

**Green Product and Process Innovation, Corporate Environmental Ethics and Competitive Advantages among Manufacturing Firms in the Kingdom of Saudi Arabia**

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**Abstract:** The prime objective of the study is to examine the impact of green product innovation, green process innovation, and corporate environmental ethics on the competitive advantages of Saudi manufacturing firms. In addition to that, the study has also planned to examine the mediating role of corporate environmental ethics and moderating role of corporate environmental management in the relationship between green product innovation, green process innovation, and competitive advantages of Saudi manufacturing. This study used a quantitative approach to research with a cross-sectional method for the collection of data. This study used purposive sampling for the collection of data from the production managers of the manufacturing industry of KSA. The participation of the production managers in current was on a volunteer base. A structured questionnaire was used to gather the data from the respondents. The scale item for all constructs was adapted from the previous studies and measured on a 5-point Likert scale. "Partial Least Squares" (PLS) method of analysis was employed for the analysis of the research model using the Smart-PLS (Ringle et al., 2020). The present study found out that if a firm is consistent about investing more in CEE, the KSA manufacturing industry would witness improvement in their GRpdI and competitive advantage. Thus, these findings can be utilized by the manufacturing industries in KSA. By observing the environmentalism approach of consumers and strict rules at the international level, the firms shouldn't avoid their environmental duties. This study intends to fulfill the purpose of contributing to managers of the manufacturing industry of KSA, their researchers and policy formulators which may further contribute to their respective areas.

**Keywords:** *Green product innovation, green process innovation, and corporate environmental ethics on the competitive advantages.*

## 1. Introduction

Green Innovation is considered now as one of the crucial and effective strategies for sustainable development of manufacturing industries due to the increasing stress on environmental issues (Ikram et al., 2021). An investment made in environmental projects was considered as a wastage of resources in the earlier period. But now, new trends for the firms have been set as new strict rules and regulations have been formulated for environmental issues which have completely rotated the concepts of competitiveness for organizations (Shafique et al., 2017). Green products and green processes are two categories of green innovation, encompassing innovative technologies regarding the reduction of unnecessary energy consumption, averting pollution, recycling of wastes, corporate environmental management (CEM) or green product designs (Levidow et al., 2016).

If organizations want to practice green innovation vigorously, the advantage can be taken from low cost and differentiation which may alter the rules for competition (Song and Wang, 2018). Hence, Green innovation is adopted more nowadays, as it is considered more profitable for the organization in the present era (Asadi et al., 2020). Focusing on how to be Green can lead to the exploitation of new market opportunities, consistent innovativeness and the creation of more wealth (Leyva-de la Hiz et al., 2022). The designs and packaging of products of the company can indulge the green concept with the idea of protecting the environment which can increase their repute of differentiation (Rajendran et al., 2019). While practicing environmental management, not only the company would be able to avoid persecution and complaints, but might become able to boost the efficiency of the production.

Establish new environmental markets, and thus, it can contribute to greater green innovation capabilities (Djenontin et al., 2018). According to the definition by Kuncoro and Suriani (2018), competitive advantage

(CA) is a particular situation in which no other market competitors can imitate the executed competitive strategies of a firm. It has been discussed in the prior research that regarding the KSA manufacturing industry, there is a positive relationship between green innovation and competitiveness (Huang et al., 2021). There is a greater impact of green innovation on product value which can balance the cost of investment in environmental causes. Green innovation ultimately leads to superior productivity and then the organization excels in its goal attainment (de Medeiros et al., 2022). As the global environment is changing drastically, environmental management is getting crucial for companies, and green innovation is consistently taking maximum attention of the firms for its implication. Hence, green innovation is a bright source for the economic and environmental development of a firm (Ghauri et al., 2021). KSA has implemented environmental regulations which can be satisfied by green innovation and hence, can improve the environmental management performance of an organization (Wang, 2019). Though the research in this domain about the antecedents of green innovation is still limited in the previous literature.

