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A causal relationship model of green logistics management and lean management affecting food and beverage industrial performance in Thailand

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***Abstract*---**This research aims to study the effect of green logistics management and lean management on environmental performance and industrial performance of food and beverage industry in Thailand. The research was designed as quantitative. The sample consisted of 430 food and beverage enterprises in Thailand. Data were analyzed using structural equation modelling (SEM) technique. The findings revealed that green logistics management and lean management influence environmental performance and industrial performance of the food and beverage industry in Thailand at a statistical significance level of 0.05 with the statistical values of □2= 99.472, df = 83, p-value = 0.105, □2/df = 1.198, RMSEA = 0.022, RMR = 0.009, GFI = 0.976, AGFI = 0.945, CFI = 0.998, which can predict 77.80% of industrial performance. This indicates that that green logistics management and lean management can help improve performance of organizations and industries, enabling them to compete and survive in a dynamic business environment. Not only do green logistics management and lean management help improve financial performance, but they also help protect the environment, leading organizations to develop sustainable growth.

***Keywords*---**green logistics, lean management, industrial performance, environmental performance, food beverage industry.

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Introduction

At present, manufacturing sector, along with consumption are growing rapidly, creating more environmental problems. More and more organizations around the world have become more aware of environmental issues (Daniel et al., 2020). Manufacturing sector plays a key role in driving Thailand's economy. One of the major industries in manufacturing sector driving and creating value in the manufacturing sector significantly is the food and beverage industry, which is raw material and labour intensive (Bank of Thailand, 2020). With the current global economy, the food and beverage industry face intense price competition as product prices are determined by the customer and the market (Kasikorn Research Center, 2020). Therefore, to survive in the food and beverage industry, which is highly competitive, firms must increase their profitability and gain competitive advantage by reducing costs or increasing efficiency in the production or operation process.

Green logistics management has played an increasingly important role in logistics management (Chatongrat et al., 2020). It plays an integral part in reducing environmental impact, driving organizations and industries to achieve their goals, and increasing organizational performance from both environmental and financial perspectives (Choi & Zhang, 2011). On the other hand, lean management focuses not only on reducing wastes, but also eliminating non-value-added activities, managing production capacity, and utilizing resources efficiently (Pearce et al., 2018). Lean management also helps increase market share and customer’s satisfaction, improve performance, develop metrics, and guide organizations towards sustainability (Almanei et al., 2017). The concepts of green logistics management and lean management are similar in various aspects. Both emphasize on reducing wastes which is a major contributor of environmental problems. Both also focus on optimizing resource management to improve organizational performance. Hence, green logistics management and lean management are instrumental business approaches which can be adopted by organizations and industries to increase performance and reduce environmental problems. The objective of this research is to study the causal relationship of green logistics management and lean management affecting the performance of the food and beverage industry in Thailand in which the research result can be used to propose guidelines to help improve the performance of food and beverage industry. The paper is organised with an introduction and followed by a literature review on green logistics management, lean management, environmental performance, and industrial performance, Next, a conceptual framework is proposed to identify variables related to green logistics management, lean management, environmental performance, and industrial performance. An empirical study employing a questionnaire survey is elucidated to validate the proposed conceptual framework. Finally, conclusion is presented in the last section of the paper.

Literature Review

Green Logistics Management

Green logistics management refers to the concept of logistics management that takes into account the environmental impact generated from the overall process of logistics activities. Green logistics includes activities which reduce and manage pollution such as air pollution reduction (Kwak, 2020), material handling, wastes management, and packaging and transportation management (Ismail et al., 2019). Green logistics is derived from the concept of sustainable development which consists of economic, social, and environmental aspects (Alshubiri, 2017). Green logistics management in this study involved green warehouse, environmentally friendly infrastructure design, green transport, green packaging, reverse logistics, and wastes management in the logistics process (Al Minhas et al., 2020; Agyabeng et al., 2020; Daniel et al., 2020; Cherrafi et al., 2018; Qu et al., 2017).

