The Effect of Green Innovation in Influencing Sustainable Performance: Moderating role of Managerial Environmental Concern

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***Abstract*— The objective of the current examination lies in identifying the association between green innovation, managerial environmental concerns (henceforth, MEC) and manufacturing industry of Malaysia. In particular, the current study seeks to investigate the role of MEC in moderating the impact of green innovation in driving performance. The uniqueness of the current study held in identifying the moderating effect of MEC on innovation-performance nexus using two forms of green innovation. In addition, the novelty of existing study lies in investigating multiple measures of performance. Hence, instead of evaluating the single measure of firm performance (Tang, et al., 2018), the current study analyzed the impact of MEC in moderating the effect of green product and process innovation on two vital proponents of performance, i.e. economic performance and environmental performance of manufacturing firms in Malaysia. We use PLS-SEM to examine the involvement of green innovation in effecting sustainable performance. The outcomes of the examination confirm that economic performance and environmental performance have positive and significantly influenced by green product innovation and green process innovation. The results further confirm that managerial environmental concern has positively and significantly moderates the relationship of green product innovation and green process innovation with environmental performance however, we do not find any evidence of moderating relationship of managerial environmental concern between green process innovation and economic performance and green product innovation and economic performance in Malaysia manufacturing firms.**

***Keywords*—** *Green innovation, sustainable performance, managerial environmental concern, Malaysia.*

1. Introduction

At present, governments and businesses are facing severe concerns of future stability due to growing environmental degradation and global warming [1]. The emergence of industrial developments has extensively contributed in enhancing ecological burden [2]. In the current time period, the rapid upsurge in deteriorating environments as a result of excessive wastes disposal's, toxic emissions, resource depletion, energy dependency are disastrous for environmental health causing severe damage to the prospect of mankind future growth and survival [3], [4], [5].

Considering the importance of better environment, the focus of modern businesses is directed in transferring their business methods towards green operations [6]. The inspiration of organizations in attaining green label is motivated by several reasons. First, it is based on firm's personal preference of adopting eco-friendly procedures to fulfil their environmental responsibility [7]. Second, it relies on organizational responsiveness towards customers' rising demand for sustainable goods and services to intensify the notion of customer-driven business ideology [8]. Third, it is directed to correspond with governments and foreign markets regulations of ensuring sustainable business growth [9]. Therefore, in acquiescence with the general appreciation for green economies, business enterprises are esteemed to assimilate environmental goals in their organizational objectives that subsequently given rise to academic studies linking sustainability to performance [10]. Hence, many studies opted to analyze what role does sustainable development play in influencing firm performance by utilizing different measures of performance including economic performance, social performance, environmental performance, however, failed to reach a consensus regarding the specific link of sustainable practices with firm's performance [11], [12], [13] providing room for future investigation using multiple performance indicators.

As indicated by earlier studies, the association of sustainability in driving firm's performance depends on numerous drivers of sustainability. In includes numerous green practices, activities and organizational culture that respond in multiple ways with firm's performance and competitiveness. In this context, the importance of green innovation is crucial to discuss [14]. Given the inevitable role of technological advancements in todays' business that is driven by inventive expertise in the form of skills, methods and technology, the

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importance of green innovations is considered a vital tool of achieving sustainability [3], [15].

Green innovation combines the core aspects of green product innovation (henceforth, GPD) and green process innovations (henceforth, GPR). Green product innovation involves the creation of goods or service that delivers none or minimal adverse effect on environment [16]. Similarly, GPR is the enhancement of existing creation procedures and utilization of ecologically cordial innovations to deliver products and give benefits that force no or diminished negative effect on ecological conditions [16]. The benefits of green innovation resulted in improvements in terms of knowledge enhancements, time efficiency and cost reduction; however, the extent to which the advantage of green innovation are translated into performance vary in several aspects.

In this regard, [9] stated that the influence of green innovation on firm performance is indistinct on organizational profitability and varied with different form of innovation. In addition, several studies featured that the degree to which green innovation affects performance vary with organizational culture and managerial aspects [17]. As the adaptability of green practices are fostered by several attributes, the concerns of managers in directing firms on the path of sustainability are crucial to drive green growth and performance [13]. Hence, the extent to which managers of the firm feel themselves responsible for improving environmental condition, determine the success of sustainable practices and improvements in firm' performance.