One of the antecedents of green innovation, corporate environmental ethics (CEE) is discussed in this study, thus, it provides the understanding of green innovation as the mediator which would mediate the relationship between CEE and competitive advantage in the manufacturing industry of KSA (Zameer et al., 2020). Mentioning the argument of (Teixeira et al., 2021), he states that a culture of a firm can provide a sustainable competitive advantage if that culture is rare, imperfectly imitable and valuable. Retention of legitimacy is not the only sole purpose of green management but also acts as a central hub of an organization that plays a key role in achieving sustainable competitive advantage. Organizational culture holds CEE as a key factor leading to innovative practices (Guo et al., 2020). The expectation for ethical behavior and corporate value is formalized by the CEE and, so it proves to be an incentive for competitive advantage and green innovation (Singh et al., 2019). Following is the structure of this study. The second section comprises hypotheses and a literature review. The third section comprises the methodology, data collection, sample selection and construct measurement. The fourth segment encompasses the reliability of the measurement, factor analysis, descriptive statistics, correlation coefficients between constructs and the results are demonstrated for the measurement and structural model. The present study exhibits discussions about the findings and implications and highlights the possible directions for conducting future studies in the fifth segment.

## **2. Hypotheses Development**

CA is referred to those strategies executed by an organization that is not imitable by any of the competitors of the firm, even the competitors aren't capable of achieving those advantages which are achieved by the competitive strategy executing company (Roespinoedji et al., 2019). The unique resources which are exploited by a firm to gain innovation and competitive advantage include the following characteristics: rare, imperfectly imitable, valuable and un-substitutable (Xie et al., 2019). Due to the innovative approach, isolation mechanisms are generated through which advantages can be grasped and profit margins are being protected. In this present era of the knowledge economy, innovation is a key to competitive advantage (Nanath et al., 2017). Companies enable themselves to gain long-term benefits by structuring and utilizing their capabilities through innovation (Albort-Morant et al., 2018). With the help of successful innovation, it becomes difficult for the competitors to replicate the strategies which result in sustainable competitive advantage (Mahdi et al., 2019).

Those organizations which are excelling in green innovation are capable of obtaining competitive advantage and green innovation they are able to maintain their repute by selling environmental products and even contributing to new market creation (Lin et al., 2020). The organizations which are willing to invest in environmental causes and green innovation are not only capable of waste reduction but are also capable of boosting their productivity, improving their repute and image, therefore, growing the competitive advantage of a company relating to the environmental trends of international rules of protection of the environment and relevant to customer's view (Tonial et al., 2019). Furthermore, green innovation helps to create isolation mechanisms that are concerned with greater profitability and achievements of the firm. Literature has offered bits of knowledge on expected examples of internal and external supply-chain-based relations for environmental performance improvement (Feng et al., 2018). The previous literature gives increasing evidence about the positive association between environmental performance and supply chain management.

The prior literature and research have explained how external GSCM practices (such as coordination between supplier and customer) can lead to the adoption of internal practices related to GSCM to improve environmental performance in the wider context of the supply chain (Al-Sheyadi et al., 2019). The present study categorizes green innovation into two main divisions; GRprI and GRpdI. The two sources of obtaining CA have been mentioned as low cost and differentiation (Moravcikova et al., 2017). Differentiation strategies are helpful in the establishment of unique products by giving them unique characteristics. Companies might become capable of setting off their environmental investments with differentiation costs (Campiglio, 2016). Product design, reliability and quality can be improved by deploying green product innovation (GRpdI) and due to the concerns for environmental issues; the corporations can generate high-profit margins and offer high prices for green products. An organization can boost its green image by adopting GRpdI (Confente et al., 2020). Thus, GRpdI can lead to the achievement of competitive advantage (Muñoz et al., 2022). Not only in terms of competitive advantage, but also it is helpful in the reduction of cost. It has been mentioned in prior literature that pollution is the proof of incompetent use of resources (Shittu et al., 2021).

