

Strategic management of the green industry concept for entrepreneurs in Thailand: A systematic literature review



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ARTICLE INFO

Article history:

Received 24 October 2025

Received in revised form

7 February 2026

Accepted 11 February 2026

Keywords:

Strategy

Implementation

Management

Green industry

Sustainable

ABSTRACT

The purpose of this study is to evaluate the strengths, weaknesses, opportunities, and threats of Thai enterprises that implement the green industry concept and to examine appropriate strategic approaches for entrepreneurs who adopt these principles. This study uses documentary research and analyzes secondary data through descriptive analysis, content analysis, SWOT analysis, and the TOWS matrix. The findings indicate that Thai entrepreneurs have integrated green industry practices into their businesses, supported by government policies and incentives. However, they still face challenges, including strong market competition and high investment costs for green technologies. Therefore, strategic planning should focus on the effective use of local natural resources, responding to the increasing demand for sustainable products, building cooperation with governmental and private organizations, and applying cost-efficient green operations to reduce economic pressures on traditional industries. Furthermore, the Thai government should strengthen environmental regulations and provide tax incentives and financial support to businesses that adopt sustainable practices and green technologies.

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1. Introduction

In 2024, Thailand generated 27.20 million tons of solid waste; a total of 10.51 million tons of waste was reused, while 10.42 million tons were properly disposed of, and the amount of waste that was improperly disposed of totaled 4.73 million tons (Suma et al., 2026). Furthermore, the average daily waste discarded per person was 1.2 kilograms. Inadequate waste sorting also made it difficult to properly dispose of 27.6% of the waste produced. The management of plastic waste in Thailand achieved a formal collection rate of 89%, resulting in 11% remaining uncollected. Plastic waste was disposed of in sanitary facilities 52.6% of the time, recycled 21.4%, disposed of in unsanitary facilities 15%, openly burned 8.7%, disposed of on land 1.5%, and classified as another 0.6%. Furthermore, approximately 11% of the total generated solid waste was not reused and was instead disposed of in landfills, incinerators, and through dumping.

Annually, approximately 2.13 million tons of plastic waste are generated, primarily from single-use products such as hot bags, handle bags, cooler bags, plastic straws, plastic cups, and foam food packaging. However, recycling and upcycling initiatives manage to repurpose only 0.55 million tons of this plastic waste. Additionally, untreated plastic contributes around 0.08 million tons of waste each year, accounting for 3% of the total plastic waste. The Department of Industrial Works reported that Thailand produced 16.80 million tons of industrial waste in 2019, reflecting a 24 percent reduction from the prior year. Out of the total, 15.46 million tons were categorized as non-hazardous, whereas 1.34 million tons were deemed hazardous.

The Ministry of Industry of Thailand has implemented a green concept for low-carbon economies to tackle the increasing challenges of waste and climate change on a global scale, positioning it as a mission for sustainable development. Since 2010, the Ministry has implemented strategies via the "Green Industry" project to align industrial development with environmental and societal considerations. This initiative aims to improve the reputation, credibility, and public trust of the industrial sector, establishing a basis for the advancement toward a green economy. The Ministry of Industry has reported that the implementation of the Green Industry project

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<https://doi.org/10.21833/ijaas.2026.02.015>

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resulted in a reduction of Thailand's greenhouse gas (GHG) emissions over three years, from 2017 to 2019, totaling more than 164,473 tons of CO₂ equivalent annually. In 2017, greenhouse gas emissions declined by 12,528 tons of CO₂ equivalent. In 2018 and 2019, reductions continued, with decreases of 64,357 tons and 87,588 tons of CO₂ equivalents, respectively. Additionally, effective garbage disposal techniques have contributed to enhancements in waste management programs. The volume of industrial waste entering the management system has shown a consistent decline. In 2017, the system treated 32.95 million tons of industrial waste. This amount decreased to 22.02 million tons in 2018 and further dropped to 17.25 million tons in 2019. At the end of May 2020, the system had taken in 9.38 million tons of industrial waste. From 2018 until the end of May 2020, hazardous industrial waste management statistics recorded 1.2 million tons per year, 1.33 million tons annually, and 0.71 million tons each year, respectively.

As previously indicated, Thailand still faces significant waste management challenges that hinder the industry's efforts to transition to a green economy. One primary difficulty is the inadequate infrastructure for waste collection, transportation, and disposal. Despite Thailand's implementation of recycling programs and waste segregation measures, managing hazardous waste remains particularly challenging due to financial constraints and insufficient technology, posing potential threats to human health and the environment. The effectiveness of these efforts is further limited by a lack of public awareness and engagement, illicit imports of garbage from foreign countries, and the pervasive issue of plastic pollution (Mungkung et al., 2021; Wichai-Utcha and Chavalparit, 2019). Additionally, Thailand's industrial sector encounters significant barriers in waste management and the transition to sustainable manufacturing practices. Although the country has established frameworks for green growth, many initiatives remain voluntary, which may be inadequate to meet the nation's climate goals. Strengthening policy enforcement is crucial for a successful transition; the industrial sector's dependence on fossil fuels obstructs efforts to reduce carbon emissions. Investments in renewable energy and clean technologies are essential to diminish this reliance, and the shift to a green economy requires a workforce skilled in sustainable practices.

