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Eco-Innovation as a Positive and Happy Industry Externality: Evidence from Mexico

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Abstract: This research has carried out structural equation modelling to empirically examine whether Mexican industrial firms have a green policy to reduce their environmental impact. It will allow them to enjoy sustainable development based on eco-innovation and happiness management principles. This type of innovation can be initiated by the companies' own will or by external factors, such as market requirements, the demands of customers, consumers, suppliers, and civil society through corporate social responsibility. The findings of this article highlight three main aspects. The first is that the statistically analysed eco-innovation actions undertaken by the companies are essentially motivated by market pressures through customers, the financial sector, and civil society. Secondly, economic incentives in Mexico are crucial for manufacturing companies to implement environmentally friendly production patterns within their organisations since this generates the possibility of developing new businesses. Furthermore, eco-innovation generates competitive advantages when the production of the examined companies minimises environmental pollution. It allows access to new markets. In this way, eco-innovation becomes a cornerstone in the economic and international growth of the corporations in this study.

Keywords: eco-innovation; environmental impact; sustainable development; externalities

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1. Introduction

Since the end of the 20th century, the world's population has grown steadily. This phenomenon is bringing major social, economic, and environmental problems. An excellent example of this is the sharp increase in solid and liquid waste generation at a global level observed in recent decades. For Severo et al. [1], this fact is one of the leading causes of environmental deterioration, which limits the future sustainable development of our planet. In this regard, it is worth noting that Latin American and Caribbean citizens consume goods such as food and manufactured products in today's digital society that contribute to this fact and add to the difficulties that hurt the solution of the current environmental issues [2,3].

Hence, larger companies need to develop strategic planning and directions focused on implementing environmental practices. In other words, production must be oriented toward manufacturing products that do not pollute and comply with the Sustainable Development Goals (SDGs) established by the United Nations in the 2030 agenda [1,4]. Given the above, all these business actions must go hand in hand with a solid body of international regulations and organisational structure compliance with these objectives. Firms must develop new products based on sustainability and corporate social responsibility practices.

This is why, in this paper, we propose that we analyse the study of the correlation of the variables defined by market requirements, eco-innovations products, business performance, and the emergence of new markets for these products.

With this proposal, we are raising awareness in society of the importance of combating climate change by initiating firm changes from product innovation. After successfully including new product development, we should build a proposal for new process eco-innovation. However, in the current turbulent business environment, we consider it essential for a business person to experience success on a product-level scale and then proceed to change processes all over the firm. These changes require, among other things, the implementation and manufacture of green products to drastically reduce waste and environmental damage. It leads the authors of this work to ask themselves the following question: how can these goals be achieved?

The academic world teaches us that eco-innovation constitutes a relevant core and a strategy to optimise production processes, social welfare, and the sustainable development of territories [5–9]. Eco-innovation facilitates ecosystems' development without compromising future generations' capacities and needs [1,4]. Regarding the case that concerns us, the term plays a prominent role in the productive process of manufacturing companies. These are characterised by high pollution and the scarce use of renewable energies for manufacturing their articles [10,11]. Hence, senior management develops operational actions to offer their customers a wide range of green and sustainable products. In this way, the image and branding of companies are associated with the guiding principles of ecology, corporate social responsibility or sustainability. In today's business environment, these factors and many others will significantly impact organisations' economic and financial viability in the medium and long terms [4].

According to these theories, previous research suggests that internal eco-innovation products are vital for industrial companies to gain new competitive advantages in the globalised world. A strategic position will increase when governments implement a policy of economic incentives (taxes, subsidies, emission permits and "green" public procurement) with two primary aims. The first is to encourage the use of green technologies in the production capacities of industrial companies. The second is to help change customers' current consumption patterns and suppliers' production patterns to holistically promote environmental sustainability and the circular economy [12,13]. If this occurs, the shift from product eco-innovation to process eco-innovation occurs, and the business environment shifts towards sustainability.