Along with the prevention of waste, green process innovation (GRprI) is also responsible for the improvement in the efficient use of resources (Awan et al., 2019). Productivity of the resources is boosted by GRprI through energy decreasing, material saving, reduction in resources, and waste recycling (Shahzad, et al., 2021). The benefit of GRprI is not only about the prevention of expense of pollution rather it also concerns the reduction of expenses generated through resources and cuts off the inclusive cost (Saether et al., 2021). GRprI can be carried on by organizations to boost their productivity and efficiency in the manufacturing process which may enable the organization to get the benefit of low cost (Gürlek et al., 2018). Along with all other benefits, it is easier to satisfy stakeholders through GRprI (Khan et al., 2021). Hence, a competitive advantage can be gained through GRprI adopted by the organizations. Following hypotheses, based on the above-mentioned arguments can be proposed:

**Hypothesis 1 (H1):** GRpdI has a positive impact on CA.

**Hypothesis 2 (H2):** GRprI has a positive impact on CA.

CEE is the complete belief in ethical practices, values, and environment concerning rules within an organization. There are six elements of CEE: ethics committees, ethics officers, ethics codes, ethics communication systems, disciplinary processes and ethics training programs (Remišová et al., 2019).

Internal innovative technologies can be adopted and established by developing synergetic relationships with the suppliers (Muñoz et al., 2022). According to the cousins et al. (2019) empirical evidence and coordination theory which has been mentioned in the prior section, it can be deduced that if a firm, particularly a manufacturing firm, lacks internal green innovation practices and the coordination internal with external practices can lead to less environmental performance improvements as it acts a catalyst to environmental ethics. In the same manner, the external green innovative practices, such as green design adopted for different procedures with suppliers to reduce the wastage and using customer coordination for producing environmentally friendly products, needs to be coordinated with internal practices and their process, such as special training of staff for issues on environmental management for the effective flow of task requirements from the hierarchy of the organization. Hence, the following hypothesis can be proposed by the present study on the prior mentioned arguments:

**Hypothesis 3 (H3):** GRpdI has a positive impact on CEE.

**Hypothesis 4 (H4):** GRpdI has a positive impact on CEE.

Firms must be paying attention to their objective of sustainable development by considering the global effects of environmental issues.

The values and expectations of a firm can be validated through CEE. Along with preventing the threat of protests, those companies which have a high benchmark of environmental ethics can make their repute better than those which have a low standard of environmental ethics (Vanclay et al., 2019). Thus, long-lasting advantages can be gained from effective environmental management. Firms are motivated to get a niche place in a market so that their rivals may not replicate their strategies and the firms enjoy their competitive edge, this situation is referred to as a competitive advantage. Not only the rules and regulations regarding the environment are met but the companies can make their competitors lag behind due to CEE. When companies

are devoted to maintaining their intangible assets, they become capable of sustaining their competitive advantage. Intangible assets of a firm might be comprised of CEE. It can be observed that those companies which practice environmental management can set themselves up to such a standard that no rivals can match them, they can easily sustain their competitive advantage by deploying particular competitive strategies. Hence, the following hypothesis can be proposed by the present study on the prior mentioned arguments:

**Hypothesis 5 (H5):** CEE mediates the relationship between the GRpdI competitive advantage.

**Hypothesis 6 (H6):** CEE mediates the relationship between the GRprI competitive advantage.

The external pressures of the environment may be a vital cause of adopting CEM. Nevertheless, it has been stated by neoclassical economics that the maximization of wealth should be the prime objective of an organization (41), But the institutional theory states that a firm should also pay attention to the external forces which hold an adequate impact on the strategies of that organization (Basheer et al., 2015). This further directs the firms to the point that firm's ultimate social goal is not only the maximization of profit but also to fulfill the requirements of legitimacy as it asserts certain pressures. Companies can use green innovation and put their products under the umbrella of green factors so that they can become capable of meeting the requirements of external pressures regarding legitimacy. Referring to the Resource-based view, it has been explicated that the main resources and competencies can lead to competitive advantage (Nuseir et al., 2020). It has been suggested by RBV that a firm can sustain its competitive advantage by making its corporate social responsibility a key competency (Muneer et al., 2019).

