Green Logistics Management Practices and Sustainability Performance of Manufacturing Firms in Ghana and Indonesia: The Moderating Role of Cross-Country ICT Development Status

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Abstract. The present study sets out to examine the correlation between green logistics management practices, cross-country ICT development status, and sustainability performance within the manufacturing industry of Ghana and Indonesia. Data was collected from a sample of 374 companies in Ghana and 379 in Indonesia. The results indicate a positive and significant association between green transportation, waste management, energy efficiency, sustainable packaging, and overall sustainability performance in both countries. The study also reveals that ICT development status has a positive impact on sustainability performance, and that the interaction between ICT development status and specific green logistics practices enhances this impact. These findings have practical implications for manufacturing firms, emphasizing the importance of implementing green practices and utilizing ICT development to improve sustainability performance. Furthermore, policymakers are encouraged to promote sustainable practices and invest in ICT infrastructure to support green logistics management. The study contributes to the international literature by providing empirical evidence on the relationship between green logistics practices, ICT development, and sustainability performance within the manufacturing sector.

Keywords: Cross-Country ICT Development Status, Green Logistics Management Practices, Sustainability Performance.

1 Introduction

The increasing awareness of the importance of environmental sustainability has resulted in a trend towards the adoption of green logistics management practices, particularly in the manufacturing industry [1]. This sector is disproportionately affected by global resource consumption and environmental foot- print, necessitating a closer examination of the relationship between green logistics practices and sustainability performance [2]. Contextual factors, such as the level of Information and Communication Technology (ICT) development across nations, can moderate this relationship, resulting in varying effects in different geographical regions. Green logistics practices include eco-friendly transportation, efficient waste management, energy optimization,

R. Hurriyati et al. (eds.), *Proceedings of the 8th Global Conference on Business, Management, and Entrepreneurship (GCBME 2023)*,
Advances in Economics, Business and Management Research 288,
https://doi.org/10.2991/978-94-6463-443-3_54

and sustainable packaging materials [3]. These practices have been shown to mitigate carbon emissions, reduce waste production, improve resource efficiency, and foster sustainable progress [4,5].

However, a comprehensive analysis of their collective impact on sustainability performance, particularly in the manufacturing sector, is still uncommon [5,6]. The manufacturing sector is crucial for implementing sustainable measures and understanding how the combination of green logistics management practices impacts the sustainability performance of manufacturing companies is essential for creating effective strategies and policies [7,8]

This study fills a gap in existing knowledge by providing an in-depth understanding of how the integration of green logistics management strategies can improve sustainability outcomes in manufacturing enterprises [9]. It also considers the moderating influence of cross-country ICT development status on the association between green logistics practices and sustainability performance.

The study investigates the potential moderating effect of cross-country ICT development status on the association between green logistics practices and sustainability performance, assuming that ICT infrastructure and capabilities play crucial roles in facilitating efficient and sustainable logistics operations. The varying levels of ICT development among the countries under consideration provide a unique opportunity to investigate this dynamic [10]. By resolving these research gaps, the study contributes to the discourse surrounding green logistics management practices and sustainability performance, providing a thorough understanding of their interplay within the manufacturing industry.

2 Method

The study employed a descriptive survey design and a quantitative approach within a positivist paradigm [11]. The study population comprised of manufacturing firms in Ghana and Indonesia. A stratified and simple random sampling technique was utilized to select 424 manufacturing firms from each country, resulting in a total of 374 responses from manufacturing companies in Ghana and 379 responses from manufacturing companies in Indonesia. The study utilized the Ordinary Least Squares (OLS) model to examine the relationship between green logistics management practices, cross-country ICT development status, and sustainability performance in the manufacturing sector. The OLS model is specified as follows:

$$SP\beta_0 + \beta_1 GT + \beta_2 WM + \beta_3 EE + \beta_4 SUP + \beta_5 ICT + \beta_6(M) + \varepsilon \quad (1)$$

In this model, the coefficients (β_0, β_1, β_2, β_3, β_4, β_5, β_6) represent the effects of the respective variables on sustainability performance. The interaction terms

$$\text{M (GT} \times \text{ICT, WM} \times \text{ICT, EE} \times \text{ICT, SUP} \times \text{ICT)} \quad (2)$$

Capture the combined effects of each green logistics practice and ICT development status. The error term (ε) represents the unobserved factors that influence sustainability performance but are not explicitly included in the model.