The choice of Mexico as the spatial framework for this research is mainly based on three factors. First, the Mexican industry is aware of the benefits of enjoying a business landscape based on achieving sustainability objectives (production, consumption, and innovation) and a green economy in the era of Industry 4.0 [14]. Second, the industrial sector is significant in turnover and employment generation in the Mexican economy [15]. Lastly, Mexico is one of the emerging economies characterised by lower innovation rates in its gross domestic product and the size of its economy [16].

Thus, this article wants to empirically examine the dimensions of market requirements, customer demands, financial institutions, and social responsibility, and find out whether they significantly influence the eco-innovation processes and the production processes of the manufacturing companies that are the subject of our research. Consequently, it will be possible to determine whether this phenomenon leads to less environmental pollution, new market niches, and international marketing.

Finally, this academic work is divided into four main sections. The first section presents the literature review of this article, where the variables that make up our theoretical model are addressed. The following section describes the methodology used to develop this scientific research. Thirdly, the empirical results obtained using a structural equation model are presented. Finally, the conclusions, future lines of research and the limitations of this academic work are presented.

2. Literature Review

One of the earliest definitions of eco-innovation is provided by Fussler and James [17]. It conceptualises eco-innovation as "new products and processes that provide value to the consumer and the firm and significantly reduce environmental impacts". Since then, this theoretical contribution has given rise to many definitions of eco-innovation that emphasise "newness" and "reduced environmental impact". In this sense, Johansson and Magnusson [18] describe eco-innovation as "new products and processes that provide value for the customer, using fewer resources and with reduced environmental impact". In the same line of research, Rennings [19] defines eco-innovation as "new or modified processes, techniques, practices, systems and products aimed at preventing or reducing environmental damage".

For Kuehne [20], eco-innovation is an innovation aimed at measuring, avoiding, limiting, minimising or correcting environmental damage to natural resources and issues related to waste, noise and impacts on ecosystems. Therefore, eco-innovation includes all activities that aim to protect the environment. It includes new production processes, goods, services, and organisational systems. Furthermore, the EU Eco-innovation Observatory [21] defines this concept as "the introduction of any product, process, organisational change or marketing solution that reduces the use of natural resources". This conceptualisation led to two things. First, that eco-innovation is any innovation that reduces the use of natural resources and reduces the release of harmful substances throughout the life cycle. Secondly, eco-innovation is integrative and linked to the following aspects: process, organisation, marketing, social responsibility, and environmental impact (for materials, energy, water, and land). Therefore, it is unsurprising that the European Union uses this definition to design the national eco-innovation index.

The above is the solid conjunction between the factors that potentialize eco-innovation and the factors that determine conventional innovation processes [21]. Indeed, companies are potential eco-innovators if that potential is maximised and exploited in implementing eco-innovative practices and actions. It will largely depend on circumstances specific to the regulatory environment in which these companies operate economically. Regulatory environment laws differ from one territory to another. This fact makes it challenging to conduct research to determine the effects of the regulatory environment on eco-innovation with scientific depth in the era of Industry 4.0. Furthermore, socioeconomic and political factors affect the multipolarity of the eco-innovation dimension. It includes the internal capabilities of firms and the economic incentives they have to engage in such practices [22,23].

In this regard, the eco-innovation dimension also generates both positive and negative externalities for companies and society. An example of a negative externality would be capital expenditure, which translates into increased operational and functional costs for companies [24]. Positive externalities include reducing environmental costs through environmentally friendly products and processes [25].

Meanwhile, other recent research shows that technology and demand are not the only elements that directly influence eco-innovation actions carried out by industrial companies [26]. In addition to these two factors, the following two instruments must be added. The first is the environmental regulatory and legal framework in the countries where companies' economic activity is based. These regulations pressure organisations to internalise the environmental costs arising from their manufacturing process [27–29]. Moreover, the set of economic incentives offered by public administrations through the development of the following legislative actions include the following: tax forgiveness, subsidies, and pollutant emission permits [23,30].

A close reading of the studies that focus on examining the effectiveness of these governmental measures reveals two basic things. On the one hand, environmental regulation contributes to implementing eco-innovation processes. However, this fact alone does not guarantee sustainable treatment regarding raw materials, water, and energy use. On the other hand, economic subsidies focus exclusively on inducing the implementation of eco-innovation processes aimed at improving the efficiency of their manufacturing process by

reducing their production costs [31–33]. Changes in companies' environmental behaviour may be justified by the factors mentioned above (environmental regulations and economic incentives) and market requirements [34]. For example, consumers demand an environmentally friendly product or service. In this roadmap, the financial sector prioritises access to its services to corporations that abide by the guiding principles of sustainability and corporate social responsibility [35].