To promote equitable and sustainable development, Thailand is dedicated to leveraging global trends toward economic growth and a green transition, as stated in the description above. The emphasis is on optimizing resource efficiency, minimizing greenhouse gas emissions, and fostering sustainable production and consumption. Thailand's green industry objective in 2025 is for all industries in Thailand to attain full compliance with the green industry (GI) requirements, guaranteeing that GI-certified factories function with safety, environmental stewardship, and minimal impact on

adjacent communities and the environment. Thailand emphasizes green productivity, promoting economic and social advancement while considering environmental factors. The concept of green industry in Thailand is actively promoted through policies set by the Ministry of Industry, which encourages businesses to adopt environmentally friendly production processes. The Green Industry Mark standard serves as a certification tool for factory sustainability and supports the implementation of clean technology and efficient resource management. In addition, the government collaborates with the private sector and local communities to establish green supply chains. Moreover, Thailand's industrial sector offers both investment and marketing incentives to facilitate the practical implementation of these initiatives (Youngswaing et al., 2024).

As mentioned above, the analysis of the green industry for Thai industries is essential, as it offers data on sustainable production and consumption trends. It helps identify opportunities and challenges that Thai entrepreneurs may encounter in adapting to these trends. Additionally, this analysis acts as a valuable resource for developing policies and strategies that align with international standards. Ultimately, it boosts Thailand's competitiveness in an increasingly environmentally conscious global market. Furthermore, effective management of the green industry enables Thai industries to increase efficiency and reduce operational expenses. It allows companies to comply with environmental regulations and improve their market competitiveness. Embracing the green concept fosters innovation in eco-friendly products and sustainable processes. Overall, it supports long-term industrial growth while promoting environmental responsibility. This study presents a SWOT analysis (strengths, weaknesses, opportunities, and threats) of Thai firms that include the green industry idea and recycled materials in their production processes. We examine the strategic management of firms that embrace the green industry concept and the consequences for the implementation of this concept in enterprises and industrial estates for sustainable business development.

2. Conceptual framework

Green industry refers to manufacturing and industrial activities that prioritize environmental sustainability, efficient use of resources, and the reduction of pollution (Harrison et al., 2017; Veugelers et al., 2024). Green industry management requires careful consideration of several important factors to ensure that industrial operations are consistent with sustainability and environmental objectives.

One of the main elements of the green industry is environmental sustainability. This concept focuses on controlling pollution, reducing waste, using renewable energy sources, and lowering carbon emissions. It involves managing production processes and business activities in a way that

respects the environment's capacity to support long-term resource use. The primary goal is to continuously reduce negative impacts on ecosystems.

Green industries must therefore improve energy efficiency, decrease emissions, reduce pollution and greenhouse gases, and encourage recycling and the use of renewable resources. In addition, product design and manufacturing processes should be environmentally responsible. Environmental sustainability also emphasizes the protection of biodiversity and the restoration of natural resources.

An important component of the green industry is green manufacturing. Green manufacturing aims to minimize waste and pollution at all stages of production. It promotes the efficient use of energy and raw materials to reduce environmental impacts while maintaining economic sustainability (Dahlquist, 2021; Grillitsch and Hansen, 2019).

Regulatory and policy frameworks play a critical role, since government standards, international agreements, and compliance with environmental laws guide organizational practices. Regulatory and policy frameworks are vital tools for aligning industrial development with environmental sustainability goals. Governments must enact laws, standards, and regulations that govern resource use, energy consumption, and waste management. Industrial organizations are required to comply with relevant regulations, including those that address pollution and measures aimed at reducing greenhouse gas emissions. In addition, support mechanisms such as tax incentives, subsidies, and other financial incentives are essential for businesses that pursue green initiatives. Policy frameworks encourage collaboration among government, corporate, and civil society sectors to facilitate the transition to a green economy. Strong legal and legislative frameworks can effectively promote and enforce sustainable practices within the industrial sector. Moreover, the availability of inexpensive, non-sustainable products in the market reduces the attractiveness of green transitions, while infrastructure deficiencies, such as inadequate recycling facilities and renewable energy grids, impede progress. Additionally, complexities within supply chains and resistance to shifts from traditional practices further obstruct advancement, and regulatory gaps and inconsistent regulations create uncertainty for businesses. To tackle these challenges, policymakers, businesses, and researchers must work together to develop structured plans for long-term progress in the industry (Bendig et al., 2023; Goyal et al., 2019; Kannan et al., 2022; Sarasi et al., 2024).

Technological innovation must be prioritized, especially the implementation of sustainable technology, cleaner industrial methods, and digital solutions for resource efficiency. The focus is on developing and applying technology designed to minimize environmental impact. Industries should allocate resources for research and development to incorporate clean technology into production

processes, which will reduce energy consumption, raw material usage, and emissions. Furthermore, combining automation and digital technologies like the Internet of Things (IoT), Artificial Intelligence (AI), and Big Data can make resource management more accurate and efficient. In addition, recycling and the use of renewable raw materials are also crucial components of the circular economy. Green innovation helps the environment stay healthy and makes industries more competitive in the global market. Technological advancements in renewable energy, biomaterials, and carbon management systems help maintain a balance between economic growth and environmental protection. Furthermore, progress in green technologies, through interdisciplinary approaches focused on environmental sustainability, drives advancements in the green sector (Asiaei et al., 2023; Kannan et al., 2022; Khan et al., 2024).