3 Result and Discussion

The results and discussion pertain to the reliability evaluation, statistical profile, and multiple linear regression investigation. The reliability analysis indicates that the measurement scales employed to assess the constructs in the study exhibit high internal consistency, indicating that the items within each construct are reliable measures of the intended concepts. The result of descriptive statistic shown in Table 1 as follow:

Table 1. Descriptive Statistics

Ghana								
	N	Min	Max	Mean	SD	Skewness		Kurtosis
						Stat	Std. Err	Stat	Std. Err
SP	374	1	7	5.255	1.308	-1.498	.126	2.013	.252
CC	374	1	7	5.104	1.442	-1.315	.126	.844	.252
GT	374	1	7	4.974	1.383	-1.586	.126	1.860	.252
WM	374	1	7	4.750	1.406	-1.265	.126	1.183	.252
EE	374	3	7	5.496	.684	-.771	.126	.411	.252
SUP	374	2	7	5.471	1.004	-1.222	.126	1.374	.252
Indonesia								
	N	Min	Max	Mean	SD	Skewness		Kurtosis
						Stat	Std. Err	Stat	Std. Err
SP	379	2	7	5.513	1.180	-1.370	.125	1.204	.250
CC	379	1	7	5.286	1.292	-1.485	.125	1.621	.250
GT	379	1	7	4.999	1.521	-1.208	.125	.645	.250
WM	379	1	6	5.092	1.376	-1.452	.125	1.499	.250
EE	379	1	6	4.792	1.455	-1.387	.125	1.138	.250
SUP	379	1	7	4.996	1.236	-1.284	.125	1.704	.250

Note: SP: Sustainability performance. CC: Cross-country ICT development status. GT: Green transportation. WM: Waste management. EE: Energy efficiency. SUP: Sustainable packaging.

It is evident from the mean scores and distributions of each construct that there are similarities between the two countries, although there are some differences in the score ranges, the degree of skewness, and the degree of kurtosis. These findings provide initial insights into the sustainability performance and other constructs of manufacturing enterprises in Ghana and Indonesia.

3.1 Regression Analysis

The result of green logistics management practices, cross-country ict development and sustain- ability performance shown in Table 2 as follow:

Table 2. Green Logistics Management Practices, Cross-Country ICT Development and Sustainability Performance.

Dependent Variable: Sustainability Performance								
	Ghana				Indonesia			
	1	2	3	4	5	6	7	8
Constant	-0.489	0.854***	2.152**	3.498	1.738***	1.172***	1.185***	1.090**
	(0.633)	(0.000)	(0.023)	(0.167)	(0.000)	(0.000)	(0,000)	(0.005)
GT	1.056***				0.659***			
	(0.000)				(0.000)			
WM		1.009***				0.731***		
		(0.000)				(0.000)		
EE			0.632**				0.756***	
			(0.001)				(0.000)	
SUP				1.128***				0.684***
				(0.000)				(0.000)
CC	0.369**	0.282***	-0.028	0.154	0.231**	0.361***	0.462***	0.479***
	(0.047)	(0.000)	(0.869)	(0.130)	(0.002)	(0.000)	(0.000)	(0.000)
CC*GT	-0.059*				-0.026			
	(0.078				(0.102)			
CC*WM		-0.048***				-0.045**		
		(0.000)				(0.010)		
CC*EE			0.010				-0.065***	
			(0.776)				(0.000)	
CC*SUP				-0.059**				-0.054**
				(0.001)				(0.011)
Net Effect	1.204	0.764	na	0.827	na	0.501	0.424	0.408
Obs.	374	374	374	374	379	379	379	379
R2	0.651	0.619	0.543	0.141	0.654	0.609	0.608	0.522
Adjusted R2	0.648	0.616	0.539	0.134	0.651	0.605	0.604	0.518
F-Stats.	229.66***	200.47***	146.56***	20.19***	236.22	194,60***	193.63***	136.51***