Lean Management

Lean management was first created and written in the book called “the Machine that Changed the World” by James P. Womack, Deniel T. Jones and Daniel Roos in 1991 (Dekier, 2012). Lean management is based on Toyota Production System (TPS) principles which focus on customer, quality, cost, and delivery time (Mello et al., 2020). Primary concepts and tools of lean management include people integration, continuous improvement, 5S activities, Kaizen activities, line balancing, standardization, man-machine separation, pull flow, using takt time (T/T) to set the pace of production per unit according to the customer’s demand, teamwork, and wastes reduction (Wagner, 2017). Dimensions of lean management used in this research were wastes reduction, Just in Time (JIT), continuous improvement, people integration, and standardization (Loyd et al., 2020; Tupamahu et al., 2019; Cherrafi et al., 2018; Hussain et al., 2018).

Environmental Performance

At present, solving environmental problems is a matter of interest in the world. Focusing solely on economic growth does not lead to sustainable development. Corporate sustainability contributes significantly to success of business (Wongwilai et al., 2021). To achieve sustainability, industrial development in other dimensions, such as environmental conservation, need to be taken into consideration (Department of Industrial Works, 2019). Global environmental indicators that are used to assess the environment in each country are SDG Index and Dashboard. It encompasses 17 goals consisting of three main dimensions which are economic, social, and environmental dimensions (Kostoska & Kocarev, 2019). In this study, dimensions of environment performance were identified from literature review as different organizations have different guidelines and indicators in terms of environmental performance. The dimensions of environmental performance used in this study were standard and system, pollutant releases, resource consumption, accident and hazardous material, and training and stakeholders’ involvement (Rehman et al., 2021; Agyabeng et al., 2020; Effendi, 2018; Hussain et al., 2018; Zaid et al., 2018).

Industrial Performance

Performance measurement is important in businesses and industries. Performance measurement is a topic of interest in both academic and corporate realm. (Taticchi, 2010). Popular tools for measuring organizational performance are balanced scorecard, economic value-added system, and Six Sigma system (Rompho, 2014). There are also other methods that various companies utilize to create their own tools or indicators based on their organizational context. However, most of them are in line with the balanced scorecard approach, which is still highly popular. Balanced scorecard is a technique invented for evaluating organizational performance. It was first presented in 1990 by Robert Kaplan and David Norton from Harvard Business School (Kaplan & Norton, 2007). It comprises four main perspectives which are financial perspective, customer perspective, internal process perspective and learning and growth perspective. These four main perspectives have been employed as indicators of performance both in research and in business and adopted in this study (Daniel et al., 2020; Sarraf & Nejad, 2020; Acuna-Carvajal et al., 2019; Cheng et al., 2018).

Relationship between Green Logistics Management, Lean Management, Environmental Performance, and Industrial Performance

From the literature review, it was found that green logistics management positively influences organizational performance (Daniel et al., 2020). Chrisostom & Monari (2018) conducted a study on the sample of an industry and found that the majority of the respondents agreed that green logistics had large impact on industrial performance. Lean management can be utilized to drive organizational quality and performance improvement (Abreu-Ledon et al., 2018; Agus & Hajinoor, 2012). Environmental performance can help increase corporate sustainability (Handayati & Rochayatun, 2015) and positively affect business performance (Paton & Elsayed, 2005). Green logistics, green purchasing and environmentally friendly product and process design can enhance business performance (Ali, 2014). Moreover, Agyabeng-Mensah et al. (2020) studied the effect of green logistics management on financial, marketing, environmental and social operation and found that green logistics management had a positive effect on environmental performance. Lean management, in terms of wastes reduction, helps boost the environmental performance of the organization (Shashi et al., 2019; Garza-Reyes et al., 2018). Based on the literature review of green logistics management, lean management, environmental performance, and industrial performance, the research hypotheses were developed and presented as follows:

- H1: Green logistics management directly influences industrial performance of the food and beverage industry in Thailand.
- H2: Lean management directly influences industrial performance of the food and beverage industry in Thailand.
- H3: Green logistics management directly influences environmental performance of the food and beverage industry in Thailand.
- H4: Lean management directly influences environmental performance of the food and beverage industry in Thailand.

- H5: Environmental performance directly influences industrial performance of the food and beverage industry in Thailand.
- H6: Green logistics management indirectly influences t industrial performance of the food and beverage industry in Thailand through the environmental performance.
- H7: Lean Management indirectly influences industrial performance of the food and beverage industry in Thailand through environmental performance.