Operations of a company can be impacted by several forces which might include; competitive pressures, stakeholder activism and environmentalism, policies and regulations at the national level and international levels (Vanclay et al., 2019). Therefore, the firms should work on environmental management to cope with the international standards and policies regarding the environment. Thus, a set of a firm's strategies might include environmental management as a key element, additionally, from RBV perspective, it should be considered as a crucial competency for a firm (Agudelo et al., 2019). The previous studies conducted on corporate social responsibility indicate that the economic goals of a firm can be achieved by fulfilling its social responsibilities (Israel, 1992). The organizations are intended to be socially responsible and because of this, they are in CEM. Though it is noticed that environmental management does not serve short-term objectives but it complies to improve economic goals in the long-run objectives of a company. Moreover, it has been advised to the organizations that they should be considerate about their key stakeholders.

While formulating policies and strategies so that they could capture their trust and assistance (Muneer et al., 2019). It would be tough for the organizations to merge environmental management with their strategies if the organizations continue to give prime importance only to economic goals. The companies must be focusing on non-profit objectives and should be concerned about external institutions and stakeholders. Companies become capable of formulating competitive policies and ultimately firms are allowed to get first-mover benefits. Firms are forced by the environmental management standards that the green factor should be strictly incorporated in the products and services and thus generating high barriers to entry. To obtain a competitive advantage, firms can take assistance from their key stakeholders and external institutions. Therefore, referring to corporate social responsibility, institutional theory, RBV, and stakeholder theory, the arguments can support the positive relationship between competitive advantage and corporate environmental practices.

**Hypothesis 7 (H7):** CEM moderates the relationship between the GRpdI and CA.

**Hypothesis 8 (H8):** CEM moderates the relationship between the GRprI and CA.

### 3. Methodology

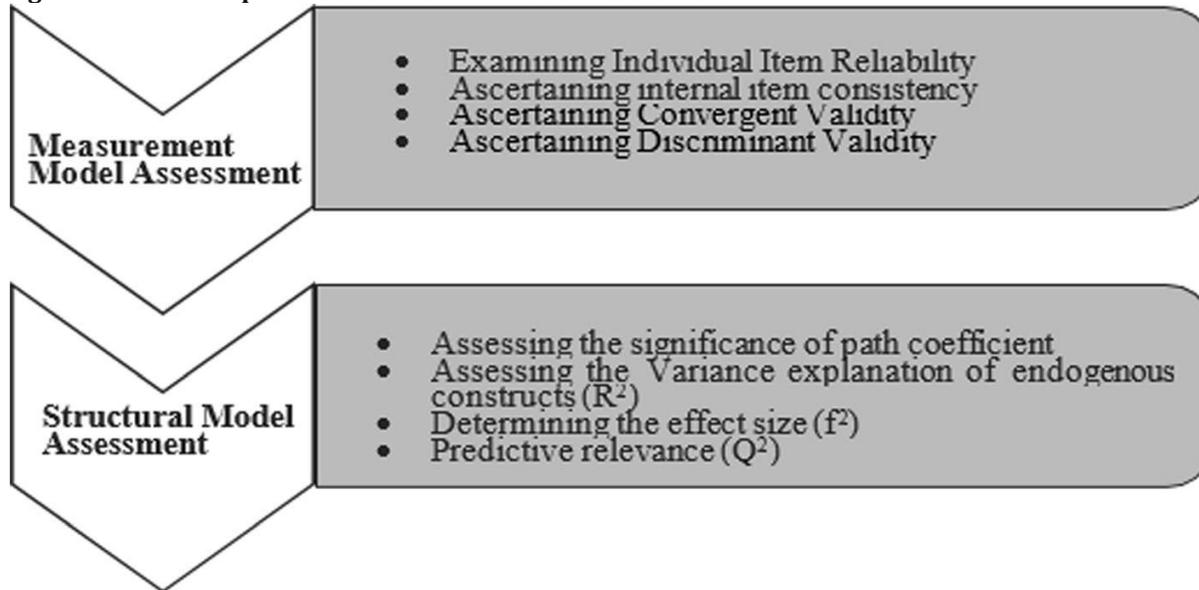
**Sample and Data Collection:** As this study concerns CA and environmental ethics in manufacturing firms in KSA, the sample contains employees of the manufacturing industry. The targeted respondents were the production managers of the manufacturing industry. In the selection of sample size, this study used inferential statistics. According to Israel (1992), a sample of fewer than fifty respondents is considered weaker, a sample of one hundred is reflected as a weak sample size, two hundred respondents assumed an adequate sample size, and a sample of three hundred respondents is considered a good sample size. This study also employed the G power software in the calculation of the minimum required sample size. The model