***,**,* P<0.001,P<0.05, P<0.01 respectively. SP: Sustainability performance. CC: Cross-country ICT development status. GT: Green transportation. WM: Waste management. EE: Energy efficiency. SUP: Sustainable packaging. na: not applicable because at least an unconditional or a conditional effect needed for the computation of net effects is not significant.

The examination of the outcomes presented in Table 2 is carried out on two levels. The initial assessment was conducted without considering inter-action, while the second was done with interaction, utilizing both conditional and unconditional effects. The net impact of green transportation, for example, was calculated as: 1.204[(-0.059×5.104)] + [(0.056)], the condensation effect is the interaction between cross-

country ICT development and green transportation (-0.059), the mean value of the interaction term cross-country ICT development is (5.104) and the unconditional effect of green transportation is (1.056).

Our study, which examined the relationship between green logistics management practices and sustainability performance in Ghana and Indonesia, discovered a positive correlation. The implementation of green transportation, waste management, energy efficiency, and sustainable packaging practices has been found to positively impact sustainability performance in both countries, which is consistent with previous research [12]. Cross-country ICT development status exerts a positive influence on the sustainability performance of enterprises, indicating the potential of advanced information and communication technology infrastructure and digital innovations to promote eco-friendly logistics procedures and enhance sustainability outcomes. Interaction effects reveal significant interactions between the status of ICT development across countries and specific practices related to green logistics management. In Ghana, the overall impact of green transportation, waste management, and sustainable packaging practices is positive, further augmented by cross-country ICT development status. In Indonesia, the overall impact of green transportation, waste management, energy efficiency, and sustainable packaging practices is affirmative, suggesting that the interplay between cross-country ICT development and these practices reinforces their positive effect on sustainability performance [1]

The correlation between green logistics management practices and sustainability performance conforms to the principles of the resource-based view theory, which emphasizes the significance of environmentally conscious practices as valuable assets for organizations [13]. Institutional theory offers perspectives on external factors and institutional pressures that influence the implementation of environmentally sustainable logistics management practices, such as regulatory frameworks and societal expectations. Institutional factors may exert an influence on the positive impact of cross-country ICT development status, given that the level of ICT development is indicative of a country's broader institutional context and technological infrastructure. The study con- tributes to the ongoing discourse on sustainability by emphasizing the significance of implementing environmentally-friendly logistics management strategies and the interplay between these practices and the level of information and communication technology development across different countries. The insights provided by manufacturing companies are valuable to policymakers, industry practitioners, and researchers seeking to foster sustainable practices and facilitate favorable environmental and social outcomes.

4 Conclusion

This study examines the relationship between green logistics management practices, ICT development status, and sustainability performance in the manufacturing sectors of Ghana and Indonesia. The investigation reveals that green transportation, waste management, energy efficiency, and sustainable packaging practices have a significant impact on sustainability performance. The study also demonstrates that cross-

country ICT development status serves as a catalyst for improved sustainability performance. Furthermore, the interaction effects between ICT development and specific green logistics practices further enhance their positive influence on sustainability. These findings suggest that the adoption of green logistics practices within manufacturing operations, coupled with the utilization of advanced ICT infrastructure, can lead to improved sustainability outcomes and competitiveness. However, the study's limitations include a limited focus on specific countries and industries, the use of self-reported data, and the potential for response biases.

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