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Customer green demand and competitive pressure as drivers of Eco-innovation and sustainable competitive performance: Evidence from Mexican firms

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Abstract

Globally, interest has been increasing in sustainable development, which involves understanding both external and internal factors that enable the implementation of strategies to mitigate environmental damage and achieve a performance that is both competitive and sustainable. In the context of emerging countries, research on this topic has been scarce. Therefore, the purpose of this study is to contribute empirical evidence on the influence of two external factors—customer green demand and competitive pressure—on eco-innovation and its effect on sustainable competitive performance. The study was conducted with a group of 184 enterprises in the manufacturing sector in Mexico. Data were analyzed using AMOS version 26 through structural equation modeling. The results indicate that both factors have a positive and significant influence on eco-innovation, which in turn positively affects sustainable competitive performance. These findings deepen the understanding of the determinants of eco-innovation and its effects on business sustainability, as well as their practical implications in an emerging country.

Keywords: Competitive pressure, Customer green demand, Eco-innovation, Manufacturing sector, Sustainable competitive performance.

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1. Introduction

In today's organizational management environment, there have been changes in the landscape in which results are obtained that favor performance and competitiveness. These transformations emphasize the development of capabilities and the implementation of strategies to improve them. Currently, sustainable competitive development is particularly relevant due to the increased level of awareness regarding organizational performance, which is often addressed in economic or market terms, leaving the environmental, social, and economic dimensions in the background. In this sense, eco-innovation is presented as a facilitator of sustainable development in companies by contributing to the reduction of pollution and the efficient use of energy resources Kemp and Pearson [1]. Almeida and Wasim [2] first identified the concept of eco-innovation and differs from traditional innovation in that it generates additional value for customers and businesses while reducing environmental impacts.

The growing interest in developing sustainable businesses has led to an increase in studies on eco-innovation issues, mainly due to the additional challenge of incorporating a positive environmental impact into business dynamics. External pressures such as customer green demand, regulation, and competitive pressure influence this challenge. However, there are discrepancies in the literature regarding the relationship between eco-innovation and competitive sustainable performance in different contexts and disciplines, which creates uncertainty about the profitability of investments aimed at developing sustainable practices [3].

In Mexico, for example, as in other countries around the world, environmental policies have been implemented with the aim of strengthening the commitment to achieving the Sustainable Development Goals (SDGs) of the UN's 2030 agenda. This scenario raises the need to investigate further the role played by certain predictor variables in the adoption of eco-innovation and its effect on sustainable competitive performance. Two lines of research have been identified based on the study of eco-innovation: one refers to the factors that trigger its implementation, and the other is the study of the repercussions of eco-innovation. Regarding the first line, there are several studies, including those by Cai and Li [4] and Dong, et al. [5] who point out various factors that trigger eco-innovation, including technological capabilities, corporate social responsibility, environmental organizational capabilities, environmental regulation, stakeholder pressure, external pressures, and social expectations. Almeida and Wasim [2] identify precursors as internal and external, in accordance with the proposal by Bossle, et al. [6]. Several studies on the subject consider these factors to be determining elements in the results of eco-innovation, sustainability, or competitive advantage [7-9]. Other studies also point to factors such as firm strategies, technology, market, and regulation [10]. For their part, Wu, et al. [11] point to competitive pressure, environmental regulation, and customer green demand as determinants for adopting eco-innovation.

Regarding the second line of research, focused on the repercussions of eco-innovation, there are studies that analyze the effects of eco-innovation on economic performance, sustainable competitive performance, competitive advantage, among others [12-18]. In fact, changing established routines within companies is a behavioral change in the organization that is reflected in management systems with greater environmental awareness. Referring to the study of the determinants of eco-innovation, Hojnik, et al. [19] argue that they vary according to their type: while customer green demand influences product eco-innovation, competitive pressure influences all three categories of eco-innovation (product, process, and organizational). The application of sustainability in management has been considered of enormous importance for business success, as it impacts companies' reputations [2]. However, many studies have been conducted in developed countries and large companies [20] while studies in developing countries remain limited. In this context, the study of the determinants of eco-innovation is considered fundamental for the adoption of eco-innovation, as it leads to the sustainable competitive performance of firms. According to Mady, et al. [21] and Mora-Contreras and Carrillo-Hermosilla [22] the literature still presents fragmented knowledge and significant gaps regarding the role of competitive pressure, eco-innovation, among other factors for improving sustainable competitive performance in certain industrial sectors [22] and even in emerging countries.