Based on the literature review on the relationship of each variable, research conceptual framework is proposed and shown in Figure 1.

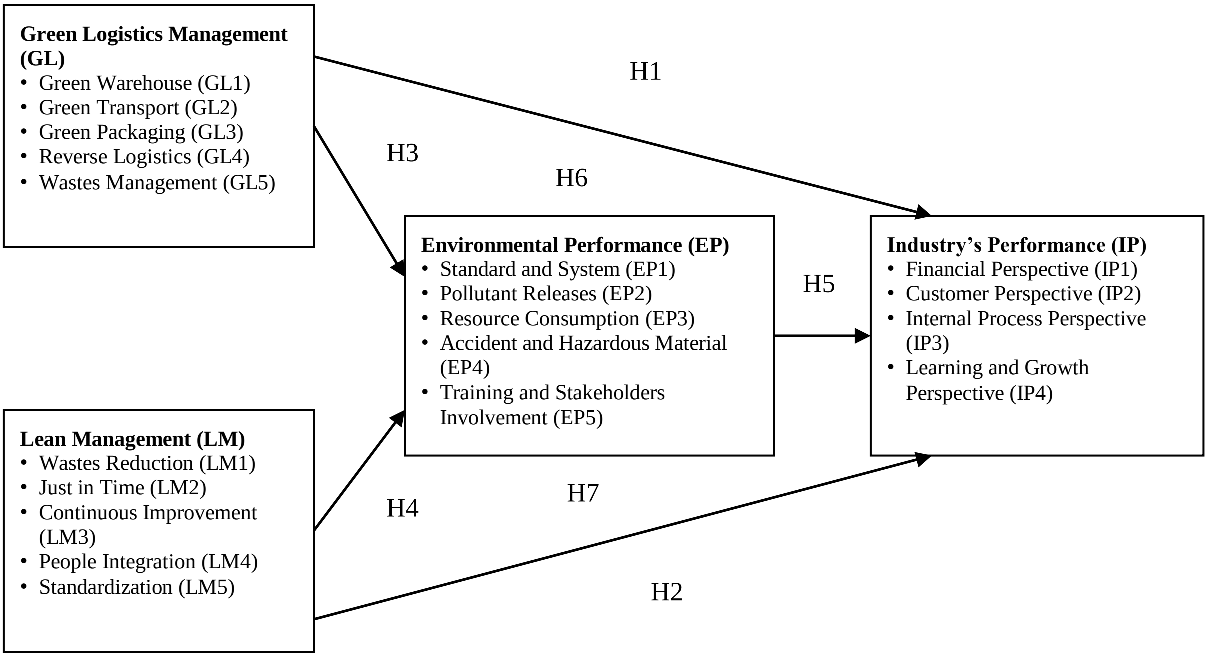

Figure 1. Conceptual Framework

Methodology

Literature review was conducted to identify key variables and explore the relationship between the variables. A conceptual framework was created based on the literature review. The population of the research was the food and beverage enterprises in Thailand. A sample was selected using multi-stage sampling method. Stratified random sampling was first utilized and then simple random sampling was employed to obtain the sample of 430. According to Kline (2011), the sample size should approximately be 5-10 per estimated parameter which can be used for analysis in SEM. The research instrument used in this research was a questionnaire which utilized 5-point Likert scale (Likert, 1932). The questionnaire content validity was assessed by 5 experts and the Index of Item Objective Congruence (IOC) was performed. The IOC value of all items was 0.80 or higher. The score of 0.5 needed to be achieved to pass the content validity test (Rovinelli and Hambleton, 1997). Therefore, the questionnaire was suitable to be used in the sample. To check the reliability of the questionnaire, a pilot study was performed with 30 samples and Cronbach's Alpha Coefficient test was conducted. The result showed the value of 0.987 which was greater 0.7, indicating that questionnaire was reliable (Hair et al., 2010). Descriptive analysis was conducted using skewness and kurtosis to analyze the distribution of observed variables. Correlation analysis was performed using Pearson's Correlation Coefficient to investigate the correlation between variables. SEM was utilized to analyze the effect size of the variables.