Supply chain and stakeholder collaboration is significant, requiring integration of sustainable practices across suppliers, distributors, and customers. It focuses on building partnerships between supply chain stakeholders, from manufacturers, distributors, and customers to government agencies and communities. In addition, stakeholder collaboration facilitates information exchange, improves manufacturing processes, and reduces environmental impacts. Such integration also improves logistics efficiency, reduces waste, and optimizes resource use. It also creates transparency and trust in the market. Effective collaboration is therefore key to driving a sustainable green industry (Dahlquist, 2021; Grillitsch and Hansen, 2019). In the marketing sector, green marketing has evolved into a strategy where corporations promote products or services based on their ecological benefits. This approach meets consumer demand for sustainable products while enhancing corporate reputation and competitiveness. The evolution of green marketing illustrates a growing awareness and preference among customers for ecologically sustainable products (Lievano Pulido and Ramon-Jeronimo, 2023; Papadas et al., 2017). Additionally, the adoption of green practices typically involves integrating lean manufacturing principles, which focus on waste reduction and efficiency improvement. The combination of green and lean principles, referred to as Green, Lean, and Sustainable (GLS) practices, has demonstrated a positive impact on organizational performance across multiple dimensions (Haldorai et al., 2022; Lievano Pulido and Ramon-Jeronimo, 2023).

Organizational and managerial aspects should be considered, such as leadership commitment, corporate social responsibility (CSR), environmental management systems (EMS), and employee engagement. It involves the adoption of clean technologies, renewable energy, and eco-friendly processes aimed at reducing environmental impact. Embracing green industry concepts allows organizations to reduce waste, lower energy consumption, and minimize environmental

consequences, leading to cost savings and improved efficiency. This approach enhances corporate reputation, attracts environmentally conscious consumers, and ensures compliance with environmental standards. The organizational and managerial aspects of the green industry encompass both structure and management practices aimed at sustainability. Executives are responsible for defining environmental policies and strategies and ensuring their integration across all operational levels. Furthermore, it is important to expand the knowledge and skills of personnel to foster a green organizational culture. Continuous improvement necessitates monitoring and evaluation systems, while effective management plays a key role in reducing risks and enhancing long-term competitiveness for organizations. (Al-Hakimi et al., 2022; Tsai et al., 2023).

Eco-friendly techniques, "Eco-friendly techniques" in the green industry refer to methods and processes that minimize environmental impact. Additionally, eco-friendly practices encompass reducing waste, conserving energy, and utilizing sustainable materials. The green industry concept involves integrating eco-friendly techniques into industrial processes to minimize ecological damage and promote sustainable development. This strategy consists of two primary components: Improving resource efficiency and reducing pollution in existing industries, as well as encouraging the establishment of new green industries that develop and implement environmentally sustainable technologies and services (Larsen and Dupuy, 2023; Tsai et al., 2023). In addition, pollution in the green sector will be reduced by decreasing emissions, waste, and hazardous materials; utilizing renewable energy and

energy-efficient technologies will enhance the sector's energy efficiency; and promoting recycling, reuse, and the transformation of waste into resources will contribute to creating a circular economy (D'Amato and Korhonen, 2021; Fujii and Managi, 2019; Omar et al., 2024).

As previously stated, environmental sustainability is essential for the green industry, compelling enterprises to reduce resource consumption, mitigate pollution, and protect ecosystems in order to achieve sustainable growth. Well-defined legal and policy frameworks establish standards and incentives that encourage corporations to adopt environmentally sustainable practices and align with global sustainability goals. Additionally, technological advancements enhance efficiency and promote sustainable production methods, enabling companies to remain competitive in an eco-conscious market. Collaboration among supply chains and stakeholders is vital for integrating sustainability objectives across sourcing, production, and distribution processes, thereby improving accountability. Furthermore, organizational and management factors significantly influence the effectiveness with which organizations implement green initiatives in their daily operations and long-term strategies. Adopting eco-friendly practices, such as waste reduction, renewable energy use, and the choice of sustainable materials, directly lessens environmental impacts and bolsters the industry's reputation. Together, these components create a strong framework that supports the transition towards a more sustainable and competitive green industry. The conceptual framework is shown in Fig. 1.

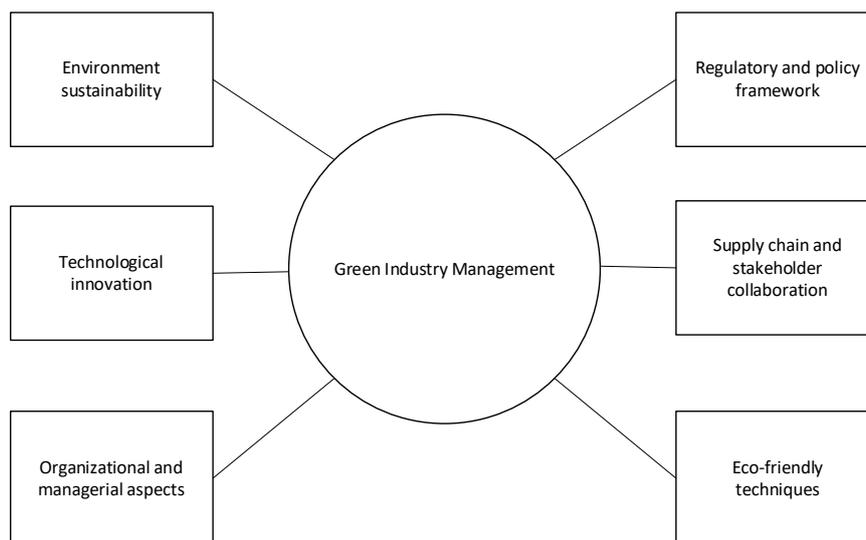


Fig. 1: Conceptual framework

3. Research method

This paper presents a systematic literature review that combines bibliometric and content analysis. It specifically examines journals listed in the Thailand Citation Index (TCI) and Scopus databases that focus on the green industry and its

relationship to sustainability. Additionally, a researcher has incorporated information from various websites and previously conducted surveys. The data collected from these sources, along with the number of articles included in our analysis, are presented in Table 1.

