MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 35 Issue 2, 2025, Pages: 640-651

POTENTIAL TRANSITION MODELS FOR LOW-CARBON BUSINESS FOR SMALL AND MEDIUM-SIZED ENTERPRISES IN THAILAND

Phatcharaya Pongpunyayuen[1], Tanapol kortana [2], Bundit Pungnirund [3], Chompoo Saisama [4], Nathakorn Kumpetch [5]

[1,2,3,4,5] Suan Sunadha Rajabhat University, Thailand
Doctor of Philosophy Program in Management Innovation, Suansunandha Rajabhat University, Thailand. E-Mail: s65584945019@ssru.ac.th, tanapol.ko @ssru.ac.th, bundit.pu@ssru.ac.th, chompoo.sa @ssru.ac.th, nathakorn.ku@ssru.ac.th

Abstract

Low-carbon business refers to a concept that encourages enterprises to transform their operations to reduce GHG emissions. This includes promoting efficient use of energy and resources, minimizing waste throughout production processes, and transitioning toward renewable or clean energy sources. The shift toward low-carbon business models presents both challenges and opportunities, requiring strategic adaptation to align with the United Nations Sustainable Development Goals (SDGs). These goals have become a central framework for modern business management, emphasizing sustainability, social responsibility, and environmental stewardship.

This research aims to: (1) examine the levels of external pressure, internal management, organizational resources, and the potential for small and medium enterprises (SMEs) in Thailand to transition toward low-carbon business; (2) investigate the influence of external pressure, internal management, and organizational resources on the transition potential of Thai SMEs; and (3) develop a model representing the transition potential of Thai SMEs toward low-carbon business.

A mixed−methods approach, integrating both quantitative and qualitative research, was employed. The quantitative phase involved 240 SMEs that were interested in transitioning to low-carbon business. The sample size was determined using a criterion of 20 times the number of observed variables and selected through multistage random sampling. Data were collected via questionnaires and analyzed using structural equation modeling (SEM). The qualitative phase utilized in−depth interviews with 20 key informants, including SME entrepreneurs and experts in low-carbon business practices.

The findings revealed that: (1) external pressure, internal management, and organizational resources were at a moderate level, while the transition potential was rated high; (2) external pressure, internal management, and organizational resources significantly influenced the transition potential at the 0.05 statistical level; and (3) the researcher developed a model named the “EMR Model,” comprising three core components—E: external pressure, M: internal management, and R: internal resources. Qualitative findings further indicated that enhancing the transition potential requires entrepreneurs to adopt environmentally friendly innovations and alternative energy technologies, provide personnel training in emerging competencies known as “green skills,” and build strategic partnerships to strengthen competitiveness. The results of this study offer policy recommendations for the government to foster a supportive ecosystem and provide practical guidelines for SME entrepreneurs to plan sustainable transition strategies.

Keywords Low-carbon business/ External drivers/ Potential for transition/ Organizational resources

MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 35 Issue 2, 2025, Pages: 640-651

1.INTRODUCTION

The Thailand Greenhouse Gas Management Organization (Public Organization) (TGO) (2023) defines Carbon Credit as the amount of greenhouse gas (GHG) reduction or sequestration achieved through a GHG reduction project. This may involve using renewable energy, improving energy efficiency, adopting technology to reduce GHG emissions in production processes, or implementing reforestation projects to absorb carbon dioxide, among others. The implementation must adhere to the criteria and processes of specific standards to ensure verifiability and international reference ability. Notably, carbon credits can simultaneously generate economic opportunities and address environmental issues by incentivizing GHG reduction projects. The global community's shared goals have fostered a new business ecosystem for the trading of carbon credits. Furthermore, the imposition of a Carbon Tax—a levy on the volume of GHG emitted throughout an organization's activities or product production—represents an additional cost for organizations to assume social responsibility for their emissions. Consequently, an organization's ability to reduce GHG emissions will lead to lower tax liabilities and act as a defense against environmentally-based trade barriers.

Low-Carbon Business is a concept aimed at compelling the business sector to modify its operational methods to reduce GHG emissions, support the efficient use of energy and resources, minimize process waste, and transition towards renewable or clean energy sources (Dahiya, 2015) Therefore, a low-carbon business trajectory is one that leads to sustainability and aligns with the United Nations Sustainable Development Goals (SDGs) (Madurai Elavarasan et al., 2021), which are a cornerstone of contemporary global business management emphasizing sustainability, social responsibility, and environmental stewardship. Low-carbon business may be referred to by other names, such as Green Business, Sustainable Business, or Environmentally Friendly Business. The transition to a low-carbon business involves an organization setting clear and tangible goals for reducing GHG emissions while simultaneously improving energy efficiency, increasing the use of renewable energy, modifying processes to reduce and recycle waste, and undertaking other activities that mitigate environmental impact. The integration of carbon taxation and the carbon credit mechanism is considered a vital tool for stimulating organizations and corporations to proactively adopt more environmentally friendly operating models.