Results

In Table 1, a descriptive analysis of the distribution of observed variable for each latent variable used in the research is shown. Descriptive statistics used were mean ($\bar{x}$), standard deviation (SD), skewness (Sk), kurtosis (Ku), and coefficient of variation (% CV). The criteria for evaluating normal distribution of data were skewness and kurtosis. The skewness must be between -3 and +3 and the kurtosis must be less than 10 (Kline, 2011).

Table 1
Descriptive Analysis of Observed Variables

Variable	Mean	S.D.	Max	Min	% C.V.	Skewness	Kurtosis
Industry's Performance (IP)							
IP1	3.42	0.78	5.00	1.00	22.65%	-.409	-.122
IP1	3.52	0.71	5.00	2.00	20.19%	-.183	-.601
IP1	4.07	0.57	5.00	3.00	14.10%	-.112	-.457
IP4	3.82	0.69	5.00	1.67	18.02%	-.300	-.247
Environmental Performance (EP)							
EP1	4.05	0.75	5.00	1.67	18.45%	-.600	.031
EP2	4.03	0.77	5.00	1.00	19.16%	-.865	1.536
EP3	3.85	0.65	5.00	1.67	16.83%	-.485	.569
EP4	3.98	0.71	5.00	1.67	17.95%	-.392	-.146
EP5	3.82	0.75	5.00	2.00	19.61%	-.409	-.262
Green Logistics Management (GL)							
GL1	3.77	0.67	5.00	2.00	17.64%	-.047	-.551
GL2	3.75	0.70	5.00	1.75	18.72%	-.293	-.305
GL3	3.69	0.79	5.00	1.00	21.48%	-.381	.075
GL4	3.72	0.75	5.00	1.33	20.26%	-.351	.036
GL5	3.86	0.71	5.00	1.50	18.39%	-.412	-.058
Lean Management (LM)							
LM1	3.96	0.70	5.00	1.00	17.75%	-.466	.957
LM2	3.79	0.71	5.00	2.00	18.65%	-.315	-.371
LM3	3.96	0.80	5.00	1.00	20.12%	-.824	.562
LM4	3.79	0.80	5.00	1.00	21.01%	-.524	.397
LM5	3.95	0.70	5.00	1.67	17.74%	-.258	-.398

The correlation coefficient of the 19 observed variables of the measurement model indicated that correlation of 171 pairs of variables was statistically significant at the level of 0.05 with the value of more than zero. The correlation coefficient also showed a positive relationship between the variables, which was in the same direction, with values ranging from 0.313 to 0.816. The Bartlett's Test of Sphericity showed the values of Chi-square = 8558.23, df = 171, and p-value = 0.000. It indicated that the correlation matrix differs from the identity matrix at a statistical significance level of 0.05. This is consistent with the result of the Kaiser-Meyer-Olkin (KMO) test which showed the value of 0.952. This proves that that the variables were highly correlated and suitable to be used in the analysis of SEM. Coefficient correlation analysis of observed variables is shown in Table 2.

Table 2
Correlation Matrix, Mean, Standard Deviation of Observed Variables of the Measurement Model

