

# ARTICLES

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## EFFECT OF ENVIRONMENTAL INNOVATION ON SUSTAINABILITY IN THE HOTEL SECTOR

*Efecto de la innovación ambiental sobre la sustentabilidad en el sector hotelero*

*Efeito da inovação ambiental sobre a sustentabilidade no setor hoteleiro*

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### ABSTRACT

Given the growing concern about environmental degradation in tourist destinations, hotel companies are implementing new capabilities to counteract the damage caused and improve their sustainable practices. The objective of this research is to analyze the effect of innovation on sustainability practices from an environmental approach, from the perspective of hotel workers in the Riviera Maya, Mexico. The study is based on a quantitative approach of non-experimental, cross-sectional, and explanatory design. The technique used was Partial Least Squares Structural Equation Modeling (PLS-SEM), considering a sample of 386 employees of hotels. The results show that environmental innovation has a significant and positive effect on environmental sustainability. It is concluded that hotels should direct their efforts towards the development and implementation of strategies to improve their capacity for innovation and sustainability in environmental terms.

**Keywords:** environmental innovation, environmental sustainability, hotel sector, environmental management, organizational capabilities.

### RESUMEN

Ante la creciente preocupación por la degradación ambiental en los destinos turísticos, las empresas hoteleras están implementando nuevas capacidades para contrarrestar los estragos generados y mejorar sus prácticas sustentables. El objetivo de investigación es analizar el efecto de la innovación sobre las prácticas de sustentabilidad desde un enfoque ambiental, a partir de la perspectiva de los trabajadores del sector hotelero de la Riviera Maya, México. El estudio se basa en un enfoque cuantitativo de diseño no experimental, transversal y de alcance explicativo. La técnica utilizada fue la modelación de ecuaciones estructurales por mínimos cuadrados parciales (PLS-SEM); con una muestra de 386 empleados de la hotelería. Los resultados evidencian que la innovación ambiental tiene un efecto significativo y positivo sobre la sustentabilidad ambiental. Se concluye que los hoteles deben orientar sus esfuerzos hacia el desarrollo e implementación de estrategias para mejorar su capacidad de innovación y sustentabilidad en términos ambientales.

**Palabras clave:** innovación ambiental, sustentabilidad ambiental, sector hotelero, gestión ambiental, capacidades organizacionales.

### RESUMO

Diante da crescente preocupação com a degradação ambiental em destinos turísticos, as empresas hoteleiras estão implementando novas capacidades para neutralizar os danos causados e melhorar suas práticas sustentáveis. O objetivo desta pesquisa é analisar o efeito da inovação sobre as práticas de sustentabilidade a partir de uma abordagem ambiental, com base na perspectiva dos trabalhadores dos hotéis na Riviera Maya, México. O estudo é baseado em uma abordagem quantitativa com um desenho não experimental, transversal e explicativo. A técnica utilizada foi a Modelagem da Equação Estrutural Parcial dos Mínimos Quadrados (PLS-SEM), considerando como amostra 386 funcionários de hotéis. Os resultados mostram que a inovação ambiental tem um efeito significativo e positivo sobre a sustentabilidade ambiental. Conclui-se que os hotéis devem direcionar seus esforços para o desenvolvimento e implementação de estratégias para melhorar sua capacidade de inovação e sustentabilidade em termos ambientais.

**Palavras-chave:** inovação ambiental, sustentabilidade ambiental, setor hoteleiro, gestão ambiental, capacidades organizacionais.

## INTRODUCTION

In the face of contingent changes and demands for consumption and demands for more responsible consumption for the care of tourist destinations, companies in the sector have developed new strategies to reduce environmental impacts and ensure their presence in the market (Mendoza-Silva, 2020). Similarly, the situation faced by the economy due to COVID-19 has alerted organizations (Bhattacharyya & Thakre, 2021), mainly due to the new travel habits and preferences that tourists will follow after the pandemic.

In this sense, international organizations and discipline experts envision that the reactivation of tourism will be based on innovation and sustainability; because this post-pandemic moment has allowed reflection on how the sector impacts nature and society, urging new tourist goods and services that ensure a more resilient, inclusive, and resource-efficient future.

Currently, environmental degradation has become a global challenge, given that consumers, companies, governments, and society, in general, are increasingly concerned about the loss of natural resources and their degradation (Asadi et al., 2020). Therefore, the study of environmental issues is considered one of the main business challenges in the tourism sector (Asadi et al., 2020).

At present, various global hotel companies face the inevitable pressure to adopt innovation and sustainability practices in environmental terms under different objectives. For example, Khatter et al. (2021) show how Australian hotels seek to limit their environmental footprint while providing good service. Also, Martínez-Martínez et al. (2019) analyze the Spanish hotel sector based on strategies to promote the creation and development of environmental systems contributing to business sustainability. On the other hand, there is evidence of the importance of innovation in the process of adopting sustainability in Indian hotels (Tiwari & Thakur, 2020). Additionally, researches technological green innovation as a driver of ecological products and services in Chinese hotels for the achievement of sustainability (Xie et al., 2019).

Thus, it can be observed that environmental innovation emerges as a capacity that, through useful knowledge, systems, and tools, helps companies mitigate the ecological problems and risks that arise from the provision of tourist services. However, companies in this sector have implemented few innovative strategies, processes, and actions (environmental impact studies, training staff on environmental issues, extraction of pollutants with technology, among others) that encompass environmental sustainability factors, leaving it out of their priority (Garay et al., 2019).

The hotel industry is estimated to be a highly water and energy-consuming sector (Vargas, 2015). Moreover, 85% of hotel managers do not implement ecological strategies and are unaware of how to implement a sustainable tourism model (Ortega et al., 2018). However, in the face of market changes, some hotels design new management methods that implement environmental technologies (Chan et al., 2020), comply with government legislation and regulations (Tiwari & Thakur, 2020), leading their collaborators to an innovative and sustainable culture (Ferrer, 2018).

With strong growth in the hotel industry, Quintana Roo is one of the most important tourist states in Mexico. The Riviera Maya, located on the coastal littoral strip of the state of

Quintana Roo, maintains approximately 56,625 hotel rooms (Tourism Secretary of the Quintana Roo State [Sedetur], 2023); but despite its natural attractions and cutting-edge urbanization, pollution problems arise from the overexploitation of commercial and tourist activities (Brenner et al., 2018).