However, the majority of business organizations in Thailand—up to 99.5%—are classified as Small and Medium-sized Enterprises (SMEs). This sector employs over 71.86% of the total workforce nationwide. Concurrently, this group has continuously increased its electricity consumption, collectively accounting for up to 30% of the country's total electricity demand (ElMassah & Mohieldin, 2020). This highlights that SMEs are a crucial driver of the Thai economy. Although they employ a large workforce, their labor potential may not be high, and they may lack advanced technology or innovation, often operating with limited working capital. Yet, they possess significant potential for development, presenting both considerable constraints and opportunities for transforming their operations into a low-carbon business model. This transition is essential for enhancing business competitiveness amidst the global sustainability trend, mitigating environmentally driven trade barriers, and fostering positive customer attitudes and loyalty.

Wonglimpiyarat (2007) found that SMEs often prioritize economic performance over environmental and social impact to maintain competitiveness. Only as environmental regulations become more stringent do SMEs become more responsive to adopting green technology, which increases their potential to transition into environmentally friendly organizations (Shen et al., 2020).

Current efforts to transition to a low-carbon business model involve various organizations attempting to reduce GHG emissions through internal operations. Beyond waste reduction and energy efficiency improvements, adopting renewable energy, switching to electric vehicles, and using environmentally friendly materials all require additional budgets or may increase initial operating costs. Furthermore, certain process modifications necessitate technology for carbon management or capture, which presents a significant barrier that makes it difficult for SMEs to easily become low-carbon organizations (Shan-jun, Qiao-xi, & Mei, 2009)

MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 35 Issue 2, 2025, Pages: 640-651

When compared to the accelerating factors for sustainable organizational change, a study by Kamiguchi and Tamai (2019), using an innovation-based perspective, found that the level of innovation and economic factors are crucial, which aligns with the aforementioned constraints faced by Thai SMEs. Similarly, Morikawa (2012) studied credit support mechanisms for organizations transitioning from coal-based energy to more environmentally friendly practices. They classified variables affecting organizational change into three categories: Government, Organization, and Commercial Bank, reflecting a pathway from government policy, through commercial banks, to the organizational drivers facilitating the low-carbon transition. In this context, capital and policy support may enhance an organization's capacity for GHG reduction. However, they concluded that the cost of the project and the relative benefits of the operational change are more critical to an environmentally friendly business transformation than funding alone. Additionally, economic support and appropriate interest rates that allow for long-term profitability are key, aligning with the research of Boettiger, Savari and Khaleghi (2025) on the importance of a business perspective in policymaking.

Considering the findings of Huang et al. (2024), factors contributing to policy success include project objectives, skilled personnel, management oversight, sufficient attention and resource allocation, and stakeholder participation. Synthesizing the variables from the aforementioned research allows them to be grouped into two primary categories: external factors originating outside the organization and internal factors within the organization. Regarding internal factors, Somwethee, Ru-Zhue, Aujirapongpan, Chanthawong, and Usman (2025) proposed variables affecting the transition to sustainability, including management commitment, human resource management, and intellectual capital. That is, the vision and commitment of top executives, along with the organization's technological and human resources, are critical drivers of internal management. Specifically, the human resource management perspective leads to knowledge dissemination and campaigning, fostering cooperation in activities that contribute to a successful low-carbon business transformation.

Nevertheless, an aversion to change is a natural human tendency, stemming from a safety instinct to avoid the unfamiliar. The same applies to organizational operations, where change inevitably creates friction and may not receive cooperation from all parties. A synthesis of research related to the impact of global trends on organizational change indicates that the organization itself, its management, and its personnel are all crucial components of the transition (Kittichotsatsawat, Rauch, & Tippayawong, 2024). This can be broadly termed "Internal Organizational Management," which is considered the most critical holistic factor. It harmonizes the goals of everyone in the organization and defines their behavior and work methods to align with those goals. Consequently, establishing a robust internal management system facilitates rapid and efficient organizational direction, operations, and response to change. Conversely, a poor internal management system can lead to negative attitudes and resistance to positive change. Thus, internal organizational management can be a significant barrier to transitioning from conventional operations to unfamiliar low-GHG, environmentally friendly operations.

Child, Karmowska, and Shenkar (2022) studied 300 SMEs across various industries in Thailand and China, demonstrating that managerial goal-setting had the highest influence on project initiation, followed by collaboration, delegation of authority, and organizational climate, respectively. This is consistent with Troise, Corvello, Ghobadian, and O'Regan (2022), who emphasized the dimensions of organizational management, organizational agility, and executive leadership. It is evident that goal-setting by senior management drives the initiation of new projects, including the adoption of environmentally friendly operational models. However, executive leadership must also ensure a shared understanding of the goals among operational staff at all levels. Therefore, internal organizational management, particularly in the dimension of human resource management, is necessary to achieve organizational (Kim, Jesiek, & Mazzurco, 2022). A low-carbon business transition is successfully achieved when internal organizational management is driven by executive commitment, internal collaboration, and governance to ensure goal attainment.

