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# Building a Latent Scale of Tourism Innovation for Tourist Destinations in Extremadura (Spain) Using Irt Modelling

# Construcción de una Escala Latente de Innovación Turística para los Destinos Turísticos de Extremadura (España) Mediante Modelización IRT

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## Abstract

The STD (Smart Tourist Destinations) methodology is being implemented in Spain by the State-Owned Company for the Management of Innovation and Tourism Technologies (Segittur) in numerous Spanish tourist destinations. One of the five fundamental pillars of this methodology is innovation.

The purpose of this study is to assess the degreeof tourism innovation in all regional tourist destinations in Extremadura and conduct a critical analysis of this degree. To this end, a questionnaire based on the proposed tourism innovation indicators in UNE 178502 standard was designed. This questionnaire consists of 13 innovation indicators and was completed by the 24 Local Action Groups of Extremadura and the 4 main cities of the region between January and March 2023.

The findings of this research enable the identification of territories implementing a more effective strategy regarding tourism innovation, as well as highlighting the indicators that best differentiate between destinations and have a more notable impact on significant innovation advancement. The establishment of business incubators is emphasized as a highly beneficial initiative for promoting innovation in tourism. Additionally, specific strategic action lines are proposed that the analyzed destinations should implement so that innovation in the tourism sector produces a significant effect on the condition of tourism intelligence for each of the study destinations.

*Keywords:* Innovation, STD methodology, difficulty, discrimination, IRT model

*JEL code:* L83, O18, R11

**Resumen**

La metodología DTI (Destinos Turísticos Inteligentes) está siendo implementada en España por la Sociedad Mercantil Estatal para la Gestión de la Innovación y las Tecnologías Turísticas (Segittur) en numerosos destinos turísticos españoles. Uno de los cinco pilares fundamentales de esta metodología es la innovación.

El propósito de este estudio es evaluar el grado de innovación turística en todos los destinos turísticos regionales de Extremadura y llevar a cabo un análisis crítico de dicho grado. Para este propósito, se diseñó un cuestionario basado en los indicadores de innovación turística propuestos en la norma UNE 178502, publicada por la Asociación Española de Normalización (AENOR) y dirigida a los destinos españoles que deseen convertirse en inteligentes. Este cuestionario consta de 13 indicadores de innovación y fue completado por los 24 Grupos de Acción Local de Extremadura y las 4 principales ciudades de la región entre enero y marzo de 2023.

Los hallazgos de esta investigación facilitan la identificación de los territorios que implementan una estrategia más efectiva en relación con la innovación turística, además de señalar los indicadores que mejor diferencian entre destinos y que tienen un impacto más notable en el avance significativo de la innovación. Se destaca la creación de incubadoras de empresas como una iniciativa altamente beneficiosa para promover la innovación en el turismo. Además, se proponen líneas de acción estratégicas específicas que los destinos analizados deberían implementar para que la innovación en el sector turístico produzca un efecto significativo en la condición de inteligencia turística para cada uno de los destinos del estudio.

*Palabras clave:* Innovación, modelo DTI, dificultad, discriminación, modelo IRT

*Códigos JEL*: L83, O18, R11

## 1. INTRODUCTION

The changes brought about by the increasing application of new Information and Communication Technologies (ICTs) in the management of tourism have undoubtedly contributed to strengthening the link between innovation and tourism. According to some authors, innovation in the tourism sector is closely linked to the use of ICTs, which have transformed the sector's modus operandi (SiLA-Gat-Signes et al., 2019) by incorporating electronic tools that facilitate both operational and strategic management of institutions and companies, as well as the management of information and knowledge from different stakeholders (Buhalis, 2003).

In this context, the evolution of the tourism model has given rise to the concept of a Smart Tourist Destination (STD), which expands from the idea of a smart city, adapting it to the tourism realm to go beyond a municipal character. This model is based on the premise of improving the quality of life for citizens and resource management through the application of ICTs. As pointed out by Femenia-Serra and Ivars-Baidal (2018), the two main objectives of STDs are to enhance the tourist experience and destination management.

Despite being a relatively nascent concept, the STD concept has gained momentum within the academic community and has garnered increasing interest, particularly in Spain (Gretzel et al., 2015), where the STD model stands out. The STD model can be defined as a management program promoted by the Spanish Ministry of Tourism through the State-Owned Company for the Management of Innovation and Tourism Technologies (SEGITTUR). Its main feature is to provide a guide for destination managers interested in obtaining this accreditation, offering a methodology to improve the tourist intelligence of their destinations. The impetus provided by this entity for converting Spanish destinations into STDs is reflected in the STD network, which currently comprises a total of 437 accredited destinations (SEGITTUR, 2023).

To achieve this goal, SEGITTUR conducts an initial diagnosis, establishes an action plan, and monitors the destination's evolution based on five fundamental axes of the STD model: governance, innovation, technology, sustainability, and accessibility. These axes, in turn, are developed through a set of indicators specified in the UNE 178502 standards as of January 2022.

Although the STD methodology serves as a valuable guide for converting destinations into smart ones, being a relatively recent concept, its evolution requires further studies to deepen the understanding of the phenomenon for proper conceptualization, as suggested by Shafiee et al. (2021). These authors highlight the need for conducting case studies to gain more knowledge in this area.