According to Green Globe (2021), only 23 hotel establishments in Quintana Roo have some certification in sustainability. On the other hand, the average water consumption per tourist is estimated to range from 150 to 450 liters per day; thus, hotels in the Riviera Maya collectively consume 30% of the annual volume distributed throughout Mexico (Santacruz & Santacruz, 2020). Therefore, to achieve business sustainability, environmental innovations are required that seek to make a profound change, such as the use of alternative energies, water purification, smart air conditioning, digitization of administrative processes, or intelligent use of resources (Velázquez et al., 2016).

For this reason, the objective of this research is to analyze the effect of environmental innovation on environmental sustainability practices in hotels from the perspective of workers. The article is structured as follows. First, the literature review that supports the research hypotheses is presented. The following section refers to the methodology followed to test the hypotheses and fulfill the work's objective. Subsequently, the analysis and discussion of results are presented. Finally, conclusions, future lines of research, and study limitations are proposed.

## LITERATURE REVIEW

Research on innovation and sustainability in environmental terms confirms that tourist companies face various challenges to counteract the effects of environmental deterioration (Tang et al., 2019). One of them is to address the inevitable pressure from different tourism actors to adopt new sustainable practices that, in addition to obtaining ecological benefits, lead companies to achieve higher levels of economic performance, business performance (Asadi et al., 2020; Garay et al., 2019), and quality of their goods and services (Donner & Vries, 2021).

Particularly in the hotel sector, environmental sustainability is seen as a novel management model that guides meeting market demands while simultaneously considering the care of the natural environment (Asadi et al., 2020). This indicates that environmental innovation can be a vital element in the performance of tourist business sustainability practices.

In response to this, various scientific contributions have sought to explain the relationship and effect between these two variables in the hotel industry, aiming to explain how, through them, natural resource consumption can be reduced and more ecological and competitive products can be developed (Khatter et al., 2021; Pereira-Moliner et al., 2021). There is empirical evidence that innovation drives companies to prioritize sustainability as an organizational priority. For this reason, Behnam and Cagliano (2016) argue that organizations with high innovative performance tend to achieve high sustainable performance. Thus, the positive and significant correlation between innovation and sustainability is noticeable (Longoni & Cagliano, 2015); there is also

a mutual effect, developing ecological organizational capabilities (Asadi et al., 2020); as when companies seek to implement new environmental policies, practices, or products, they are introducing innovation in terms of sustainability (Horng et al., 2017). However, environmental innovation is not a unidirectional process of material flow to develop tourist products and services but a complex process that integrates technologies, personnel, regulation, and organizational structures, among other factors (Horng et al., 2017; Park et al., 2017) to challenge existing practices in companies (Behnam & Cagliano, 2016).

## Environmental Innovation

Faced with ecological challenges, innovation has shifted toward an environmental focus, for organizations to develop new ideas and implement actions that do not jeopardize the natural environment, efficiently use resources, and generate greater competitive advantages (Abbas & Sağsan, 2019). The European Commission (2008) defines environmental innovation as "the production, assimilation, or exploitation of a novelty in products, production processes, services or methods of management and business, the objective is to prevent or substantially reduce environmental risk, pollution, and other negative impacts of resource use throughout its life cycle" (p. 11). Xie et al. (2019) and Tiwari and Thakur (2020) state that environmental innovation aims to encourage companies to develop products and services that are more environmentally friendly, emphasizing the use and development of technological techniques and processes, as well as management and organizational methods that lead to sustainable business development.

Similarly, Aboelmaged (2018) points out that environmental innovation should go beyond the development of new products and services, focusing on sustainable development and economic progress through the responsible and efficient use of natural resources, ultimately achieving a balance between the company and nature (Peiró-Signes et al., 2011). Thus, when companies develop environmental innovation, they adopt changes that adapt to the dynamic environment, making the organization's internal capabilities drive actions that efficiently respond to environmental improvement (Salim et al., 2018).

Some research reveals that environmental innovation is a multidimensional construct in itself, as it can create or improve processes, products, or services; or develop technological capabilities that are a necessary condition for achieving sustainability (Zhang et al., 2020). The same applies to organizational capacity, as the company requires fundamental knowledge, strategies, and procedures to manage organizational changes in environmental innovation (Lopes et al., 2017).

## Technological Capacity

According to Jørgensen (2001), environmental technologies are conceptualized as a set of knowledge, artifacts, and high-performance tools to mitigate environmental problems and

risks. These technologies are also seen as intellectual models that provide effective solutions in the use of resources and energy, environmental quality, ecological safety, and health (Delgado et al., 2021; Wicki & Hansen, 2019). The literature has recently begun to analyze how technological capacity builds environmental innovations, as it reduces resources used in production, supports reuse and recycling practices, and decreases pollution (Sadiku, 2020).

All environmental technology has an impact on nature and the organization; therefore, its choice should be based on the benefits, advantages, and value it will generate, as well as the competencies required to use it (Hötte, 2020; Xie et al., 2019). In this sense, companies must integrate technological processes that generate more complex competencies and consolidate their position in the market (Delgado et al., 2021).

## Organizational Capacity

Organizational capacity has emerged as a mechanism that allows the adoption of strategies, procedures, and management practices that, in turn, help achieve environmental goals and objectives (Fernando et al., 2019; Muñoz-Pascual et al., 2021; Reyes-Santiago et al., 2017). These actions have been considered a potential part of corporate strategy and a viable source of growth, productivity, and efficiency for companies (Kennedy et al., 2017). Organizational capabilities are conceived as a set of collective resources that a company possesses and are reflected as skills and knowledge to improve functional activities and facilitate decision-making, having a positive effect on its performance (Bustinza et al., 2016). In this regard, organizational capacity depends on the support of all functional areas of the company, so collaborative work, idea exchange, and acquired competencies should be encouraged (Martínez-Rubio et al., 2021), differentiating the company from its competitors in terms of environmental efficiency (Fernando & Wah, 2017).

