The Influence of Green Logistics towards the Business Performance under Circular Economy Principles: The Case of the Packaged Food Industry in Thailand

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Abstract

This study examined the factors influencing the firm performance under circular economy principle using Thailand packaged food industry context. We hypothesized that the firm performance under circular economy optimizes when process alignment exists in green logistics, customer integration, and production efficiency. We distributed the questionnaire survey to 400 entrepreneurs of packaged food enterprise in Thailand and analyzed the data via Partial Least Square Structural Equation Modeling (PLS-SEM) using SmartPLS 4.0 program. Reflective-formative model was employed and the reliability test, validity test, and hypothesis testing were conducted. The results confirmed that green logistics positively influence firm performance under circular economy principle directly and indirectly via the mediating roles of customer integration and production efficiency. The findings imply that customer integration and production efficiency play important roles in enhancing the operational success and firm stability. Our empirical results provide guidelines for entrepreneurs in strategic green supply chain management such as logistics efficiency, waste reduction, pollution prevention, green innovation access, all of which enable advancement in Thailand packaged food industry towards becoming a sustainable manufacturing base for the global markets.

Keywords: Green logistics, Circular economy, Business performance, Packaged food industry

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Introduction

Responding to severe resource efficiency problems, the circular economy has become the choice of green industries that aim to contribute to the sustainable resource efficiency encouragement. Notably, circular economy enhances the solution for environmental problems such as carbon emission and provides guideline for sustainable business processes for both goods and service providers, particularly in resource management. By implementing circulation, reuse, recycle and waste reduction which leads to zero-waste action, industrial sectors can better business performances via modern manufacturing process as well as innovative product design aligning with environmentally friendly code of conduct and supporting new economic development (Del Giudice et al., 2020).

Particularly, for logistics system, circular economy and green logistics are interrelated with the goal to reduce carbon emission, enhance fossil energy use and especially encourage the end-of-life product return. Green logistics helps reduce plastic packaging production and usage, and accordingly decrease natural environmental harm. Circular economy is the principle of the paradigm of sustainable economic development that promotes the reduction of natural resource usage, waste generation, pollution, and energy leak as well as the enhancement of closed material and energy loop. Principally, green logistics are parts of circular economy towards sustainable logistics operation (de Souza et al., 2022), aiming to lessen negative environmental impacts occurred during product shipping, sourcing, packaging, service providing, purchasing, manufacturing, distributing, consuming, and recycling. Consequently, green logistics focuses on innovative processes that reduce carbon emission, energy usage and production cost. In the meantime, it increases the value added of products and services as well as sustainable firm profits.

The current study focuses on the context of packaged food industry. Packaged food industry has expanded with advancement of food processing techniques. Moreover, variety of packaged food has been activated while home delivery alternative and attractive sales promotion positively stimulates global packaged food markets. Therefore, packaged food industry is the significant driver of Thailand economy. However, packaged food manufacturing is one of the causes of over production problem that leads to the waste of raw materials and labors as well as unnecessary cost of shipping and distribution.

Previous literature studies overall business performance under green supply chain management but still lacked of contextual and interrelated views regarding other relevant factors; thus, the interpretations of the business performance were biased. Hence, there are still limited number of research that links green supply chain management with critical green logistics factors under circular economy.

This study contributes to existing literature by identifying the needs of waste management in production process to develop the circular economy supply chain. We hypothesized that circular supply chain is most efficient when related factors are aligned with each other to support green logistics operations, customer relationship, and production capabilities. Therefore, this research investigates the influence of green logistics under circular economy in Thailand packaged food industry context by developing measurement tools for data collection. The factors evaluated included operation performances under circular economy, green logistics, customer integration and production efficiency. The empirical results demonstrate causal model of factors impacting green logistics operations of packaged food industry under the circular economy including various implementations such as logistics process efficiency, waste, and pollution reduction as well as green innovation promoting sustainable competency of Thailand manufacturers towards global markets.