Variable	Correlation Coefficient																		
	IP1	IP2	IP3	IP4	EP1	EP2	EP3	EP4	EP5	GL1	GL2	GL3	GL4	GL5	LM1	LM2	LM3	LM4	LM5
IP1	1.000																		
IP1	.752**	1.000																	
IP1	.455**	.399**	1.000																
IP4	.550**	.486**	.685**	1.000															
EP1	.568**	.433**	.620**	.711**	1.000														
EP2	.395**	.313**	.518**	.605**	.695**	1.000													
EP3	.602**	.507**	.539**	.696**	.726**	.729**	1.000												
EP4	.536**	.421**	.560**	.666**	.733**	.644**	.740**	1.000											
EP5	.538**	.411**	.555**	.710**	.737**	.592**	.742**	.815**	1.000										
GL1	.571**	.515**	.562**	.738**	.631**	.568**	.689**	.655**	.694**	1.000									
GL2	.639**	.657**	.554**	.666**	.532**	.499**	.680**	.574**	.586**	.697**	1.000								
GL3	.588**	.551**	.516**	.670**	.587**	.550**	.689**	.633**	.620**	.716**	.740**	1.000							
GL4	.661**	.608**	.387**	.637**	.574**	.474**	.721**	.632**	.670**	.651**	.708**	.699**	1.000						
GL5	.646**	.544**	.548**	.695**	.687**	.581**	.722**	.699**	.671**	.674**	.608**	.669**	.740**	1.000					
LM1	.605**	.521**	.602**	.625**	.646**	.593**	.683**	.600**	.551**	.639**	.603**	.570**	.599**	.756**	1.000				
LM2	.625**	.552**	.640**	.712**	.631**	.592**	.671**	.652**	.645**	.732**	.637**	.730**	.634**	.812**	.781**	1.000			
LM3	.618**	.485**	.658**	.748**	.760**	.648**	.720**	.723**	.735**	.690**	.616**	.651**	.660**	.807**	.795**	.778**	1.000		
LM4	.575**	.524**	.603**	.781**	.634**	.573**	.651**	.666**	.645**	.675**	.634**	.692**	.669**	.743**	.684**	.758**	.816**	1.000	
LM5	.523**	.468**	.601**	.729**	.700**	.603**	.702**	.714**	.695**	.659**	.566**	.631**	.645**	.793**	.743**	.707**	.804**	.806**	1.000
$\bar{x}$	**3.42**	**3.52**	**4.07**	**3.82**	**4.05**	**4.03**	**3.85**	**3.98**	**3.82**	**3.77**	**3.75**	**3.69**	**3.72**	**3.86**	**3.96**	**3.79**	**3.96**	**3.79**	**3.95**
SD.	**0.78**	**0.71**	**0.57**	**0.69**	**0.75**	**0.77**	**0.65**	**0.71**	**0.75**	**0.67**	**0.70**	**0.79**	**0.75**	**0.71**	**0.70**	**0.71**	**0.80**	**0.80**	**0.70**
Bartlett's test of Sphericity: Chi-Square = 8558.23, df = 171, p-value = 0.000, KMO = 0.952																			

Remark: **p < 0 .01

Table 3
Fit Index Analysis

Fit Index	Criteria of Acceptable Fit	Before Model Modification		After Model Modification	
		Value	Assessment of Fit	Value	Assessment of Fit
χ^2	p>0.05	0.000	Not Acceptable	0.105	Acceptable
χ^2/df	< 2.00	8.658	Not Acceptable	1.198	Acceptable
GFI	≥ 0.90	0.754	Not Acceptable	0.976	Acceptable
AGFI	≥ 0.90	0.682	Not Acceptable	0.945	Acceptable
CFI	≥ 0.90	0.868	Not Acceptable	0.998	Acceptable
RMSEA	< 0.08	0.134	Not Acceptable	0.022	Acceptable
RMR	< 0.08	0.026	Not Acceptable	0.009	Acceptable