## Environmental Sustainability

The concept of sustainable development emerged with the Brundtland Report in 1980, with the aim of efficiently and rationally managing resources while meeting present needs without compromising the needs of future generations (Tiwari & Thakur, 2020). Jones et al. (2016) point out that the concept of sustainability has changed over the years; however, businesses recognize it as one of the emerging drivers of competitiveness. Therefore, current business models are moving towards sustainable development that impacts high economic, environmental, and social performance (Evans et al., 2017; Maletič et al., 2016).

Zoogah (2014) defines environmental sustainability as all processes and practices used by companies to improve the quality of the natural environment in the long term. Therefore, sustainability in businesses adds environmental actions, mainly impacting increased performance, efficiency, and business growth (Maletič et al., 2016; Sun et al., 2021; Zhang et al., 2020).

There is evidence from hospitality studies indicating that sustainability is a trend, so environmental actions are still in an adoption stage. Thus, hotels still lean towards mostly known

or well-established strategic movements of the organizational structure (Tiwari & Thakur, 2020). In this sense, decision-makers must seek strategic environmental alternatives that enhance their capabilities and business resources oriented towards sustainability (Aboelmaged, 2018; Severová et al., 2021; Wang et al., 2012). Some factors that help explain environmental sustainability are the legal requirements that companies must comply with regarding environmental regulations, the creation of a culture that promotes greater public awareness in the ecological sphere (Jones et al., 2016), and proposals for business models that generate changes in consumption levels and patterns, factors significantly associated with culture and compliance with legislation (Sandberg, 2021).

## Environmental Culture

"The way individuals relate to the natural environment is culturally determined" (Milfont & Schultz, 2016, p. 194), In this sense, authors like Miska et al. (2018) consider that environmental culture in companies should be promoted through participation in sustainable activities, leading to greater employee engagement. According to Caprar and Neville (2012), environmental culture is the antecedent or condition that influences the adoption of sustainable practices; therefore, it is an important explanatory variable in terms of variations related to sustainability (Beekun et al., 2008; Haxhi & Ees, 2010; Parboteeah et al., 2012).

Environmental culture in companies is constantly built, reflecting the organization's use of natural resources and its degree of responsibility towards the environment. Therefore, it is necessary to integrate organizational knowledge and values about environmental care through teamwork, promoting an innovative ideology among employees (Fraj et al., 2013; Reyes-Santiago et al., 2017; Tiwari & Thakur, 2020).

## Environmental Regulations

In recent years, governments and other public and private institutions have issued a series of environmental regulations to develop and implement sustainable strategies for environmental protection (Fernando et al., 2019). Thus, companies need to comply with these regulations through the design of policies, certifications, and evaluation or audit systems, to offer services aligned with natural resource conservation and environmental preservation (Han et al., 2020; Tiwari & Thakur, 2020). Environmental regulation applied by the public administration represents one of the main determinants for business changes towards sustainability. Green practices are related to compliance with environmental legislation and regulations promoted by institutions, which affects the improvement of the tourism sector's performance (Vargas et al., 2011). On the other hand, certifications are a form of business authority, through which the organization is recognized for maintaining policies, rules, and standards that provide legitimacy in fulfilling its environmental responsibility (Lambin & Thorlakson, 2018).

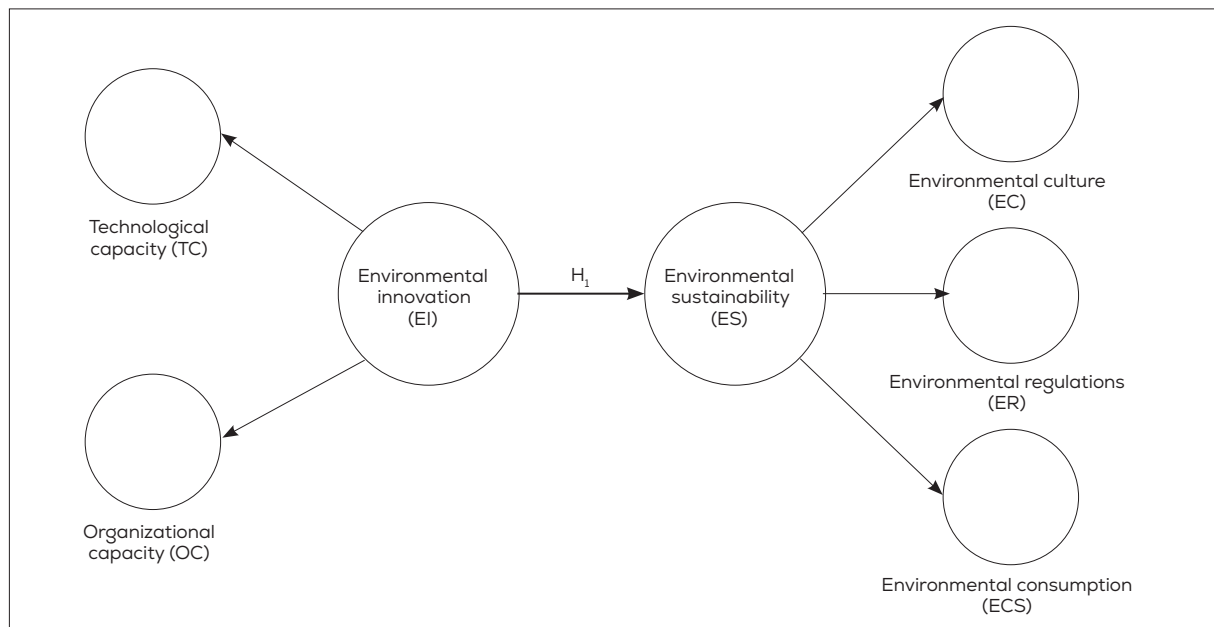
## Environmental Consumption

In the tourism sector, there is a high consumption of resources, becoming a primary activity of pollution and environmental degradation (Azam et al., 2018). Therefore, directing environmental consumption makes business activities more eco-efficient (Alonso-Almeida et al., 2016; Azam et al., 2018). Environmental consumption requires identifying opportunities to reduce the use of natural resources through recycled materials, reusable products, or the acquisition of environmentally friendly products (Aboelmaged, 2018; Fernando & Wah, 2017; Reyes-Santiago et al., 2017). The United Nations Environment Programme (Kostova, 2015) defines environmental consumption as the use of more ecological services and products that provide higher quality, minimizing the use of natural resources and toxic materials for the environment, as well as waste and pollutant emissions during the life cycle to avoid endangering the needs of future generations.