Therefore, the present study aims to fill this gap in the literature by proposing a case study to critically assess the indicators of the innovation axis of the STD model, with a dual objective. Firstly, to analyze the difficulty level and discriminative capacity of each of these indicators, verifying their validity and relative importance in the ultimate goal of improving the destination's tourist intelligence. Secondly, to evaluate the degree of compliance with these indicators in each microdestination through the creation of a latent scale, which provides an overview of the relative situation of each microdestination at the time of the study. The results obtained thus represent valuable outputs to guide the action plan of destinations by identifying the most relevant indicators to enhance their relative position in terms of intelligence.

To achieve these objectives, the study uses the region of Extremadura (Spain) as a case study. This region is characterized as an inland region with a tourism model mainly based on two products: cultural tourism and nature tourism, both highly dependent on sustainable development models. It currently has seven destinations affiliated with the STD network, including the four main cities: Badajoz, Cáceres, Mérida, and Plasencia, along with three joint municipalities. Additionally, the region continues to work at the microdestination level to join the network. Hence, it is considered a relevant case study for the implementation of the STD model in inland destinations.

The territorial division used is based on the various Local Action Groups (LAG) that divide the region since tourism management policies are mainly carried out at this level of territorial disaggregation. Therefore, the results obtained are an important tool made available to microdestination managers.

The study uses an Item Response Theory (IRT) model, starting from a diagnosis of the initial situation of each microdestination based on a set of items extracted from the UNE 178502 standard. The estimations made allow for positioning of the territories on a latent scale of innovation and characterizing the indicators based on their discriminative capacity and level of difficulty. This analysis becomes a tool that allows destinations to know their relative position in terms of innovation and focus their efforts on items that, based on their discriminative capacity, could help improve their relative position, thus contributing to the management of destination intelligence in terms of innovation.

To fulfill its objectives, the study is organized as follows: after this introductory section, where the research problem is presented and the objectives are established, a review of the existing literature is conducted to provide the reader with an understanding of the importance of the analyzed axis. Subsequently, the study presents the data and describes the methodology used to achieve the established objectives. Finally, the results and conclusions drawn from the study are presented.

## 2. LITERATURE REVIEW

### 2.1. Innovation as a differentiating element of tourist destinations

When trying to define the term innovation in the context of tourist destinations, Marakova and Medvedova (2016) refer to it as a prerequisite for a destination to succeed in tourism by offering new and unique products that capture the attention of tourists. For them, innovation is anything that represents a new idea or concept that creates new needs, attracts new tourists, and provides new job opportunities. On the other hand, Ozseker (2019) defines innovation as the process of generating and applying new ideas, approaches, products, or services that enhance the tourist experience, drive competitiveness, and create added value to the destination. It involves the successful introduction of significant and novel changes to meet the demands of the tourism market.

As a more novel approach, Trunfio and Campana (2019) interpret innovation in tourist destinations as a complex and evolutionary phenomenon driven by the interaction between public and private actors and technology. They argue that their proposed framework goes beyond the traditional focus solely on technology. They emphasize the complementary role of social capital in creating conditions that facilitate innovation in destinations. Del Vecchio et al. (2018) address innovation based on social networks, emphasizing its importance in generating interactions between tourists

and local residents, allowing tourist destinations to innovate their offerings in an open and collaborative manner.

In summary, tourism innovation can be explained as the introduction of novel approaches that lead to significant changes and improvements in a destination. It enables destinations to adapt to new trends and preferences of tourists and residents, contributing to the economic, social, and environmental development of destinations by promoting job creation, sustainable growth, and community well-being. Due to its great importance in tourism development, several contributions highlight the positive relationship between up-to-date and cutting-edge innovation and efficient tourism development.

In this regard, Gardiner and Scott (2018) explain that destination managers must consider whether to continue consolidating their current markets and experiences or, conversely, focus their efforts on innovating by developing new ideas and incorporating new markets into destination planning. Their results show that most destinations opt for market consolidation as they consider it a safer option. However, tourism innovation through the development of new experiences and attracting new markets is necessary to expand the destination's appeal and differentiate it from its competitors.

Martínez-Pérez et al. (2019) discuss radical innovation as innovative knowledge shared through interorganizational relationships connecting companies within and between destinations. The results of their study reveal that companies that leverage the variety of relationships between organizations to explore different innovative knowledge develop more radical innovations. They emphasize the importance of clustered companies building their network, where relationships are formed to obtain knowledge that can be fundamental to the development of radical innovation. On the other hand, Casais et al. (2020) conduct interviews with hosts and users of Airbnb accommodations to understand the value creation resulting from the relationship between both parties. The study's results emphasize that innovation in facilities and services and novel marketing are essential to obtaining quality reviews from users of different chosen accommodations.

Once the importance of innovation within tourist destinations has been established, the study will focus on observing the relationship between the public sector and private companies in the innovative functioning of multiple tourist destinations. Regarding innovation by the public sector, Jugend et al. (2020) identify public support as one of the main current themes in innovation management and economic and industrial development in tourist destinations. They propose four ways to measure public sector support for innovation in a destination: financial support for R&D activities, development through innovation, support for sectoral programs, and university-industry-government collaboration. Trunfio and Campana (2019) explain that a destination's ability to achieve a high level of innovation is subject to existing cooperation among political actors, destination management organizations, local tourism companies, and the local community. They consider a strong connection between the public and private sectors essential to the progress of innovation in tourist destinations.