of this study consists of 2 predictors for the independent construct i.e. CA. The G power software confirmed that a three hundred sample size is required. Therefore, this study set sample size of three hundred respondents to collect the data. This study used a quantitative approach to research with a cross-sectional method for the collection of data. This study used purposive sampling for the collection of data from the production managers of the manufacturing industry of KSA. The participation of the production managers in current was on a volunteer base. A structured questionnaire was used to gather the data from the respondents. The scale item for all constructs was adapted from the previous studies and measured on a 5-point Likert scale.

#### 4. Analysis and Results

“Partial Least Squares” (PLS) method of analysis was employed for the analysis of the research model using the Smart-PLS (Ringle et al., 2020). This study follows the two-stage analytical technique recommended (Matthews et al., 2018). This study examined the measurement model followed by the testing of the structural model (Ringle, et al., 2020). Fig. 1 elucidates the two-step PLS-SEM process.

**Figure 1: A Two-Step Process of PLS Path Model Assessment**



**Measurement Model Evaluation:** Two forms of validity were estimated by the examination of the measurement model, i.e., convergent and discriminant validity. In a measurement model, convergent validity is generally discovered by investigating the outer loadings, average variance extracted (AVE) and the composite reliability (CR) (Matthews et al., 2018). To establish the convergent validity, the value of loadings should be higher than 0.5 and the CR and AVE values should be greater than 0.7 and 0.5 respectively. The discriminant validity is examined by the HTMT ratio and the method of SMA. The output of the measurement model is given in Figure 2 and Table 1, Table 2 and Table 3.