With the above, it is considered that innovation represents an important variable to achieve sustainability in hotels from an environmental perspective, where technological and organizational capacity should be useful to promote environmental culture, integrate actions that address regulations, and identify opportunities to reduce the consumption of natural resources to make the company an environmentally sustainable organization. On these bases, it is inferred that environmental sustainability is supported by the actions of companies to implement environmental innovations. Therefore, the following central hypothesis is proposed:

H1: Environmental innovation has a significant and positive effect on environmental sustainability.

**Figure 1.** Model of the Effect of Environmental Innovation on Environmental Sustainability



## METHODOLOGY

### Research Design

The research was based on the quantitative approach and the hypothetical-deductive method, as it countered a theoretical explanation of a particular reality. The design was non-experimental, the study adopted a cross-sectional design, as no variable was deliberately manipulated, and the data were collected at a single point in time, revealing the phenomenon as it naturally occurs. Furthermore, its scope was explanatory, determining the effect of environmental innovation on the environmental sustainability of the hotel sector in the Riviera Maya.

### Instrument and Data Collection

Data collection utilized a survey technique, employing a questionnaire as the instrument which was designed and validated through several stages. Initially, a literature review in the hotel industry identified dimensions and units. Subsequently, experts in the management of tourist enterprises evaluated it, adjusting the items. A pilot test (n=50) was then conducted in the hotel context, which yielded satisfactory results. Finally, the questionnaire underwent statistical validity tests to ensure its relevance.

The instrument consisted of three sections. The first comprised 28 items for assessing variables (Table 1) on a six-point Likert scale: 1 for "totally disagree" to 6 for "totally agree." The second section focused on the socio-demographic data of the respondents (Table 2). The questionnaire was self-administered to hotel sector workers in April and May 2021, with information provided about data use and confidentiality.

### Population and Sample

A non-probabilistic sampling method was employed, involving 386 voluntary subjects from 96 hotels in the Riviera Maya, all rated above four stars (four and five-star hotels), as well as Grand Tourism (GT). Hotel workers were chosen as respondents due to their role in implementing environmental practices during their work activities. The sample comprised both genders, predominantly young adults aged 21 to 35, (87.5%), of Mexican nationality (94.8%), single (58.4%), and in free union (23.3%); with an educational level of high school (43.5%) and bachelor's degree (33.9%). These workers perform in operational areas (76.4%), with work experience ranging from one to five years (58%). It is worth mentioning that 72.7% of them do not have training on environmental care.



**Table 1.** Operationalization of the Variables

Variables	Dimension	Code	Item	
Environmental innovation (EI)	Technological capacity (TC)	TC_01	Implement new technologies to optimize the use of natural resources.	
		TC_02	A new technique or process is implemented to reduce the pollution generated by service operations.	
		TC_03	Implements new methods for solid waste recycling.	
		TC_04	Adopt new knowledge for pollution reduction.	
		TC_05	Utilize renewable energy sources to promote environmental care.	
	Organizational capacity (OC)	OC_01	It has defined an organizational strategy for environmental care.	
		OC_02	It has established objectives and goals for environmental care.	
		OC_03	Designs plans for environmental management.	
		OC_04	It has defined organizational procedures for development of environmental innovations.	
		OC_05	Delimits the functions, activities or tasks of workers related to environmental care.	
		OC_06	Develops new environmental management systems.	
		OC_07	It promotes environmental innovation through its organizational practices.	
		OC_08	Train your workers on environmental issues to generate innovative ideas.	
		OC_09	It facilitates knowledge exchange among its areas for environmental care.	
		OC_10	Stimulates communication among its collaborators to generate innovative environmental proposals.	
	Environmental sustainability (ES)	Environmental culture (EC)	EC_01	Fosters an innovative culture for environmental enhancement.
			EC_02	Encourages participation in environmental activities.
EC_03			Encourages teamwork to address environmental issues.	
EC_04			It's recognized as an environmentally conscious firm.	
Environmental regulations (ER)		ER_01	It has an environmental policy that guides its activities.	
		ER_02	Complies with legal obligations regarding environmental care.	
		ER_03	Its practices have enabled it to attain environmental certification	
		ER_04	Conduct environmental assessments to prevent negative impacts.	
Environmental consumption (ECS)		ECS_01	Conducts preliminary studies or assessments for the procurement of ecological products.	
		ECS_02	It has identified opportunities to reduce the consumption of natural resources.	
		ECS_03	Encourages the procurement of eco-friendly products.	
		ECS_04	It strives to diminish the consumption of environmentally harmful products.	
		ECS_05	Encourage the use of recycled material or reusable products.	

**Table 2.** Description of the Sample

Variable	Value	Frequency (f)	Percentage (%)
Gender	Male	193	50.2
	Female	192	49.8
Age	Less than 20 years	4	1.0
	21-25 years	112	29.1
	26-30 years	141	36.5
	31-35 years	83	21.5
	36-40 years	28	7.2
	41-45 years	13	3.4
	46-50 years	5	1.3
Job position	Executive/Senior level	5	1.3
	Middle management	86	22.3
	Operational staff	295	76.4
Nationality	Mexican	366	94.8
	Another (foreigner)	20	5.2
Education level	Middle School/Junior High School	34	8.8
	Vocational/Technical career	46	11.9
	High School	168	43.5
	Bachelor/degree	131	33.9
	Postgraduate	7	1.9
Marital status	Single	226	58.5
	Married	66	17.1
	In a relationship	90	23.3
	Divorced	4	1.1
Time working in the company	Less than a year	103	26.7
	From 1 to 5 years	224	58.0
	From 6 to 10 years	46	11.9
	From 11 to 15 years	11	2.8
	More than 15 years	2	0.6
Do you have any training or certification related to environmental issues?	Yes	105	27.2
	No	281	72.8
Hotel category	4 stars	88	22.8
	5 stars	267	69.2
	Luxury Class (more than 5 stars)	31	8.0

## Data Treatment

The research applied Partial Least Squares Structural Equation Modeling (PLS-SEM) to test the central hypothesis. Considering environmental innovation and environmental sustainability as second-order variables, a Hierarchical Component Model (HCM) (Hair et al., 2018). Likewise, this HCM model adopted a reflective-reflective logic, as the items reflect or manifest a dimension, and, in turn, these dimensions reflect a more complex variable (Hair et al., 2017). The characteristic of these models allows for measuring complex variables by ordering and hierarchizing the components that integrate them, thereby respecting the postulate of dimension reduction to offer a more efficient explanation of the treated phenomenon.