Other academic studies have focused on exploring the internationalisation dimension's influence on eco-innovation processes [36], which drive the generation of emerging business opportunities. Secondly, the requirements of new markets play an essential role in driving product eco-innovation [37]. In this regard, recent research indicates that product eco-innovation is positively related to the internationalisation process that leads firms to expand their market shares abroad [36]. The new globalised markets demand eco-innovative products that tacitly comply with the legal requirements established by countries regarding the environment. They are manufactured sustainably and environmentally friendly [36,38–40]. This fact reveals, on the one hand, that industrial companies have no genuine altruistic interest in respecting the environment. On the other hand, the eco-innovative culture implemented by companies is motivated by economic and marketing incentives in the era of Industry 4.0 [37,41,42].

This is where the drivers of eco-innovation processes lie [43]. Multiple economic agents develop these factors, which include several groups. The first of these is the customers. Corporate governance is carrying out eco-innovation processes as one of the ways to achieve this end and increase competitiveness [44–46]. The second comprises managers. Their interest lies in examining whether a sustainable and environmental strategic direction is economically and financially viable for companies in the industrial sector. The third is public administration. These entities want to undertake policies in line with the guiding principles of the SDGs and eco-innovation. These should include the following concepts: smart city [47], research and development [48], digital transformation [49], information systems [50], corporate environmental responsibility [51], and economic sustainability [52]. Moreover, universities are debating whether companies can maximise their profits in the medium and long terms. These can carry this out by implementing competitive strategies under the approaches of sustainability [53,54], corporate social responsibility [55], collaborative financing [56], international orientation [57], and public incentives [58].

Based on the contributions described in this conceptual framework, the following research hypotheses are proposed:

H1. *Market requirements positively influence the eco-innovation of products.*

H2. *Eco-innovation in products positively influences the generation of new entrepreneurial businesses.*

H3. *Eco-innovation in products positively influences business expansion into new markets.*

3. Materials and Methods

To test the hypotheses and fulfill the objectives set out, a descriptive-correlational, non-experimental, and cross-sectional research study was carried out. A questionnaire was applied to medium and large industrial companies in Baja, California (Mexico), to empirically measure the variables listed in Table 1 from institutional sources [59].

It is a quantitative study as the responses were recorded on a scale to proceed to statistical measurements. The design was non-experimental as the study variables were not modified but analysed according to their nature without affecting their structure. It was cross-sectional because a single data collection was conducted simultaneously (mid-2022). The scope of this research is correlational between the independent and dependent variables. However, this nature is limited to the number of variables considered in the proposed model (Figure 1).

Table 1. Variable operationalisation.

Variable	Specification
Market Requirements	We used consumer and supplier requirements for this variable to generate environmentally friendly products. Policies of financial companies condition the generation of eco-innovative products and, finally, social responsibility actions as a proxy for the requirements or demands of civil society towards companies.
Eco-Product Innovation	For these variables, the OECD and the Oslo Manuel use a Likert scale specified by OECD and the Oslo Manuel.
New Markets	A Likert scale is also used for these variables. The questions were formulated to measure how eco-innovation actions have allowed companies to participate in new markets, generate new business and reduce costs.
Business Performance	

Source: Own elaboration based on [19,23,25,30,59].