From a more critical perspective, Brogaard (2021) recognizes that governments and businesses increasingly collaborate to innovate through public-private partnerships; however, he criticizes the lack of knowledge about whether they achieve the planned objectives and how they reach them. He believes that consistent criteria for measuring innovation in destinations should be developed to guide private, public, or mixed innovation systems. Similarly, Gusakov et al. (2020) conduct a study for major European tourist cities, revealing that collaboration between government and businesses in tourist destinations promotes the creation of incubators that improve tourism management, favoring digital transformation, digital business models, and open innovation platforms.

Based on the points presented so far, the significant importance of innovation in the implementation of tourist destinations is undeniable. Therefore, various works discuss the advantages of effective innovation in different destinations. Kofler et al. (2018) explain that a striking characteristic of regional tourism innovation networks is their high proportion of intersectoral links, leading to extensive collaboration between different sectors in innovation implementation. Among the sectors that show the most collaboration of all analyzed are tourism innovation networks, making it even more interesting for tourism companies to invest in improving their innovative methods and techniques.

On the other hand, Rastrollo-Horrillo and Rivero (2019) base the innovative behavior of small businesses on the relationships of the agents interacting in the destination. They argue that a company's innovative drive is not solely influenced by entrepreneurial social capital but also by the support provided by public institutions and the involvement of the local community in the addressed

objectives. With a similar approach, based on small companies in the Spanish hotel sector, Romero and Tejada (2020) mention various advantages of innovation supported by public institutions. They highlight improved service quality, ease of adopting quality standards and information technologies, reduced dependence on tourism intermediaries, and boosted business competitiveness and sustainability.

## 2.2. Innovation and intelligence of tourist destinations

Ivars-Baidal et al. (2019) discuss the strategy of Smart Tourist Destinations (STD) as a process that fosters innovation and the consolidation of truly intelligent destinations. They explain that these destinations should adopt an approach where smart solutions are not isolated initiatives but act as catalysts to enhance innovation and cooperation among stakeholders. However, they point out that the structural problems that characterize tourist destinations hinder their evolution towards smart destinations. They propose an appropriate strategy to overcome these problems, as they believe smart solutions help promote more ambitious collaboration processes. To achieve the proposed solution, they consider it necessary to tailor technological and innovative implementation to the characteristics of each destination interested in applying them, achieving a more flexible and adaptive approach.

Similarly, Ammirato et al. (2018) state that the adoption of new information and communication technologies (ICT) combined with collaborative business models supports the emergence of smart tourist destinations. These are innovative destinations built on state-of-the-art technology infrastructure and novel organizational models that support the interaction and integration of visitors with their environment. At the same time, smart tourist destinations foster cooperation, knowledge sharing, and open innovation among the actors involved. On the other hand, López de Ávila and Sánchez (2013) define a smart tourist destination as an innovative space based on the territory and state-of-the-art technological infrastructure, committed to sustainability and the singularities of the habitat. It is equipped with an intelligence system that promotes interaction between visitors and their surroundings, enriching the quality of tourist experiences.

From another perspective, Del Vecchio et al. (2018) discuss the opportunities offered by Big Data for innovation and sustainable growth of tourist destinations. They emphasize the importance of social networks as valuable sources of data for collaborative innovation in the tourism sector. They advocate for the need for a renewed culture and organizational skills that aid in creating value and converting tourist destinations into smart destinations. They also see innovation as crucial within the political agendas of destinations, believing that their development programs and instruments must be up-to-date to compete globally and take measures to face the challenges of sustainable growth.

The different studies mentioned explain the necessary implementation of innovation in achieving the intelligence of tourist destinations. They consider it essential as it drives competitiveness, improves the tourist experience, promotes sustainability, fosters collaboration among local actors, and increases efficiency. By adopting new technologies and innovative approaches, destinations can adapt to changing market demands and provide more attractive and sustainable tourism experiences. Ammirato et al. (2018) explain that the combination of technology and innovation fosters knowledge exchange among destination actors, offering innovative services to both residents and visitors, ultimately transforming the destination into a smart tourist destination.

Similarly, Polese et al. (2018) mention the importance of communication between hosts and guests in a destination to achieve an innovative approach. They explain that the exchange of resources is essential to understand the different opinions and preferences of tourists. This shared information during the stay allows the creation of innovation in service and improves the current and future customer experience, contributing to economic value creation and social and environmental well-being. The combination of all these characteristics derived from connections between different actors results in a better understanding of the strengths and weaknesses of the destination, enabling work to turn the destination into a smart destination.

On the other hand, Del Chiappa and Baggio (2015) see innovation as fundamental in achieving the qualification of a smart tourist destination. In particular, they point out that in an increasingly globalized and dynamic environment, innovation is the key element for cities and tourist destinations to be competitive. Organizations must consider location and spatial information as a common good,

making every effort to make this information available on the network, thereby stimulating tourism innovation. Regarding the hotel sector, Fernández et al. (2017) emphasize the importance of developing a culture of cooperation and alliance in tourism, creating ecosystems of innovation and knowledge transfer. They also insist on applying innovation in management and processes, helping to analyze more variables to improve the tourist experience and, combined with technological advances, allow for a qualitative leap to transform the tourist destination into a smart tourist destination.

