair delivery	Community wisdom, well-being branding	Dye workshop and co-creation	Community artist knowledge networks
8	Chak Yai Jeen Handicraft	Pallet wood collected from packaging donors	Carpentry and polishing	Retail and cafe-based stock	Online listing and festival booths	Guarantee and delivery support	Design support via agro-tourism branding
9	Banana Good Case	Molasses, manure and sludge mixture delivered	Biofermentation and R&D testing	Sack and pot-based product sale	Content on soil health impact	Demo plots and member advisory	Standards certification and lab testing
10	Tha Takroh Woven Crafts	Paper tape supply from SCGP	Basket weaving from paper tape	Exhibition and delivery via Shopee	Handcrafted local identity	Basketry design adaptation	Cultural knowledge and OTOP branding
11	Maliburi Sock Ring Crafts	Silk waste sourced from office discards	Handmade stationery crafting	Direct sale to consumers	Story-based branding for stationery	Post-sale craft support	Stationery design guidance
12	R-AA-K	Plastic strips from packaging suppliers	Basket weaving from plastic	Roadshow and consignment drop	Zero-waste storytelling	Educational events	Packaging co-design with SCGP

13	Auan Glom (Happy Farm)	CBD and bee resin extraction materials	Soap formulation with CBD resin	Soap bundling and shipment	Health-conscious marketing with PM2.5 focus	Soap use education and feedback	FDA certification and bioscience R&D
14	Rak – R~AA~K Biofertilizer (Tha Rong Chang)	Fly ash supplied by SCGP partners	Casting and decoration	Display in OTOP or trade fair	Regenerative culture pitch	Post-expo customer tracking	Spiritual and mythological advisors
15	Furniture by Nine	Bio-soil raw mix from household waste	Soil pellet processing	Retail packaging	Membership and awareness campaigns	Soil training in schools	Tech support from DIW incubators

The utilization of Porter's Value Chain Model in the analysis of 15 SME business plans demonstrates the complex integration of IS innovation throughout the phases of value generation. Inbound logistics predominantly encompassed the procurement of various waste materials—including PIR foam, paper tape, banana sheath, and agricultural sludge—illustrating active waste exchange and input substitution, in alignment with the initial phase of IS (UNIDO, 2018). Operations predominantly focused on converting these waste materials into value-added products, such as furniture, eco-soap, fertilizer, and crafts. This signifies the "transformation and innovation" phase in Information Systems, when waste is redefined as a resource via process reengineering and material experimentation. Outbound logistics, typically a technical function, evolved into an adaptive activity in these companies, accommodating delicate recycled products and informal distribution through fairs, community hubs, and social enterprise platforms. Marketing and sales prioritized narrative techniques, ethical branding, and digital localization, corresponding with "market integration" inside information systems ecosystems. The "service" component often served as a bastion of posthumanism, incorporating ecological stewardship, the reintegration of disenfranchised labor (such as incarcerated individuals), and the dissemination of information via workshops. Support activities, including university research and development collaboration, certification initiatives, and artisan co-design, demonstrate systemic infrastructural frameworks that enable information systems to flourish at the grassroots level of small and medium-sized enterprises. These value chain innovations not only expand the IS paradigm but also illustrate how Thai SMEs reconceptualize waste flows as opportunities for co-creation rather than just exchange—presenting a persuasive model for regenerative entrepreneurship.

Posthumanism-Informed Business Model Patterns

Table 5. Summary of Cross-Case Thematic Categories

Theme Category	Count (out of 15)
Eco-centric Value Propositions	11
Health/Social Integration Value	6
More-than-human Customer Segments	7
Export/OEM Human Customers	3
Organic/Waste-based Resources	8
Technological/Certification-based Resources	4

The cross-case analysis of 15 SME business plans participating in the IS initiative reveals a significant departure from anthropocentric logics traditionally associated with business model innovation. Each theme corresponds to a recurrent configuration observed through inductive-

deductive coding and is aligned with components of the posthumanism Business Model Canvas (PHBMC). The table highlights how ecological logics, more-than-human agency, and material interdependence are recurrently embedded within value creation strategies. The frequency of each theme reflects its cross-case salience, and example cases illustrate how Thai SMEs operationalize posthumanism and symbiotic principles in diverse contexts, as summarized in Table 5.

Through comparative analysis using the Business Model Canvas (BMC) framework, several posthumanism themes emerged

I. Eco-centric and Relational Value Propositions

Eleven of the fifteen business models explicitly articulate ecological or regenerative value propositions, often combining environmental restoration with waste valorization. Projects such as Eco Block, Banana Good Case, and R-AA-K Biofertilizer emphasize biocompatibility, biodegradability, or carbon reduction, suggesting a shift from value as market differentiation to value as ecological regeneration.