Regarding the PLS-SEM model with an HCM approach, path analyses, bootstrapping, and blindfolding were substantial to ensure its fit. Additionally, the results were presented in a stepwise manner: descriptive, correlational, and explanatory. For data processing, the software used was SmartPLS version 3 (Ringle et al., 2015) and JASP (JASP Team, 2021).

## Methodological Support

For methodological support, reliability and validity tests were employed. As presented in Table 3, the statistics of Cronbach's alpha, rho\_A, and composite reliability for each construct were considered. The values of these statistics demonstrate satisfactory internal consistency of the instrument, as they exceed 0.700.

**Table 3.** Reliability

Variable/Dimension	Cronbach's Alpha	rho_A	Composite reliability
Environmental innovation	0.950	0.951	0.956
Technological capacity	0.870	0.873	0.906
Organizational capacity	0.944	0.946	0.952
Environmental sustainability	0.940	0.943	0.948
Environmental culture	0.911	0.912	0.937
Environmental regulations	0.880	0.889	0.918
Environmental consumption	0.887	0.890	0.917

Table 4 displays the item loadings, revealing that all of them maintain values above the minimum criterion ( $>0.707$ ). Additionally, the values of the Variance Inflation Factor (VIF) being less than 5 allow and indicate the absence of multicollinearity issues.

**Table 4.** VIF and cross loads

Item	VIF	TC	OC	EC	ER	ECS
TC_01	2.091	0.809				
TC_02	2.221	0.830				
TC_04	1.846	0.771				
TC_05	2.303	0.855				
TC_06	1.929	0.792				
OC_01	3.292		0.805			
OC_02	3.437		0.808			
OC_03	2.513		0.744			
OC_04	2.597		0.806			
OC_05	3.900		0.872			
OC_06	3.491		0.868			
OC_07	2.386		0.790			
OC_08	3.261		0.834			
OC_09	3.925		0.859			
OC_10	2.698		0.774			
EC_01	2.697			0.886		
EC_03	3.202			0.907		
EC_04	2.749			0.884		
EC_05	2.550			0.876		
ER_01	2.563				0.880	
ER_02	1.740				0.781	
ER_03	2.445				0.871	
ER_05	2.851				0.898	
ECS_01	2.027					0.750
ECS_02	2.419					0.822
ECS_03	2.729					0.867
ECS_04	2.983					0.869
ECS_05	2.896					0.841

Furthermore, convergent and discriminant validity were achieved, as the values of the Average Variance Extracted (AVE) exceeded 0.500 in all cases, and the square root of AVE was greater than the correlation between variables, in accordance with Fornell and Larcker's criteria (1981) (Table 5).

**Table 5 – Convergent and Discriminant Validity**

Dimensions	AVE	TC	OC	EC	ER	ECS
Technological capacity (TC)	0.659	0.812*				
Organizational capacity (OC)	0.667	0.748	0.817*			
Environmental culture (EC)	0.789	0.650	0.802	0.888*		
Environmental regulations (ER)	0.737	0.539	0.668	0.698	0.859*	
Environmental consumption (ECS)	0.690	0.549	0.669	0.687	0.698	0.831*

Note: \*Square root of the variance extracted AVE.

## RESULTS

### Descriptive Analysis

Results indicated that hotels in the Riviera Maya exhibited weaknesses in implementing environmental innovation and sustainability, with most constructs having values around a mean of 3.812. On the scale, this is considered between "slightly disagree" and "slightly agree," indicating a low level. In environmental innovation, technological capacity was the highest-rated construct, with a mean of 4.085, translating to "slightly agree" but at a low level.

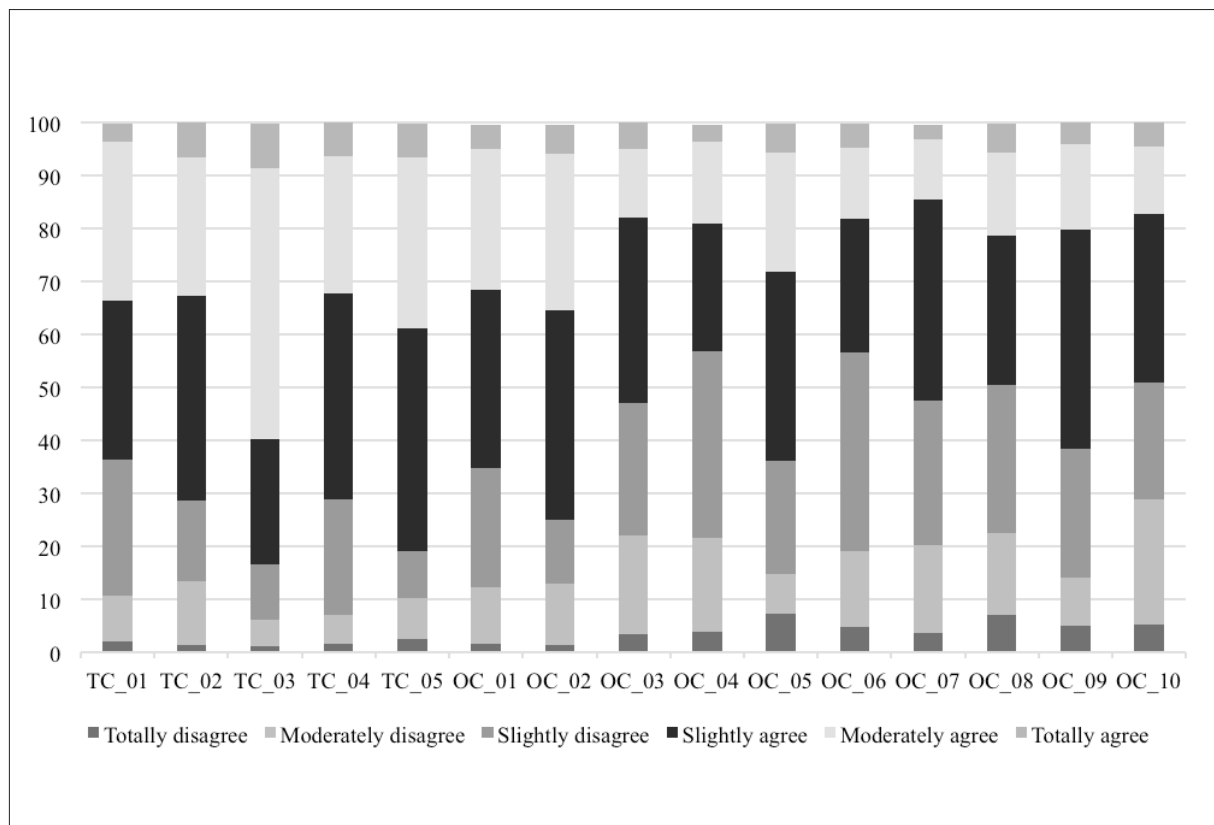
Environmental sustainability constructs (EC, ER, ECS) were similarly evaluated, with an average mean of 3.795, indicating a low score (Table 6).