Figure 2: Measurement Model Assessment

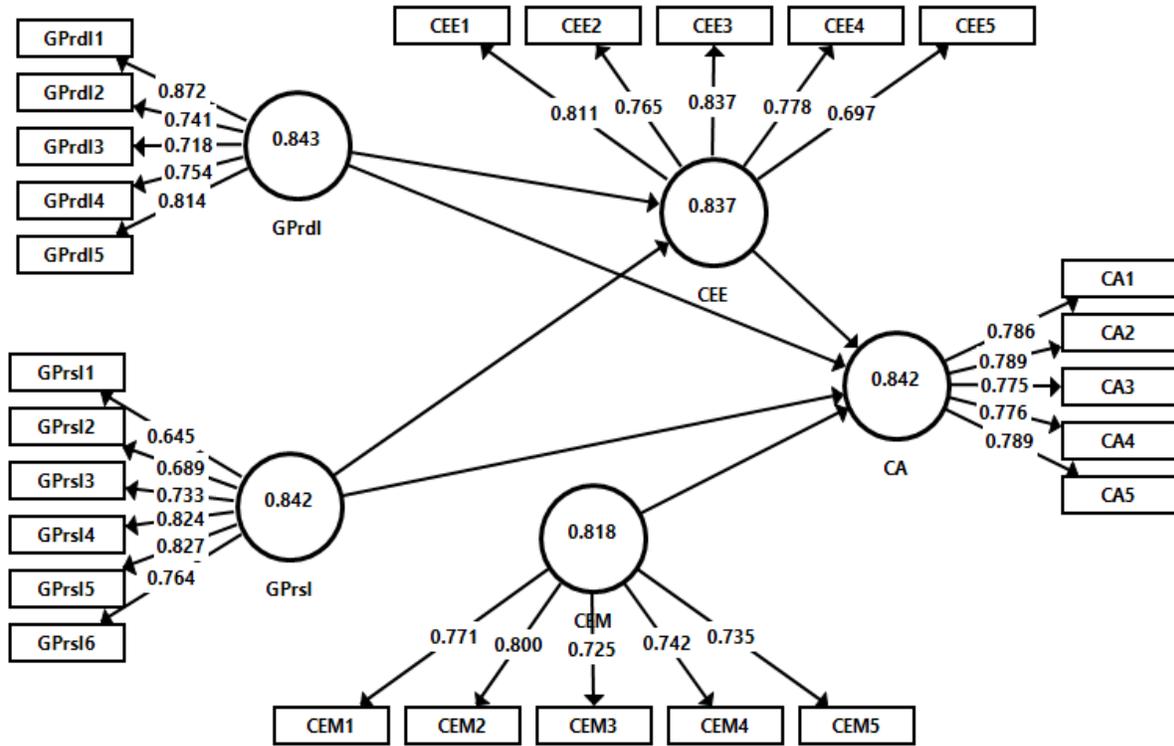


Table 1: "Internal Consistency, Convergent Validity, Composite Reliability and AVE"

Construct	Indicators	Loadings	Cronbach's alpha	Composite Reliability	AVE
competitive advantage	CA1	0.786	0.842	0.888	0.613
	CA2	0.789			
	CA3	0.775			
	CA4	0.776			
	CA5	0.789			
Corporate Environmental Ethics	CEE1	0.811	0.837	0.885	0.607
	CEE2	0.765			
	CEE3	0.837			
	CEE4	0.778			
	CEE5	0.697			
Corporate Environmental Management	CEM1	0.771	0.818	0.869	0.570
	CEM2	0.800			
	CEM3	0.725			
	CEM4	0.742			
	CEM5	0.735			
Green Product Innovation	GPrdI1	0.872	0.843	0.887	0.611
	GPrdI2	0.741			
	GPrdI3	0.718			

		GPrdI4	0.754			
		GPrdI5	0.814			
Green Innovation	Process	GPrsI1	0.645	0.842	0.884	0.562
		GPrsI2	0.689			
		GPrsI3	0.733			
		GPrsI4	0.824			
		GPrsI5	0.827			
		GPrsI6	0.764			

Table 1 elucidated that the loadings of all items are higher than 0.6, the value of CR for all variables is above 0.7 and the value of AVE is also above 0.5 as recommended by (Hair et al., 2013). Hence, this study establishes convergent validity.

**Table 2: Fornell-Larcker Criterion**

	CA	CEE	CEM	GPrdI	GPrsI
<b>CA</b>	0.783				
<b>CEE</b>	0.604	0.779			
<b>CEM</b>	0.740	0.726	0.755		
<b>GPrdI</b>	0.685	0.541	0.619	0.782	
<b>GPrsI</b>	0.642	0.557	0.670	0.705	0.750

According to Ringle et al. (2020), discriminant validity is tested by the matching of correlations among the variables and the AVE square root of that variable. Referring to Table 2, the square root of the AVEs is higher than the correlations of constructs.