II. Emergence of More-than-Human Customer Logics

While most ventures maintain conventional customer segments (e.g., B2B, retail consumers), seven projects engage more-than-human perspectives, either directly or metaphorically. Health to Wealth targets schools not only as buyers but as ethical ecosystems fostering public hygiene. Chan Rong Thapma's anti-PM2.5 soap appeals to urban ecologies rather than individuals alone, indicating a conceptual broadening of customerhood.

III. Waste as Key Resource and Agent

Eight cases rely on organic or industrial waste—such as banana stems, foam, fly ash, and CBD byproducts—not simply as inputs, but as actants that materially constrain and enable business practices. In several cases, the composition and behavior of waste determined product form, pricing strategy, and even marketing narratives, reinforcing the idea that waste configures value systems, rather than merely feeding them.

IV. Tensions Between posthumanism and Capitalist Logics

Despite these innovations, only a minority of cases (2 cases) reflect deep integration of social or rehabilitative ethics, such as prison labor reintegration or spiritual cultural preservation. Meanwhile, three projects target OEM and export markets, suggesting an ongoing tension between posthumanism aspirations and capitalist imperatives. This highlights a spectrum where Thai SMEs navigate hybrid logics—seeking profitability while engaging ecological entanglements.

Applying UNIDO's Industrial Symbiosis Framework to Thai SME Models

Table 6. five defining characteristics of IS as outlined by UNIDO

UNIDO IS Characteristic	**Observed in Plans (approximate count)**	**Examples from Thai SME Plans**

1. Collaboration among diverse organizations	14	Eco Block (prison, Vintherms, municipality), Furniture by Nine (CPRAM, Khao Mai Kaew Shelter)
2. Use of by-products or waste as resource input	15	All projects: PIR foam, banana sheath, paper, sludge, sock loops, CBD resin
3. Geographic proximity	14	Maliburi (local textile reuse), R-AA-K (local compost input), Arak (OTOP network)
4. Mutual economic and environmental benefit	14	Banana Good Case (zero waste + youth market), Health2Wealth (hygiene + green chemistry)
5. Long-term relationship and trust-building	12	Chak Yai Jeen (senior artisan co-op), Tha Rong Chang (university partnership), Eco Block (reintegration)

To further contextualize the symbiotic logic embedded in the 15 Thai SME business models, this study applied the five defining characteristics of IS as articulated by the United Nations Industrial Development Organization (UNIDO, 2018). The analysis reveals a high degree of alignment between grassroots circular entrepreneurship and systemic IS principles as shown in Table 6.

I. Collaboration among diverse organizations was observed in 14, often involving partnerships between local government agencies, private firms, NGOs, and community actors. For example, Eco Block brought together a thermal foam company, correctional institutions, and municipal actors to co-develop construction materials, while Furniture by Nine engaged agrotourism networks and refugee shelters.
II. Use of by-products or waste as resource input was universal across all projects. Each business model explicitly repurposed industrial or agricultural waste streams—including PIR foam, banana stems, fly ash, molasses sludge, and sock loops—into new value-added products.
III. Geographic proximity played a substantial role in 14 plans. Projects like Maliburi, Arak Group, and R-AA-K leveraged locally sourced waste and labor, minimizing transportation needs and embedding production within the surrounding community ecosystem.
IV. Mutual economic and environmental benefit appeared prominently in 14 plans. Enterprises such as Banana Good Case and Health to Wealth not only created income streams but also supported ecological goals like zero waste and community hygiene, demonstrating symbiosis between economy and ecology.
V. Long-term relationships and trust-building was evident in 12 cases, particularly those rooted in cooperatives, reintegration programs, or academic partnerships. Chak Yai Jeen's senior artisan co-op and Tha Rong Chang's university-linked R&D illustrated how trust-based collaboration enables stable and adaptive IS systems.

This framework reinforces the finding that Thai SME-led IS is not simply an economic reaction to resource scarcity, but a socially embedded, networked response shaped by proximity, mutuality, and long-term cooperation. The alignment with UNIDO's IS model supports the ecological legitimacy of the symbiotic innovations identified in this study.

