Which destination is smarter? Application of the (SA)^6 framework to establish a ranking of smart tourist destinations

¿Qué destino es más inteligente? Aplicación del marco (SA)^6 para establecer un ranking de destinos turísticos inteligentes

Asunción Huertas[1], Antonio Moreno[1], Tran Ha My[1]

[1] Universitat Rovira i Virgili, Spain

sunsi.huertas@urv.cat , antonio.moreno@urv.cat , hamytran@urv.cat

ABSTRACT. Nowadays destinations implement new technologies in order to be smart and to generate satisfactory experiences to tourists, but it is difficult to evaluate and compare their degree of smartness. In this study the (SA)6 framework has been used to evaluate the smartness of destinations and to create a ranking of smart tourist destinations. The (SA)6 model comprises 6 main dimensions of analysis and 57 indicators. The weights of each indicator have been determined by using the Analytic Hierarchy Process (AHP) and the values of each destination are aggregated into a single score by applying the Weighted Ordered Weighted Averaging operator (WOWA). The selected case studies for the analysis are 5 Spanish destinations with different characteristics and levels of smartness. The (SA)6 framework has been shown useful for the analysis of specific aspects of smartness and for the creation of a ranking between destinations.

RESUMEN. En la actualidad los destinos implementan las nuevas tecnologías con el objetivo de ser inteligentes y generar experiencias satisfactorias a los turistas, pero es difícil evaluar y comparar su grado de inteligencia. En este estudio se ha aplicado la metodología (SA)6 para evaluar la inteligencia de los destinos y crear un ranking de destinos turísticos inteligentes. El modelo (SA)6 comprende 6 dimensiones de análisis y 57 indicadores. Los pesos de cada indicador se han establecido a través del Proceso Analítico Jerárquico (AHP) y los valores de cada destino se han agregado en una puntuación única por la aplicación de la Media Ponderada Ordenada con Pesos (WOWA). Los casos de estudio seleccionados para el análisis son 5 destinos turísticos españoles con diferentes características y niveles de inteligencia. Se ha demostrado que la metodología (SA)6 es útil para el análisis de específicos aspectos de inteligencia y para la creación de un ranking de destinos inteligentes.

KEYWORDS: Smart tourism destinations, Smartness, Ranking, New technologies, DMOs, Multi-criteria decision making.

PALABRAS CLAVE: Destinos turísticos inteligentes, Inteligencia, Ranking, Nuevas tecnologías, OMDs, Procesos de decisión multi-criterio.

1. Introduction

The evolution of new technologies in the last years has modified the way in which tourists search and share information (Del Chiappa & Baggio, 2015; Wang, Li & Li, 2013). This fast development of Information and Communication Technologies (ICTs) has provoked many changes in the behaviour of tourists. The huge increase of distribution channels (Buhalis & Amaranggana, 2013) and communication platforms (Gretzel, Koo, Sigala & Xiang, 2015) has provided tourists with new ways of obtaining information about the destinations and organizing their trips (Gretzel, 2011; Wang, Li & Li, 2013; Del Chiappa & Baggio, 2015). In this context, destinations are adapting to these new technologies in order to satisfy new travellers' needs (Gretzel, Sigala, Xiang & Koo, 2015). The concept of Smart Tourist Destinations (STDs) has appeared as a strategic tool for destinations to communicate interactively with tourists and to enhance a satisfactory tourism experience (Lamsfus & Alzua-Sorzabal, 2013; Boes, Buhalis & Inversini, 2015; Hyun, Lee & Hu, 2009; Sotiriadis, 2017).

The concept of STD is usually based on the main features of Smart Cities (SCs), such as smart economy, smart environment or smart mobility (Buhalis & Amaranggana, 2013; Gretzel, Sigala, Xiang & Koo, 2015). Lamsfus and Alzua-Sorabal (2013) argued that STD is a term which indicates a place where Destination Management Organisations (DMOs), local institutions, and separate tourism entities co-operate and take actions together using big data gathered in the destination. Smart destinations are integrating technological infrastructures and end-user devices with the aim of achieving a more satisfying tourist experience (Buhalis & Amaranggana, 2014; 2015). Moreover, with the spread of smartphones, tourists can obtain information from DMOs or from other users in real time (Huertas, 2018), achieving more satisfactory tourist experiences and the co-creation of tourism experiences (Buonincontri & Micera, 2016).