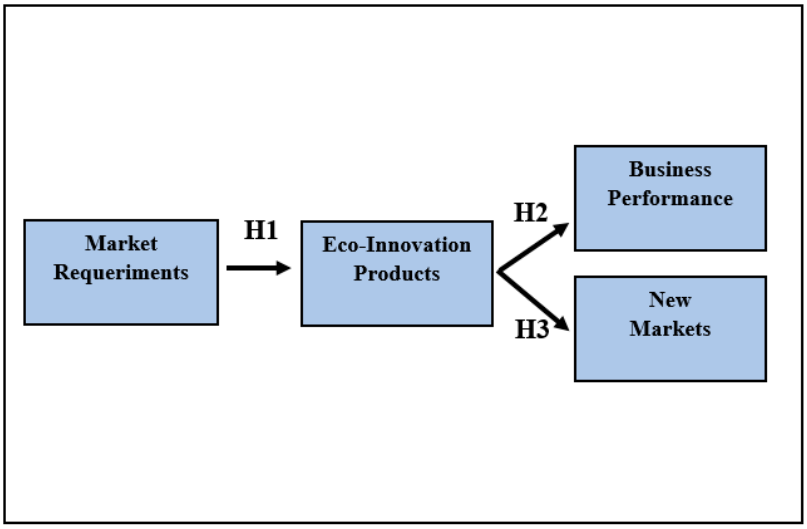

Figure 1. Theoretical model.

It resulted in a sample population selected with a non-probabilistic approach, consisting of 107 valid responses with an 8.5% error and 95% confidence level from 599 manufacturing companies based in Tijuana, Mexico, on the border with San Diego, CA, USA. The respondents were managers from these companies, and the interviews were conducted in mid-2022. According to SMART-PLS 4.0, a sample of this size is sufficient and appropriate for this study [60].

Once the parameters of this research were defined, we proceeded to apply a structured equation analysis (SEM). The decision was motivated by the fact that this statistical technique allows us to analyse those relationships between variables that are complex and non-linear. Given the characteristics of the sample, a PLS model uses as it is a very reliable and valid technique for exploring the theoretical model of this work on small samples [60].

Figure 1 shows the relationship between the study variables. It observes that market requirements are derived from the development of strategies for the production of eco-innovative products. This is shown in Hypothesis 1. Hypothesis 2 is the relationship between eco-innovation in products that positively influences the generation of new businesses. Hypothesis 3 refers to how eco-innovation in products positively influences the expansion of businesses toward growth in new markets. This figure also reflects the theoretical model used to show the methodological approach that supports our research and is shown in this document.

4. Results

Next, we describe the results of this work to analyse the hypotheses put forward in this research. For this purpose, reliability and validity tests were carried out for our theoretical model's constructs (Table 2).

Table 2. Reliability and validity.

	Cronbach's Alpha	Composite Reliability	Average Extracted Variance (AVE)
Business Performance	0.970	0.975	0.869
Eco-Innovation Products	0.872	0.912	0.723
Market Requirements	0.777	0.868	0.689
New Markets	0.974	0.978	0.865

Source: Own elaboration with PLS data.

The table above shows three indicators of reliability and validity. The first two, Cronbach's Alpha and composite reliability, measure the latent variables' internal consistency. The third indicator, the average variance extracted (AVE), measures the representativeness of the items in the construct. In this sense, the value of these three indicators must be greater than 0.50 to affirm reliability and validity. The results indicate that all the constructs of the theoretical model are above 0.5. It means that there is reliability and validity (Figure 2).

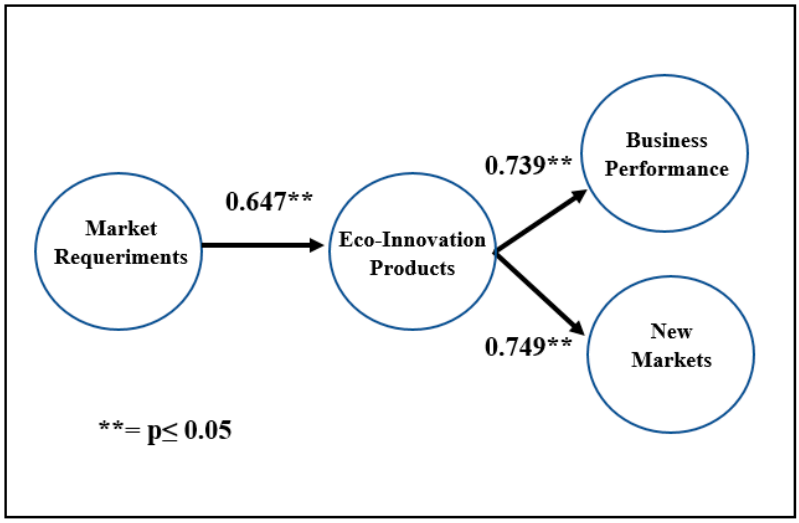

Figure 2. Resulting structural equation model.