**Table 3: Heterotrait-Monotrait Ratio (HTMT)**

	CA	CEE	CEM	GPrdI	GPrsI
<b>CA</b>					
<b>CEE</b>	0.715				
<b>CEM</b>	0.753	0.793			
<b>GPrdI</b>	0.783	0.620	0.717		
<b>GPrsI</b>	0.763	0.655	0.821	0.825	

HTMT also shows that this study established the discriminant validity because all values of HTMT are lower than 0.85 (Referring to Table 3). Overall, both convergent and discriminant validities of the measures in the current study are established.

**Structural Model Evaluation:** A bootstrapping technique was employed to check the significance of the path coefficients (Hair et al., 2013). To examine the t-values, a bootstrapping method with 1000 sample was used. The output of the structural model is given in Figure 3 and Table 4, Table 5 and Table 6.

Figure 3: Structural Model Assessment

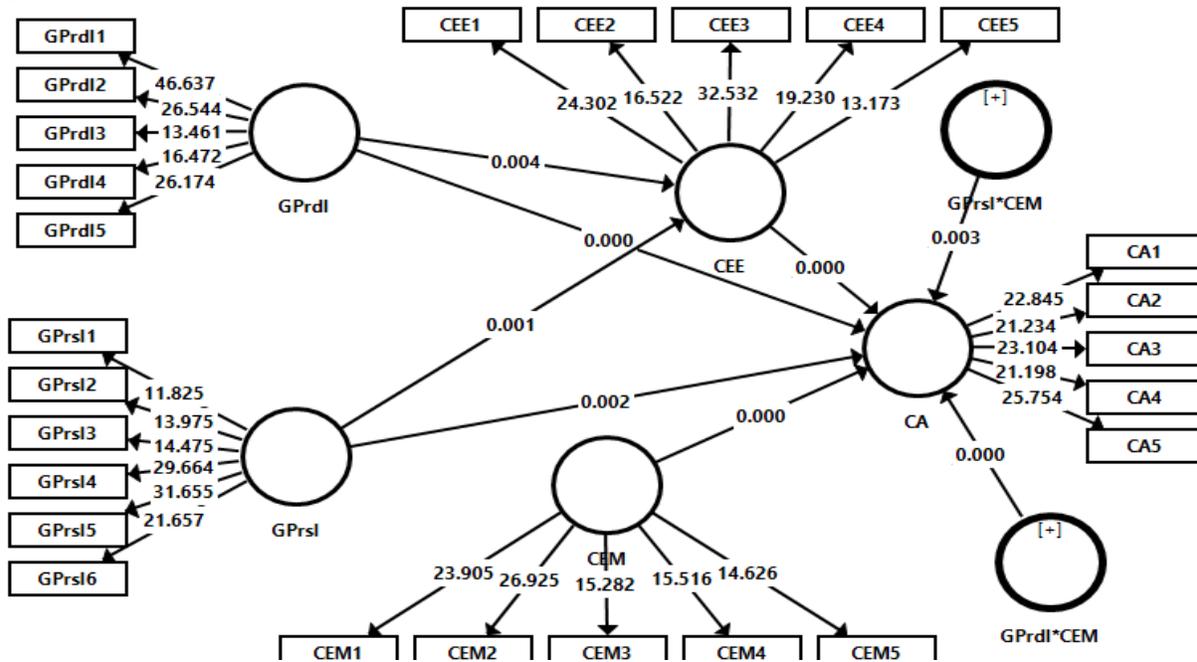


Table 4: Structural Model Assessment (Direct Effect Results and Decision)

Hypotheses	Relationship	Beta	STD	T Value	P Values
H <sub>1</sub>	GPrdI -> CEE	0.294	0.102	2.868	0.004
H <sub>2</sub>	GPrsI -> CEE	0.350	0.107	3.276	0.001
H <sub>3</sub>	GPrdI -> CA	0.334	0.078	4.258	0.000
H <sub>4</sub>	GPrsI -> CA	0.269	0.084	3.202	0.002