In emerging economies such as Mexico, one of the main challenges for companies is to invest in strategies that promote sustainable development, as environmental efforts represent additional costs that can reduce short-term returns. However, it is a fact that there are factors that allow companies to develop eco-innovation with benefits that eventually lead to better sustainable performance, with the need for empirical evidence to identify these factors and support the benefits associated with their implementation.

From this perspective, the purpose of this study is to evaluate the relationship between two external factors (customer green demand and competitive pressure) and their influence on eco-innovation, as well as on sustainable competitive performance in manufacturing companies. It seeks to contribute to the literature with empirical evidence on the contribution of driving forces, particularly external factors, to eco-innovation practices in organizations in an emerging context, thereby closing gaps in research focused on developed economies. It also offers practical implications for manufacturing companies in the formulation of policies to promote decisive strategies in the development of eco-innovation that enhance sustainable competitive performance, especially in environments with limited resources.

The structure of the article first presents a literature review that supports the hypotheses of the theoretical model to be evaluated. Second, the reader will find the methodology followed in the development of the study, and finally, the results and conclusions are presented.

2. Literature Review

2.1. Customer Green Demand and Eco-Innovation

The concept of eco-innovation has gained significant traction in the scientific literature [23] however, terms like green innovation [24-28] sustainable innovation [29-31] and environmental innovation [32, 33] are often used interchangeably. The term eco-innovation will be used in this study because of its comprehensive approach to the environmental impacts throughout the life cycle of innovations.

> "Eco-innovation is the production, assimilation, or exploitation of a product, production process, service, or management or business method that is novel to the organization (that develops or adopts it) and that results, throughout its life cycle, in a reduction in environmental risk, pollution, and other negative impacts of resource use (including energy use) compared to relevant alternatives [1].

From a strategic perspective, market orientation argues that understanding and responding to customer needs is critical to organizational success [34] while resource-based theory (RBV) points out that it is necessary to respond proactively to customer demand, in this case with eco-friendly products, which can become a competitive advantage that is difficult to imitate [35]. Similarly, stakeholder theory points out that companies must consider all groups that affect or are affected by their activities, including customers. Thus, customer green demand is a key driver for the adoption of eco-innovation, as the market factor pulls eco-innovation practices, influencing demand and market share with subsequent benefits [36]. Characterized by a preference for products that do not harm the environment, even if this means paying more for the product, the green market represents a market segment that can be a business opportunity, as it offers products to satisfy its demands and allows for a reduction in the company's positioning costs [37].

Some studies provide empirical evidence of the influence of customer green demand and eco-innovation in China, Europe, and Latin America, identifying the key role played by customer requirements, especially for products and processes that improve environmental performance, and their influence on eco-innovation [21, 38-40]. Regarding determinants of eco-innovation, a study conducted in China on 442 firms Cai and Li [4] which shows the positive and significant influence of customer green demand on the adoption of eco-innovation. They point out that the increase in customers with higher income levels, living standards, and environmental awareness allows them to accept paying the same price or even higher for green products. Similar findings correspond to Ben Amara and Chen [41] and Yuan and Cao [42]. For their part, Mora-Contreras and Carrillo-Hermosilla [22] in a study of Colombian manufacturing companies, confirm the significant influence of stakeholder pressure, including customer demand, on the development of sustainability practices and the achievement of competitive advantages.

In the same vein, in a systematic literature review conducted by Mady, et al. [43] after analyzing the external factors that most influence eco-innovation, they found that after regulatory pressure, customer green demand has been one of the most influential pressures on organizations to implement eco-innovation practices, as it forces organizations to reflect on and modify their priorities in terms of strategies and processes within the organization. Among these are studies by Ben Amara and Chen [41] and Zhang and Zhu [44]. In Mexico, Galván-Vela, et al. [45] conclude in a study of 107 medium and large companies that customer green demand influences eco-innovation. According to Horbach, et al. [10] demand for environmentally friendly products by green customers is considered a determinant of eco-innovation.

However, the results are not yet conclusive. Bortoluzzi, et al. [46] point to a positive but not significant influence in an analysis of 96 companies, suggesting that the impact may depend on the context and the type of eco-innovation implemented. For their part, Hojnik, et al. [16] in a study of 80 companies in Slovenia, find that customer green demand influences product eco-innovation, but not processes and management. In emerging economies such as Mexico, where environmental regulations are still developing and companies face resource constraints, understanding the role of customer green demand is crucial.

Based on the above evidence, the following hypothesis is presented:

H_1: Customer green demand has a positive and significant influence on eco-innovation.