**Table 6.** Descriptive Statistics and Normality

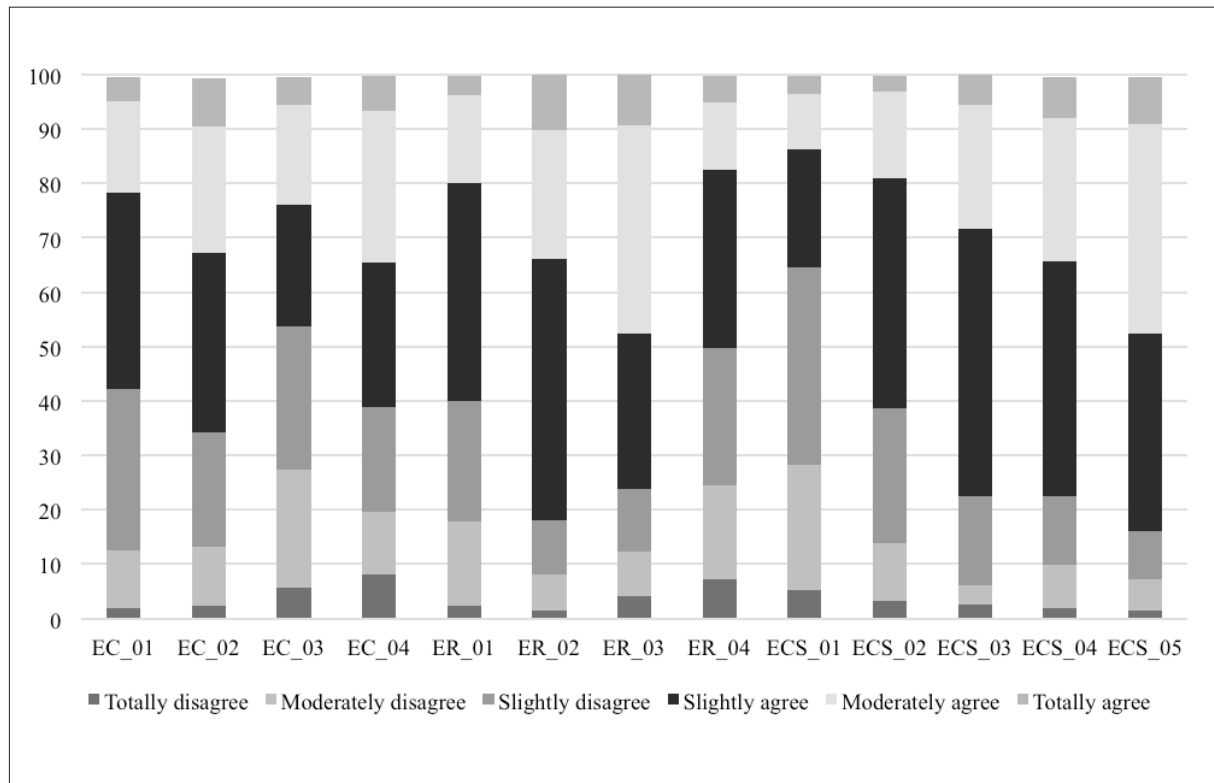
Variable	Construct	Media	$\sigma$	Asymmetry	Curtosis
Environmental innovation (EI)	Technological capacity (TC)	4.085	0.876	-0.641	0.723
	Organizational capacity (OC)	3.591	0.955	-0.163	-0.142
Environmental sustainability (ES)	Environmental culture (EC)	3.693	1.099	-0.125	-0.590
	Environmental regulations (ER)	3.839	1.003	-0.300	-0.199
	Environmental consumption (ECS)	3.854	0.887	-0.322	0.802

Through the analysis of environmental innovation, the highest percentage of positive responses (83.2%) was observed for the implementation of new methods for solid waste recycling (TC\_03). Similarly, the use of renewable energy for environmental conservation (TC\_05) received a positive value of 80.8%. In the organizational capacity dimension, item OC\_02 was the highest-rated, with 74.7% of respondents perceiving that their hotel had defined goals and objectives for environmental care. However, 56.8% negatively evaluated the exposure of organizational procedures for the development of environmental innovations (OC\_04) (Figure 2).

**Figure 2.** Assessment of Environmental Innovation Items



Considering responses to the environmental sustainability variable, hotels encouraged the use of recycled materials and reusable products (OC\_05), made efforts to comply with legal obligations related to the environment (ER\_02), favored the acquisition of ecological products (ECS\_03), and sought to reduce the consumption of environmentally harmful products. However, it was evident that hotels were not concerned about conducting prior studies or diagnostics for the acquisition of more ecological products (ECS\_01). Additionally, they did not promote teamwork to solve environmental problems (EC\_03), and there were minimal environmental assessments to prevent negative impacts on nature (ER\_04) (Figure 3).