Objectives

The objectives of this research are as follows:

1. To examine the framework of factors influencing the operations of Thailand packaged food industry under the circular economy principles.

2. To analyze the direct and indirect impacts of relevant factors on the operations of Thailand packaged food industry under the circular economy principles.

Literature Review

Green Logistics and Firm Performance for Circular Economy

Green logistics has played essential roles in promoting environmental protection to prevent environmental problems (Karaman et al.,2020; Rizvi et al.,2020). Accordingly, green logistics research have been in focus (Zhang et al.,2020). Meanwhile, process and operation

alignment with circular economy covers reuse, repair, remanufacturing, business development, innovation and follow up evaluation to ensure the closed-loop of products and materials. Moreover, employing circular economy principle into the organization help improve resource management, and create competition competency towards green innovation (Shahzad et al., 2020). Previous literature stated that green logistics directs the company to the reverse logistics that enables continuous production efficiency improvement (Bag & Pretorius, 2020). Empirical results indicated that green logistics simplifies the production process and at the same time reduces lead time and pollution (Karaman et al., 2020; Umar et al., 2021). Besides, Seroka and Ociepa (2019) revealed that green logistics encourages operation achievement under the circular economy by improving resource usage and alternative input sourcing such as green energy. Similarly, Torasa and Mekhum (2020) studied the effects of green logistics on circular economy practice in ASEAN and found that the most practical green logistics activity is recycling and reusing of raw materials. Existing research confirmed the positive interrelation between green practice and firm performance.

Green Logistics, Customer Integration and Production Efficiency

Green logistics management can be employed in various processes including service providing, customer relation, production control, employee management and supplier relationship. Green logistics assists the firm to increase market shares and positive reputation. Green suppliers and distributors may mutually join the green logistics system, by designing or developing activities that lessen energy consumption but strengthen the value of products or services (Wong et al., 2021). Existing studies empirically proved that green management promotes standardization, trust, and quality assurance. Circular economy principle has switched the roles of the customer from “consumer” to “user,” showing that value transfer between business and customers focuses more on “utility” than “possession”. Moreover, producers employ environmentally friendly code of conduct in order to create organizational sustainability (Susanty et al., 2020). Besides, relevant research analyzed green logistics practices such as system design to prevent material leakage and innovative waste disposal process. Previous research found that organizations should proactively engage in environmental practice to enhance the comparative advantage (Takacs et al., 2022).

Customer Integration and Firm Performance for Circular Economy

Currently, consumers' green attitude influences on the purchase intention, either positively or negatively. Higher level of environmental concerns has driven people to be aware of environmental impacts and natural resource protection. With more demands of environmentally friendly goods, green products have high potential to enhance economy growth (Kamalanon et al., 2022) Customer integration is a part of customer relationship management that applies technologies to assist customers when doing transactions and interacting with the organizations. It supports human resource efficiency, and it targets effective integration with customers such as customer communication improvement and customer retention (Yang et al., 2021). Economic change towards sustainable management concerns activities that continuously encourage customer relationship and customer satisfaction on the goods and services, for instance, customer participation on the decision making and information sharing about goods and services. Zhu et al., (2019) examined the cooperation among green supply chains and its impacts on the circular economy of manufacturers in China and found that the practices of cooperative green supply chain positively improve the firm's environmental performance. Susanty et al., (2020) investigated the circular economy practice in wood furniture industry and disclosed that collaborative decision making in eco-design of reusable or recyclable materials is the most powerful tools to maximize green logistics efficiency. Trivellas et al., (2020) studied sustainable logistics and supply chain efficiency in agricultural industry and proved that customer integration in information sharing is the significant antecedent of sustainable business and improved profitability.