2.2. Competitive Pressure and Eco-Innovation

From an environmental perspective, organizations are immersed in an environment where multiple external factors influence strategic decision-making for the adoption of innovations, such as industry, suppliers, services, regulations, competitors, and the adoption of new technology, among others [47]. In this vein, competitive pressure is defined as the intensity of rivalry between companies that drives the improvement of their products, processes, and management to maintain or increase their market position [48]. Institutional theory suggests that competitive pressures are a mechanism that requires companies to adapt to meet market expectations [49]. Similarly, resource-based theory Barney [35] suggests that competition encourages companies to develop strategies to differentiate themselves and respond to demands.

In investigations into the determining factors of eco-innovation, Mady, et al. [43] review the results of 67 studies and find that competitive pressure is the third type of factor that influences the use of eco-innovation in companies, as competitive pressure causes them to replicate successful environmental practices by their competitors. Similar results are found in Ning, et al. [50] and Cai and Zhou [51]. Similarly, Mady, et al. [21] present findings from a study of 183 manufacturing companies in Egypt that competitive pressure influences eco-innovation through the mediation of environmental capabilities, while Ben Amara and Chen [52] in a study of companies in Tunisia, and confirm a positive influence of competitive pressure and sustainable growth through eco-innovation.

Competitive pressure is considered a factor influencing sustainable practices and the implementation of eco-innovations. In China, a study of the hotel industry found that competitors are seen as a mechanism that accelerates the use of sustainable technologies and drives organizations to adopt more sustainable practices to remain competitive [53]. Similarly, Huang and Chen [54] confirm that companies facing strong competition have a greater incentive to adopt green technologies, which is even greater when there is growing ecological demand. Similar results are reported by Hasan and Rahman [55] and in Europe by Hojnik, et al. [16].

However, some studies suggest that this effect may depend on the internal capabilities of the company since, in the face of high rivalry; firms opt for conservative rather than innovative strategies if they lack the necessary resources [56]. This highlights the importance of studying competitive pressure as a determinant of eco-innovation in contexts where resources are more limited, such as in emerging economies. In Mexico, empirical evidence is still in its infancy, although recent studies show that external pressures, including customer demands and competitive pressure, influence the adoption of sustainable practices [45].

Based on the above evidence, the following hypothesis is presented:

H_2: Competitive pressure has a positive and significant influence on eco-innovation.

2.3. Eco-innovation and Sustainable Competitive Performance

Corporate sustainability refers to the actions taken by a company regarding the environment and the promotion of sustainable development in society [57] which is understood as satisfying the organization's stakeholders by meeting future needs, with an emphasis on economic, social, and environmental values [58]. In this sense, the company adopts practices that lead to economic growth without affecting the environment, drive the company to be socially and environmentally sustainable, and achieve a good image among consumers. Competitive sustainable performance comes from including the environmental dimension in its business strategy and deciding to invest in ecological actions [59]. From the perspective of resource theory, eco-innovation is considered a strategic, rare, inimitable, and non-substitutable resource that enables organizations to differentiate themselves and obtain sustainable competitive advantages [35].

There is a debate between continuing with practices that lead to business as usual and adopting sustainable business practices. From this point of view, eco-innovation emerges as a key mechanism for achieving sustainable competitive performance, various empirical studies support the relationship between these variables, including that of Tegethoff, et al. [60] who conducted a study of 568 small and medium-sized Colombian companies, demonstrating the positive impact of eco-innovation on environmental, economic, and social performance through improved resource efficiency, reduced emissions, and waste management, as well as on job satisfaction and profitability. Similarly, Ben Amara and Chen [52] confirm in a group of 308 Tunisian companies that eco-innovation mediates the effect of competitive pressure on sustainable growth. According to Li [13] several studies indicate that environmental management reduces costs, decreases spending, and increases marginal profits.

In the European context, Almeida and Wasim [2] conclude, based on a study of 249 Portuguese SMEs, that eco-innovation in products, processes, and management systems has a positive and significant effect on sustainable performance. Aksu and Akman [20] find a positive and significant relationship between eco-innovation and sustainable performance in a group of 152 Portuguese manufacturing SMEs. According to Liu and Wang [61] eco-innovation emerges as a critical determinant for sustainable development. In the same vein, there is evidence of positive influences between eco-innovation and competitive sustainable performance in several dimensions, such as competitive advantage, return on investment, market share, and increased sales and profits [62-64].

The effective implementation of eco-innovation dimensions has an impact on environmental performance, sustainability, and the performance and competitiveness of the firm [65, 66]. For their part, Bortoluzzi, et al. [46] in Brazil, in a study of 95 meat companies, found a positive and significant influence of eco-innovation on sustainable competitive development, while Mady, et al. [40] found a positive and significant effect on sustainable competitive advantage.