Once the relative importance of innovation and its role within the framework of smart tourist destinations is known, the investigation will focus on which current cities or destinations have characteristics that make them smart and which of them have implemented innovative measures to achieve their goals and objectives. In their study of the Valencian city of Gandía, Sigalat-Signes et al. (2020) conclude that this could be a city that presents characteristic features of a smart tourist destination. However, they consider that to be considered truly smart, it must more comprehensively meet all the proposed dimensions for a smart city. They explain that although at the time of writing the article, the destination is in an early stage of the transition towards a smart tourist destination, they are on the right path, and with the help of citizens, the city will develop and can be considered a smart city, in tourism terms.

For the Tyrol region, Birgit et al. (2018) explain that there are innovation barriers such as business management, human resources, and lack of cooperation between companies. They state that improving quality and developing employee skills, along with better market research and tourism policy supporting innovation, can facilitate the elimination of the aforementioned barriers and make this region efficient as a tourist destination.

On the other hand, Femenia-Serra and Ivars-Baidal (2018) conduct their research based on the tourist city of Benidorm. They explain that this strategy is beneficial for tourism in Benidorm, mainly in terms of management and marketing. However, they emphasize the need for a better measurement of tourists' perspective since having this information is valuable for the successful implementation of technological solutions aimed at improving the destination and tourists' experience. On the other hand, they also highlight the importance of considering the negative side of implementing technology and innovative techniques, explaining that destination managers should plan smart destination areas where disconnection is possible.

## 3. MEASURING INNOVATION IN THE TOURIST DESTINATIONS OF BADAJOZ AND CÁCERES

### 3.1. Data.

To measure the degree of innovation in the tourist destinations of Extremadura, a questionnaire consisting of 13 questions was developed, adapted from the UNE 178502 Standard on Indicators and tools for smart tourist destinations (Aenor, 2022), specifically focusing on the indicators proposed in that standard to measure innovation in smart tourist destinations.

The questionnaire primarily included dichotomous questions (presence/absence) related to the existence of a documented commitment to innovation, the allocation of a specific budget for innovation, the presence of an innovation management unit, the existence of a systematic process of technological surveillance or competitive intelligence, the monitoring of innovation management actions, the existence of business incubators, the generation of a knowledge database, and the existence and management of tourism plans. However, the questionnaire also included some quantitative questions related to aspects such as the percentage of innovation objectives achieved, the percentage of implemented ideas that add value, the analysis of innovation profitability, the level of involvement of the private sector, and the number of new businesses created in the last year.

Due to the methodology used in this study requiring the use of dichotomous items, the five quantitative questions in the questionnaire were dichotomized based on whether the destination's value was above or below the regional average (1=above the average value; 0=below the average value).

The unit of analysis for this study was the 24 Local Action Groups (LAG) of Extremadura, along with the four main cities in the region (Badajoz, Cáceres, Mérida, and Plasencia). In total, 28 tourist destinations covering the entire Extremadura territory were analyzed.

Data on the 13 aforementioned items for each of these 28 destinations were obtained through telephone interviews. The survey period extended from November 2022 to March 2023.

## 3.2. Methodology.

For the analysis of these 13 indicators, a model from the family of models of Item Response Theory (IRT) (Hambleton & Swaminathan, 1985; Baker & Kim, 2004; Embretson & Reise, 2013; Van der Linden & Hambleton, 1997; Demars, 2010) has been used. This theory differs from Classical Test Theory (CTT) (Spearman, 1904; Novick, 1966) in several aspects:

- The unit of analysis is the item.
- Tests with a lower number of items may be more reliable than tests with a higher number of items.
- The responses to items from different individuals (cases) can always be compared to the extent that all items are measuring the same latent trait.
- The properties of each item do not depend on a representative sample.
- The position on the continuous latent trait is obtained by comparing the distance between items on the ability scale.
- Items can have different response categories.

The starting assumptions of the IRT models are as follows (Bichi & Talib, 2018):

1º) Monotonicity: As the position on the latent scale increases, the probability of giving a correct response to the items also increases.

2º) Unidimensionality: There is a single latent trait that determines the observed responses for each item.

3º) Local independence: The responses given to different items are mutually independent given a certain level of ability.

4º) Invariance: The parameters of each item can be estimated at any position on the item response curve and from any group of individuals who have responded to the item.

Given the dichotomous nature of the items used in the tourism innovation questionnaire, the ability (θ) of each analyzed tourism territory has been estimated through dichotomous IRT models. In this specific case, this ability is the level of innovation of each territory represented on a latent scale that, theoretically, can range from -∞ to +∞. Thus, territories positioned further to the right on the latent scale will have better tourism innovation than those positioned further to the left. The positioning of each territory on the latent scale will depend on the response (affirmative or negative) given by the territory to the 15 items that make up the questionnaire.