Despite the existence of numerous smart city rankings, the current scientific literature has not yet created any structured ranking framework for STDs. One of the aims of this study is to propose a ranking framework, called (SA)6, that may be used to analyse the smart development of destinations and also as a guideline for the destinations who want to become STDs. (SA)6 is a comprehensive framework which includes and measures a wide range of indicators that define STDs. As described in this paper, the ranking methodology includes the application of complex decision-aid tools like the Analytic Hierarchy Process (AHP) (Saaty, 1980) and the Weighted Ordered Weighted Aggregation operator (WOWA) (Torra, 1997).

In this paper the proposed methodology has been applied to a case study of five Spanish destinations with different characteristics. Three of them are emerging STDs, included in the list of Smart Destinations in the Spanish Integral National Plan for Tourism 2012-2015: Haro, El Hierro and La Gomera. One of them, Valencia, is a big city that has developed a Smart Tourism Destination Plan. The last one is a small destination, which is working heavily in the development of smart tools: La Pineda (Tarragona).

The reminder of the paper is structured as follows. The following section describes briefly the state of the art on the definition and ranking of STDs. After that the (SA)6 framework is summarily described and it is explained in detail how AHP may be used the determine the weights of the ranking indicators and how the WOWA operator may be used to analyse all the data of a destination and obtain a global assessment. Finally, the case study is presented and some conclusions are reached.

2. Related work

In the existent literature many authors (Boes, Buhalis & Inversini, 2015; Gretzel, Koo, Sigala & Xiang, 2015, Gretzel, Sigala, Xiang & Koo, 2015; Li, Hu, Huang & Duan, 2017; Vasavada & Padhiyar, 2016) have highlighted the fundamental role of ICTs in STDs. Boes, Buhalis and Inversini (2015) considered that the core elements of STDs are the integration of ICTs into the physical infrastructure, the use of sensors and smartphones, big data, technology-mediated co-creation, and public-private collaboration. Buhalis and Amaranggana (2013) specified five deeply interrelated stakeholders in a STD, including tourism organisations, governments, local residents/local communities, tourists, and environment.

Gretzel, Sigala, Xiang and Koo (2015) argued that STDs are a special case of smart cities that not only consider residents but also tourists in their efforts to support mobility, resource availability and allocation, sustainability and quality of life/visits. Li, Hu, Huang and Duan (2017) stated that smart tourism is the typical example of integrated development by combining tourism industry with technological innovations. Smart technologies such as decision support systems, recommender systems, context-aware systems and augmented reality systems help tourists to anticipate their needs, to make decisions and to improve their touristic experiences (Borràs, Moreno & Valls, 2014; Moreno, Valls, Isern, Marin & Borràs, 2013). STDs should collect large amounts of dynamic and heterogeneous data (Big Data) and analyse it in order to improve their tourist services (Gretzel, Sigala, Xiang & Koo, 2015).

The Smart Destination Report of Segittur (2015) presents a Spanish approach to the concept and implications of STD. The report offers a practical guide on how to become a smart destination, with a model based in four indicators: technology, innovation, accessibility and sustainability. This methodology has been applied in a study of three Spanish destinations (Femenia-Serra & Perea-Medina, 2016). However, some authors (Lamsfus, Martin, Alzua-Sorzabal & Torres-Manzanera, 2015) affirm that a destination is not smart because it makes intensive use of technology, but because it uses this technology to understand and facilitate human mobility. Moreover, smart technologies such as decision support systems, recommender systems, context-aware systems and augmented reality systems help tourists to anticipate the user's needs, to make real-time decisions (Boes, Buhalis & Inversini, 2016) and to improve their touristic experiences (Borràs, Moreno & Valls, 2014; Moreno, Valls, Isern, Marin & Borràs, 2013).

The competitiveness of cities (and destinations) has increasingly been a cross-cutting topic in recent decades. Consequently, city rankings have become a central instrument for assessing the attractiveness of urban regions (Anholt, 2006; Giffinger & Gudrun, 2010). The research platform IESE Cities in Motion Strategies (belonging to IESE Business School) produces also an annual rating of the smart cities in the World. In these kinds of comparative studies (Anholt, 2006; Giffinger, Fertner, Kramar & Meijers, 2007) cities are evaluated and ranked by different economic, social and geographical characteristics in order to reveal the best places for certain activities. Similarly, a destination ranking system should aim to analyse the performance of the destination as a useful instrument for strategic planning. Although there are many structured city ranking frameworks, there does not yet exist any comprehensive ranking method for smart destinations. Since cities and destinations are different entities in terms of geographical boundary, objectives, operating board, and priorities, a city ranking system may not fit to evaluate the smartness of a destination and, hence, it is necessary to build a specific ranking system for smart destinations.