DISCUSSON

The implementation of Resource Dependence Theory underscores the notion that business model innovation in Information Systems contexts is inherently related. Instead of perceiving enterprises as independent entities, RDT elucidates how SMEs reorganize their operations in response to varying dependencies, including waste inputs, energy recovery systems, and stakeholder requirements. By merging this theoretical framework with a posthumanist perspective, the study highlights the dynamics of power, uncertainty, and collaboration that function not only within corporations but also inside more-than-human networks. This study enhances posthumanism business literature by demonstrating how Thai SMEs redefine agency inside information systems models, framing trash as a co-constitutive actor rather than a mere passive input. Utilizing an ANT perspective, we illustrate that material actants influence SME tactics in two primary manners: physically (e.g., breakdown rates of banana stems) and symbolically (e.g., cultural significance of sacred ash), hence contesting the anthropocentrism inherent in conventional business frameworks such as the BMC. Our research challenges three assumptions: (i) the notion of human exclusivity in innovation, by demonstrating how the characteristics of waste influence product design (e.g., Eco Block's foam waste); (ii) the dichotomy of profit versus ethics, as SMEs amalgamate capitalist and posthumanist principles (e.g., Chan Rong Thapma presenting soap as "PM2.5 mitigation for urban ecologies"); and (iii) the concept of universalist posthumanism, by situating theory within Thai ecological cosmologies (e.g., Buddhist animism facilitating Arak Group's spiritual repurposing of CBD byproducts).

We propose a sympoietic business paradigm (Haraway, 2016) that reconceptualizes value production as a multispecies negotiation, integrating ANT's emphasis on materiality with the ethical mandates of posthumanism. The posthumanism BMC (Table 1) serves as a framework for regenerative entrepreneurship, advocating for measurements that extend beyond financial gain, such as soil health as a "customer segment". The limitations encompass the cultural distinctiveness of the Thai environment, prompting cross-regional comparisons. Future study should measure the influence of non-human agency and investigate the contribution of Indigenous ontologies to the decolonization of organizational theory. This study redefines SMEs as ecological mediators, with business models arising from dynamic human-nonhuman interactions—a crucial shift for economies confronting planetary challenges.

CONCLUSION

We reframe SME innovation using posthumanism and Actor-Network Theory (ANT), demonstrating how trash and non-human entities collaboratively shape IS business models in Thailand. Through the examination of 15 Thai SMEs, we illustrate that waste streams—rather than mere passive inputs—function as active agents that influence value creation, operational logistics, and customer interactions (e.g., fuel-dependent emission profiles from industrial boilers; Pongpiachan et al., 2021). Our findings contest anthropocentric corporate paradigms and provide three significant contributions to posthumanism scholarship and circular economy practices.

The study proposes a sympoietic business framework (Haraway, 2016), wherein SMEs operate as hybrid networks comprising both human and non-human entities (e.g., PIR foam waste shaping product design in Eco Block, or microbial communities affecting compost manufacturing schedules). This paradigm provides an alternative to the anthropocentrism of

the Business Model Canvas by redefining "key resources," "customers," and "value propositions" to encompass more-than-human action, representing a theoretical advancement toward multispecies justice in organizational studies.

Secondly, we elucidate the conflicts between capitalist and posthumanist paradigms in Thai SMEs. Some initiatives, such as Chan Rong Thapma, conceptualize PM2.5 reduction as ethical coexistence with urban ecosystems, whilst others, like OEM-focused schemes, emphasize market demands. This hybridity indicates that posthumanist entrepreneurship in the Global South does not dismiss profit but rather redefines it through ecological reciprocity—a subtlety lacking in Eurocentric posthumanist discourse.

The study elucidates how localized ecological ontologies, such as Thai Buddhist cosmologies that ascribe agency to rivers or forests, empower SMEs to implement posthumanist ethics. For example, Arak Group's utilization of sacred ash (CBD byproducts) in spiritual items illustrates how cultural narratives enhance the agency of waste. Such instances necessitate a reevaluation of "development" within sustainability policy, advocating for measurements that extend beyond GDP to encompass ecological co-governance (Tsing, 2015).

Implications for Theory and Practice

For posthumanism business studies: Our ANT-driven analysis calls for research into non-human stakeholder management—e.g., how policies or infrastructures act as "obligatory passage points" (Callon, 1986) in SME networks.

For policymakers: Supporting regenerative SMEs requires post-anthropocentric incentives, such as subsidies for waste's agential capacity or grants for community-microbe collaborations.

For entrepreneurs: The posthumanism BMC (Table 1) provides a tool to design businesses as ecological contracts, where value extends beyond profit to multispecies flourishing.