Dichotomous IRT models are, in fact, logistic models in which the probability of an affirmative response to each item may depend on either one parameter (difficulty) or two parameters (difficulty and discrimination). Since the objective of this work is not only to establish a hierarchy of territories based on their higher or lower level of tourism innovation but also to analyze the items that are more or less frequent in the analyzed territory and those that contribute more or less to improving innovation in destinations, the two-parameter logistic model (2-PL model) has been chosen. Its mathematical expression is as follows:

$$P_{ij}(\theta_j; \alpha_i; \beta_i) = \frac{exp[\beta_i(\theta_j - \alpha_i)]}{1+exp[\beta_i(\theta_j - \alpha_i)]} \qquad (1)$$

Where $P_{ij}$ is the probability that destination j responds affirmatively to item i. As can be observed, this probability will depend both on the position occupied by this destination on the latent scale of tourism innovation ($\theta_j$) and on the difficulty and discrimination of that item ($\alpha_i$ and $\beta_i$, respectively).

The difficulty parameter $\alpha_i$ indicates how item i behaves across the latent ability scale (or latent trait). This difficulty parameter is the value of the latent scale at which there is a 50% probability that the analyzed territories will give an affirmative response to said item. Thus, easier items will be located further to the left of the latent scale, which means that it will not be necessary to have a high level of tourism innovation to respond affirmatively to said item. Conversely, more difficult items will be located further to the right of the latent scale, which means that only territories with a higher level of tourism innovation will give a positive response to the item. In other words, easier items

will correspond to criteria that most of the analyzed destinations meet, while more difficult items correspond to criteria that only a minority of destinations meet, which are also those with the highest level of tourism innovation. Typically, values lower than -1 of this difficulty parameter correspond to very easy or easy items, while values higher than +1 correspond to difficult or very difficult items (Bichi & Talib, 2018).

On the other hand, the discrimination parameter $\beta_i$ indicates how well (or poorly) an item can differentiate between two destinations with different latent ability (tourism innovation). Thus, an item will have a positive discrimination when destinations with lower tourism innovation have a lower probability of responding affirmatively to it than destinations with better tourism innovation. And the higher the value of this discrimination parameter, the greater the difference between these probabilities. Consequently, an item with a negative discrimination parameter would be one in which it is more likely that a destination with lower innovation responds affirmatively to it than a destination with better innovation. Therefore, items with negative discrimination would be of little validity for constructing the latent innovation scale and, consequently, should be eliminated or revised (Bichi & Talib, 2018).

Furthermore, there is a relationship between the probability of responding affirmatively to an item and the value of the latent scale, i.e., between $P_{ij}$ and $\theta_j$, so that the former should be higher as $\theta_j$ is also higher. This functional relationship, graphically represented, is called the Item Characteristic Curve or Item Probability Function (Lord & Stocking, 1988; Fischer, 1995). However, not all items will have the same Item Characteristic Curve, since not all items will have the same discrimination parameter (slope of the curve) nor will they all reach 50% probability at the same value of the latent scale. In fact, the higher the parameter $\beta_i$, the higher the probability of giving an affirmative response to the item should also be (provided the parameter is positive), while the higher the parameter $\alpha_i$, the lower this probability will be. The functional relationship between the probability of giving an affirmative response to the item, on one hand, and the latent value of the territory and the difficulty and discrimination of the item, on the other hand, is precisely the two-parameter logistic model (2PL) of expression (1).

The methods for estimating the parameters of the model (1) assume that the subjects responding to the questionnaire items are independent of each other, and that the items behave in the same way with all subjects (Johnson, 2007). In the present case, in which both the difficulty and discrimination parameters of the items and the latent trait of the analyzed destinations must be estimated simultaneously, the initially used estimation method was the joint maximum likelihood (Lord, 1980; Birnbaum, 1968), although the most commonly used method currently is the marginal maximum likelihood (Johnson, 2007), which overcomes the technical disadvantages of the former. This method is based on an EM algorithm (Dempster et al, 1977; Rizopoulos, 2006), which includes an E step (which calculates the expected value of the log-likelihood function of the parameters from the observed data) and an M step (which maximizes the function obtained from the E step).

Finally, to determine the goodness of fit of the IRT model to the analyzed data, it is common to use information criterion indices, which are based on the value of the logarithm of the maximized likelihood function of the estimated model ($log\ log\ L$) and penalize both the complexity of the model (number of parameters to be estimated) and the sample size. Specifically, all these goodness of fit criteria have in common the calculation of $-2\ log\ log\ L$ plus the penalty. In the present work, three goodness of fit criteria will be used: the Akaike information criterion (AIC), the Bayesian information criterion (BIC), and the BIC adjusted for sample size (SABIC), whose mathematical expressions are as follows (Chen et al, 2017):

$$AIC = -2\ log\ log\ L + 2p \quad (2)$$

$$BIC = -2\ log\ log\ L + p\ log\ log\ (N) \quad (3)$$

$$SABIC = -2\ log\ log\ L + p\ log\ log\ \left(\frac{N+2}{24}\right) \quad (4)$$

Where $p$ is the number of parameters to be estimated in the model and $N$ is the sample size.

### 3.3. Results.

In Table 1, the parameter estimates for the difficulty of the 13 analyzed tourism innovation indicators are presented. As observed, there are 7 indicators with a negative difficulty value, so they can be defined as easy indicators, meaning indicators that are present in a high percentage of destinations. Among them, the indicator regarding the percentage of achieved objectives out of the total planned innovation objectives (-3.286) stands out, indicating that a large majority of destinations have achieved a percentage of planned objectives higher than the regional average. Conversely, the remaining 6 indicators have a positive difficulty, meaning they are "difficult" indicators to varying degrees, indicating that they are met in a minority of the analyzed destinations. Among these difficult indicators, the one regarding the existence of business incubators (2.966) stands out, showing that there are many more destinations that do not have business incubators than those that do have them.