**Figure 3.** Assessment of Environmental Sustainability Items

## Correlational Analysis

Regarding the correlation between environmental innovation and environmental sustainability dimensions, the Pearson coefficient ( $r$ ) was used. All associations were highly significant and positive, particularly between environmental culture and organizational capacity, showing the strongest relationship ( $r=0.803$ ;  $p\leq 0.01$ ). This result indicates that hotels develop strategies, objectives, and systems that promote an innovative culture for the improvement of environmental activities, portraying them as companies that respect nature.

Similarly, the association between environmental culture and technological capacity ( $r=0.648$ ;  $p\leq 0.01$ ) indicates the adoption of new techniques, processes, and technological methods to optimize the use of natural resources while promoting teamwork in environmental activities. On the other hand, organizational capacity and technological capacity have a moderately high relationship ( $r=0.745$ ;  $p\leq 0.01$ ), as environmental innovation helps adopt new knowledge, techniques, and methods to reduce environmental damage.

Regarding environmental regulations, they are linked to technological capacity ( $r=0.540$ ;  $p\leq 0.01$ ) and organizational capacity ( $r=0.665$ ;  $p\leq 0.01$ ), indicating the connection between the

adoption of policies, official regulations, and certifications with the improvement of organizational and management processes to minimize negative impacts on the environment.

Various official policies and regulations aim to encourage companies to advance in terms of sustainable practices, providing incentives for companies to significantly improve their products and services. This situation is not unique to Mexico; for example, governments in other countries such as Australia, Malaysia, China, and India, among others, are increasingly proactive in providing a regulatory environment and infrastructure that promotes and rewards environmentally friendly business strategies, minimizing negative environmental effects (Asadi et al., 2020; Fernando et al., 2019; Khatter et al., 2021; Tiwari & Thakur, 2020, Xie et al., 2019).

Environmental consumption has a moderate to high correlation with environmental regulations ( $r=0.699$ ;  $p\leq 0.01$ ), reflecting that hotel companies comply with their legal environmental obligations, identifying opportunities to reduce natural resource consumption, achieve more certifications, and incentivize the acquisition of eco-friendly products.

Furthermore, environmental consumption is related to the dimensions of environmental innovation: organizational capacity ( $r=0.670$ ;  $p\leq 0.01$ ) and technological capacity ( $r=0.550$ ;  $p\leq 0.01$ ). This result indicates that hotel companies can adopt new technologies and knowledge, as well as improve resource optimization processes.

**Table 7.** Pearson Correlation

Variable	Construct	TC	OC	EC	ER	ECS
Environmental innovation (EI)	Technological capacity (TC)	1				
	Organizational capacity (OC)	0.745**	1			
Environmental sustainability (ES)	Environmental culture (EC)	0.648**	0.803**	1		
	Environmental regulations (ER)	0.540**	0.665**	0.696**	1	
	Environmental consumption (ECS)	0.550**	0.670**	0.682**	0.699**	1

Note: \*\* $p < 0.001$ .

## Explanatory Analysis

To ensure the fit and validity of the structural model, bootstrapping with a total of 5,000 cases was applied (Henseler et al., 2016) (Table 8). From this, the standardized root mean square residual (SRMR), with a value of 0.095, was examined. It evaluates the average magnitude of discrepancies between observed and expected correlations as an absolute measure of fit. Regarding this value, a very conservative stance requires a value less than 0.080. However, it is possible to report a value less than 0.100 and consider it a good fit for PLS-SEM, especially in an initial study with limited theoretical support, as indicated by Sarstedt et al. (2014).

On the other hand, blindfolding analysis through the cross-validated redundancy index ( $Q^2$ ) was greater than zero in all cases, indicating the predictive relevance of the model (Stone,



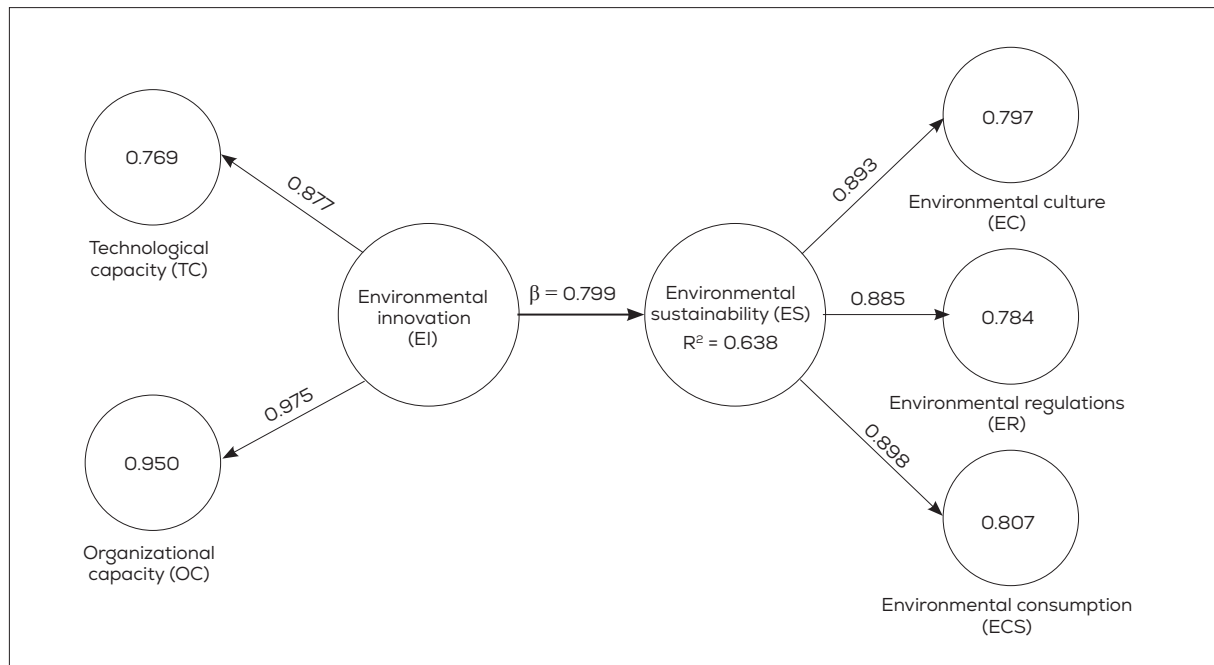
1977). Finally, the  $t$  and  $p$  values for each of the coefficients met the criteria  $t \geq 1.960$  and  $p < 0.001$ , demonstrating the relevance of the dynamics between first and second-order variables (Table 8).