In the light of above discussion, the objective of the current examination lies in identifying the association between green innovation, managerial environmental concerns (henceforth, MEC) and firm performance of manufacturing firms of Malaysia. In particular, the current study seeks to investigate the role of MEC in moderating the impact of green innovation in driving performance. The uniqueness of the current study held in identifying the moderating effect of MEC on innovation-performance nexus using two forms of green innovation. Unlike earlier studies that examined the sole contribution of GPD [18], [19] or GPR [20] or in general green innovation [13], in analyzing firm performance, the preset study examines the individual contribution of both GPD and GPR in influencing firm performance in Malaysian manufacturing firms. In addition, the novelty of existing study also lies in investigating multiple measures of performance. Hence, instead of evaluating the single measure of firm performance [9], the current study analyzed the impact of MEC in moderating the effect of GPD and GPR on two vital proponents of performance, i.e. economic performance and environmental performance of manufacturing firms in Malaysia.

The layout of the current study is organized as follow. Section two reviewed the existing literature of sustainability by focusing the link between green innovation, managerial concern for environment and firm's performance. Section three presented the methodology of the current study by reporting the process of data collection and measure information. Furthermore, section four provide the statistical analysis and interpretation of the derived results. Finally, section five explained the conclusion of the research outcomes and provided future recommendations.

2. Literature review and hypotheses development

According to the fundamentals of organization learning theory, firms tends to behave and learn from their existing expertise and knowledge spillovers. In doing so, organizations learn from inter-related operations, models and strategic drives that determine managers' attitude that are modified from past experiences, decision support and future organizational behaviors [21]. In addition, the basis of learning theory elucidates that the degree of firms' potentials to learn depend on organization's prior experiences related to knowledge and expertise assimilation into organizational functions [22]. In similar aspect, green innovation is considered crucial in offering adequate direction, intelligence and support to adjust firm's knowledge and skills in helping the prospect of becoming 'green' [23].

Green innovation in the form of GPD involves organization's ability to generate product and services through energy conservation and reduction in atmospheric pollution [1], [4]. Similarly, GPR refers to firm's utilization of technical and knowledge expertise in its operations considering eco-friendly practices in offering energy efficiencies and diminishing toxic emissions [1], [4]. Hence, knowledge expansion, through green innovation enable organization to expand firm's efficiency, responsiveness, skill development & attractiveness through its aptitude of greater organizational adaptability towards customer, society and government need of sustainability that influence organizational performance [24].

Many studies investigated the relationship between green innovation and performance, however the literature in this regard is ambiguous to establish a specific link among the variables. In this regard, majority of studies identified the positive association between green innovation and performance. These include the empirical examinations of [15], [25], [26], [27] that suggested that improvement in organizational prospect of green innovation led to increase firm's performance. However, few studies established negative link between green innovation-performance nexus. For instance, [18] found that augmentation in green innovation reduced firm's financial performance. Similarly, [28] established that adoption of green innovation increases organizational costs. On the other hand, [14], in examining the green innovation and financial performance nexus, analyzed 255 institutions and concluded that non-green innovative companies experienced increased financial performance as compare

to green innovative firms that do not experience rise in financial performance.

Similarly, [23] analyzed the relationship of green innovation in the form of green process, green product and green managerial innovation in influencing environmental performance. The empirical findings of the study established that GPD and GPR significantly brought positive impact on environmental performance but failed to support the evidence of green managerial innovation and environmental performance linkage. More recently, Tang et al, examined the role of green product and GPR in influencing firm performance in China. The findings of the study reported that both GPR and GPD are significant to influence firm performance suggesting that increase in GPR improves firm performance. Hence, noticing the ambiguity in literature related to the specific contribution of green innovation on firm performance, the current study hypothesizes that;

Hypothesis 1: GPD is significant to influence Firm's economic performance.
Hypothesis 2: GPD is significant to influence Firm's environmental performance.
Hypothesis 3: GPR is significant to influence Firm's economic performance.
Hypothesis 4: GPR is significant to influence Firm's environmental performance.

Hierarchical help is a vital element to accomplish fruitful development applications [9]. This contention is additionally perceived for green innovation. [29] established that the greater managers support green innovation, the greater will be its effectiveness in executing sustainable advancements. Similarly, [30] also stated that MEC is the crucial feature that fosters green practices and improves the efficiency of green innovation that led to enhance firm's performance and competitiveness. Furthermore, In Taiwan, [31] supported the evidence of mediating impact of corporate environmental ethics in influencing the association of green relationship learning & green innovation performance.