Table 1: Number of articles

Journal databases	Number of articles
Thailand citation index (TCI)	16
Scopus	54
Information from a website	10
Total	80

Furthermore, the researcher employed a four-step process utilizing a PRISMA-style methodology: 1) Identification Phase, 2) Screening Phase, 3) Eligibility Phase, and 4) Inclusion Phase, as delineated below:

1. Identification phase: This phase commences with the delineation of keywords that encapsulate the research's scope. The search phrases encompassed "green industry," "strategic management," "entrepreneurs in Thailand," "sustainable industry," "environmental strategy," "SMEs," "green innovation," and "SWOT analysis of the green industry." These keywords were queried in the TCI and Scopus databases from their establishment until the year of the study. Initially, all document categories, including peer-reviewed journal articles, conference papers, and reviews, were incorporated. This inquiry yielded a preliminary collection of records from all three databases.
2. Screening phase: In this phase, duplicate records were eliminated from the databases. The titles and abstracts of the remaining articles were further evaluated for relevance according to established inclusion criteria. The inclusion criteria encompassed publications relevant to the green industry, sustainable strategies, or environmental management; studies focused on strategic management frameworks such as SWOT, TOWS, or similar tools; research involving entrepreneurs, SMEs, or industrial sectors in Thailand or Southeast Asia; and documents accessible in English or Thai. The exclusion criteria encompassed articles irrelevant to environmental or strategic management, studies inapplicable to entrepreneurship or industry, non-academic documents (including news items, blogs, or opinion pieces), and publications devoid of methodological clarity. At this juncture, extraneous papers were excluded following an examination of titles and abstracts.
3. Eligibility phase: Full-text papers were obtained and assessed for eligibility. The primary requirement for this phase was for the study to provide empirical, conceptual, or theoretical insights into the progress of the green industry. The publication must include strategic analysis or environmental performance measurements. Furthermore, the paper must furnish sufficient data suitable for doing SWOT and subsequently TOWS matrix analysis. Finally, research that exhibited methodological opacity, failed to address strategic elements, or offered insufficient data for strategic evaluation was removed.
4. Included phase: The final selection of eligible studies consisted of full-text articles pertinent to

the development of a SWOT analysis (Strengths, Weaknesses, Opportunities, Threats) for green industry management in Thailand, accompanied by a TOWS matrix designed to propose strategic solutions for Thai entrepreneurs adopting green industry concepts. The chosen publications were systematically arranged in a data table encompassing the study author(s) and year, research objectives, green industry components, strategic factors (both internal and external), entrepreneurial ramifications, and suggestions for sustainable industry practices. The data points were methodically synthesized to develop a complete strategy framework.

Additionally, this article employs content and descriptive analysis to scrutinize the data, a process that entails methodically coding and categorizing document content to discern themes, patterns, and interpretations. Furthermore, researchers ensure dependability by cross-referencing various papers, evaluating authors' competence, identifying potential biases, and scrutinizing authorship, publication dates, and methodological rigor, all of which augment trustworthiness. A researcher conducted a data analysis employing SWOT analysis, the TOWS matrix, content analysis, and descriptive analysis, which systematically encodes and categorizes document content to discern themes, patterns, and meanings. Moreover, SWOT analysis is a technique for evaluating an organization's internal strengths and weaknesses, as well as external opportunities and threats. It functions as a mechanism to methodically understand the comprehensive state of a company. The TOWS Matrix analysis is a strategic enhancement of SWOT analysis, emphasizing the interactions among Strengths-Opportunities (SO), Strengths-Threats (ST), Weaknesses-Opportunities (WO), and Weaknesses-Threats (WT). This method seeks to determine the most appropriate operational strategies for the organization. Ultimately, TOWS matrix analysis enables the formulation of effective strategies that can improve competitiveness. A disadvantage of this study is its dependence on secondary sources for data collection and the utilization of pre-existing data, which may not comprehensively encompass all occurrences. Nonetheless, the results of this study can aid business organizations and higher education institutions in recognizing and enhancing the green industry in the future.

4. Results

This study's results are based on existing literature regarding Thailand's green industry to perform a SWOT analysis aimed at entrepreneurs within this sector. Additionally, we conduct a TOWS matrix strategy analysis for individuals implementing green industry concepts. Furthermore, we present two case studies that illustrate

management practices utilizing these green industry principles.

4.1. The SWOT analysis of entrepreneurship in Thailand utilized the green industry concept

The SWOT (strengths, weaknesses, opportunities, and threats) analysis of enterprises in Thailand incorporates the green industry concept and the use of recycled materials into their production processes as follows.