Eco-innovation is a strategic implementation that improves competitiveness in innovation, operations, and marketing, enhances the company's reputation, improves employee quality of life, and increases customer and community satisfaction [47]. Other studies have demonstrated the indirect influence of product and process eco-innovation on environmental performance and its impact on sustainable competitive performance [67].

However, a meta-analysis study suggests that, although the relationship between eco-innovation and sustainable competitive performance is positive, its magnitude is moderate and depends on factors such as the type of industry, the institutional context, and the strategic orientation of the company [68]. This highlights the opportunity to study this relationship in emerging contexts, where dynamics may arise.

Based on the above, the following research hypothesis is proposed.

H_3: Eco-innovation has a positive and significant effect on sustainable competitive performance.

3. Methodology

This study takes a quantitative, non-experimental, cross-sectional approach, analyzing the level of eco-innovation and sustainable competitive performance based on customer green demand and competitive pressure in manufacturing industries. The information obtained was examined using the structural equation method.

A search was conducted for scales that measured each of the variables with the characteristics of this study and with national and international validity in other research studies. These scales are eco-innovation, customer green demand, competitive pressure and sustainable competitive performance. To design the questionnaire, the scales were translated and adapted so that the 32 items were clear to the key respondent group, owners/senior management, who are knowledgeable about the company's strategic decisions. The instrument was structured in five blocks, with the first and second blocks requesting general company data and the key respondent.

The following blocks consisted of the measurement scales for each of the constructs. Eco-innovation was measured using an adaptation of the scale developed by Chen [69] and Chiou, et al. [70] for the product and process dimensions: product eco-innovation (6 items), process eco-innovation (5 items), and for the organizational eco-innovation dimension (6 items), the scale by Cheng and Shiu [71] was used. The customer green demand factor was measured using the scale proposed by Agan, et al. [18] which includes four items. For the competitive pressure construct, the adapted scale by Li [13] as used, which includes three items in total. For these factors, a 5-point Likert scale was used, strongly disagree 1 to strongly agree 5. Finally, a Likert scale from 1 to 5 was used, where 1 is extremely declined to 5 extremely improved, based on the scale adapted by Ying, et al. [72] and based on Degong, et al. [73] to measure the sustainable competitive performance factor, which includes eight items covering fund performance, sales, product delivery time, response to market demand, market share, customer satisfaction, and reduction in operating costs compared to its main competitors over the last three years.

The study was conducted on companies in the manufacturing sector in Aguascalientes, Mexico, with more than eleven employees. The questionnaire was delivered to 749 companies, 192 surveys were received in response and after the data cleaning process, and 184 valid surveys remained for the study. This corresponded to a response rate of 24.56%, which is adequate for organizational-level studies [74, 75].

The descriptive demographic data of the key respondents show that 68.5% are men and 31.5% are women. In terms of their level of education, 73.4% have undergraduate and graduate degrees, 23.3% have technical degrees and high school diplomas, and 3.3% have basic education. The length of service of managers in the organization is 59.8% between 6 and 20 years, 33.2% more than 20 years, and 7.0% less than 6 years.

The economic activities in the manufacturing sector that accounted for the highest percentages were 33.7% in the food industry, 35.3% in textiles and clothing, transportation equipment, and metalworking, and 14.6% in furniture, machinery, and equipment manufacturing, and paper and cardboard manufacturing. The chemical industry and other manufacturing activities accounted for 12.5%, with a smaller percentage for plastic and rubber manufacturing at 3.9%. In terms of the number of employees, 60.3% were in companies with 11 to 50 employees, and 39.7% in companieswith more than 50 employees. 60.3% are mainly family-owned. In terms of the age of the company, 42.4% of companies have been in the market for more than 20 years, and 57.6% for less than 20 years.

A descriptive analysis of the results of the measurement instrument was carried out. Table 1 shows the mean of the study variables and the standard deviation of the data, as well as the bivariate correlation. All results were positive and significant ($r<0.001$). In addition, the bivariate correlation results ranged from (0.581) to (0.833), with no value above 0.850, confirming that there are no multicollinearity issues in the data.

Table 1.
Descriptive analyses.

	Mean	**Standard deviation**	**EPR**	**EPRT**	**EIO**	**CGD**	**CP**	**SCP**
EPC	4.104	0.716	**1**					
EPRT	4.290	0.658	0.833***	**1**				
EIO	3.969	0.835	0.689***	0.668***	**1**			
CGD	4.144	0.783	0.613***	0.674***	0.671***	**1**		
CP	4.010	0.835	0.593***	0.625***	0.701***	0.747***	**1**	
SCP	4.263	0.623	0.666***	0.602***	0.581***	0.597***	0.624***	**1**

Note: Own creation. EPC=Process eco-innovation; EPRT=Product eco-innovation; EIO=Organizational eco-innovation; CGD=Customer green demand; CP=Competitive pressure; SCP=Sustainable competitive performance.