[27] also analyzed the relationship of GPD with Turkish manufacturing companies' performance. In addition, the study also explored the moderating effects of MEC in influencing the innovation-performance nexus. Applying structural equation modeling in the sample of 140 firms, the outcomes of the study confirmed the existence of a positive link between GPD and organizational performance. Furthermore, the results also supported that MEC moderates the association of green product development with Turkish firm's performance. Likewise, [9] also analyzed the moderating impact of MEC in affecting the relationship between green product and process innovation on firm performance. Utilizing the data of 188 Chinese manufacturing companies, the findings of the study established that MEC only moderate the impact of GPR on firm performance but not of GPD. Thus, in the light of above literature, we hypothesize that;

Hypothesis 5:* MEC *moderates the relationship of GPD on organization's economic performance.
Hypothesis 6:* MEC *moderates the relationship of GPD on organization's environmental performance.
Hypothesis 7:* MEC *moderates the relationship of GPR on organization's economic performance.
Hypothesis 8:* MEC *moderates the relationship of GPR on organization's environmental performance.

Demonstrated in figure 1 is the conceptual model of the current examination.

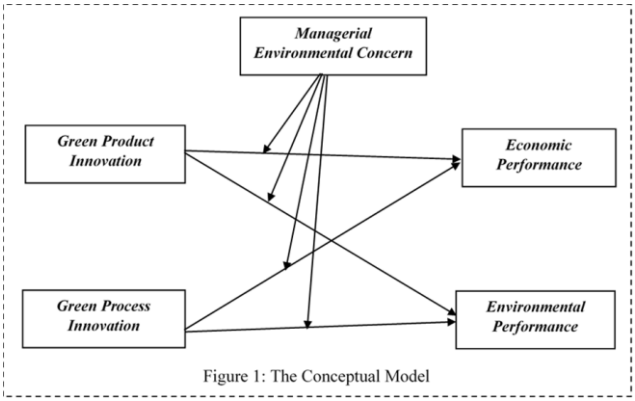

Figure 1: The Conceptual Model

3. Methodology

3.1. Measures:

The present investigation analyzed the involvement of green innovation in effecting sustainable performance. In order to achieve this goal, we examine the theorized model showed in Fig. 1. The properties of the inspected variables are explored by using the Likert scale showing 5 (Strongly Agree) to 1 (Strongly Disagree). Altogether, the current examination used five elements to be researched. They comprise green product innovation (GPD), green process innovation (GPR), economic performance (ECP) and environmental performance (ENP). Managerial environmental concern (MEC) is taken as a moderator variable in the relationship of these variables. The investigation used in accumulated 20 items including four items of GPD and GPR are taken from the earlier study of [4], four items of ECP are taken from [18]. For estimating environmental performance, we adapted four items from the earlier research of [18]. Finally, the study used four measures MEC adapted from the investigation of [17].

3.2. Data Collection and Sample

The procedure of information gathering in the present investigation is done by gathering information from the manufacturing companies of Malaysia. The determination of the manufacturing industry sample is done by following [32] that built up that manufacturing industries have higher innovation, client driven and knowledge intensity. Thus, we select 137 associations

inside the manufacturing sector by sending the survey to the different outlets in each of the fourteen states of Malaysia. For more prominent gathering, the survey is chosen to be written in English language and sent to the selected manufacturing firms. Accordingly, a sum of 548 survey instrument were sent utilizing both online and printed copy of the surveys. The procedure of information gathering took a time of aggregate three months and got 306 managers reply with the reaction rate of 55.83%.

4. Data Analysis

The data examination of the present examination is done by utilizing the SmartPLS Version 3.2.8 [33] and Statistical Package for Social Sciences (V-23). A final valid sample used in the present examination is 297 by removing univariate and multivariate outliers. The approach for perceiving of univariate and multivariate outliers are Z-test score and Mahalanobis distance (D2) by utilizing Statistical Package for Social Sciences and the rest of the data examination is finished by utilizing SmartPLS. Exhibited Table 1 is the association and composition of the valid responses of the accumulated sample used in this examination. Besides, Table 2 clarify the mean, standard deviation and Pearson's Correlation of the factors used in the present examination. Moreover, to recognize the issue of multicollinearity, the present investigation utilizing [34] contended that most of the properties in the Pearson's Correlation analysis should under 0.90. In this way, certify the nonappearance of multicollinearity among the factors [34], [35], [36].