Limitations and Future Research

This study focuses on Thai IS contexts; comparative work in other Global South regions could test the framework's transferability. Longitudinal studies are also needed to assess whether posthumanism models endure under financial pressures. Finally, interdisciplinary collaborations (e.g., with environmental scientists) could quantify non-human actors' impact on SME resilience.

In closing, this research reframes entrepreneurship as a pluriversal practice (Escobar, 2018), where businesses thrive not by dominating nature but by entangling with it. As climate crises escalate, such posthumanism reorientations are not merely theoretical—they are existential necessities.

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Appendix: Supporting Tables and Diagram

Figure 1: BMC model coding

List	Project Name	Key Partners	Key Activities	Value Proposition	Customer Relationships	Customer Segments	Key Resources	Channels	Cost Structure	Revenue Streams
1	Eco Block	Vintherms Co., Temporary Prison, Nong Laluak Community	Lightweight brick production, skills training, product development, marketing	Fire resistance, insulation, eco-friendly from industrial waste, social reintegration	Public-private-community engagement, environmental value alignment	B2B (builders, developers), B2C (eco-conscious individuals, community projects)	PIR foam waste, prison/community labor, knowledge from Vintherms	Online (Facebook, website), offline stores, trade fairs	Materials, equipment, transport, labor, marketing	Product sales at THB 23/block, production ~10,400 blocks/month
2	Ban Saphan Hin	Local housewife network, Rayong Industrial Development Co., Private logistics	Production of organic soil enhancer, product quality control, marketing strategy	Soil enrichment, ease of use, odorless pellet form, uses household organic waste	Factory tours, membership system, customer feedback loop	Homeowners, office workers, condo dwellers, distributors, farmers	Dry bio-soil pellets, brand identity, inventory management system	Social media, household networks, partner storefronts	Product sourcing, operation costs, salaries	Retail and wholesale sales revenue
3	Arak Group	SCGP, craft artisans, OTOP networks, local frame makers	Waste upcycling, spiritual product creation, workshops and training	Cultural-symbolic value, emotional/spiritual resonance, decorative items	Sales via fairs (e.g., IMPACT), online engagement, product guarantees	Spiritual believers, artists, nature lovers, general consumers	Fly ash from SCGP, cultural symbolism, artisan input	Online shop, exhibitions, fairs	Raw materials, production equipment, logistics, marketing	Retail and custom product sales, educational visits
4	Chom Muang (Chomruam)	CP, ETA, housing authority, local government agencies	Handicraft, events, learning center	Unique design, lightweight and durable, eco-materials	Storytelling, friendly service, post-sale care	Professionals, tourists, public/private offices, students	Silk waste, recycled office paper	Facebook, TikTok, Shopee, Lazada, exhibitions	Raw materials, wages, shared benefits, equipment, admin	Retail product sales
5	Palang Rak	Siam Wire Co., TSN Wire Co., Rayong Tourism Group, prison system	Furniture production from waste	Supports circular economy, reuse of tires and pallets	Basic online and booth presence	Restaurants, hotels, furniture retailers	Used tires, wooden pallets	Facebook, trade fairs	Tire and pallet costs, labor, tools	Furniture sales profit
6	Health to Wealth	Local government, packaging producers, raw material networks, state agencies	Hand wash production, learning center, R&D, cost control	Functional (cleansing), emotional (gifting, story), BCG model	Fanpage, TikTok, workshop engagement	Project-based buyers (80%), B2C (20%), OEM (5%)	Visionary leadership, trained workers, proprietary formulas, certifications	Group location, e-marketplaces, fairs	Raw materials, packaging, certification, marketing, admin	Hand wash sales, workshop fees
7	Chan Rong Thapma	TNR Bioscience, Thai Nippon Rubber, universities, FDA, local authorities	Bee resin (propolis) and CBD soap production, R&D,	Natural antibacterial soap with hemp and bee propolis, eco-packaging	CRM system, workshops, post-sale care	Health-conscious, urban consumers, anti-PM2.5, nature-oriented buyers	CBD ingredients, certified factory, trained workforce	Online (e-commerce, FB), offline fairs, shop placements	Raw materials, certification, wages, overhead	Soap sales (THB 180 each), training/workshops
8	Chak Yai Jeen Handicraft	SCi, Siam Compressor, Local Municipality, Modern Dye Co.	Plastic strip basketry, community skill training, quality control	Upcycled industrial waste, senior citizen empowerment, zero waste branding	Social media engagement, roadshows, CSR gifting	Local residents, tourists, OTOP outlets, Japanese buyers	Used plastic strips, trained artisans, community co-op	Craft fairs, Facebook, local stores	Packaging, labor, marketing, delivery, utilities	Sales of handcrafted baskets, workshop fees