The absence of bias in the common method was verified using Harman's single-factor test (46.56%), confirming that no factor exceeded the 50% threshold [76]. The normal distribution was evaluated for the development of structural equation modeling (SEM) with maximum likelihood estimation (MLE), which was found to be adequate when examining the asymmetry and kurtosis for each item. The ranges were identified as -1.5 to +1.5, which are within the ranges established by theory, which states that values below -/+ 2.0 are considered adequate [77]. To verify multivariate normality, the Mardia coefficient was considered, with the maximum likelihood estimation, for which AMOS 26 software was used. According to theory, "if the sample size is moderate and the model is specified correctly, the ML method provides good results even under conditions of deviation from the assumption of multivariate normality." Noel Rodríguez Ayán and Ruiz Díaz [78] establish as a limit result that do not exceed a value of 70 in the Mardia coefficient. In our study, the coefficient obtained a value of 20,500 using the MLE estimate, so it is considered that adequate results are obtained in compliance with multivariate normality.

The analysis begins by validating the latent constructs through Confirmatory Factor Analysis (CFA) [79] prior to modeling the structural model and performing the structural analysis for hypothesis testing. Within this process, two items were removed from the product and process eco-innovation factor and one from the organizational eco-innovation factor to adjust the measurement model, leaving 28 items. See Table 2. To verify convergent validity, the factor loadings were reviewed, and all estimates were statistically significant. In addition, the average factor loadings on each factor are greater than 0.7 [80] with values between 0.720 and 0.870 (see Table 2). This data confirms the convergent validity of the measurement model.

Table 2.
Variable items and their factor loadings.

Variables	**Standardized load**
Product eco-innovation Hojnik, et al. [16]*;* Chen, et al. [15]*;* Chen [69] and Chiou, et al. [70].	
The company uses environmentally friendly materials.	0.809***
The company improves and designs environmentally friendly packaging for existing and new products.	0.854***
The company chooses materials for products that consume as little energy and resources as possible to carry out product development or design.	0.762***
The company uses as few materials as possible to create the product in order to carry out product development or design.	0.771
Process eco-innovation Hojnik, et al. [16]*;* Chen, et al. [15]*;* Chen [69] and Chiou, et al. [70]	
Low energy consumption of materials such as water, electricity, gas, and gasoline during production, use, and disposal	0.741***
Recycling, reuse, and remanufacturing of materials	0.741***
The company's manufacturing process effectively reduces the emission of hazardous substances or waste	0.753***
The company's manufacturing process reduces the use of raw materials	0.756
Organizational eco-innovation Hojnik, et al. [16] and Cheng and Shiu [71]	
Our company's management often uses innovative systems to manage eco-innovation	0.830***
Our company's management often collects information on eco-innovation trends	0.885***
Our company's management often actively participates in eco-innovation activities	0.878***
Our company's management often communicates information about eco-innovation to our employees.	0.756***
Our company's management often communicates the experiences of the various departments involved in eco-innovation.	0.807
Customer green demand Agan, et al. [18].	
The environment is an important issue for our valued customers.	0.813***
Our valued customers often raise environmental issues.	0.849***
The ecological demands of customers stimulate us in our environmental efforts.	0.849***
Our customers have specific environmental requirements.	0.889
Competitive pressure Li [13].	
We create a green image compared to competitors through environmental concepts.	0.854***
We increase market share through environmental concepts.	0.896
We gain a competitive advantage through environmental concepts.	0.853***
Sustainable competitive performance Ying, et al. [72] *and* Degong, et al. [73]	
Return on investment	0.782***
Profits as a percentage of sales	0.798***
Reduction in product or service delivery cycle time	0.753***
Rapid response to market demand	0.694***
Rapid confirmation of customer orders	0.642
Increased customer satisfaction	0.618***
Increased profit growth rates and market share	0.736***
Reduction in operating costs	0.763***

The adjustments of this measurement model were verified with a chi-square value divided by the degrees of freedom (chi2/df) of 1.569, which follows the findings of Carmines and McIver [81] indicating that a value less than three is a good fit. For the root mean square error of approximation (RMSEA), a value of 0.056 was obtained, with values lower than 0.08 [79] which are therefore considered acceptable; the incremental fit index (IFI) was 0.949, the Tucker-Lewis index (TLI) was 0.941, and the comparative fit index (CFI) was 0.948. In these indices, the literature indicates that they must be close to 1 to have an acceptable and satisfactory fit [82] and all were within the appropriate limits.