Table-1: Descriptive Statistics

Gender			
		Frequency	Percent
Valid	Female	112	38%
	Male	185	62%
	Total	297	100%
Age			
		Frequency	Percent
Valid	20-30 years	27	9%
	31-40 years	173	58%
	41-50 years	55	19%
	51 and above	42	14%
	Total	297	100%
Working Experience			
		Frequency	Percent
Valid	1-5 years	102	34%
	6-10 years	111	37%
	11-15 years	39	13%
	More than 15 years	45	15%
	Total	297	100%
Education			
		Frequency	Percent
Valid	Undergraduate	42	14%
	Graduate	192	65%
	Post Graduate	3	1%
	Others	60	20%
	Total	297	100%

Source: Authors Estimation

Table-2: Means, Standard Deviations, Pearson Correlations

	MEAN	SD	GPD	GPR	ECP	ENP	MEC
GPD	4.21	1.03	-				
GPR	4.02	1.38	0.43*	-			
ECP	4.39	1.09	0.23*	0.37*	-		
ENP	3.95	1.21	0.33*	0.44*	0.42*	-	
MEC	3.58	1.33	0.34*	0.42*	0.34*	0.36*	-

N=297

* Correlation is significant at the 0.01 level (2-tailed).

Content validity is ensured if the items utilizing in the investigation loads with high value in their specific variable then other items presented in the framework, while internal consistency is achieved if the valuation of composite reliability and Cronbach's alpha outperforms 0.7 [37], [38], [39]. Factor loadings and composite reliability provide in Table 3 which exhibits that most of the items are more than 0.7 factor loading value in their different factors and satisfying the cut-off limit of previously mentioned internal consistency.

Table-3: Measurement Model Results

	Factor Loadings	Cα	CR	AVE
GPD	0.873	0.858	0.826	0.602
	0.842			
	0.889			
	0.783			
GPR	0.852	0.845	0.812	0.643
	0.885			
	0.891			
	0.821			
ECP	0.823	0.821	0.792	0.655
	0.801			
	0.856			
	0.772			
ENP	0.834	0.793	0.754	0.643
	0.792			
	0.743			
	0.792			
MEC	0.811	0.826	0.805	0.621
	0.802			
	0.773			
	0.753			

Source: Authors Estimation

Besides, convergent validity notices to what extend an item of a particular factor merged and loaded to a comparative factor where they anticipated to be

loaded [40], [41]. In the current investigation, convergent validity is affirmed by taking an average variance extracted (AVE) for every variable [42]. They provide threshold value of more than and proportional to 0.5 for confirming up the convergent validity. So, AVE in Table 3 is affirming the basic measures.

Table-4: Discriminant validity Fornell-Larcker criterion

	GPD	GPR	ECP	ENP	MEC
GPD	*0.775*				
GPR	0.382	*0.801*			
ECP	0.432	0.374	*0.809*		
ENP	0.512	0.481	0.428	*0.801*	
MEC	0.495	0.511	0.393	0.442	*0.788*
Source: Authors Estimation					

Table-5: Results of Loadings and Cross Loadings

	GPD	GPR	ECP	ENP	MEC
Green Product Innovation	0.873	0.324	0.459	0.213	0.467
	0.842	0.542	0.3457	0.321	0.392
	0.889	0.123	0.248	0.289	0.442
	0.783	0.456	0.441	0.349	0.482
Green Process Innovation	0.852	0.248	0.604	0.266	0.358
	0.885	0.213	0.359	0.564	0.301
	0.891	0.123	0.257	0.492	0.339
	0.821	0.329	0.294	0.362	0.444
Economic Performance	0.823	0.349	0.296	0.274	0.386
	0.801	0.216	0.479	0.301	0.502
	0.856	0.216	0.226	0.276	0.439
	0.772	0.543	0.437	0.185	0.379
Environmental Performance	0.834	0.376	0.226	0.893	0.395
	0.792	0.482	0.477	0.801	0.567
	0.743	0.593	0.443	0.773	0.395
	0.792	0.438	0.364	0.824	0.338
Managerial Environmental Concern	0.811	0.286	0.239	0.335	0.493
	0.802	0.229	0.357	0.421	0.348
	0.773	0.346	0.546	0.389	0.410
	0.753	0.555	0.248	0.447	0.395
Source: Authors Estimation					

In the subsequent stage, discriminant validity is uncovered as how much the items of a particular single factor is one of a kind and discriminant from interchange factors [37, [43]. According to [42], the discriminant validity is said to be developed if the square root of AVE outperforms the pair wise correlation of the covert factor. As seemed Table 4, italic values are the square root of AVE which is outperforming the off diagonal values which are the pair wise correlation of every factor (which are GPD, GPR, ECP, ENP and MEC). The Table 5 demonstrates the study loadings of different and separate factors hence affirming the threshold value. Similarly, the discriminant validity is also asserted if the Hetro Trait and Mono Trait ratio is lesser than 0.85 as suggested by [44] and [51]. The results in Table 6 revealed that all variables have Discriminant validity.