Consequently, any study examining the factors influencing the low-carbon business transition potential of Thai SMEs must consider External Pressure, Internal Organizational Management, and Organizational Resources. It must also measure efforts to reduce GHG emissions, improve energy efficiency,

MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 35 Issue 2, 2025, Pages: 640-651

and minimize environmental impact, which are key indicators of an organization's low-carbon transition (Ahmed, Bhatti, Gölgeci, & Arslan, 2022). This aligns with the research of Chaudhuri, Subramanian, and Dora (2022), who studied the transition to low-carbon business in the food and agricultural sectors, measuring GHG emission reduction, waste management, and land remediation—broadly equivalent to reducing GHG emissions and environmental impact. Furthermore, Adomako, Amankwah-Amoah, Tarba, and Khan (2021) research also referred to success indicators but included a greater focus on business aspects. That is, the outcome of modifying existing operations to reduce overall organizational GHG emissions can lead to cost savings from the carbon tax mechanism or potentially generate additional income through carbon offset projects. Therefore, the volume of GHG reduction, the results of energy efficiency activities, and the measurable operational outcomes of environmental impact reduction all indicate the low-carbon business transition potential of Thai SMEs.

Given the importance and benefits of the low-carbon organizational transition discussed above, this research aims to study the factors influencing the low-carbon business transition potential of SMEs in Thailand. This work is intended to inform policy, action plans, and internal organizational management for the low-carbon transition, as well as serve as a guideline for designing appropriate public sector policies, regulation, and management. The researcher is thus interested in investigating the effects of External Pressure, Internal Organizational Management, and Organizational Resources on the low-carbon business transition potential of SMEs in Thailand, with the ultimate goal of enhancing the sector's performance in this transition.

2. RESEARCH OBJECTIVES

1. To examine the levels of external pressure, internal management, organizational resources, and the potential for small and medium enterprises (SMEs) in Thailand to transition toward low-carbon business;
2. To investigate the influence of external pressure, internal management, and organizational resources on the transition potential of Thai SMEs; and
3. To develop a model representing the transition potential of Thai SMEs toward low-carbon business.

3. METHODOLOGY

Population and Sample Scope

Scope of the Research

A. Scope of Data and Samples

1. Population: The population for this research consists of Small and Medium-sized Enterprises (SMEs) interested in transitioning to a low-carbon business, totaling 320,000 entities (Office of Small and Medium Enterprises Promotion, 2024).
2. Quantitative Sample: The sample size for the quantitative phase was determined by estimating the ratio of observed variables, using a ratio of 1:20. As the study involves 12 observed variables, the researcher set the sample size at 240 respondents. The samples will be selected using a multi-stage sampling method from the defined population of SMEs interested in the low-carbon transition.
3. Qualitative Informants: Qualitative data will be collected through in-depth interviews with 10 SME entrepreneurs in Thailand who are interested in the low-carbon transition and 10 experts in low-carbon business operations, totaling 20 informants. These informants will be selected using Purposive Sampling for data analysis.

B. Scope of Variables

The variables used in this research were identified through a literature review and are categorized into two types:

1. Internal Variables:
   - Internal Organizational Management
   - Low-Carbon Business Transition Potential
2. External Variables:
   - External Pressure
   - Organizational Resources

MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 35 Issue 2, 2025, Pages: 640-651

C. Scope of Content

The content of this research focuses on studying the variables that affect the Low-Carbon Business Transition Potential of Small and Medium-sized Enterprises (SMEs) in Thailand, encompassing the variables External Pressure, Organizational Resources, and Internal Organizational Management.

D. Scope of Time

This research will be conducted from September 2023 to November 2024.

E. Scope of Area

4. RESULT

The quantitative sample (n=240) was characterized by a marginal majority of Male respondents (50.42%) and was predominantly composed of individuals in the 25–40 age bracket (51.25%). Academically, the largest group held a Bachelor's Degree (49.17%). A striking feature of the sample's organizational profile was the overwhelming representation of Micro Enterprises (85.42%). Reflecting this structure, nearly half of the participants held General Staff positions (49.58%), and the most common professional tenure fell within the 2–4 years' experience range (48.33%). The data thus suggests the study primarily captures the perspectives of younger, operational-level employees within the smallest tier of Thai SMEs.

Table 1. Means, standard deviations, and interpretations of the variables: external drivers, internal organizational management, organizational resources, and the potential for low-carbon business transformation of SMEs in Thailand (n = 240)

Variable	Mean	S.D.
External Push (EXTP)		
Funding Source (FUND)	3.48	.32
Tax benefits (TAXA)	3.31	.35
Carbon credit prices (CDTP)	3.47	.35
Total average	3.42	.34
Internal Organizational Management (INTM)		
Executive leadership (LEXC)	3.35	.40
Collaboration (COOP)	3.35	.42
Supervision (MNTR)	3.35	.39
Total average	3.35	.40
Enterprise Resources (INTR)		
Financial Resources (BDGT)	3.38	.44
Human resource skills (HMRS)	3.55	.41
Technological potential (TECH)	3.37	.44
Total average	3.43	.43
Potential for transition to low carbon businesses (LCBTC)		
Reduce Greenhouse Gas Emissions (GHGER)	3.46	.40
Reduce environmental impact (ENVIR)	3.47	.42
Increase energy efficiency (IENGE)	3.63	.40
Total average	3.52	.41

Table 1. found that external pressure (EXTP) was at a moderate level with an average of 3.42. When considering each aspect, it was found that funding sources (FUND), tax benefits (TAXA) and carbon credit prices (CDTP) were all at a moderate level with an average between 3.31 and 3.48.