3. Methodology: definition and application of a ranking model for STDs

In a recent previous work (Hà My, Huertas & Moreno, 2017) we defined a novel ranking model for STDs, which extends previous works by Buhalis (Buhalis, 2000). This section makes a brief presentation of this model and describes in detail how it should be applied. The interested reader may find more details in (Hà My, Huertas & Moreno, 2017). In this section first the (SA)6 hierarchical model is described, and then it is explained how to obtain the weight of each of the indicators in the hierarchy. After that, it is described how to aggregate all the values of each destination to obtain a global score, so that the destinations can be ranked.

3.1. (SA)^6: smart dimensions of analysis

(SA)6 is a novel framework for the analysis of STDs that comprises six sets of indicators, derived from the introduction of a "smart" (S) component in each of the six A-dimensions of a successful destination: attractions, accessibility, amenities, available packages, activities and ancillary services (Buhalis, 2000). These dimensions were considered as the keys to the marketing success of a destination, and they have been adopted by many other authors in Tourism research. Gretzel mentioned that STDs build on smart services in their provision of attractions, accessibility, amenities, packages, activities and ancillary tourism services (Gretzel, Sigala, Xiang & Koo, 2015). In another article, Buhalis referred again to this 6As when identifying a tourism destination (Buhalis & Amaranggana, 2013). Tooman (2013) stated that, from the marketing perspective, the 6As are the

core components which most destinations aim to include. In the (SA)6 framework each dimension of smartness for tourism destinations has a certain number of associated indicators (57 in total): smart attractions (7), smart accessibility (20), smart amenities (7), smart ancillary services (12), smart activities (5) and smart packages (6). These indicators are arranged in a hierarchy, as shown in Figure 1. All of them are Boolean (yes/no) or 5-valued (very high/high/medium/low/very low).
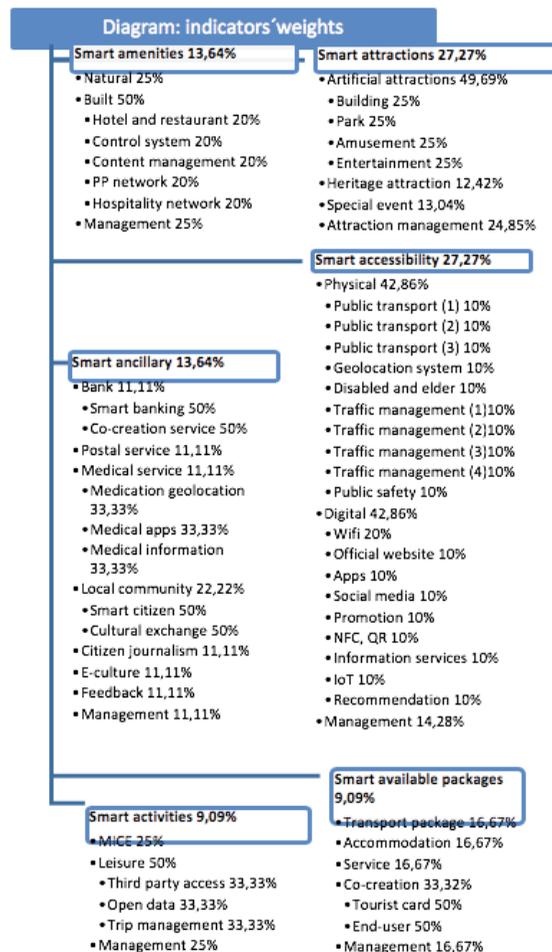

Figure 1. Hierarchy of indicators considered in the (SA)6 ranking model. Source: Self made.

3.2. Relative weight of each indicator

The first task in the application of the (SA)6 framework is the definition of the relevance of each indicator (with respect to its parent in the hierarchy). For example, the Smart Amenities dimension is divided in three categories (Natural, Built and Management); thus, the weights of these three categories must be defined. Moreover, the Built category is divided into five sub-categories, so their five weights must also be considered. At the top level of the hierarchy the relative weight of each of the six dimensions must also be defined. Thus, there is a total of 72 weights to be defined, as seen in Figure 1.