Table-6: Results of HTMT Ratio of Correlations

	GPD	GPR	ECP	ENP	MEC
GPD					
GPR	0.602				
ECP	0.349	0.584			
ENP	0.409	0.349	0.646		
MEC	0.662	0.593	0.693	0.593	
Source: Authors Estimation					

At last, in partial least square approach, essential model and theories were estimated by supposing path coefficients. According to [44] proposals, a bootstrapping procedure using 1000 sub-test was done to check the quantifiable criticalness of all beta coefficient. This is in like manner the rule of Smart-PLS programming. Table 7 reveals beta coefficients nearby their significance value.

Tabl-7: Results of Path Coefficients

Path Model	Beta	T statistics	P-Values	Remarks
ECP ← GPD	0.284	4.536	0.000	Supported
ENP ← GPD	0.483	7.456	0.000	Supported
ECP ← GPR	0.293	5.678	0.000	Supported
ENP ← GPR	0.583	4.792	0.000	Supported
ECP ← GPD x MEC	0.012	1.201	0.236	Not Supported
ENP ← GPD x MEC	0.324	6.667	0.000	Supported
ECP ← GPR x MEC	0.002	0.381	0.712	Not Supported
ENP ← GPR x MEC	0.385	3.495	0.000	Supported
Note: Level of Significance (5% i.e. 0.050)				
Source: Authors' Estimation				

Table 7 showed the result of partial least square structural equation modelling, regression path coefficient, t-statistics, value of significance and the remarks related to hypothesized path. The outcomes of the examination confirm that economic performance (β= 0.284, $p<0.000$) and environmental performance (β= 0.483, $p<0.000$) have positive and significantly influenced by green product innovation therefore confirming **H1** and **H2.** Furthermore, results of PLS-SEM also confirm that economic performance (β= 0.293, $p<0.000$) and environmental performance (β= 0.583, $p<0.000$) have positive and significantly influenced by green process innovation therefore confirming **H3** and **H4.** The results further confirm that managerial environmental concern has positively and significantly moderates the relationship of green product innovation (β= 0.324, $p<0.000$) and green process innovation (β= 0.385, $p<0.000$) with environmental performance therefor, confirming **H6** and **H8** however, we do not find any evidence of moderating relationship of managerial environmental concern between green process innovation and economic performance and green product innovation and economic performance.

5. Discussion and Conclusion

Now a days, governments and businesses are facing severe concerns of future stability due to growing environmental degradation and global warming [45, 46, 47]. The emergence of industrial developments has extensively contributed in enhancing ecological burden. In the current time period, the rapid upsurge in deteriorating environments as a result of excessive wastes disposal's, toxic emissions, resource depletion, energy dependency are disastrous for environmental health causing severe damage to the prospect of mankind future growth and survival [48, 49]. Considering the importance of better environment, the focus of modern businesses is directed in transferring their business methods towards green operations [50]. The inspiration of organizations in attaining green label is motivated by several reasons. First, it is based on firm's personal preference of adopting eco-friendly procedures to fulfil their environmental responsibility. Therefore, in acquiescence with the general appreciation for green economies, business enterprises are esteemed to assimilate environmental goals in their organizational objectives that subsequently given rise to academic studies linking sustainability to performance.

The objective of the current examination lies in identifying the association between green innovation, managerial environmental concerns (henceforth, MEC) and manufacturing industry of Malaysia. In particular, the current study seeks to investigate the role of MEC in moderating the impact of green innovation in driving performance. The uniqueness of the current study held in identifying the moderating effect of MEC on innovation-performance nexus using two forms of green innovation. The preset study examines the individual contribution of both GPD and GPR in influencing firm performance in Malaysian manufacturing firms. In addition, the novelty of existing study also lies in investigating multiple measures of performance. Hence, instead of evaluating the single measure of firm performance, the current study analyzed the impact of MEC in moderating the effect of GPD and GPR on two vital proponents of performance, i.e. economic performance and environmental performance of manufacturing firms in Malaysia. Therefore, we use PLS-SEM to examine the involvement of green innovation in effecting sustainable performance. The outcomes of the examination confirm that economic performance and environmental performance have positive and significantly influenced by green product innovation and green process innovation**.** The results further confirm that managerial environmental concern has positively and significantly moderates the relationship of green product innovation and green process innovation with environmental performance however, we do not find any evidence of moderating relationship of managerial environmental concern between green process innovation and economic performance and green product innovation and economic performance in Malaysia manufacturing firms.

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