Table 4
Results of SEM Analysis

Variable	b	β	S.E.	t (C.R.)	R^2	Factor Score
IP1	0.927	0.682	0.056	16.679	0.465	0.056
IP2	0.732	0.592	0.053	13.911	0.351	0.068
IP3	0.680	0.669	0.035	19.210	0.448	0.177
IP4	1.000	0.824	<- ->	<- ->	0.680	0.152
GL1	0.869	0.856	0.035	24.650	0.732	0.272
GL2	0.868	0.811	0.036	23.963	0.658	0.129
GL3	1.000	0.827	<- ->	<- ->	0.683	0.201
GL4	0.950	0.828	0.037	25.630	0.686	0.114
GL5	1.000	0.923	<- ->	<- ->	0.851	0.661
LM1	0.839	0.872	0.030	28.158	0.760	0.290
LM2	0.839	0.867	0.030	28.085	0.752	0.151
LM3	1.000	0.914	<- ->	<- ->	0.835	0.162
LM4	0.970	0.885	0.033	29.398	0.783	0.161
LM5	0.835	0.871	0.030	28.029	0.758	0.134
EP1	0.978	0.841	0.044	22.451	0.707	0.109
EP2	0.910	0.751	0.054	16.883	0.564	0.119
EP3	0.877	0.867	0.037	23.492	0.752	0.146
EP4	0.954	0.854	0.035	27.158	0.730	0.130
EP5	1.000	0.860	<- ->	<- ->	0.740	0.269
Chi-Square (CMIN) = 99.472, df = 83, p-value = 0.105, RMSEA = 0.022, GFI =0.976, AGFI = 0.945						
Variable	b	β	S.E.	t (C.R.)	R^2	Factor Score
IP1	0.927	0.682	0.056	16.679	0.465	0.056
IP2	0.732	0.592	0.053	13.911	0.351	0.068
IP3	0.680	0.669	0.035	19.210	0.448	0.177
IP4	1.000	0.824	<- ->	<- ->	0.680	0.152
GL1	0.869	0.856	0.035	24.650	0.732	0.272
GL2	0.868	0.811	0.036	23.963	0.658	0.129
GL3	1.000	0.827	<- ->	<- ->	0.683	0.201
GL4	0.950	0.828	0.037	25.630	0.686	0.114
GL5	1.000	0.923	<- ->	<- ->	0.851	0.661
LM1	0.839	0.872	0.030	28.158	0.760	0.290
LM2	0.839	0.867	0.030	28.085	0.752	0.151
LM3	1.000	0.914	<- ->	<- ->	0.835	0.162
LM4	0.970	0.885	0.033	29.398	0.783	0.161
LM5	0.835	0.871	0.030	28.029	0.758	0.134
EP1	0.978	0.841	0.044	22.451	0.707	0.109

Remark: β refers to factor loading, R^2 refers to coefficient of determination, p < ***0.001, the symbol <- -> refers to constrained parameters, therefore S.E. and t (C.R.) values are not reported.

From Table 3 and 4, the SEM analysis of causal relationship of green logistics management and lean management affecting industrial performance of the food and beverage industry in Thailand indicated that that goodness of fit of the model was satisfactory. This is based on fit index assessment which showed Chi – Square = 99.472, df = 83, and p-value = 0.105. Moreover, χ^2 was more than 0.05 at a statistical significance level of 0.05 and χ^2/df = 1.198 which was less than 2. In addition, the other two index RMSEA = 0.022 and RMR = 0.009 had the value which was close to zero and GFI = 0.976, AGFI = 0.945, CFI = 0.998 had the value which was close to one. This proves that the SEM of causal relationship of green logistics management and lean management affecting industrial performance of the food and beverage industry in Thailand was valid. The analysis showed a positive factor loading for each variable which was higher than zero at a statistical significance value of 0.05. The variable which had the highest factor loading was wastes management at 0.923, while the variable which had the lowest factor loading was customer perspective at 0.592. Additionally, coefficient of determination of the variable (R^2) which was used to explain the covariance of the causal relationship model of green logistics management and lean management affecting industrial performance of the food and beverage industry in Thailand had the value ranging from 0.351 to 0.851. The R^2 of each variable is described as follows:

- Green logistics management (GL) which consisted of 5 observed variables had factor loadings ranging from 0.811 to 0.923, which were statistically significant at the level of 0.05. The observed variable with the highest factor loading was waste management (GL5) which had a factor loading of 0.923 and a higher covariance than other variables (R^2 = 0.851).
- Lean management (LM) which consisted of 5 observed variables had factor loadings ranging from 0.867 to 0.914, which were statistically significant at the level of 0.05. The observed variable with the highest factor loading was continuous improvement (LM3) which had a factor loading of 0.914 and a higher covariance than other variables (R^2 = 0.835).
- Environmental performance (EP) which consisted of 5 observed variables had factor loadings ranging from 0.741 and 0.867, which were statistically significant at the level of 0.05. The observed variable with the highest factor loading was resource consumption (EP3) which had a factor loading of 0.867 and a higher covariance than other variables (R^2 = 0.753).
- Industrial performance (IP) which consisted of 4 observable variables had factor loadings ranging from 0.592 to 0.824, which were statistically significant at the level of 0.05. The observed variable with the highest factor loading was learning and growth perspective (IP4) which had a factor loading of 0.824 and a higher covariance than other variables (R^2 = 0.680).