**Table 1. Difficulty parameters of tourism innovation items (items ordered from lowest to highest difficulty)**

| Difficulty Indicators | $\alpha_i$ |
|---|---|
| I6: Achieved objectives out of the total planned objectives in innovation | -3,286 |
| I13: Existence of tourism plans derived from competitive surveillance | -1,234 |
| I12: Generation of a Knowledge Database | -0,624 |
| I5: Existence of monitoring of innovation action management | -0,411 |
| I7: Implemented ideas that add value | -0,282 |
| I1: Existence of a documented commitment to innovation | -0,227 |
| I9: Private sector participation in innovation projects | -0,155 |
| I2: Existence of a specific budget allocated for innovation | 0,001 |
| I3: Existence of an innovation management unit in the destination | 0,493 |
| I10: Tourism businesses created annually per 100000 inhabitants | 0,769 |
| I4: Existence of a systematic process of Technological Surveillance/Competitive Intelligence | 0,794 |
| I8: Value of innovations based on resources (profitability) | 1,202 |
| I11: Existence of business incubators | 2,966 |

Source: Self-prepared based on the results obtained using the mirt library in R.

Meanwhile, Table 2 presents the discrimination parameters of the 13 innovation indicators. Of all of them, only indicator 9 has a negative discrimination (-1.123), suggesting a reconsideration of its measurement in terms of innovation or, simply, its elimination. Of the remaining 12 indicators, 5 of them show low discrimination capacity, meaning they have a positive discrimination parameter less than 1. These 5 indicators are indicators 6, 11, 2, 8, and 10. Conversely, the indicators that best discriminate between destinations on the latent innovation scale are those with a discrimination coefficient greater than 1. These indicators are I12, I7, I3, I1, I13, I4, and especially I5 (14.826). It is evident, therefore, that the existence of monitoring of innovation management actions carried out at the destination is the main factor that allows differentiation between destinations on the latent innovation scale, i.e., it enables a clearer and more significant advancement in innovation in relative terms.

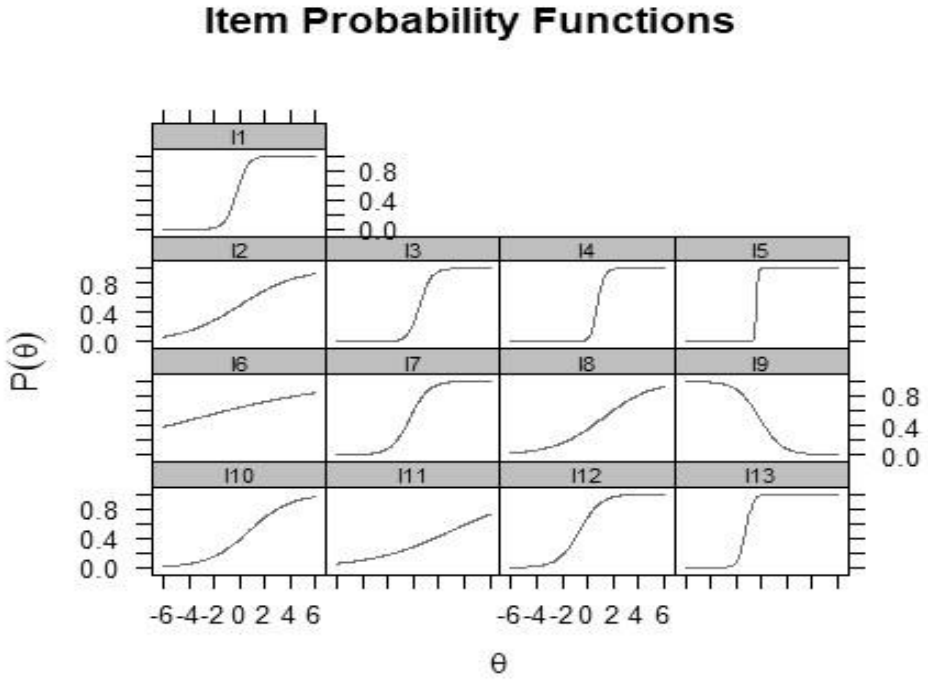
**Table 2. Discrimination parameters of tourism innovation items (items ordered from lowest to highest discrimination)**

| Discrimination indicators | $\beta_i$ |
|---|---|
| I9: Private sector participation in innovation projects | -1,123 |
| I6: Achieved objectives out of the total planned objectives in innovation | 0,180 |
| I11: Existence of business incubators | 0,316 |
| I2: Existence of a specific budget allocated for innovation | 0,432 |
| I8: Value of innovations based on resources (profitability) | 0,521 |
| I10: Tourism businesses created annually per 100000 inhabitants | 0,619 |
| I12: Generation of a Knowledge Database | 1,184 |
| I7: Implemented ideas that add value | 1,371 |
| I3: Existence of an innovation management unit in the destination | 2,197 |
| I1: Existence of a documented commitment to innovation | 2,229 |
| I13: Existence of tourism plans derived from competitive surveillance | 3,348 |
| I4: Existence of a systematic process of Technological Surveillance/Competitive Intelligence | 3,795 |
| I5: Existence of monitoring of innovation action management | 14,826 |

Source: Self-prepared based on the results obtained using the mirt library in R.