The reliability of each scale was calculated using Cronbach's alpha coefficient, the Composite Reliability Index (CRI), and the Extracted Variance Index (EVI). Cronbach's alpha index values ranged from 0.836 to 0.920, which meets the criteria set forth by Nunnally and Bernstein [83] who consider values greater than 0.7 to be acceptable. In the CRI, values above 0.7 are adequate; in this regard, values between 0.835 and 0.918 were obtained [84] confirming the reliability of the model variables. On the other hand, the AVE had values between 0.527 and 0.753, which are higher than 0.5 [84] and are therefore acceptable. In addition, the Variance Inflation Factor (VIF) was verified, which indicates the absence of collinearity in the model. The values ranged from 1.695 to 3.462, which meets the criterion that all values must be below the threshold level of 10 [76]. The above calculations are shown in Table 3.

Table 3.
Reliability and convergent validity.

Factor	Item	Mean	Standard deviation	Average loadings	Cronbach's alpha	CRI	AVE	VIF
Eco Product	PRT1	4.38	0.759	0.800	0.879	0.876	0.640	2.341
	PRT2	4.28	0.757					2.541
	PRT4	4.21	0.792					2.035
	PRT5	4.29	0.769					2.202
Eco process	PRC1	4.08	0.899	0.748	0.836	0.835	0.559	1.803
	PRC2	4.11	0.940					1.695
	PRC4	4.14	0.822					1.836
	PRC5	4.09	0.834					2.137
Eco organization	EIO1	4.11	0.929	0.830	0.920	0.918	0.693	2.634
	EIO2	4.06	0.953					3.462
	EIO3	3.93	0.953					3.253
	EIO4	3.85	0.974					2.376
	EIO6	3.90	0.987					2.799
Green demand customer	CGD1	4.36	0.831	0.850	0.913	0.913	0.723	2.723
	CGD2	4.07	0.935					2.888
	CGD3	4.07	0.853					2.952
	CGD4	4.08	0.899					3.133
Competitive pressure	CP1	4.05	0.904	0.870	0.901	0.902	0.753	2.631
	CP2	3.96	0.928					3.173
	CP3	4.02	0.911					2.814
Sustainable competitive performance	SCP1	4.20	0.795	0.720	0.899	0.898	0.527	2.371
	SCP2	4.20	0.852					2.507
	SCP3	4.26	0.801					2.122
	SCP4	4.37	0.786					2.153
	SCP5	4.42	0.728					2.039
	SCP6	4.46	0.651					1.698
	SCP7	4.19	0.797					2.047
	SCP8	4.01	1.053					2.108

Note: Model fit measure: Chi2/df=1.569 (p=0.000); RMSEA=0.056; IFI=0.949; TLI=0.941; CFI=0.948; Significance values: * = $p < 0.05$; ** = $p < 0.01$; ***= $p < 0.001$. Own elaboration.

The discriminant validity analysis was performed using the confidence interval test, which involves calculating a confidence interval of +/- 2 standard errors between the correlation between the factors and determining whether this interval includes one. If it does not include 1, discriminant validity is confirmed. Table 4 shows the intervals that confirm discriminant validity, as they do not include the value 1 [79]. The bold diagonal line shows the square root of the AVE.

Table 4.
Discriminant validity.

	EPC	EPRT	EIO	CGD	CP	SCP
EPC	**0.748**					
EPRT	0.739–0.927	**0.800**				
EIO	0.575–0.803	0.566–0.77	**0.832**			
CGD	0.507–0.719	0.574–0.774	0.541–0.801	**0.850**		
CP	0.484–0.701	0.523–0.727	0.563–0.839	0.609–0.885	**0.868**	
SCP	0.594–0.738	0.538–0.666	0.499–0.663	0.517–0.677	0.538–0.71	**0.726**

Another technique used to determine discriminant validity is Heterotrait-Monotrait (HTMT). Threshold values are suggested to be less than 0.850 for strict discriminant validity and up to 0.900 for liberal discriminant validity [85]. With the support of AMOS software (26), the HTMT was determined, following [86]. Table 5 shows values ranging from 0.574 to 0.837, which meets the criteria confirming discriminant validity in the model.

Table 5.
Results of Heterotrait Monotrait (HTMT) values.

	EPC	EPRT	EIO	CGD	CP
EPC					
EPRT	0.837				
EIO	0.678	0.660			
CGD	0.602	0.668	0.670		
CP	0.584	0.626	0.718	0.740	
DS	0.646	0.584	0.574	0.597	0.613

Note: Own elaboration based on the results reported in AMOS 26.