Internal management (INTM) is at a moderate level with an average of 3.35. When considering each aspect, it was found that leadership by executives (LEXC), cooperation (COOP), supervision (MNTR) are all at a moderate level with an average of 3.35.

Organizational resources (INTR) were at a moderate level with an average of 3.43. When considering each aspect, it was found that human resource skills (HMRS) were at a high level with an

MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 35 Issue 2, 2025, Pages: 640-651

average of 3.55. Financial resources (BDGT) and technological potential (TECH) were at a moderate level with an average of 3.37 - 3.38.

potential for changing to a low carbon business (LCBTC) is at a high level, with an average of 3.52. When considering each aspect, it was found that increasing energy efficiency (IENGE) is at a high level, with an average of 3.63. For reducing greenhouse gas emissions (GHGER) and reducing environmental impact (ENVIR), it is at a moderate level, with an average between 3.46 - 3.47.

Table 2. Mean (M), standard deviation (S.D.), percentage coefficient of distribution (% CV), skewness (Sk), kurtosis (Ku) and P - value of chi-square test statistic (χ^{2}) of the empirical variables studied (n = 240).

Variable	M	S.D.	% Cv	Sk	Ku	χ^{2}	P - Value
FUND	3.48	.32	9.23	-. 730	.795	103.300	.000
TAXA	3.31	.35	10.66	-.748	1.940	178,000	.000
CDTP	3.47	.35	10.13	-. 565	1.036	124.975	.000
LEXC	3.35	.40	11.85	-.461	1.221	193.733	.000
COOP	3.35	.42	12.58	-. 075	.980	144.533	.000
MNTR	3.35	.39	11.77	-.069	.821	134.250	.000
BDGT	3.38	.44	12.92	.034	.934	120.875	.000
HMRS	3.55	.41	11.54	. 040	1.302	129.950	.000
TECH	3.37	.44	13.19	.201	.606	85. 850	.000
GHGER	3.46	.40	11.54	.404	1.150	148.375	.000
ENVIR	3.47	.42	12.11	.563	2.277	171,600	.000
IENGE	3.63	.40	11.16	.144	1.847	158.625	.000

Note: Chi-square statistic (χ^{2}) Statistically significant (P - value <.05) indicates a non-normal distribution.

Table 4.3 shows the results of checking the normal distribution (Normal Score) of the studied variables in all models. From the evaluation with the skewness (Sk) and kurtosis (Ku) of the empirical variables, including the chi-square test (χ^{2}) statistics, it was found that all the studied empirical variables were distributed non-normally (Non-Normal Distribution) (p - value <.05). This problem makes the assessment of the fit of the model to the empirical data (Model Fit) with the chi-square test (χ^{2}) problematic. Therefore, the researcher solved the problem of the statistics in evaluating the fit by finding the ratio of chi-square (χ^{2}) to the degrees of freedom (df). If the value is less than 5.00, it indicates that the empirical model is well-fitted. Although the test statistic of the model was statistically significant (p - value <.05) (Griffiths, Terluin, Trigg, Schuller, & Bjorner, 2022)

Results of structural equation model analysis according to the hypothesis (Hypothesis Model)

hypothesis model with the empirical data was checked using the AMOS program using the additional tool Model Fit Measure (de Oliveira Bussiman et al., 2022).Considering the fit index, it was found that the hypothesis model was not yet fit with the empirical data according to the fit index criteria in Table 3.

Table 3. Results of analysis according to the structural equation model's goodness of fit index.

List of criteria	Specified criteria (Barney, Barrett, Lensegrav-Benson, Quakenbush, & Twohig, 2021)	Model statistics	Consideration
χ^{2}	p - value greater than or equal to.05	χ^{2} = 68.706 p - value = 0.033	Failed
df	-	49	-
χ^{2}/ df	More than 1 but less than 3	1.402	pass
CFI	More than.95	.978	pass
SRMR	Less than.08	.086	Acceptable
RMSEA	Less than.06	.041	pass
PClose	More than.05	.732	pass

MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 35 Issue 2, 2025, Pages: 640-651

From the results of the examination, it was found that the results of the analysis according to the Fit Index did not pass the specified criteria (Klarenberg et al., 2022) because χ^2 It is statistically significant (p - value less than.05) and the standardized root mean square index of the residuals (Standardized Root Mean Square Residual) or SRMR The value is greater than.0 8 but not more than The researcher is still not confident in the parameter estimation that occurs in the model according to the hypothesis model. The researcher therefore needs to modify the model to be consistent with the empirical data by allowing the variance of the standard error (θ) of some pairs of empirical variables to be related. Considering the appropriateness and feasibility in terms of concepts and theories, as well as related research and the possibility of discussing the research results from the model modification. By considering increasing the relationship between the variables External driving forces (EXTP) and organizational resources (INTR), external driving forces will influence organizational resources in various aspects, such as supporting access to funding sources (FUND), which will increase the organization's financial resources (BDGT), and tax benefits (TAXA) also indirectly affect the organization's financial resources (BDGT) as well. This may lead to stimulation of technology development (TECH) including human resource development (HMRS) and carbon credit price (CDTP) itself also helps to develop technology or use technology (TECH) as well, with the revised model as shown in Figure 1.