Combining the values of the difficulty and discrimination parameters of the 13 analyzed indicators, Figure 1 presents their item characteristic curves. In this figure, the effect of negative discrimination on the curve of indicator I9 is clearly visible, as well as the strong discrimination (slope of the curve) of indicators such as I5, I4, or I13, and the low discrimination of indicators such as I6, I11, or I2.

**Figure 1. Item Characteristic Curves of the innovation indicators of Extremaduran tourist destinations.**



In an attempt to prioritize the studied indicators to guide a strategy for improving innovation in the studied tourist destinations, Table 3 presents a double classification of these indicators according to whether they have high or low difficulty and negative, low positive, or high positive discrimination. As can be seen, there are two indicators that are not of interest for the destinations in the region: the participation of the private sector in innovation projects (I9) due to its negative discrimination, and the percentage of achieved objectives out of the total planned innovation objectives (I6) due to both its low difficulty and discrimination.

**Table 3. Classification of tourism innovation items based on their difficulty and discrimination parameters.**

| | Very low or low difficulty ($\alpha_i < 0$) | High or very high difficulty ($\alpha_i \geq 0$) |
|---|---|---|
| Negative discrimination ($\beta_i < 0$) | I9 | |
| Low positive discrimination ($0 \leq \beta_i < 1$) | I6 | I2 – I8 – I10 – I11 |
| High positive discrimination ($\beta_i \geq 1$) | I1 – I5 – I7 – I12 - 123 | I3 – I4 |

Source: Self-prepared based on the results obtained using the mirt library in R.

At the opposite end of this hierarchical classification are the indicators that have high difficulty and, at the same time, show high discrimination. These indicators are the existence of an innovation management unit at the destination (I3) and the existence of a systematic process of Technological Surveillance/Competitive Intelligence. Due to their properties in constructing a latent innovation scale, the efforts of the analyzed destinations should focus on meeting these two indicators, as they offer a clearer comparative advantage compared to other destinations (high difficulty) and allow for faster progress in this latent scale of tourism innovation (high discrimination).

**Table 4. Correlation between innovation indicators and the latent scale of tourism innovation ($\theta_j$) of Extremaduran destinations**

| Ítem | $\rho_{ij}$ | Ítem | $\rho_{ij}$ |
|---|---|---|---|
| I1 | 0,798 | I8 | 0,292 |
| I2 | 0,246 | I9 | -0,551 |
| I3 | 0,791 | I10 | 0,342 |
| I4 | 0,912 | I11 | 0,183 |
| I5 | 0,993 | I12 | 0,571 |
| I6 | 0,105 | I13 | 0,891 |
| I7 | 0,627 | | |
| Proportion of explained variance: 0,400 | | | |

Source: Self-prepared based on the results obtained using the mirt library in R.

On the other hand, Table 4 shows the correlation between the latent scale of tourism innovation constructed by estimating the 2PL logistic model and each of the indicators used for it. As observed, the indicator with negative discrimination (I9) is negatively correlated with the latent scale, indicating that destinations verifying this indicator would be (assuming the same response to the other indicators) in a worse position on the latent scale than those destinations that do not verify it. For this reason, it would be advisable to eliminate (or redefine) this indicator in constructing a latent innovation scale. On the other hand, it is also noted that the highest correlations are recorded in the indicators with the greatest discrimination capacity (indicators I4 and I5 have a correlation greater than 0.9 with the latent scale). Conversely, the least correlated indicators with the latent innovation scale are also those with, albeit positive, reduced discrimination value (indicators I6 and I11 have a correlation less than 0.2 with the latent scale). As a complement to the previous analysis, Table 5 ranks the 28 analyzed tourist destinations based on their position on the constructed latent innovation

scale. The value $\theta_j$ presented in this table represents the position of each destination on the latent scale, and since these values are ordered from highest to lowest, the hierarchy presented orders these destinations according to their innovative character. Thus, it is observed that two cities, Badajoz and Plasencia, lead the ranking of innovative destinations, to which the city of Cáceres should be added, which ranks sixth in the ranking. With the exception of the city of Mérida, it seems evident that tourism innovation in the studied region (Extremadura) is mainly located in its most populous cities. In this latent innovation scale, there are 16 destinations that are in the positive range of it ($\theta_j > 0$), while only 12 destinations are located in its negative range. Among these last destinations, the territories of ADERSUR and CEDER LA SERENA stand out, as they have the lowest tourism innovation in the region as a whole. Finally, it is also observed that tourist destinations in the province of Cáceres generally have a higher level of tourism innovation than destinations in the province of Badajoz. Thus, among the top 14 destinations in the region, there are 9 destinations in the province and only 5 in the province of Badajoz. Additionally, among the top 10 destinations, 7 of them are located in the province of Cáceres, while among the bottom 10 destinations, 8 of them are located in the province of Badajoz.