Production Efficiency and Firm Performance for Circular Economy

Efficient production refers to continuous production with limited pause during the manufacturing process in order to minimize machine breakdown and improve overall equipment effectiveness. Continuous production requires well-managed planning and follow up system so that manufacturers can comprehensively see the plan and systematically operates. Furthermore, waste generation is the core of lean production management which is commonly implemented in production and efficiency improvement planning (Kendall et al., 2018). Nonetheless, manufacturers have faced certain problems when employing circular economy principle, especially in competing with the competitors in production efficiency, cost management and

solutions for supply chain complexity. Series of research showed that it is undoubtedly necessary to reduce waste management cost. Also, cost of product life cycle management should be well managed to maximize the resource efficiency (Lingyu et al., 2019). In accordance with the literature, currently, product quality improvement, cycle time reduction, and improvement of asset utilization, are strategic tools for circular economy practice that would lower the risks of environmental crisis.

Hypotheses

The research hypotheses were set as follows:

H_1: Green Logistics is positively associated with Firm Performance for Circular Economy

H_2: Green Logistics is positively associated with Customer Integration

H_3: Green Logistics is positively associated with Production Efficiency

H_4: Customer Integration is positively associated with Firm Performance for Circular Economy

H_5: Production Efficiency is positively associated with Firm Performance for Circular Economy

Conceptual Model

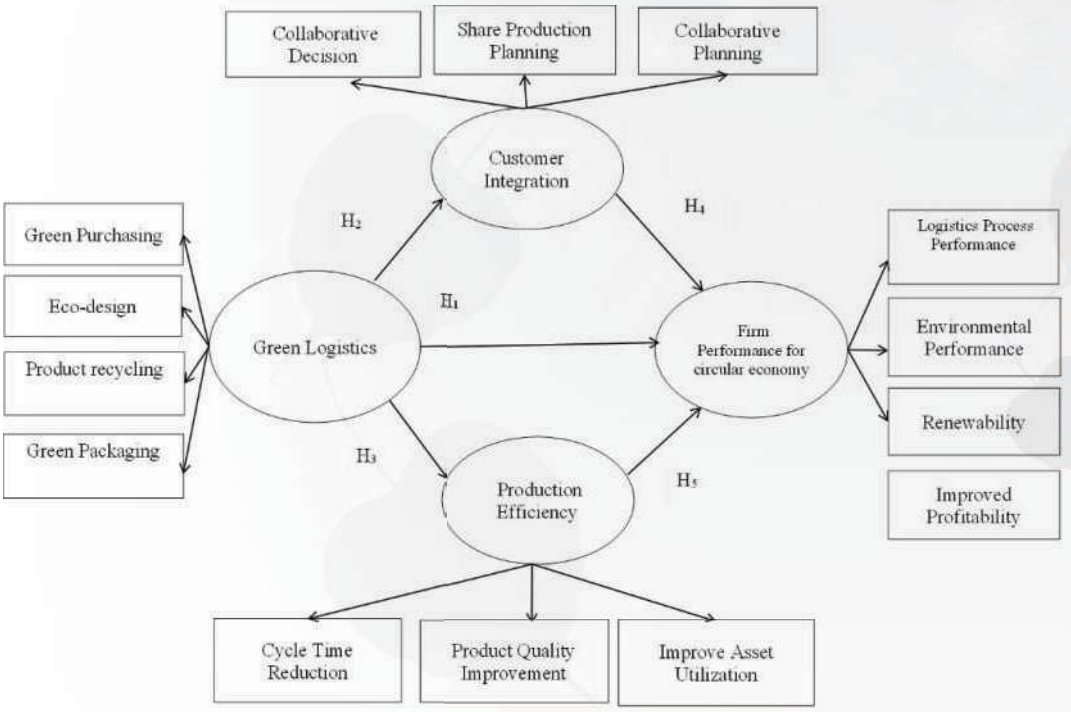

Figure 1 Conceptual framework and the related hypothesis of the research

Source: Adapted from Jinru, L., Changbiao, Z., Ahmad, B., Irfan, M., & Nazir, R. (2022). How do green financing and green logistics affect the circular economy in the pandemic situation: key mediating role of sustainable production. *Economic Research-Ekonomska Istrazivanja*. 35(1): 3836-3856.