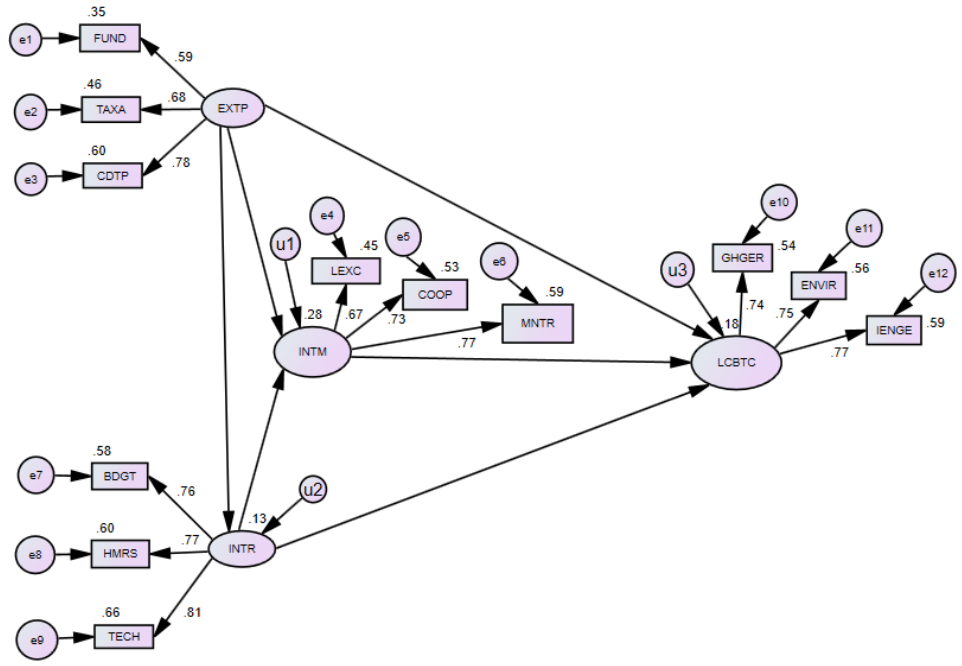

Figure 1. Model based on the revised research hypothesis.

This allows us to further define the research hypothesis that external forces have a direct influence on organizational resources and can rewrite the research hypothesis as follows:

H1 External forces directly influence the low-carbon transformation potential of SMEs in Thailand.
H2 External forces have a direct influence on internal management of an organization.
H3 Organizational resources have a direct influence on internal management of the organization.
H4 External forces have a direct influence on organizational resources.
H5 Organizational resources directly influence the low-carbon transformation potential of SMEs in Thailand.
H6 Internal governance has a direct influence on the low-carbon transformation potential of SMEs in Thailand.

MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 35 Issue 2, 2025, Pages: 640-651

Results of the analysis of the adjusted structural equation model (Adjust Model)

From the model modification by adding the relationship between external driving variables (EXTP) and organizational resources (INTR) to be consistent and appropriate in terms of concepts and theory as well as related research, the results of the modified structural equation model analysis can be shown as in Table 4

Table 4. Results of analysis according to the goodness of fit index of the modified structural equation model.

List of criteria	Specified criteria	Model statistics	Consideration
χ^2	p - value greater than or equal to.05 (Hanghon & Rinthaisong, 2018)	χ^2 = 48.896 p - value = 0.437	pass
df	-	48	-
χ^2 / df	More than 1 but less than 3 (Dochat et al., 2020)	1.019	pass
CFI	More than.95 (Keyser, Harrington, & Ahn, 2016)	.999	pass
GFI	Greater than or equal to.90 (Beccaria, Beccaria, & McCosker, 2018)	. 968	pass
AGFI	Greater than or equal to.90 (Beccaria et al., 2018)	. 948	pass
RMR	Less than or equal to.05 (Keyser et al., 2016)	. 005	pass
SRMR	Less than.08 (Keyser et al., 2016)	.038	pass
RMSEA	Less than.06 (Keyser et al., 2016)	.009	pass
PClose	More than.05 (Dochat et al., 2020)	.983	pass

Table 4 . shows that the fit index of the adjusted structural equation model is consistent with the empirical data, which is considered from the fit index (Fit Index), with the result of "passing" for all items. It can be concluded that the adjusted model is consistent with the empirical data and the parameter estimates in the model are therefore acceptable.