9	Banana Good Case	Thai Me Dee Interfood, Bio-Plastic Lab, Community Co-op	Manual crafting of banana stem phone cases, R&D, online marketing	100% biodegradable, customizable, blends eco-design with utility	E-commerce CRM, social media branding, story-driven design	Eco-conscious youth, Gen X-Y with disposable income, community fairgoers	Banana sheath, rubber latex, handweavers	Online platforms (FB, IG, TikTok), booths at events	Raw materials, labor, marketing, logistics	Case sales (~THB 250 each), branding partnerships
10	Tha Takroh Woven Crafts	SCG, SCGP, local authorities, retail partners	OEM production, basket weaving, customer-led design	Eco-friendly, reparable, unique handwoven designs, upcycled paper	Custom orders, exclusive OEM rights, design interaction	Government orgs, private offices, export clients	Soft & hard paper tape, traditional weaving skill	Facebook, Shopee, TikTok, exhibition booths	Labor, utilities, admin, transport, materials	Sales, OEM commissions, training workshops
11	Maliburi Sock Ring Crafts	Local OTOP & community development offices	Crafting rugs, bags, slippers from sock loops	Each product is handmade with unique aesthetics and sustainability	Facebook-based outreach, fan interaction, workshop events	Middle-aged women, homemakers, working women	Sock loops, local labor, handcrafted technique	Facebook, local markets, OTOP events	Sock loops (~20 THB/kg), production labor, tools	Sales, training service
12	R-AA-K Biofertilizer	University partners, organic networks, industrial donors	Fertilizer production, packaging, demo plot cultivation	Organic fertilizer from industrial/agricultural waste with certifications	Product training, field demos, post-sale consultation	Small & large-scale farmers, eco gardening community, OEM buyers	Compostable waste (molasses, sludge), animal manure, biolabs	Line OA, FB, TikTok, retail stores, fairs	Fixed: machines, depreciation; Variable: raw materials, logistics, staff	Fertilizer sales, vegetable sales, planter & pot sales
13	Auan Glom (Happy Farm)	Souvenir shops, Food manufacturers, Packaging firms, Agricultural cooperatives, Educational institutions	Product R&D, fermentation technology, showcasing carbon footprint reduction, collaboration with agri-network	Health-benefiting fermented drinks, carbon footprint labeling, product derived from natural fermentation	Education-based engagement, story-driven marketing, exhibitions, after-sales support	Health-conscious consumers, green lifestyle individuals, tourists, social enterprises	Fermented agricultural raw materials, probiotics, carbon footprint data, storytelling branding assets	Online marketing (FB, IG), partnership stores, trade events, carbon footprint certified networks	Equipment, raw materials, branding, standardization testing, distribution	Product sales (retail and educational), fermentation training programs, online market
14	Rak – R~AA~K Biofertilizer (Tha Rong Chang)	Surat Rajabhat University, Soil Station, organic networks, CP RAM, ThaiBev, Makro, Big C, local factories and fertilizer dealers	Biofertilizer production, marketing & distribution, demo plot cultivation, organic vegetable farming	Chemical-free soil enhancement, eco-safe, affordable high-quality compost, certified standard compliance	Product variety, post-sale advice, member system, demo plot visits, promotions, soil testing services	Retail: hobby gardeners, health-conscious individuals; Wholesale: large-scale farmers, dealers, OEM clients	Industrial waste (molasses, palm debris), animal manure, PUD-1 agents, composting plant, machinery, demo field	Facebook, TikTok, Line, direct sale shops, modern trade outlets, agricultural fairs, distributor networks	Fixed: machinery, branding, depreciation; Variable: raw materials, transport, labor, utilities, marketing	Compost sales (bulk/sack), organic vegetables, decorative pots, specialty soil blends
15	Furniture by Nine	Beko (wood supply), Khao Mai Kaew Temporary Shelter, Suphattra Land Agro-Tourism, local government offices	Design and production of handmade furniture, quality control, delivery, after-sales service	Durable, multifunctional, eco-friendly, handmade, circular economy, minimalist style, product warranty	Consultation services, free nationwide delivery (during festivals), quality guarantee	Urban professionals (30–45 yrs, mid-income), tourists, public/private institutions, real estate projects	Pallet wood, skilled labor, woodworking equipment	Retail cafes, agro-tourism sites, booths, online (Facebook, Shopee, Lazada)	Labor, tools/materials, transport, utilities, marketing	Furniture sales, educational workshops