It would be very complex for the user to define all these weights manually. Thus, we propose to use the Analytic Hierarchy Process (AHP), developed by Saaty (Saaty, 1980), to support the user in this process. AHP, one of the most popular and powerful tools for the analysis of complex Multi-Criteria Decision Making (MCDM) problems, can be used to identify the relevance of different factors that are arranged in a hierarchy.

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For each node in the hierarchy that is not a leaf the user must fill a pairwise (k*k) comparison matrix A of the node's k children. The values in the matrix (a_{ij}) are integers between 1 and 5, where 1 means that the i-th and the j-th element are equally important, and 5 means that the i-th is absolutely more important than the j-th. The children's vector of weights v is calculated as the normalised right eigenvector associated to the largest eigenvalue of the matrix.

As shown in figure 1, it was necessary to fill 1 global matrix for the 6 main dimensions and 1 small matrix for each dimension. In the case of subcategories the weight was equally distributed among its children. Figure 1 shows the final weight given to each node in the hierarchy, after we provided specific values for the comparison matrices. This mechanism is very flexible, as another user could decide to make the comparison assigning different weights to the dimensions or to the basic indicators.

3.3. Determining the global score of each STD

In order to rank a set of STDs first it is necessary to provide values in a common scale for the 57 Boolean and categorical indicators for each destination. The aim is to merge somehow the 57 values of each destination to get its global score, which is then used to rank the destinations.

The scientists working on MCDM have defined many different aggregation operators. In our framework we propose to use the Weighted Ordered Weighted Averaging (WOWA) operator (Torra, 1997). This operator permits, on the one hand, to assign a weight to each of the values to be aggregated (as we have done in the case of the STD indicators) and, on the other hand, to define different aggregation policies (so that the decision maker can use the most appropriate one for the problem at hand). The WOWA aggregation of a vector v of k values (K={1,2,…,k}) is defined as follows:

$$WOWA(v) = \sum_{j \in K} \omega_j v'_j$$

The vector v' contains the same values than the vector v to be aggregated, but ordered in a descendent way, so that $v'_1 \geq \ldots \geq v'_k$. The components of the weighting vector ω_j are defined as follows:

$$\omega_j = g\left(\sum_{i \leq j} p_i\right) - g\left(\sum_{i < j} p_i\right)$$

In this expression the vector p contains the weights of the indicators associated to the values to be aggregated, and g is a monotone increasing function on the [0,1] interval, which defines the aggregation policy. One way to define this function is to use a particular value α in the following generating function (Kasperski & Zielinski, 2016):

$$g_\alpha(x) = \frac{1}{1 - \alpha}(1 - \alpha^x)$$

The smaller the value of α, the bigger will be the contribution of the higher values of v (so, with a small α, a destination that has good scores in a small percentage of indicators may obtain a high global score; on the contrary, with a higher α, a destination will only achieve a high global score if it has high scores in the majority of indicators). As an example, the following table shows the values of the weighting vector ω if we want to aggregate 7 values that have the same weights (i.e. all the values in p are 1/7), depending on the value of α. (Table 1).

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α	Weights ω
0.1	[0.311, 0.224, 0.161, 0.116, 0.084, 0.060, 0.043]
0.3	[0.226, 0.190, 0.160, 0.135, 0.113, 0.096, 0.080]
0.5	[0.189, 0.171, 0.155, 0.140, 0.127, 0.115, 0.104]

Table 1. Vectors of weights for the aggregation of 7 values for different α. Source: Self made.

4. Case study: five Spanish smart destinations

4.1. Presentation of the destinations of the case study

The aim of the case study was to include destinations of different sizes and with different degrees of development of their "smartness" to evaluate their current technological implementations and the differences in their approaches towards becoming a STD. This is why we analysed three emergent smart tourist destinations that have already completed the first phase towards the development to STDs according to the Spanish National Integral Tourism Plan 2012-2015 (El Hierro, Haro and La Gomera), as well as Valencia (a big and established smart destination) and La Pineda (a small destination in Tarragona not recognised as a smart). Each destination is briefly commented in this section.