The second component in the EMR Model is internal management. Refers to internal operations of the organization to be consistent with strategies, practices, creating participation in activities to achieve goals, and overseeing to make the transition to a low-carbon business, which includes executive leadership, cooperation, and supervision. Good management will enable efficient operations and facilitate goal attainment. However, effective management must begin at the organizational policy level, encompassing strategic planning and a focus on goals, and proceed to the operational level to foster shared goals and operational participation. This will also foster effective management and governance systems, ensuring the successful transition to a low-carbon business. Both in terms of reducing greenhouse gas emissions, reducing environmental impacts and increasing energy efficiency.

The third element in the EMR Model is the organizational resource variable. Refers to the portion of organizational resources aimed at reducing greenhouse gas emissions, reducing pollution, and conserving the environment. This includes investment budgets, operational approaches, technology, and personnel skills for using that technology, as well as the social skills of personnel involved in the organization's transformation into a low-carbon business. This includes financial resources, human resource skills, and technological capabilities. An organization's financial resources are a key element in business operations. Small and medium-sized enterprises must manage their capital for business development, maintain liquidity, and maintain long-term profitability and growth. This is similar to investing in technology or training personnel to equip them with the technological knowledge or skills necessary for the transition to a low-carbon business. However, few entrepreneurs possess more than one technological component. Developing

MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 35 Issue 2, 2025, Pages: 640-651

organizational resources will enhance the organization's potential to transform its operations to reduce greenhouse gas emissions, minimize environmental impacts, and increase energy efficiency. and move towards low-carbon business more quickly

The fourth element in the EMR Model is: The variable, the potential for transitioning to a low-carbon business of SMEs in Thailand, refers to the ability to modify an organization's operational processes to reduce its total greenhouse gas emissions, waste reduction and recycling, energy efficiency improvement and renewable energy use, and other activities to reduce environmental impacts, with empirical results and can be calculated in terms of tons of carbon dioxide equivalent, where the modification must maintain profitability or have a competitive advantage in business. Therefore, it can be said that the potential variables for the transition to low-carbon businesses of SMEs in Thailand include reducing greenhouse gas emissions. Reduce environmental impact and increase energy efficiency

When all the elements are combined, it will lead to a model for creating a potential for the transformation into a low-carbon business for SMEs in Thailand. The analysis results indicate that: External forces are the initial factors that have a significant influence on organizational resources and internal management. These two factors jointly have a direct impact on the potential for transformation to a low-carbon business. In other words, for SMEs to be successful in their transformation to a low-carbon business, they need to be supported by external factors such as government policies and market mechanisms to enhance the readiness of internal resources (financial, human resources, and technology) and stimulate effective internal management (executive leadership). Collaboration and governance) all of which will lead to a sustainable reduction in greenhouse gas emissions, environmental impacts and increased energy efficiency. Furthermore, qualitative data emphasize the importance of internal organizational management, which includes executive leadership, collaboration, and a clear governance and monitoring system to ensure sustainable and effective change. This importance reflects the role of internal management as a mediating variable linking external drivers and organizational resources to the potential for transformation to a low-carbon business, as shown in Figure 2.

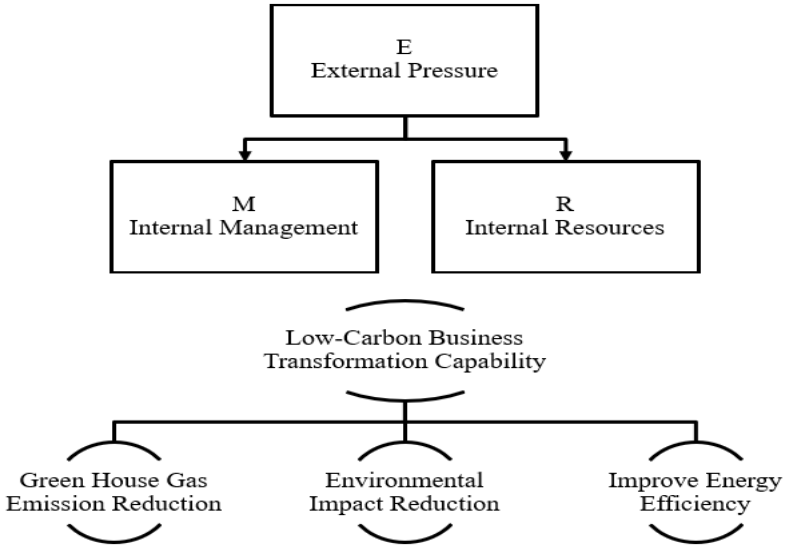

Figure 2. The EMR Model, which is a model of potential and potential for transformation to low-carbon businesses of SMEs in Thailand.

5. Summary

The sample was primarily drawn from the smallest segment of the SME sector, with an overwhelming 85.42% representing Micro Enterprises. Demographically, the respondents were younger, mainly falling into the 25–40 age bracket (51.25%) and holding a Bachelor's Degree (49.17%). The majority

MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 35 Issue 2, 2025, Pages: 640-651

worked as General Staff (49.58%) with 2–4 years of experience (48.33%). This composition suggests the findings primarily reflect the operational-level perceptions within the smallest, most resource-constrained tier of Thai businesses.