Methodology

Data Collection

We employed the primary data collected via questionnaire survey sent to entrepreneurs of packaged food producers in Thailand. The sample was selected using multi-stage sampling which includes 1) determining sample size 2) cluster random sampling 3) selecting sample size by the population portion. There are 384,777 packaged food companies in Thailand. We randomly contacted 2,500 companies and ask for the cooperation from the entrepreneur to complete the

questionnaire without any incentive. Finally, all 400 companies responded and completed the survey (response rate = 16%). There are not any responses with the missing or incomplete data; therefore, all 400 responses are usable.

Measurement Scales

There were 14 first-order constructs and each consisted of 3 questions; therefore, there are totally 42 measurement items. We created the measurement tools by developing the measurement items using five-point rating scale (Likert, 1972). Some of the scales were modified from existing literature while some were newly developed according to the literature in the context of green logistics influence on firm performance under circular economy. All measurement items were reviewed by experts in the field of supply chain management, and were adjusted based on the feedback. The population and sample targets packaged food industry in Thailand. We tested data Reliability using Cronbach Alpha with the threshold value of >0.7, and the Cronbach's Alpha was 0.959, confirming high level of reliability. Moreover, we tested the reliability with Corrected Item-Total Correlation (CITC) with the threshold value of >0.2, and the results show that CITC of all scales are between 0.566 - 0.851.

Structural Equation Modeling (SEM)

Data analysis was conducted using Structural Equation Modeling (SEM). Generally, two types of SEM commonly used are; 1) Covariance-based SEM (CB-SEM) which focuses on the Covariance among the latent variables and is usually performed via the computer software such as LISREL and AMOS 2) Variance-based SEM (VB-SEM) or so-called Partial Least Square SEM (PLS-SEM) which are centered on the variance among endogenous variables and is usually performed via computer software such as Smart PLS. PLS-SEM is more flexible than CB-SEM because it supports the statistical analysis of non-normal multivariate distributed data and small sample data. However, the most important reason this study applied PLS-SEM was that it enables statistical testing of complex model, for instance, the research framework with not only observed variable and latent variable but also mediator, moderator, and control variable. Moreover, PLS-SEM can identify both the formative and reflective relationship between observed variable and latent variable.

Hypothesis Testing

Main effects

Hypothesis testing was conducted via Partial Least Square Structural Equation Modeling (PLS-SEM) using Reflective-formative model. At the significance level 0.05, all the hypotheses including H1, H2, H3, H4, and H5 were supported. Regarding the antecedent role of green logistics, green logistics significantly and positively associated with firm performance for circular economy (β=0.151, t=2.340, p=0.019), customer integration (β=0.663, t=10.567, p=0.000), and firm performance (β=0.584, t=8.284, p=0.000); therefore H1, H2, and H3 were supported. For the firm performance for circular economy, customer integration (β=0.236, t=6.587, p=0.000) and production efficiency (β=0.490, t=6.587, p=0.000) significantly and positively influence the firm performance for circular economy; thus, H4 and H5 were supported.

Mediating effects

The analysis of indirect effects showed that, apart from the direct effects, green logistics also indirectly influence the form performance for circular economy via the mediating roles of customer integration (β=0.157, t=2.299, p=0.022) and production efficiency (β=0.286, t=4.891, p=0.000). Therefore, green logistics is the essential pathway to enhance the firm performance under circular economy principle. Hypothesis testing results are shown in Table 1.