The hypotheses in this scientific work are tested based on the data shown in Figure 2. The market requirements factor is an explanatory variable for eco-innovation in products. It has indirect effects on the participation of companies in new markets and new businesses. The weight of the hypothesised relationships is measured through the step coefficients and using Student's *t*-test. In this way, we can test whether the hypothesised relationships are statistically significant (see Table 3).

Table 3. Relationship validation.

	T Student	*p* Values
Eco-Innovation Products—Business Performance	20.243	0.000
Eco-Innovation Products—New Market	17.358	0.000
Market Requirements—Eco-Innovation Products	17.723	0.000

Source: Own elaboration with PLS data.

The Student's t-value and the *p*-value allow us to assess the significance of the relationships proposed in this study. All these relationships present a statistically significant and valid linkage. The coefficient of determination or adjusted R-squared are used to test the dependence and explanatory relationships between the constructs (Table 4).

Table 4. Coefficients of determination.

Construct	Adjusted R-Squared
Business Performance	0.540
Eco-Innovation Products	0.412
New Markets	0.557

Source: Own elaboration with PLS data.

The R-squared values obtained are low. It may be because only one is used to determine factor use. The literature points out that many factors, such as legal, socio-political or economic, may influence eco-innovation processes [23,27,28,30].

One of the objectives of this research is to demonstrate that market requirements are decisive in the eco-innovation of products for their internationalisation process. Consequently, the validity of the proposed theoretical model is explored to assess the goodness of fit. Three indices are used for this. The first normalises the root mean square residual (SRMR). This statistical test considers a model a good fit when this indicator measure values below 0.08. The second is the squared Euclidean distance (d_ULS), which indicates that a model fits well when the values exceed 0.05. Moreover, the last one is the normed Fit index or Bontler and Boneth index (NFI). This index indicates that values must be above 0.09 to be considered an acceptable threshold for the measure (see Table 5).

Table 5. Adjustment of the model.

Measure	Acceptable Parameters	Value
SRMR	Below 0.08	0.078
d_ULS	Above 0.05	3.929
NFI	Above 0.09	0.672

Source: Own elaboration with PLS data.

Table 5 shows that all three indices used exceeded the recommended thresholds. It guarantees the validity of our theoretical model and, therefore, the reliability of the results.

The research hypotheses are accepted at a 95% confidence level. The results are shown in Table 6.

Table 6. Hypothesis testing.

Hypothesis	Postulate	T-Student	*p*-Value 95%	Result
H1	Market requirements positively influence the eco-innovation of products.	20.243	0.000	Accepted
H2	Eco-innovation in products positively influences the generation of new entrepreneurial businesses.	17.358	0.000	Accepted
H3	Eco-innovation in products positively influences business expansion into new markets.	17.723	0.000	Accepted

Source: Own elaboration with PLS data.

5. Discussion

The results of this work allow us to expand the literature on the topic of eco-innovation products and processes in the era of Industry 4.0. From this perspective, the following three aspects are highlighted. First, hypothesis H1 shows that companies should undertake marketing campaigns to promote sustainable and environmentally friendly products under eco-innovation. Second, hypothesis H2 reveals that the market demands sustainable and environmentally friendly products. Moreover, hypothesis H3 indicates that the eco-innovation processes carried out by companies within their organisations constitute a solid driving force to expand their products to the globalised market.

These three issues were clarified, and this academic work detected that the market generates the demand for eco-innovative products. These findings align with those of Tsai and Liao [37] and Torrencillas and Fernández [40]. This research empirically points to the fact that eco-innovation processes are oriented toward manufacturing sustainable and eco-friendly products to satisfy the demand of their potential customers [34]. This scientific enquiry supports the idea that industrial governments develop eco-innovation actions not to obtain public subsidies but to improve their productive efficiency, i.e., positive externalities [31–33]. Therefore, it is necessary to innovate and invest in high technology. It will bring about two things, as discussed throughout this article. One at the internal level is lower levels of environmental pollution and thus high social benefits for citizens. The other, externally, is to encourage the international of these companies into new markets.