All four main constructs—External Pressure (EXTP), Internal Organizational Management (INTM), Enterprise Resources (INTR), and Low-Carbon Business Transition Potential (LCBTC)—were rated at moderate to high levels. Low-Carbon Business Transition Potential (LCBTC): This latent variable was rated high (Mean = 3.52). The highest single indicator was Increasing Energy Efficiency (IENGE, mean = 3.63), which was rated high, while GHG Emission Reduction and Environmental Impact Reduction were rated moderately high (Means 3.46–3.47). External Pressure (EXTP): The overall pressure was moderate (Mean = 3.42). All component variables (Funding Source, Tax Benefits, and Carbon Credit Prices) also fell within the moderate range. Enterprise Resources (INTR): This was rated as moderate (Mean = 3.43). Notably, Human Resource Skills (HMRS, mean = 3.55) was the only indicator in the entire model rated high, suggesting SMEs perceive their staff skills to be a relative strength compared to their Financial Resources and Technological Potential (Means 3.37–3.38), which were rated moderate. Internal Organizational Management (INTM): This construct was rated moderate (Mean = 3.35). All three indicators (Executive Leadership, Collaboration, and Supervision) were rated identically at 3.35.

Initial testing showed that all empirical variables had a non-normal distribution ($\chi 2, p<.05$ in Table 2), which complicated the standard $\chi 2$ test for model fit. Although the initial Hypothesis Model showed acceptable fit across most indices (e.g., $\chi 2/df=1.402$, CFI = 0.978, RMSEA = 0.041), the statistically significant $\chi 2$ and the slightly elevated SRMR (0.086) suggested a necessary modification. The researcher modified the model by adding a direct link from External Pressure (EXTP) to Organizational Resources (INTR). This adjustment was theoretically justified, as external forces (like funding access and tax benefits) logically influence an organization's internal resources (financial and technology capital). The revised model introduced a new set of hypotheses (H1 to H6). The Adjusted Model demonstrated an excellent fit with the empirical data, passing all specified criteria (e.g., $\chi 2=48.896$, p−value=0.437, $\chi 2/df=1.019$, CFI = 0.999, RMSEA = 0.009, SRMR = 0.038).

External Forces act as the initial drivers, directly influencing both Organizational Resources and Internal Management.

Organizational Resources and Internal Management then jointly and directly impact the Low-Carbon Transformation Potential (LCBTC). This structure suggests that for SMEs, achieving a successful transition requires external support (policies, market mechanisms) to simultaneously build internal capacity (resources like finance and technology) and motivate managerial change (executive leadership and cooperation). Furthermore, qualitative data underscored the critical role of Internal Organizational Management as a mediating variable, connecting external stimuli and resource availability to the final success of sustainable GHG reduction and energy efficiency efforts.

6. REFERENCES

Adomako, S., Amankwah-Amoah, J., Tarba, S. Y., & Khan, Z. (2021). Perceived corruption, business process digitization, and SMEs' degree of internationalization in sub-Saharan Africa. *Journal of Business Research, 123,* 196-207. doi:10.1016/j.jbusres.2020.09.065

Ahmed, A., Bhatti, S. H., Gölgeci, I., & Arslan, A. (2022). Digital platform capability and organizational agility of emerging market manufacturing SMEs: The mediating role of intellectual capital and the moderating role of environmental dynamism. *Technological Forecasting and Social Change, 177*. doi:10.1016/j.techfore.2022.121513

Barney, J. L., Barrett, T. S., Lensegrav-Benson, T., Quakenbush, B., & Twohig, M. P. (2021). Confirmatory factor analysis and measurement invariance of the Cognitive Fusion Questionnaire-Body Image in a clinical eating disorder sample. *Body Image, 38,* 262-269. doi:10.1016/j.bodyim.2021.04.012

MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 35 Issue 2, 2025, Pages: 640-651

Beccaria, L., Beccaria, G., & McCosker, C. (2018). A Confirmatory Factor Analysis of the Student Evidence-Based Practice Questionnaire (S-EBPQ) in an Australian sample. *Nurse Educ Today, 62*, 69-73. doi:10.1016/j.nedt.2017.12.010

Chaudhuri, A., Subramanian, N., & Dora, M. (2022). Circular economy and digital capabilities of SMEs for providing value to customers: Combined resource-based view and ambidexterity perspective. *Journal of Business Research, 142*, 32-44. doi:10.1016/j.jbusres.2021.12.039

Child, J., Karmowska, J., & Shenkar, O. (2022). The role of context in SME internationalization – A review. *Journal of World Business, 57*(1). doi:10.1016/j.jwb.2021.101267

Dahiya, A. (2015). Wood and Grass Energy Service Learning Projects and Case Studies. In *Bioenergy* (pp. 89-106).

de Oliveira Bussiman, F., Silva, F. F. e., Carvalho, R. S. B., Ventura, R. V., Mattos, E. C., Ferraz, J. B. S., . . . Balieiro, J. C. d. C. (2022). Confirmatory factor analysis and structural equation models to dissect the relationship between gait and morphology in Campolina horses. *Livestock Science, 255*. doi:10.1016/j.livsci.2021.104779