Strengths: Thai entrepreneurs exhibit numerous strengths in embracing green industry principles. Thailand's green sector derives advantages from its plentiful natural resources, encompassing diverse biodiversity, arable land, and vast agricultural and forest regions. Natural resources supply vital raw ingredients for sustainable production. This natural resource promotes the use of sustainable practices, renewable materials, and environmentally friendly technologies across many sectors. They exhibit adaptability in modifying their production processes to comply with international standards and capitalize on favorable government policies that promote environmentalism and sustainability. Numerous entrepreneurs recognize the need of reducing expenses by optimizing energy and resource utilization, so enabling them to secure competitive advantages in a worldwide market that is more oriented towards sustainable products. Moreover, collaborative networks with corporate partners and communities are essential for the effective promotion of sustainable operations (Wichai-Utcha and Chavalparit, 2019). Thailand's large agricultural base provides a wealth of raw resources, including agricultural waste that can be recycled into environmentally friendly packaging, making it a stronghold for entrepreneurs using recycled materials for production. Moreover, utilizing recycled materials enhances the value of waste and provides farmers with alternative revenue sources. Entrepreneurs can also lower production costs by using recycled materials, which are usually less expensive than new raw materials. A considerable proportion of Thai entrepreneurs have exhibited a positive disposition toward the adoption of green industry methods, indicating their preparedness to integrate recycled materials into their production processes. The rising environmental consciousness among Thai customers has resulted in heightened demand for eco-friendly products, prompting enterprises to implement sustainable methods. Moreover, Thai exporters, especially in the automotive and electronics industries, get advantages from green certifications (ISO 14001), which improve their access to environmentally aware countries like the EU and Japan (Amornkitvikai et al., 2024).

Weaknesses: An insufficient understanding of green technologies and financial restrictions are significant weaknesses for entrepreneurs who use recycled materials in production and hinder the effective integration of recycled materials into

manufacturing processes. The current waste management systems in Thailand are poorly equipped to support comprehensive recycling activities, creating obstacles for businesses seeking quality recycled materials. Entrepreneurs may face challenges in creating products that successfully incorporate recycled materials, which could negatively impact product quality and market appeal. Additionally, they may have limited market opportunities for products made from recycled resources, restricting their sales potential. Moreover, businesses often encounter substantial initial costs associated with green technology, such as renewable energy systems and pollution control equipment, while limited access to funding exacerbates this issue. Furthermore, many Thai industries lack the technical know-how to effectively implement new green technology. Despite a growing demand for eco-friendly products, many Thai consumers remain price-sensitive, opting for cheaper, non-sustainable alternatives; consequently, this limits the profitability of green investments for some enterprises (Youngswaing et al., 2024).

Opportunities: Thailand's implementation of green industry promotes sustainable economic development, mitigates pollution, and conserves natural resources. Furthermore, it strengthens competitiveness in global markets by adhering to international sustainability standards. Additionally, it generates green employment opportunities and supports the nation's transition to a low-carbon economy (Al-Hakimi et al., 2022; Liu et al., 2020). Entrepreneurs have the opportunity to use recycled materials for production because of the global focus on sustainability and circular economy models, which foster innovation and the use of recycled resources. Moreover, in accordance with global trends and consumer preferences, Thailand's 3Rs (Reduce, Reuse, Recycle) strategy and associated regulatory measures offer a conducive framework for entrepreneurs to participate in recycling initiatives and implement sustainable practices. Moreover, governmental assistance via the formulation of laws that advocate for sustainability can provide entrepreneurs with incentives and resources for utilizing recycled materials, in accordance with global trends towards circular economies, thereby creating new business opportunities and collaborations. Additionally, Thailand's involvement in global collaborations, such as the UN Partnership for Action on Green Economy (PAGE), enhances access to foreign assistance and investment in sustainable initiatives. The emergence of green innovations offers Thailand the chance to modernize its industrial sector, improve competitiveness, and penetrate new sustainability-oriented markets (Mungkung et al., 2021).

Threats: The risk of businesses using recycled materials for manufacturing lies in the lack of suitable legislative incentives and the presence of administrative obstacles that may deter entrepreneurs from fully committing to the use of recycled materials. Smaller businesses often face

significant competition from larger corporations that possess greater resources to invest in sustainable technologies and can achieve economies of scale, potentially marginalizing smaller entities. The recycling sector is competitive, with numerous entities vying for the same materials and markets. Additionally, factors that exacerbate market failures in plastics recycling include import restrictions on high-quality, recyclable scrap plastics and the insufficient internalization of plastic waste management costs by plastic manufacturers. Entrepreneurs encounter workforce shortages and high turnover rates, which impact the consistency of production processes that rely on recycled resources.

Furthermore, despite the growing green job market, Thailand is experiencing a shortage of skilled professionals in green technologies and sustainable practices, and this gap complicates the effective implementation of green industry initiatives; the transition to sustainable sectors may negatively impact traditional industries, leading to job displacement and economic challenges, particularly for low-skilled workers in declining sectors. Moreover, access to green funding presents a significant hurdle, as many initiatives do not meet private sector investment criteria. This limitation hinders the influx of critical capital into sustainable ventures.

Moreover, Thailand's green industry encounters regulatory obstacles stemming from the fragmentation, inconsistent enforcement, and absence of a coherent long-term strategy in environmental legislation. Inadequate coordination among governmental entities results in deficiencies that hinder policy execution and diminish support for green innovation. Furthermore, inadequate incentives and compliance oversight hinder industries from completely adopting sustainable practices. The summarized results of the SWOT

analysis of entrepreneurship in Thailand utilizing the green industry concept are presented in [Table 2](#).