**Table 5. Level (capacity) of tourism innovation of Extremaduran tourist destinations (value of the latent trait of each destination) (B=Badajoz; C=Cáceres)**

| Destination | $\theta_j$ | Destination | $\theta_j$ |
|---|---|---|---|
| BADAJOZ (city) (B) | 1,403 | ADEME (C) | 0,078 |
| PLASENCIA (city) (C) | 1,398 | CEDER CÁPARRA (C) | 0,022 |
| DIVA (C) | 1,291 | ARJABOR (C) | -0,087 |
| CEDER ZAFRA RÍO BODIÓN (B) | 1,139 | ADISGATA (C) | -0,227 |
| ADISMONTA (C) | 0,987 | CEDECO TENTUDÍA (B) | -0,625 |
| CÁCERES (city) (C) | 0,929 | MÉRIDA (city) (B) | -0,730 |
| CAMPIÑA SUR (B) | 0,838 | ADIC HURDES (C) | -0,792 |
| APRODERVI (C) | 0,780 | ADEVAG (B) | -0,965 |
| ADICOVER (C) | 0,750 | SAN PEDRO-LOS BALDÍOS (B) | -0,977 |
| TAGUS (C) | 0,396 | FEDESIBA (B) | -1,013 |
| ADECOM-LÁCARA (B) | 0,328 | CEDER LA SIBERIA (B) | -1,038 |
| ADESVAL (C) | 0,317 | ADICOMT (C) | -1,166 |
| SOPRODEVAJE (C) | 0,214 | ADERSUR (B) | -1,538 |
| ADERCO (B) | 0,128 | CEDER LA SERENA (B) | -1,819 |

Source: Self-prepared based on the results obtained using the mirt library in R.

To conclude this results analysis, Table 6 presents the main goodness-of-fit indices of the IRT model estimated in this study, which has been used to estimate the parameters of difficulty and discrimination, as well as the latent value of tourism innovation. As observed, the logarithm of the likelihood function reaches a value of -200.27. From this, considering that the total number of estimated parameters was 26, we obtained an AIC value of 452.54, a BIC value of 487.18, and a SA-BIC value of 406.34.

**Table 6. Goodness-of-fit indices of the estimated IRT model**

| |
|---|
| - Logarithm of the likelihood function: -200,2689 |
| - Estimated parameters.: 26 |
| - AIC: 452,5377 |
| - BIC: 487,1750 |
| - SABIC: 406,3395 |

Source: Self-prepared based on the results obtained using the mirt library in R.

## 4. DISCUSSION AND CONCLUSIONS

Innovation emerges as a crucial axis within the STD model, understood from a dual perspective, encompassing both product and management innovation. According to various studies, innovation enhances the tourist experience, promotes sustainability, fosters collaboration among local stakeholders, and increases efficiency.

This study aims to critically evaluate the indicators proposed by the STD model to measure destination innovation, using the region of Extremadura as a case study. The results obtained have allowed us to identify that most indicators have a low level of difficulty and are present in the majority of the analyzed micro-destinations. Particularly noteworthy for its level of difficulty is the existence of business incubators indicator.

Regarding the improvement of this indicator, which represents the highest difficulty among all those proposed in the analyzed territory, the case study conducted by Gusavok et al. (2020) seems interesting. They concluded that collaboration between government and tourist destination businesses promotes the creation of incubators, which enhance tourism management by favoring digital transformation, digital business models, and open innovation platforms.

Furthermore, the results achieved by this study also confirm the effectiveness of the proposed indicators in measuring tourism intelligence. One identified indicator exhibits negative discrimination capacity, as demonstrated by the construction of the latent scale. This implies that destinations with a higher probability of complying with this indicator would worsen their position on the latent scale rather than improving it. This finding undoubtedly calls for an analysis of why this situation is occurring and a possible redefinition of the indicator if necessary, Bichy and Talib (2018).

To conclude the critical analysis of the indicators, it is worth noting that one of the main notable outcomes at the management level is the comparative analysis concerning the level of capacity and discrimination that allows for the ranking of the indicators. It is relevant to highlight that this analysis represents a novel contribution to the field of study, as it has not been addressed previously in the existing literature. Indeed, this analysis identifies which indicators are most important on the analyzed axis, focusing managers' attention on them with the ultimate goal of improving destination intelligence in terms of innovation. In this case, it is evident that, considering the level of difficulty and discrimination capacity, the existence of an innovation management unit in the destination and a systematic process of Technological Surveillance/Competitive Intelligence are the most interesting indicators to improve to achieve a substantial improvement in tourism intelligence. Therefore, this critical assessment represents a valuable tool for destination management.

Finally, based on the results obtained regarding the second objective pursued, a ranking of the territories has been carried out, allowing the identification of which destinations make the greatest advances in innovation and providing a relative measure of the distance between each of them. This scale, while identifying the best and worst-positioned micro-destinations in terms of innovation, also identifies the leading territories, enabling benchmarking practices.

As stated in the introduction, this article is conceived as a case study to generate knowledge through a critical evaluation of the indicators proposed by SEGITTUR, applied to a destination of interest. For this purpose, and as a future line of research, it would be interesting to replicate this study in other inland destinations to generalize the results. Furthermore, replicating the study in destinations with other tourism models would be valuable to identify differentiating characteristics inherent to each tourism model.

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