El Hierro - It is known as Isla del Meridiano (the "Meridian Island"). It is the smallest of the Canary Islands, with a population just over ten thousand people (2015). According to the action plan 2012, El Hierro will be the first Smart Island of the world, following two main pillars: application of new ICTs, and sustainable development in environmental, social and economic aspects. El Hierro has positioned itself as a world reference in energy development, starting up with the first hydroeolic plant of the world, making the island self-sustaining from the energy standpoint. Since 2013 the island offers 26 access points to a free WiFi network, which gives coverage to the entire territory. Concerning the tourism activities, the island has developed a strategy for encouraging visitors to share their experience at the destination. Moreover, the Island has deployed sensors and surveillance cameras in order to provide information to tourists, allowing them to take real-time decisions about the weather, water level, and so on.

Haro – Haro is a city of around 12,000 inhabitants located in La Rioja, which presents itself as the "Capital de la Rioja" (the "Rioja Capital"), due to its important wine industry and its associated enotourism activities. The Statal Society for the Management of Innovation and Tourism Technologies (SEGITTUR) and the Ministry of Energy, Tourism and Digital Agenda are developing joint actions to make Haro an "Intelligent Tourist Destination" in various areas, such as the development of e-commerce platforms to buy products from Rioja through Internet. They also plan marketing, promotion and dissemination actions on the main social networks (Facebook and Twitter), the creation of a virtual reservation centre for ticket sales and the implementation of LED systems and urban screens that improve the signage of the most visited places. Moreover, they intend to develop an application for mobile devices based on augmented reality and geolocation which will support the tourist in the discovery of routes and points of interest, especially those linked to industrial tourism. Another proposal is a "video mapping", that will project images in the architectural monuments, obtaining 3D movement effects.

La Gomera - It is also one of the Canary Islands. With an area of 369.76 square kilometres, it is the second smallest of the seven main islands in this archipelago. La Gomera possesses a pristine ecosystem and unique ecology. The uppermost slopes of the ravines (barrancos) are covered by the laurel forest (laurisilva), where up to 50 inches of precipitation fall each year. They form the protected environment of Spain's Garajonay National Park, which was declared a UNESCO World Heritage Site in 1986. The island is on the list of "ten up-to-be Spanish smart destinations" released by SEGITTUR.

Valencia - It is the third biggest city of Spain (almost 800,000 inhabitants in 2017). It is one of the founders of the Spanish network for Smart Cities and it also belongs to the Euro Mediterranean network of sustainable cities. The city has already developed a Smart Tourism Destination plan and it has been chosen by the European Comission to run for European Capital of Smart Tourism in 2019. Its strategy is based on smart growth (knowledge and innovation), sustainable growth (with the effective use of resources) and inclusive growth (high level of employment, delivering social and territorial cohesion). Its Smart City plan, which also has a Smart Destination component, is being translated into specific actions like free wi-fi access at tourist attractions in the city centre, the upgrading of infrastructure and public transport, and quick and flexible connectivity with other cities.

La Pineda (Tarragona) - It is a small town of just over three throusand inhabitants in Southern Catalonia, on the Mediterranean coast. It belongs to the municipality of Vila-seca, which offers important leisure attractions that include two of the biggest thematic parks in Europe (Port Aventura and Ferrari Land), aquatic parks and the Natural Park ¨Serra del Montsant¨. Although La Pineda was not included in the Spanish national smart destination plan, it is certainly taking numerous actions related to the deployment of new technologies and to the enhancement of local tourism activities.

4.2. Matrix with the data of the indicators for each destination

The data of this case study was collected by using two channels. First, a specific survey was sent to the DMOs of the selected destinations. This questionnaire included 57 yes-no questions and a grade from 1 to 5 for each of them. The interviewees had to write a confirmation (yes/no) and a grade for each question.

After that, a detailed face to face interview with the tourism managers was intended. Due to distance constraints, it was only possible to make the interviews in the cases of Valencia and La Pineda. In order to complete the information of all the destinations, secondary data sources were used, including governmental reports on tourism policies and regional statistics, and information of official tourism websites.

4.3. Ranking of the destinations

In this section we present the results of the application of the WOWA-based ranking procedure on the data obtained for each destination. By applying the mechanism explained in the previous section we obtain a global score for each destination. We first present the global results, and then we make an individual analysis of the six dimensions of analysis of the (SA)6 model.

The final value of the aggregation procedure depends on the parameter α defined in section 3.3. We have tested the values 0.1, 0.3, 0.5, 0.7 and 0.9 in this case study, and the relative ordering between destinations does not change in this particular problem. Thus, in the following section we present the results for the case in which α takes the value 0.1.