Table 2: SWOT analysis of Thai entrepreneurs adopting the green industry concept

Description	
Internal factors	
Strengths	<ul style="list-style-type: none"> Abundant natural and agricultural resources Growing positive perception toward green industry Cost reduction through resource efficiency Export competitiveness supported by certifications
	<ul style="list-style-type: none"> Limited financial and internal resources
Weaknesses	<ul style="list-style-type: none"> Inefficient waste management infrastructure High initial green technology investment costs Limited technical expertise and skilled workforce
	<ul style="list-style-type: none"> External factors <ul style="list-style-type: none"> Opportunities <ul style="list-style-type: none"> Alignment with SDGs and circular economy models Government 3Rs initiatives and policy support International collaboration and green investment <ul style="list-style-type: none"> Advancements in green technologies Threats <ul style="list-style-type: none"> Regulatory fragmentation and compliance challenges Market competition from larger firms <ul style="list-style-type: none"> Labor shortages in green skills Financial constraints and economic pressure on traditional industries
Opportunities and threats	

4.2. TOWS matrix strategy analysis for entrepreneurs applying green industry concepts

To integrate green industry principles, entrepreneurs must develop strategies that utilize their existing strengths—such as an eco-friendly reputation and cost efficiencies—transform their weaknesses, like limited resources, into opportunities through collaboration and support, protect their businesses against external threats via innovation and resilience, and align closely with global trends, including the Sustainable Development Goals (SDGs), the circular economy, and governmental initiatives. The strategy for enterprises adopting the green industrial paradigm is presented in [Table 3](#).

Table 3: TOWS matrix for Thai entrepreneurs adopting the green industry concept

	Opportunities (O)	Threats (T)
Strengths (S)	SO strategies: <ul style="list-style-type: none"> Leverage natural resources to attract green investment Align with SDGs and circular economy markets Develop export-oriented certified green products 	ST strategies: <ul style="list-style-type: none"> Differentiate through green branding Use cost-efficient green operations to offset economic pressure Strengthen compliance to reduce regulatory risk
	Weaknesses (W)	WO strategies: <ul style="list-style-type: none"> Use 3Rs policies to upgrade waste systems Build R&D partnerships to improve design and skills Seek green grants to reduce investment burden

An analysis of the strengths and shortcomings of green management in Thailand relative to other nations is crucial. It assists in identifying the distinctive structural, economic, and policy determinants that influence Thailand's green industry performance. To comprehend these disparities, Thai businesses might study global best practices and modify tactics that have demonstrated efficacy in other contexts. This comparison

underscores Thailand's competitiveness in formal certification systems and nascent green innovation. Moreover, it exposes deficiencies, such as restricted SME capacity and budgetary limitations, necessitating strategy enhancement. This comparative analysis facilitates improved policymaking, focused capability enhancement, and more efficient strategic management to promote Thailand's green sector, as illustrated in [Table 4](#).

Table 4: A comparison of the strengths and weaknesses of green management in Thailand and other countries

Strategic dimension	Thailand	Other countries	Implications for Thai entrepreneurs
Policy and institutional support	National GI certification; limited SME incentives	Strong fiscal incentives; green public procurement integration	Advocate for fiscal reform and procurement advantages
Internal capabilities	Limited green technical skills among SMEs	Strong R&D and training ecosystems	Invest in skill development and strategic management accounting
Market adoption	Growing demand; uneven SME adoption	Higher adoption in mature markets	Target premium export markets
Green supply chain	GSCM adoption limited by supplier resistance	Lead-firm driven diffusion models	Develop clusters and supplier partnerships
Financial constraints	High initial costs; limited green funding	Green credit lines and concessional loans	Develop bankable ROI-focused proposals
Innovation and competitiveness	Emerging green innovation; limited R&D depth	Advanced eco-innovation ecosystems	Focus on cost-effective green innovation with clear market demand

As noted in [Table 4](#), many industrialized nations support green management through comprehensive environmental regulations, advanced clean technologies, and strong institutional frameworks that promote high sustainability standards. In contrast, Thailand has rich natural resources and an increasing public awareness of environmental issues. However, it faces challenges related to technological readiness and enforcement capabilities. In addition, limited financing and a lack of adequate research infrastructure impede Thailand's progress, while other countries often utilize advanced innovation systems to encourage sustainable practices. Although Thailand has considerable potential, it must enhance its technology, legislation, and collaboration to meet global standards in green management performance.

5. Discussion

Thai entrepreneurs encounter various challenges in adopting green industry practices. These include limited financial resources for investing in green technologies and sustainable methods; a shortage of skilled labor and inadequate knowledge about green practices; a lack of environmental awareness and technical proficiency among staff, which hampers the effective implementation of green initiatives; and a lack of government incentives and regulatory support that discourages businesses from transitioning to eco-friendly operations. Additionally, minimal stakeholder engagement and collaboration reduce the effectiveness of green industry adoption. There are challenges in supplier coordination and a need for specialized equipment that increase operational complexities. Cultural resistance and a focus on short-term profits rather than long-term sustainability goals present significant hurdles. Moreover, limited access to green technologies and innovations complicates the adoption of sustainable practices ([Piyathanavong et al., 2019](#); [Youngswaing et al., 2024](#)). Integrating green industry principles into entrepreneurial strategies is essential for sustainable business advancement. Entrepreneurs can leverage their inherent assets, such as an environmentally sustainable reputation and cost savings, to secure a competitive advantage. Implementing circular economy strategies can effectively reduce