From the SEM analysis of causal relationship of green logistics management, lean management and environmental performance affecting industrial performance of the food and beverage industry in Thailand, it was found that the variance of the performance of the food and beverage industry in Thailand can be explained by all variables in the model at 83.80%. The factor loadings of all variables were higher than zero and positive at a statistical significance level of 0.05. The causal effect analysis of the variables is presented in Table 5.

Table 5
The Causal Effect Analysis of Green Logistics Management, Lean Management and Environmental Performance Affecting Industrial Performance of the Food and Beverage Industry in Thailand

Independent Variable	Effect	Dependent Variable	
		Environmental Performance (EP)	Industrial Performance (IP)
R^2		0.838	0.778

Green Logistics Management (GL)	Direct effect	0.372**	0.409**
	Indirect effect	-	0.071**
	Total effect	0.372**	0.480**
Lean Management (LM)	Direct effect	0.567**	0.475**
	Indirect effect	-	0.108**
	Total effect	0.567**	0.583**
Environmental Performance (EP)	Direct effect	-	0.191**
	Indirect effect	-	-
	Total effect	-	0.191**
Chi – Square = 99.472, df = 83, p-value = 0.105, χ^2/df = 1.198, RMSEA = 0.022, RMR = 0.009, GFI = 0.976, AGFI = 0.945, CFI = 0.998			

Remark: **p < .05, the symbol (–) means that there is no path for parameter estimate according to the hypothesis.

From Table 5, the followings are the main findings:

- Green logistics management had a direct effect on industrial performance of the food and beverage industry in Thailand of 0.372 at a statistical significance level of 0.05. Hence, H1 was confirmed.
- Lean management had a direct effect on industrial performance of the food and beverage industry in Thailand of 0.567 at a statistical significance level of 0.05. Thus, H2 was supported.
- Green logistics management had a direct effect on environmental performance of the food and beverage industry in Thailand of 0.409 at a statistical significance level of 0.05. Therefore, H3 was accepted.
- Lean management had a direct effect on environmental performance of the food and beverage industry in Thailand of 0.475 at a statistical significance level of 0.05. As a result, H4 was affirmed.
- Environmental performance had a direct effect on industrial performance of the food and beverage industry in Thailand of 0.191 at a statistical significance level of 0.05. Consequently, H5 was substantiated.
- Green logistic management had an indirect effect on industrial performance of the food and beverage industry in Thailand through environmental performance of 0.071 at a statistical significance level of 0.05. Accordingly, H6 was validated.
- Lean management had an indirect effect on industrial performance of the food and beverage industry in Thailand through environmental performance of 0.108 at a statistical significance level of 0.05. Therefore, H7 was accepted.

Modified structural equation model is shown in Figure 2.