4. Results

Once the measurement model has been validated, the next step is to develop the structural model, for which AMOS (Structural Equation Modeling) software version 26 was used with its graphical interface and the identification of the three study hypotheses. The six steps outlined in the theory were followed to develop the structural analysis: 1) Model specification, 2) Model identification, 3) Model estimation, 4) Model evaluation by verifying the fit indices, 6) Model re-specification to improve fit indices.

Once the model was developed, the fit of the structural model was verified, which had good levels in accordance with the theory, with the IFI (0.939), TLI (0.932), and CFI (0.939) all above 0.9 [83] Chi2/gl =1.651(p= 0.000) [81] and RMSEA (0.060) [79]. After reviewing all the indices, it was confirmed that the structural model has a good fit with the data. Figure 1.

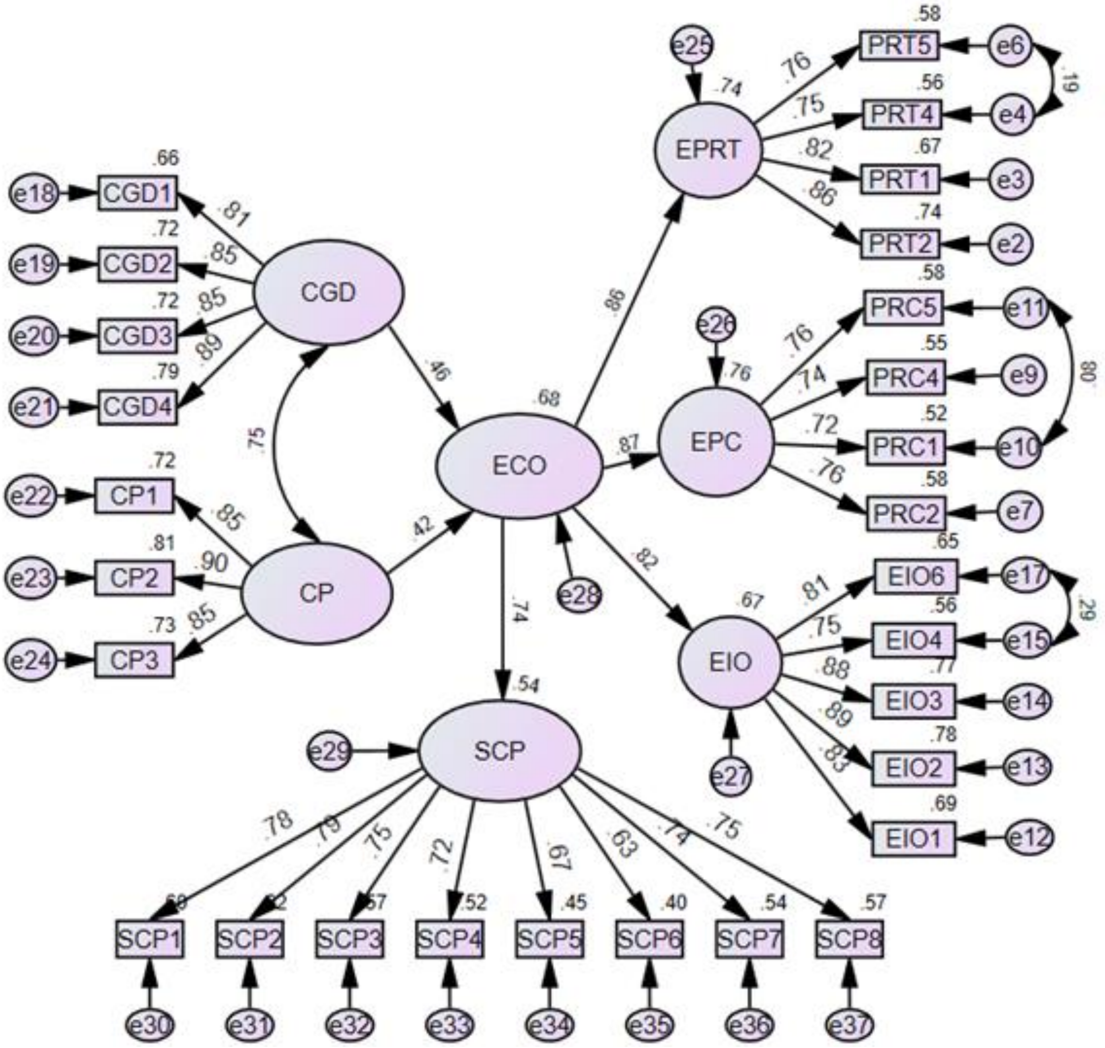

Figure 1.
Structural model developed using AMOS (Version 26).