Table 4 shows the results of direct effects. Results indicated that GRpdI has a significant and positive effect on the Corporate Advantages ( $\beta = 0.294$ ,  $t = 2.868$ ) and GRprI also has a significant and positive effect on the Corporate Advantages ( $\beta = 0.350$ ,  $t = 3.276$ ). Moreover, GRpdI has also a significant effect on corporate advantages ( $\beta = 0.334$ ,  $t = 4.258$ ) and GRpdI has also a significant effect on corporate advantages ( $\beta = 0.269$ ,  $t = 3.202$ ). Hence, H<sub>1</sub>, H<sub>2</sub>, H<sub>3</sub>, and H<sub>4</sub> are supported.

Table 5: Structural Model Assessment Indirect Effect (Mediation Effects)

Hypotheses	Relationship	Beta	STD	T Value	P Values
H <sub>5</sub>	GPrdI->CEE -> CA	0.350	0.107	3.276	0.000
H <sub>6</sub>	GPrsI->CEE -> CA	0.298	0.101	2.950	0.007

Table 5 indicates the results of mediating role of CEE between the relationship of GRpdI and GRprI with Corporate Advantages. Results show that CEE significantly mediates the relationship of GRpdI with Corporate Advantages ( $\beta = 0.350$ ,  $t = 3.276$ ). It also shows that CEE has a significant mediation role in the relationship of GRprI with Corporate Advantages ( $\beta = 0.298$ ,  $t = 2.950$ ).

Table 6: Structural Model Assessment (Moderation Effects)

Hypotheses	Relationship	Beta	STD	T Value	P Values
H <sub>7</sub>	GPrdI*CEM -> CA	0.342	0.082	4.348	0.000
H <sub>8</sub>	GPrsI*CEM -> CA	0.313	0.069	4.568	0.003

Table 6 shows the results of moderating the role of CEM on the relationship of GRpdI and GRprI with Corporate Advantages. Findings indicated that CEM significantly moderates the relationship of GRpdI with Corporate Advantages ( $\beta = 0.342$ ,  $t = 4.348$ ). Moreover, results also indicated that CEM has a significant moderation role in the relationship between GRprI and Corporate Advantages ( $\beta = 0.313$ ,  $t = 4.568$ ).

## 5. Conclusion and Recommendations

This study deals with the topic of issues of green innovation, CA, and CEE, together which makes them emerging into a new subject of “green management” considerate about the issue of economic development as well as the protection of the environment. Many manufacturing firms in KSA lack resources and hence, they are not up to mark for maintaining their standards according to the environmental protection policies. As the organizations in KSA cannot hold any compliance with the international environmental regulations, it would harm them in every possible way. Nonetheless, the present study found out that if a firm is consistent about investing more in CEE, the KSA manufacturing industry would witness improvement in their GRpdI and competitive advantage. Thus, these findings can be utilized by the manufacturing industries in KSA. By observing the environmentalism approach of consumers and strict rules at the international level, the firms shouldn't avoid their environmental duties. The external environmental pressures and increasing trends can become a driving force for the firms to engage themselves.

Environmental ethics lead to green innovation and ultimately moving forward to achieve competitive advantage. The present study has made KSA its center of research, the future researchers can make their studies more contextual by focusing on other areas as well. To test similar hypotheses in other countries according to their context would be a captivating issue. Future studies may make other countries their context of research which may be helpful in the generalization of the findings around the globe. The present study is only demonstrating the cross-sectional data by employing survey methods comprising of questionnaires, so, no vigorous changes in green innovation, environmental ethics and CA has been shown in different developmental stages of industry in KSA through longitudinal data. Thus, variations in environmental ethics, green innovation, and CA can be observed through the longitudinal study by future researchers in various developmental stages of the manufacturing industry of KSA. At the last, this study intends to fulfill the purpose of contributing to managers of the manufacturing industry of KSA, their researchers and policy formulators which may further contribute to their respective areas.

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