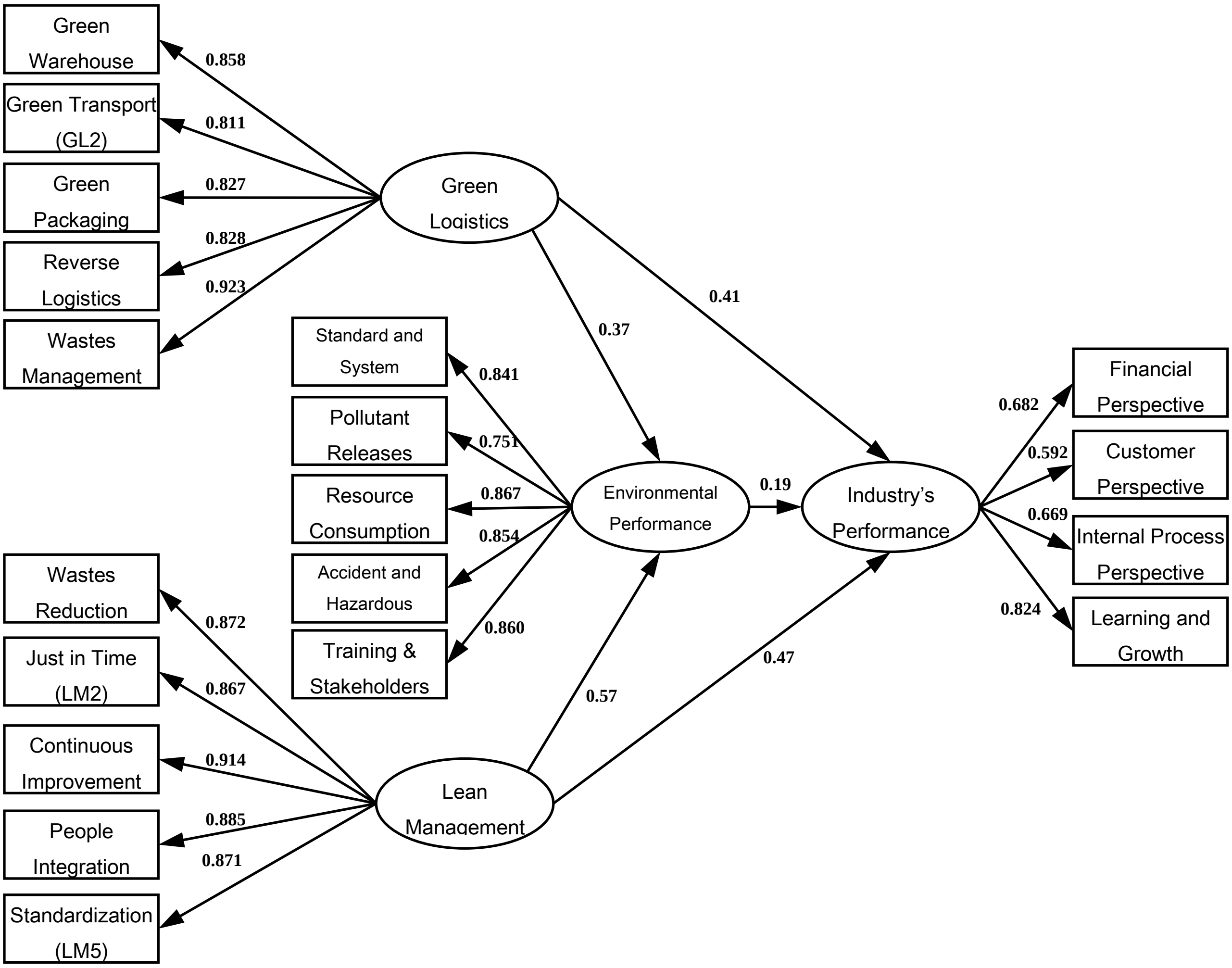

Figure 2. Modified Structural Equation Model Causal Relationship of Green Logistics Management, Lean Management and Environmental Performance on Industrial Performance of Food and Beverage Industry in Thailand

Conclusion

Based on SEM analysis, the model fitness of causal relationship model of green logistics management and lean management affecting industrial performance of the food and beverage industry in Thailand was acceptable with the statistical values of χ^2= 99.472, df = 83, p-value = 0.105, χ^2/df = 1.198, RMSEA = 0.022, RMR = 0.009, GFI = 0.976, AGFI = 0.945, CFI = 0.998, which can predict 77.80% of industrial performance. It was found that lean management had direct influence on environmental performance (□ = 0.567) and lean management also had a direct effect on industrial performance (□= 0.475). This is consistent with the research of Abreu-Ledon et al. (2018) and Agus & Hajinoor (2012) which affirmed that lean management drive work quality and performance of organizations. Lean management, focusing on wastes management, is also a critical factor in raising environmental performance of organizations (Shashi et al., 2019). The findings also revealed that green logistics management had a direct influence on environmental performance (□= 0.409). This is reflected in the study of Daniel et al. (2020) which supported that green logistics management positively affects organizational performance in financial, environmental, and social aspect. Moreover, green logistics management, green purchasing and environmentally friendly product and process design can improve environmental performance of organizations (Agyabeng-Mensah et al, 2020). All in all, green logistics management and lean management impact environmental and industrial performance. Therefore, these two concepts need be adopted to improve organizational or industrial performance allowing enterprises and industries to focus not only on enhancing financial and environmental performance, but also on sustainable development. For future research, other perspectives of sustainability such economic, social, and environmental should be studied. In addition, this model can also be applied to other industries in future research.

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