Dochat, C., Afari, N., Wooldridge, J. S., Herbert, M. S., Gasperi, M., & Lillis, J. (2020). Confirmatory Factor Analysis of the Acceptance and Action Questionnaire for Weight-Related Difficulties-Revised (AAQW-R) in a United States Sample of Adults with Overweight and Obesity. *J Contextual Behav Sci, 15*, 189-196. doi:10.1016/j.jcbs.2020.01.006

ElMassah, S., & Mohieldin, M. (2020). Digital transformation and localizing the Sustainable Development Goals (SDGs). *Ecological Economics, 169*. doi:10.1016/j.ecolecon.2019.106490

Griffiths, P., Terluin, B., Trigg, A., Schuller, W., & Bjorner, J. B. (2022). A confirmatory factor analysis approach was found to accurately estimate the reliability of transition ratings. *J Clin Epidemiol, 141*, 36-45. doi:10.1016/j.jclinepi.2021.08.029

Hanghon, P., & Rinthaisong, I. (2018). Confirmatory factor analysis of collaboration model in non-formal higher education management in southern Thailand. *Kasetsart Journal of Social Sciences, 39*(3), 472-477. doi:10.1016/j.kjss.2018.06.012

Huang, Y., Xu, Y., Zhang, J., Long, Z., Qian, Z., Liu, W., & Chen, L. (2024). Research on factors influencing the academic entrepreneurial ability of teachers in the digital age: Evidence from China. *Heliyon, 10*(2), e24152. doi:10.1016/j.heliyon.2024.e24152

Kamiguchi, A., & Tamai, T. (2019). Public investment, public debt, and population aging under the golden rule of public finance. *Journal of Macroeconomics, 60*, 110-122. doi:10.1016/j.jmacro.2019.01.011

Keyser, D., Harrington, D., & Ahn, H. (2016). A confirmatory factor analysis of the evidence-based practice attitudes scale in child welfare. *Children and Youth Services Review, 69*, 158-165. doi:10.1016/j.childyouth.2016.08.005

Kim, D., Jesiek, B. K., & Mazzurco, A. (2022). Development and validation of the sojourn readiness assessment (SRA): Exploratory and confirmatory factor analysis and translation to Chinese. *International Journal of Intercultural Relations, 88*, 95-105. doi:10.1016/j.ijintrel.2022.04.002

Kittichotsatsawat, Y., Rauch, E., & Tippayawong, K. Y. (2024). Designing sustainability measurement of a Thai coffee supply chain using axiomatic design and business model canvas. *Results in Engineering, 24*. doi:10.1016/j.rineng.2024.103443

Klarenberg, H., Dekkers, I. A., Peeters, C. F. W., de Mutsert, R., Jukema, J. W., Rosendaal, F. R., . . . Lamb, H. J. (2022). Confirmatory factor analysis including MRI-derived adipose tissues quantification improves associations of metabolic dysregulation to diastolic dysfunction. *J Diabetes Complications*, 108202. doi:10.1016/j.jdiacomp.2022.108202

Madurai Elavarasan, R., Pugazhendhi, R., Jamal, T., Dyduch, J., Arif, M. T., Manoj Kumar, N., . . . Nadarajah, M. (2021). Envisioning the UN Sustainable Development Goals (SDGs) through the lens of energy sustainability (SDG 7) in the post-COVID-19 world. *Applied Energy, 292*. doi:10.1016/j.apenergy.2021.116665

Morikawa, M. (2012). Demand fluctuations and productivity of service industries. *Economics Letters, 117*(1), 256-258. doi:10.1016/j.econlet.2012.05.019

MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 35 Issue 2, 2025, Pages: 640-651

Savari, M., & Khaleghi, B. (2025). Promoting safe and pro-environmental behaviors for sustainable forest management: Integrating technology acceptance model and the norm activation model. *Socio-Economic Planning Sciences, 98*. doi:10.1016/j.seps.2025.102158

Shan-jun, M., Qiao-xi, L., & Mei, L. (2009). Design and development of safety production management information system based on a digital coalmine. *Procedia Earth and Planetary Science, 1*(1), 1121-1127. doi:10.1016/j.proeps.2009.09.172

Somwethee, P., Ru-Zhue, J., Aujirapongpan, S., Chanthawong, A., & Usman, B. (2025). Developing social entrepreneurial capability in Thai community enterprises: The roles of intellectual capital, creating shared value, and organizational agility on sustainability. *Social Sciences & Humanities Open, 11*. doi:10.1016/j.ssaho.2024.101269

Troise, C., Corvello, V., Ghobadian, A., & O'Regan, N. (2022). How can SMEs successfully navigate VUCA environment: The role of agility in the digital transformation era. *Technological Forecasting and Social Change, 174*. doi:10.1016/j.techfore.2021.121227

Wonglimpiyarat, J. (2007). National foresight in science and technology strategy development. *Futures, 39*(6), 718-728. doi:10.1016/j.futures.2006.11.005