Table 1 Hypothesis Testing Results- Structural Model Assessment

Direct effect					
Hypothesis	Path	Coefficient (β)	T-statistics	p-value	Results
H1	GL -> FP	0.151	2.340*	0.019	Supported
H2	GL -> CI	0.663	10.567**	0.000	Supported
H3	GL -> PE	0.584	8.284**	0.000	Supported
H4	CI -> FP	0.236	2.397*	0.017	Supported
H5	PE -> FP	0.490	6.587**	0.000	Supported
Indirect effect					
-	GL -> CI -> FP	0.157	2.299*	0.022	-
-	GL -> PE -> FP	0.286	4.891**	0.000	-

Note: **, * statistically significant at 0.001, 0.05 respectively

Results

Descriptive Statistics

As shown in Table 2, among 400 respondents, 305 were female (76.25%) and 214 aged between 30-40 years old (53.50%). Moreover, most of the respondents graduated the bachelor degree. 200 of the respondent companies has the firm age of 6-10 years (50%) and 197 of them have less than 50 employees (49.75%).

Table 2 Demographic information

Items		Frequency (n=220)	Percentage
Gender	Male	95	23.75
	Female	305	76.25
Age (years old)	Below 30	10	2.50
	30-40	214	53.50
	41-50	162	40.50
	Above 50	14	3.50
Highest Education	High School or Lower	2	0.50
	Bachelor	393	98.25
	Master or Higher	5	1.25
Firm Age (years)	Less than 1	5	1.25
	1-5	50	12.50
	6-10	200	50.00
	More than 10	145	36.25
Number of Employees	Less than 50	197	49.25
	50-100	158	39.50
	More than 100	45	11.25

Validity and Reliability Test

Validity test requires that the factor loadings of all measurement items are higher than 0.50 with the significance level 0.05 (Hair et al., 2014) while the reliability test requires internal consistency with Cronbach's Alpha higher than 0.70 and Composite Reliability: CR higher than 0.70 (Hair et al., 2014). Specifically, convergent validity is examined using the threshold value of Average Variance Extracted (AVE) 0.50 or higher (Hair et al., 2014). Meanwhile, discriminant validity is tested by examining whether the square root of AVE for each construct is larger than the correlations between constructs (Fornell and Larcker, 1981).

Statistics used for investigating reflective measurement model of the First Order Construct / Lower Order Construct (LOC) include Outer Loadings (Factor loadings), Indicators Reliability, Alpha, CR, AVE and Discriminant Validity. First order measurement model includes 14 constructs and each construct has three items. Therefore, there are 42 measurement items and all of them passed the validity and reliability test. Reliability and Convergent validity test results are shown in Table 3. Discriminant validity test results are shown in Table 4.

Table 3 First Order Measurement Model (Reflective-formative Type)

Constructs	Code	Items	Factor Loadings	Cronbach's Alpha	CR	AVE
Collaborative Decision Making	CDM	CDM1	0.861	0.743	0.854	0.662
		CDM3	0.739			
		CDM4	0.835			
Collaborative Planning	CLP	CLP1	0.880	0.713	0.840	0.639
		CLP3	0.689			
		CLP4	0.817			
Cycle Time Reduction	CTR	CTR1	0.825	0.825	0.895	0.740
		CTR2	0.869			
		CTR3	0.887			

Table 3 First Order Measurement Model (Reflective-formative Type) (Continued)

Constructs	Code	Items	Factor Loadings	Cronbach's Alpha	CR	AVE
Eco-design	EDS	EDS2	0.890	0.855	0.911	0.775
		EDS3	0.839			
		EDS4	0.910			
Environmental Performance	EPF	EPF1	0.821	0.768	0.869	0.688
		EPF2	0.852			
		EPF3	0.815			
Green Packaging	GPK	GPK1	0.833	0.771	0.868	0.686
		GPK2	0.789			
		GPK3	0.861			
Green Purchasing	GPR	GPR1	0.823	0.731	0.849	0.653
		GPR2	0.844			
		GPR3	0.753			
Improve Asset Utilization	IAU	IAU1	0.877	0.877	0.925	0.804
		IAU2	0.898			
		IAU3	0.913			
Improved Profitability	IPF	IPF1	0.884	0.876	0.924	0.802
		IPF2	0.886			
		IPF4	0.915			
Logistics Processes Performance	LPP	LPP1	0.861	0.734	0.853	0.660
		LPP3	0.840			
		LPP4	0.730			
Product Quality Improvement	PQI	PQI1	0.775	0.787	0.876	0.703
		PQI2	0.832			
		PQI3	0.903			