The results of the structural relationships proposed for the three hypotheses of the study are shown in Table 6. For the results of hypothesis H1, which proposes that customer green demand has a positive and significant influence on eco-innovation, the following data were obtained: a standardized coefficient of (0.463) with a t-value of (4.552) and p<0.001.

Based on the above data, hypothesis H1 is confirmed. The results are consistent with previous findings that point to the key role of customers who demand environmentally friendly products in the adoption of eco-innovation [4, 38, 41, 44].
Regarding the second hypothesis H2, a standardized coefficient of (0.421) and a t-value of (4.184) with a p<0.001 were obtained. With these values, H2 is confirmed, indicating a positive and significant influence between competitive pressure and eco-innovation. The results are consistent with those of Ning, et al. [50]; Cai and Zhou [51]; Ben Amara and Chen [52]; Sun and Nasrullah [53]; Huang and Chen [54]; Hasan and Rahman [55] and Tyler, et al. [56] reinforcing previous evidence suggesting that competitive environments drive the adoption of sustainable innovations.

Finally, for hypothesis H3, a standardized coefficient of (0.736) and a t-value of (7.406) are observed, confirming H3 with a p<0.001, which indicates the positive and significant influence of eco-innovation on sustainable competitive performance. This result is in line with recent studies that highlight the role of eco-innovation as a determining factor in sustainable competitive performance [2, 20, 59, 60, 67]. Therefore, the results are consistent with recent studies.

Table 6.
Structural model results.

Structural relationship	Beta value (t)	R^2	P	Result
H1. Customer green demand → Eco-innovation	0.463(4.522)	0.68	0.000***	accepted
H2. Competitive pressure → Eco-innovation	0.421(4.184)		0.000***	accepted
H3. Eco-innovation → Sustainable competitive performance	0.736(7.406)	0.54	0.000***	accepted

Note: Goodness-of-fit measures: Chi2/gl =1.651(p= 0.000); RMSEA= 0.060; IFI =0.939; TLI 0.932; CFI=0.939; Significance values: * =p <0.05; ** = p<0.01; ***= p< 0.001.
Own elaboration.

In the proposed model, two exogenous variables (customer green demand and competitive pressure) are identified that explain 68% of the variance in eco-innovation (R^2 = 0.68). On the other hand, eco-innovation contributes 54% to the variance in sustainable competitive performance (R^2 = 0.54), which reinforces the strategic relevance of eco-innovation as a mechanism for improving sustainable competitive performance. Table 6.

5. Discussion and Conclusions

The results of the study have confirmed the three hypotheses in the structural model presented, providing evidence of the relevance of external factors as drivers of eco-innovation in the manufacturing industry. Customer green demand and competitive pressure drive eco-innovation, which in turn has a substantial impact on sustainable competitive performance.

Customer green demand emerges as a key determinant in stimulating sustainable innovative practices, supporting previous research which argues that the greater the importance of environmental care is to ecologically conscious customers in the manufacturing industry, and the greater the emphasis on environmental issues when demanding green or ecologically friendly products, the greater the incentives for companies to develop sustainable products, processes, and management systems. Evidence suggests that in contexts where the market strongly values green attributes, manufacturing companies are more willing to invest in clean technologies, redesign processes, and adopt organizational systems geared toward sustainability.

On the other hand, another confirmed factor that has a positive and significant influence on eco-innovation is competitive pressure. According to the results, the more a company incorporates a green image that allows it to have a better position with respect to the competition on environmental concepts and the more market share it has in terms of offering green or environmental products, the greater the eco-innovation actions will be. On the other hand, acquiring competitive advantage through environmental products will encourage the company to increase these activities. Competition, far from representing only a risk, acts as a catalyst that encourages companies to adopt innovative practices so as not to fall behind in markets that are increasingly oriented towards sustainability.

Knowing the factors that lead to the adoption of eco-innovation, whether in products, processes, or management, is relevant for the manufacturing industry because, before responding to the external environment with its internal capabilities, it must know what the external environment demands.

The results reinforce the literature that points to eco-innovation as a critical factor in achieving sustainable competitive advantages. It is confirmed that companies that use materials efficiently for environmentally friendly products/processes; that decide on the lowest energy and resource consumption for their development and the early evaluation of actions such as recycling, reuse, and decomposition in product/process development; and use clean technologies will achieve significant improvements in performance indicators such as costs, sales, market share, and customer satisfaction in relation to their competition.

It is advisable for the industry to understand customer needs and be attentive to competitive actions to respond on time with innovative decisions that address green market opportunities, which will allow for better results. The study contributes empirical evidence in an emerging country such as Mexico regarding one of the necessary questions, which is what factors promote the adoption of eco-innovation within the manufacturing industry, which is key in the country.

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