operational expenses while meeting the growing consumer demand for sustainable products ([Alkaraan et al., 2024](#)). Furthermore, entrepreneurs can cut costs by adopting environmentally sustainable practices that align with the Sustainable Development Goals (SDGs) and the principles of the circular economy. Additionally, entrepreneurs can minimize waste and repurpose materials, allowing businesses to lower manufacturing costs and optimize resource utilization. Moreover, entrepreneurs committed to SDG 12 (responsible consumption and production) can significantly enhance the sustainability of their supply chains. Initiatives related to the circular economy, such as recycling and extending product life, help reduce dependency on raw materials. Therefore, entrepreneurs can decrease costs and enhance brand value through eco-friendly innovation ([Narassimhan et al., 2024](#); [Nyangchak, 2022](#)).

Transforming weaknesses, such as limited resources, into opportunities for enhancement is achievable through collaboration and support. Therefore, cooperation among businesses, suppliers, and recycling industries can establish efficient systems for material recovery, which are essential for the functionality of a circular economy. Such cooperation includes partnerships that facilitate the exchange of knowledge and resources, fostering innovation and resilience. Additionally, business owners can take advantage of eco-friendly strategies by using government help and working with local communities. Support and incentives from the government for green innovation help reduce financial challenges in creating sustainable products; working with local communities builds trust and provides valuable information about environmental needs. Furthermore, government-sponsored research and development initiatives expedite technological progress in eco-friendly production, while collaborative endeavors bolster the competitiveness of businesses and promote long-term sustainability ([Atkins, 2024](#); [Song et al., 2024](#)). Protecting businesses from external threats requires creativity and adaptability; thus, investing in research and development enhances green innovation capabilities, enabling companies to effectively tackle environmental challenges ([Siedschlag et al., 2022](#)). Moreover, collaboration with both domestic and international partners

increases the likelihood of successfully executing sustainable initiatives (Mensah et al., 2024; Petroselli et al., 2020).

Entrepreneurs can significantly lower operational expenses by adopting sustainable business strategies that involve improving energy efficiency, minimizing waste, and optimizing resource utilization, which can also boost productivity and long-term profitability. Additionally, aligning operations with international environmental standards, such as ISO 14001, enhances compliance and facilitates access to overseas markets, while certification according to established criteria bolsters investor and customer confidence. Furthermore, the adoption of sustainable practices improves brand reputation by demonstrating environmental responsibility, and eco-friendly activities increase brand awareness and foster loyalty among environmentally conscious consumers. In addition, a strong green image distinguishes enterprises in competitive markets, and integrating the green industry promotes both economic and environmental sustainability. Entrepreneurs should closely monitor global trends such as the Sustainable Development Goals (SDGs), the circular economy, and government initiatives and regulations—such as circular economy action plan frameworks—that assist businesses in using resources more efficiently and reducing waste. Furthermore, laws promoting extended producer responsibility (EPR) require producers to be accountable for the environmental impact of their products throughout their entire life cycle, which encourages sustainable business practices. Government support, including financial incentives and training programs, is vital for facilitating the transition to green entrepreneurship, along with policies that provide green entrepreneurs with specialized financial tools and networking opportunities. Additionally, support systems are essential for overcoming financial barriers and promoting sustainable innovation (Lutfi et al., 2023; Soleimani et al., 2023).

Implementing green industry in an organization involves practical guidelines such as integrating green supply chain management (GSCM) through collaboration with eco-conscious suppliers, optimizing logistics to reduce environmental impact, and adopting lean manufacturing practices. Entrepreneurs may adopt lean methodologies to minimize waste and improve energy efficiency (Younnes, 2023; Nyangchak, 2022). Moreover, entrepreneurs should invest in green innovation and create eco-friendly products and processes to enhance sustainability and competitiveness. Utilize information technology (IT) and its capabilities to monitor and manage environmental performance effectively. Entrepreneurs should improve employee engagement by offering training and cultivating a culture that promotes environmental initiatives. This includes implementing green accounting, monitoring environmental costs and savings for informed decision-making, and seeking green certifications

such as ISO 14001 to showcase commitment to environmental standards. Entrepreneurs should engage stakeholders by effectively communicating sustainability initiatives to customers, investors, and the community to foster trust. They must establish performance metrics and regularly assess environmental KPIs to ensure ongoing improvement. Collaboration with industry peers and the sharing of best practices and innovations are essential for advancing collective sustainability efforts (Abbas et al., 2023; Afum et al., 2020; Omar et al., 2024).