Table 3 First Order Measurement Model (Reflective-formative Type) (Continued)

Constructs	Code	Items	Factor Loadings	Cronbach's Alpha	CR	AVE
Product Recycling	RCC	RCC1	0.805	0.775	0.869	0.690
		RCC4	0.848			
		RCC5	0.838			
Renewability	RNW	RNW1	0.753	0.767	0.865	0.683
		RNW2	0.894			
		RNW3	0.825			
Shared Production Planning	SPP	SPP1	0.845	0.729	0.847	0.648
		SPP2	0.767			
		SPP3	0.802			

Table 4 Discriminant validity based on Fornell-Larcker criterion

Constructs	CDM	CLP	CTR	EDS	EPF	GPK	GPR	IAU	IPF	LPP	PQI	RCC	RNW	SPP
CDM	**0.814**													
CLP	0.532	**0.799**												
CTR	0.450	0.376	**0.860**											
EDS	0.400	0.360	0.276	**0.880**										
EPF	0.447	0.399	0.422	0.240	**0.830**									
GPK	0.450	0.399	0.413	0.341	0.379	**0.828**								
GPR	0.390	0.368	0.238	0.370	0.292	0.286	**0.808**							
IAU	0.446	0.340	0.396	0.200	0.456	0.413	0.309	**0.896**						
IPF	0.376	0.326	0.327	0.161	0.496	0.385	0.290	0.431	**0.895**					
LPP	0.488	0.422	0.480	0.240	0.411	0.425	0.309	0.486	0.473	**0.812**				
PQI	0.396	0.404	0.315	0.278	0.455	0.342	0.327	0.391	0.406	0.440	**0.839**			
RCC	0.386	0.317	0.264	0.220	0.366	0.420	0.305	0.311	0.313	0.365	0.255	**0.830**		

Table 4 Discriminant validity based on Fornell-Larcker criterion (Continued)

Constructs	CDM	CLP	CTR	EDS	EPF	GPK	GPR	IAU	IPF	LPP	PQI	RCC	RNW	SPP
RNW	0.381	0.344	0.346	0.216	0.402	0.360	0.201	0.406	0.423	0.499	0.366	0.324	**0.826**	
SPP	0.373	0.477	0.370	0.305	0.376	0.377	0.356	0.380	0.351	0.434	0.399	0.339	0.324	**0.805**

Note: AVE shown in bold on the diagonal

The second order formative model consists of Second Order Construct / Higher Order Construct (HOC). The statistics used for assessing the measurement model include convergent validity, collinearity, significance, relevance, outer weight and outer loadings. In case the outer weights are not statistically significant but the outer loading is 0.50 or higher, that item should be remained. However, if the outer weights are not statistically significant and the outer loading is lower than 0.50, that item should be removed from the model. Variance Inflation Factor (VIF) should be less than 5. The VIF value higher than 5.0 indicates collinearity. As illustrated in Table 4, outer weights are all significant and outer loadings of the first order constructs are all higher than 0.50. Besides, VIF of all first order constructs are less than 5.0, affirming that all latent variables including GI, CI, PE and FP are valid and reliable.

As shown in Figure 2, R^2 of customer integration, production efficiency, and firm performance for circular economy is 43.9, 34.1 and 60.4 percent respectively. According to the forecasting accuracy criterion, R^2 value of 0.19, 0.33, and 0.67 percent represents small, medium, and large predictability (Chin, 1998). Hence, in this case, green logistics can explain the variance of customer integration and production efficiency in the medium level. In the meantime, green logistics, customer integration and production efficiency can explain the firm performance for circular economy in the medium level.