The previous findings should be addressed as managerial elements to improve the strategic approach in manufacturing companies. Attending to market trends will lead to the creation of eco-innovative products, thus serving new markets with new products and improving our performance, which is a combination of requirements, knowledge, and capabilities required of managers to meet this organisational focus. The competition demands updating managers, their strategic preparation, and a company response that facilitates their integration in the eco-innovation process supported by sustainability and strategic planning.

The company's image and brand are associated with the commercial and productive strategies of the industries, that is, sustainability, social responsibility, and ecology rather than economic incentives [4]. The results show that economic viability constitutes a positive externality in opening new markets and businesses and reducing environmental costs [25]. Another finding confirms that eco-innovation is responsible for business performance as open innovation is in research performed by Maldonado-Guzman [61]. It is a step to increase competitive advantage in the company and in the consolidation of a permanent strategy for growth and consolidation in turbulent markets and competition.

Finally, current research suggests that internal eco-innovation products and processes are effective for industrial companies. It generates competitive advantages, which increase when governments implement economic incentive policies to favour green technologies in the firm's production capacities. This way, consumption and production patterns can be changed to promote a circular economy [12,13]. These arguments could be inaccurate and counterproductive, given that government interventions could oppose the free market and, in a certain way, generate barriers that produce market failures [62].

Furthermore, this research shows that the market drives eco-innovation actions. A free market policy without state intervention may be optimal in this economic dynamic, but it should never be unattended and unsupervised. Doing this guarantees the market could develop failures and imperfections, putting revenue ahead of sustainability goals. The government should always stay an active observer of the market performance as an enforcer of the law and a promoter of the state of well-being. This theory opens the possibility of a new line of research that would be important to address in future research.

6. Conclusions

This scientific work was conceptualised with two basic ideas. The first is to expand existing knowledge about eco-innovation processes in products into manufacturing compa-

nies and introduce this strategy in their planning. The second is to correlate eco-innovation as a variable that influences positively and significantly new markets and business performance while helping to reduce environmental impact in the era of Industry 4.0. From this approach, eco-innovation processes in products can play a fundamental role in companies' sustainable and competitive development [1,4,11]. The findings reached in this research show that the eco-innovation actions undertaken by companies originated from positive externalities, which are external to the economic activity of industries [12,13]. Market requirements strongly influence organisations to carry out eco-innovation actions in products. This fact positively and actively facilitates the opening of new markets and businesses [19,23,25,30].

Finally, this construct needs to examine in-depth emerging economies such as Mexico, which has been lacking despite there being abundant studies on eco-innovation processes in products [4,9,37,40]. Furthermore, this scientific study expands the literature on the relationship of eco-innovation processes in products with market requirements, the generation of new entrepreneurial businesses and commercial expansion into new globalised markets. On the one hand, it contributes to a more comprehensive understanding of the model hypothesised in these pages. On the other hand, it underlines that companies should promote eco-innovation processes based on innovation, the interests of external stakeholders, and the green economy [15].

Limitations and Future Lines of Research

This research has some limitations that need to be taken into account. In principle, the sample bases on industrial companies in general. Therefore, it would be desirable to conduct research that considers specific segments of the industry sector. Hence, this study requires further confirmation to increase the generalisability of the constructs and relationships.

On the other hand, given that the sample consists of 107 companies, SMART-Guzman was used as a structural equation technique. This technique may offer results that are less robust than the analysis based on covariance. Another limitation is the type of research, as it is a cross-sectional study located at a single point in time, which could lead to temporal biases when collecting the information. In order to solve these problems, the authors of this paper recommend expanding the sample population and periodically collecting the information at a specific period to repeat the results and analyse them through a panel of data.

The conclusions of this work may open up new lines of research on eco-innovation in the future. Among them, empirically exploring other factors influencing eco-innovation processes, such as organisational factors, governmental regulations, economic or fiscal incentives, prosocial happiness, and societal requirements, is recommended.

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