Incorporating green industry principles into entrepreneurial strategies necessitates utilizing existing strengths, converting weaknesses through teamwork, mitigating external threats through innovation, and aligning with global sustainability trends. Moreover, eco-friendly strategies jointly strengthen robust and sustainable company structures. Furthermore, embracing green industry concepts allows entrepreneurs to establish sustainable and efficient enterprises, decrease expenses by reducing waste and optimizing energy use, and elevate brand value among environmentally conscious consumers. Furthermore, entrepreneurs adhering to environmental standards mitigate legal risks and enhance market reputation. Moreover, sustainable practices cultivate innovation, resulting in enhanced products and operational efficiency. Ultimately, it guarantees sustained growth by conforming to global environmental objectives and enhancing resilience. The Thai government aims to implement a green industrial policy for sustainable prosperity by prioritizing sustainable production and consumption, enhancing resource efficiency, minimizing greenhouse gas emissions, and considering community and environmental welfare. The green industry policy is consistent with the BCG (Bio-Circular-Green Economy) framework advocated by the Thai government. The green industry guidelines delineate three principal policy modifications: the management of waste and hazardous materials affecting public health, the improvement of safety and efficiency within industries, and the promotion of a novel industry focused on attaining carbon neutrality and net zero greenhouse gas emissions. The Thai government's green industry certification program will acknowledge establishments at many levels, including advantages such as the utilization of the green industry (GI) logo on products, financial assistance, and enhanced market opportunities. Consequently, accredited high-level institutions will obtain investment assistance and supplementary benefits to enhance their operational efficacy and sustainability (Ren and Mia, 2025). To advance the green sector, governments may choose from an array of policy interventions and financial solutions to enable the transition of energy and industrial systems, improve energy efficiency, mitigate environmental pollution, and protect and restore natural capital. This action involves the imposition of green taxes on harmful environmental practices, the enactment of more stringent regulations, and the

creation of new environmental standards and certifications for energy efficiency, emissions, and pollutants, along with tax rebates for adherence to these mandates. Moreover, subsidies and tax incentives serve as additional methods to stimulate demand for eco-friendly products and services, such as electric vehicles (EVs), solar panels, and renewable energy. Governments are allocating subsidies and grant funding to research institutes, academic institutions, and private R&D firms to foster innovation and advance transformative technologies, including renewable energy, carbon capture, waste management, and energy efficiency.

6. Conclusion

Green industry refers to the implementation of environmentally friendly practices in industrial operations aimed at minimizing environmental impact and promoting sustainability. The adoption of green manufacturing techniques enhances technical efficiency while reducing material consumption, leading to cost savings and improved environmental performance. Furthermore, companies that are committed to sustainable practices achieve greater technical efficiency compared to those that do not adopt a green approach to sustainability. Moreover, integrating green supply chain management strategies boosts both operational and environmental innovation performance. Embracing green industry practices fosters sustainable development and enhances organizational performance (Amornkitvikai et al., 2024; Ren and Mia, 2025; Tsai et al., 2023).

Additionally, Corporate Social Responsibility (CSR) plays a crucial role in advancing the green industry within the manufacturing sector by advocating for sustainable environmental practices and promoting green innovation. CSR initiatives positively impact green innovation, leading to improved environmental performance and competitive advantages. Furthermore, CSR practices are associated with better environmental, social, and governance (ESG) performance, which strengthens sustainability efforts across various industries (Okafor et al., 2021; Jaroensombut et al., 2025). The development of green industries in Thailand possesses key strengths, including abundant natural resources, cost reduction, and ongoing government promotion and support. However, entrepreneurs in Thailand face challenges such as high technological costs, market competition, and a shortage of knowledgeable and skilled labor.

Additionally, to effectively implement green industry practices, entrepreneurs need to devise strategies that leverage their existing strengths, including utilizing local natural resources, capitalizing on the growing demand for eco-friendly products, and collaborating with governmental and private companies on research to address design challenges and enhance skills.

Moreover, entrepreneurs should also focus on improving their competitiveness and green image

while preparing for potential risks and financial challenges to ensure long-term business sustainability.

The systematic literature analysis demonstrates that strategic green industry management improves resource efficiency, reduces operational expenses, and enhances competitiveness for Thai businesses in regional and worldwide markets. It assists entrepreneurs in implementing sustainable technologies, thereby enhancing adherence to environmental standards and cultivating increased consumer trust. The research highlights that the incorporation of sustainable strategies fosters innovation, allowing firms to develop environmentally friendly products and adopt cleaner production methods. Furthermore, it emphasizes the importance of solid policy frameworks, financial incentives, and knowledge dissemination as essential elements for developing a resilient green industry. The report highlights the importance of collaboration among government, industry, and stakeholders as a key driver for accelerating sustainable industrial transformation. The article concludes that adopting green strategic management fosters long-term economic resilience and environmental sustainability within Thailand's industrial sector. The study's limitation arises from its reliance on secondary sources for data collection and the use of pre-existing data, which may not capture all instances.

List of abbreviations

3Rs	Reduce, reuse, recycle
AI	Artificial intelligence
BCG	Bio-circular-green economy
CO ₂	Carbon dioxide
CSR	Corporate social responsibility
EMS	Environmental management systems
EPR	Extended producer responsibility
ESG	Environmental, social, and governance
EU	European Union
EVs	Electric vehicles
GHG	Greenhouse gas
GI	Green industry
GLS	Green, lean, and sustainable
GPP	Green public procurement
GSCM	Green supply chain management
INSEE	Siam City Cement Public Company Limited (industrial waste management context)
IoT	Internet of things
IT	Information technology
KPIs	Key performance indicators
OECD	Organisation for economic co-operation and development
PAGE	Partnership for action on green economy
PRISMA	Preferred reporting items for systematic reviews and meta-analyses
R&D	Research and development
ROI	Return on investment
SDGs	Sustainable development goals
SMA	Strategic management accounting
SMEs	Small and medium-sized enterprises
SWOT	Strengths, weaknesses, opportunities, and threats
TCI	Thailand citation index

TOWS Threats, opportunities, weaknesses, and strengths
 UN United Nations

Compliance with ethical standards

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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