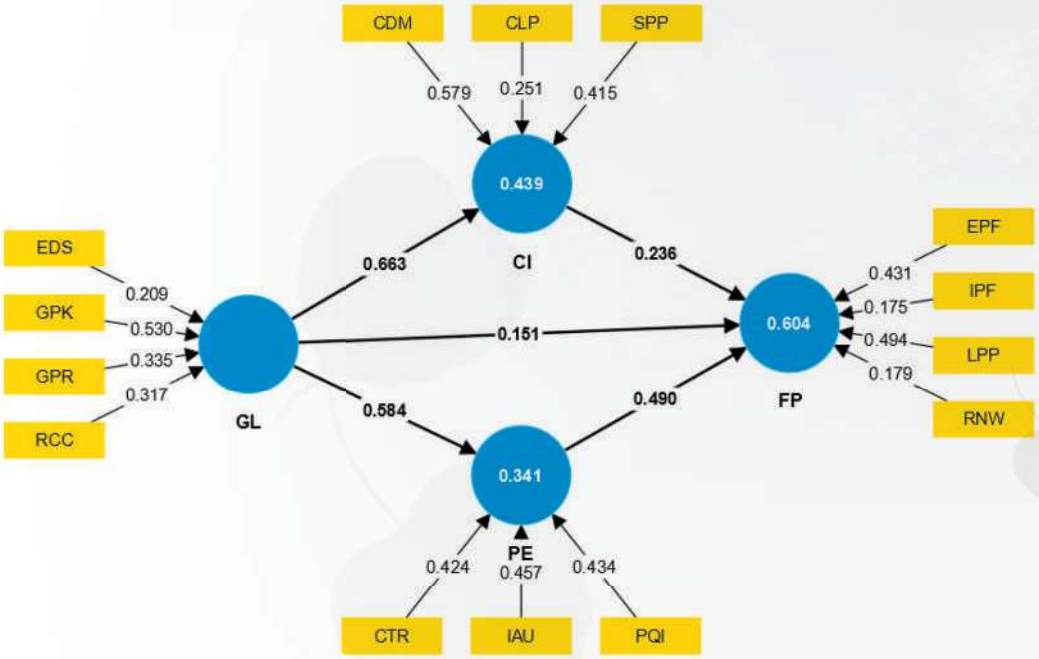

Figure 2 Structural Model - Reflective-formative Type

GL = Green Logistics, CI = Customer Integration, FP = Firm Performance for Circular Economy, PE = Production Efficiency

EDS = Eco-design, GPK = Green Packaging, GPR = Green Purchasing, RCC = Product Recycling

CDM = Collaborative Decision Making, CLP = Collaborative Planning, SPP = Shared Production Planning

EPF = Environmental Performance, IPF = Improved Profitability, LPP = Logistics Process Performance, RNW = Renewability

CTR = Cycle Time Reduction, IAU = Improved Asset Utilization, PQI = Product Quality Improvement

Source: Ringle, C. M., Wende, S., and Becker, J.-M. 2022. "SmartPLS 4." Oststeinbek: SmartPLS GmbH, http://www.smartpls.com.

Conclusion

To develop effective circular supply chain, enterprises should consider sustainable production cycle solutions and promote stakeholder cooperation in all dimensions of the operation. Such action would positively enhance the closed-loop manufacturing and logistics under circular economy principle. Businesses should take part in supporting sustainable

production in order to encourage national economy. Moreover, external stakeholder cooperation plays crucial role in efficient circular supply chain development. The current study examined the influence of green logistics on packaged food business performance under circular economy principles by developing data collection tools, evaluate the direct and indirect relationships, and identify the significant antecedents and mediators via quantitative statistical analysis (Partial Least Square Structural Equation Modeling) using SmartPLS software. Our findings showed that firm performance for circular economy is influenced directly by green logistics, and indirectly by customer integration and production efficiency.