**Table 8.** Path coefficients, Effect sizes, Predictive Power, and Relevance

Dynamic	Coefficient Path	t value	p value	R <sup>2</sup>	R <sup>2</sup> <sub>aj</sub>	f <sup>2</sup>	Q <sup>2</sup>
(EI)→(ES)	0.799	27.240	0.000	0.638	0.637	1.763	0.367
(EI) → (TC)	0.877	51.574	0.000	0.769	0.768	3.321	0.502
(EI) → (OC)	0.975	329.684	0.000	0.950	0.950	19.155	0.630
(ES) → (EC)	0.893	94.544	0.000	0.797	0.797	3.927	0.623
(ES)→(ER)	0.885	53.415	0.000	0.784	0.783	3.625	0.571
(ES) → (ECS)	0.898	76.507	0.000	0.807	0.806	4.179	0.550

In Figure 4, it can be observed that environmental innovation has a significant, positive effect ( $\beta=0.799$ ;  $p<0.001$ ) and a large size ( $f^2=1.763$ ) on environmental sustainability, to the extent of having predictive power and relevance ( $R^2=0.638$ ;  $Q^2=0.367$ ) (Table 8). With this result, the central hypothesis (H1) is confirmed, indicating that the environmental innovations carried out by hotels with the support of their technological and organizational capabilities have an effect on the level of sustainability in terms of culture, regulations, and environmental consumption.

**Figure 4.** Effect of Environmental Innovation on Environmental Sustainability



## DISCUSSION

In this study, the situation of the hotel sector in the Riviera Maya was analyzed based on the theory of resources and capabilities, proposing four hypotheses, and establishing a model to verify the dynamics between the innovation variable and sustainability from an environmental perspective. The results show that the tourist destination is composed of companies with a negative level regarding the implementation of innovations and sustainable practices in environmental terms.

It was identified that the adoption of environmental innovations is a global business limitation. However, some companies seek to improve their performance strategies and increasingly focus their actions on sustainable practices (Asadi et al., 2020; Reyes-Santiago et al., 2017). In this sense, the results converge with the research of Fernando et al. (2019), proposing that the innovation capacity of services has a relationship between sustainable organizational performance and environmental innovation. The study was supported by empirical evidence involving the participation of 95 companies in Malaysia that use green technology. Therefore, this research is similar to the present study in considering that technological capacity plays a key role in environmental innovation. It leads to improving business performance through the implementation of technologies and knowledge that help reduce environmental impacts.

The study also confirmed a link between environmental innovation and environmental regulations, stating that the integration of policies, standards, regulations, and certifications helps improve environmental initiatives in hotel operation systems. Additionally, it directs and adopts new initiatives in a cleaner and more balanced way (Aboelmaged, 2018; Asadi et al., 2020; Fernando & Wah, 2017).

The research also found similar results to the contributions of Evans et al. (2017), whose objective was to develop a theoretical perspective to understand business model innovations leading to better economic, environmental, and social performance. In this regard, the results converge by considering that environmental innovations have emerged as a mechanism for environmental balance through their operational business practices and capabilities, aiming to reduce negative environmental impacts caused by consumption and production activities, while meeting consumer needs (Aboelmaged, 2018; Fernando & Wah, 2017; Fernando et al., 2019; Tiwari & Thakur, 2020).

## CONCLUSIONS, FUTURE STUDIES, AND IMPLICATIONS

The tourism hotel sector depends heavily on natural resources for its survival and growth (Tiwari & Thakur, 2020). Therefore, companies in recent years have developed and implemented new techniques, systems, and knowledge to boost productivity, optimize resources from input to final service, improve business performance, and care for nature.

The tourism sector presents various environmental problems, mainly resource overexploitation. Therefore, in recent years, environmental innovation and sustainability practices have become increasingly important for the hotel industry. This study has shown that, through the implementation of technological innovations focused on environmental care, companies achieve new organizational capabilities, making their processes more efficient, better utilizing resources, complying with legal obligations, and promoting environmental culture, ultimately leading to business profitability.

The objective of this research is successfully fulfilled by showing that environmental innovation has a significant, positive, and strong effect on environmental sustainability. However, the hotel sector in the Riviera Maya is vulnerable in terms of innovation and sustainability, as it is at low levels of implementation. Nevertheless, this research is useful for reflecting on the impacts of current business practices and reconsidering the possibility of making them more eco-efficient.

From the study analysis, the following research lines were proposed, which may be of interest to academics, entrepreneurs, public managers, or those studying this topic: 1) studies that consolidate empirical evidence in other types of tourism companies are recommended to understand the behavior of variables; 2) an analysis is proposed on the development of capacities and competencies from environmental innovations for the generation of sustainable practices; 3) applying the instrument in other tourism business contexts is suggested, adapting it to the context and characteristics of each study, and; 4) addressing different perspectives of the involved actors such as customers, managers, and entrepreneurs in the same context. This will help provide a broader framework on how innovation and sustainability are perceived and implemented in environmental terms.

Finally, the limitations of this research revolve around considering only the perspective of workers in hotel companies, which, despite considering various levels of positions, could imply a bias in the chosen unit of analysis. Another limitation is the research cut, studying the phenomenon transversely and using a single instrument for data collection, suggesting other methodological approaches for comparison. Similarly, the findings may be consulted with discretion as the data were collected at a time when tourism was starting activities due to the pandemic.

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## CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

## AUTHOR CONTRIBUTIONS

Karen Martínez Rubio: Conceptualization, data curation, formal analysis, writing.

Elva Esther Vargas Martínez: Project administration, conceptualization, writing, formal analysis, editing.

Alejandro Delgado Cruz: Methodology, formal analysis, validation, conceptualization, writing.