The empirical results implied that business operations under circular economy optimize when process alignment exists among all dimensions of the supply chain, specifically in the way that stimulate green logistics. Particularly, customer integration and production efficiency are two main channels that link green logistics to sustainable firm performance. Our investigation revealed that the most impactful factor is green packaging; therefore, packaged food entrepreneur should emphasize environmentally friendly packaging usage and promote this information to the customers. For instance, eye-catching message that the package is made from 100% recycled paper should be presented on the package. Next, green purchasing, recycled product, and eco-design is the second, third and fourth important factors. Besides, entrepreneurs should also concentrate on regulating the organizational structure, key performance indicator and performance evaluation that enable operation improvements and business opportunities. The results of this research provide guidelines for strategic planning for green supply chain operation under circular economy principles. is, logistics process efficiency, waste and pollution generation reduction, green innovation access are the pathways to advance packaged food industry in Thailand and augment Thailand manufacturing base to sustainably respond to the global demand.

Discussion

The current research examined the direct and indirect influence of green logistics on the firm performance under the circular economy principle using Thailand packaged food industry context. The survey respondents were juristic person who are entrepreneurs of packaged food business in Thailand. The data was analyzed with quantitative approach based on Partial Least

Square Structural Equation Modeling (PLS-SEM) via SmartPLS 4.0. The data were tested two times using Reflective-formative model for the first and second-order constructs respectively.

Green logistics directly affects firm performance under circular economy principle (ß=0.151, t=2.340, p=0.019), supporting H1. This is aligning with de Souza et al., (2022) who stated that green logistics is one of the processes to achieve circular economy and sustainable logistics operations. Meanwhile, Torasa and Mekhum (2020) found that green logistics of recycle and reuse of raw materials plays considerable roles in enhancing logistics efficiency under the circular economy.

Our empirical results showed that green logistics directly influences customer integration (ß=0.663, t=10.567, p=0.000); thus, H2 was supported. This is similar to Wong et al., (2020) who disclosed that customer integration is the effective way to acquire the information on customer needs. Furthermore, Susanty et al., (2020) found that effective customer integration requires application to the whole product life cycle in order to strengthen logistics efficiency.

Based on our findings, green logistics has a direct positive relationship with production efficiency (ß=0.584, t=8.284, p=0.000), supporting H3. This is in accordance with Takacs et al., (2022) who stated that green logistics results in more material flows within the closed-loop where production can increase without refining new natural resources.

Regarding customer integration, it directly relates to firm performance under circular economy principle in the positive direction (ß=0.236, t=6.587, p=0.000); hence, H4 was supported. This is in line with Yang et al., (2021) who suggested that customer integration encourages innovative initiation particularly mutual product design. Besides, it aligns with Trivellas et al., (2020) that enterprises with customer integration can enhance environmentally friendly operation initiation.

Production efficiency has a direct influence on the firm performance under circular economy principle (ß=0.490, t=6.587, p=0.000), supporting H5. This is consistent with Kendall et al., (2018) who presented that production efficiency improvement such as work cycle time reduction can support quality assurance. In addition, Lingyu et al., (2019) also found that improvement of product and production process leads to energy and resource efficiency and finally create the competitive advantage.

Apart from direct effects, this study also paid attention to the indirect effects of green logistics on firm performance under circular economy principle via the mediating roles of customer integration and production efficiency. Customer integration (ß=0.157, t=2.299, p=0.022) and production efficiency (ß=0.286, t=4.891, p=0.000) mediates the relationship between green logistics and firm performance for circular economy via the path GL -> CI -> FP and GL -> PE -> FP respectively. It implied that green logistics influence firm performance both directly and indirectly.

Recommendation

This research focused only on packaged food industry in Thailand; therefore, the results cannot be generalized to other industries or other countries. Future search may extend the samples to other industries or other countries so that it is possible to understand the phenomenon in various contexts. Variety of samples and geographical locations would enable us to make clear about the importance and influencing factors of green production and green logistics under circular economy principle as well as consumer attitude regarding environmentally-friendly goods. Furthermore, other related variables might have been neglected; hence, future research may include other constructs such as consumer need, product reliability, consumer trust in the product or the company, consumer awareness and understanding about environmental study.

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