Figure 2 shows the results of the WOWA-based aggregation of the scores of the destinations for each of the six main dimensions of analysis (Attractions, Accessibility, Amenities, Ancillary Services, Activities and Packages) and also the global result.
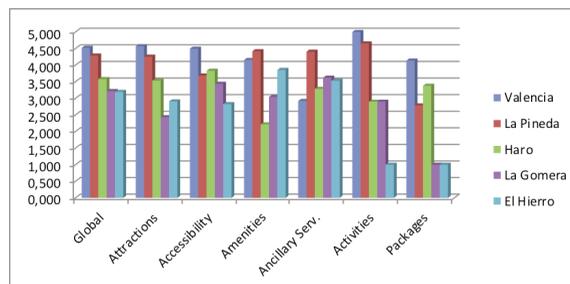

Figure 2. Results of the case study. Source: Self made.

Global smartness

All the analysed destinations have high smartness scores, although there are significant differences between them. It may be seen that Valencia occupies the first position. It is the destination with more smart elements, because it is the third largest destination in Spain with a great difference in size and number of inhabitants with respect to the other ones. Therefore, it has more resources of all kinds at its disposal for the introduction of new technologies and the application of smart features. Moreover, it is one of the founders of the Spanish network for Smart Cities and it has been implementing smart technologies in its territory for years. What is surprising is that La Pineda, a small coastal destination with only 3,000 inhabitants (much less than those of the rest of the destinations), that has few resources and has never been considered a smart destination, occupies the second position in the ranking of smart destinations. The following paragraphs analyse individually each of the dimensions of smartness.

Smart attractions

In smart attractions Valencia and La Pineda occupy the first positions with high scores. Valencia has smart attractions like the City of Arts and Sciences, the Oceanographic or the Imax cinema, and La Pineda has huge thematic parks (Port Aventura and Ferrari Land) and aquatic parks, and all of them use new technologies and smart management. Haro has wine cellars and El Hierro offers Spa and Wellness attractions, but La Gomera lacks smart attractions with smart management or managed in a participative and collaborative way.

Smart accessibility

Valencia occupies again the first position in Smart Accessibility because it can invest more capital to have a good accessibility infrastructure. Haro is above La Pineda because of its good public transport connections. La Pineda is a coastal destination with a very seasonal demand and out of season few people live there and public transport decreases. Haro also performs a good management of its social media and it offers free wi-fi in public spots. In this dimension El Hierro is the destination with lower scores.

Smart amenities

For this variable La Pineda is in the first position, followed closely by Valencia and El Hierro. Although Valencia has high scores for almost all the índicators of this dimension, La Pineda leads in natural amenities and in the creation of innovative public-private networks, in which La Gomera also shines. Thus, it seems that it is easier for medium and small destinations to create public-private networks for the management of the destination, with the exception of Haro (which only has natural amenities and CRM in hotels and restaurants management).

Smart ancillary services

La Pineda has high scores in this dimension, with a big difference with respect to the other ones. It is followed by the three medium-sized emerging destinations, while Valencia is the last one. La Pineda has mobile banking service information, geolocation of nearby 24h chemists and it has even created a program for travellers to meet local residents and businesses, among others. La Gomera, in second position, has smart banking, mobile information of postal services and complaints management.

Smart activities

This is the dimension with bigger differences in the scores. Valencia has very high scores in all the indicators, followed at a short distance by La Pineda. Haro and La Gomera share the third position while El Hierro, with low scores in all indicators, is at a great distance from the rest. Valencia and La Pineda stand out in creating and hosting meetings, conferences, exhibitions and leisure activities with an efficient and smart

management. In the case of La Pineda it is due to the fact that it is a coastal destination with a high seasonal demand, so it is very active the rest of the year organizing events to reduce this seasonal effect.

Smart available packages

Three destinations obtain high scores in this dimension: Valencia, Haro and La Pineda. Valencia has mobile applications which offer available accommodation packages with on-line reservation, multi-lingual apps, smart tourist cards and end-user smart management, among others. Haro also has smart tourist cards and multi-lingual apps. Unfortunately, La Gomera and El Hierro do not score in any indicator of this dimension.

5. Conclusions and future work

The study has shown that the (SA)6 framework, which is based on a model of successful tourism destinations, may be applied to the analysis of smart tourism destinations. The proposed framework of analysis can evaluate the smartness development of a destination to the degree of detail of its practical applications. This is one of the main contributions of this paper because up to now the existing frameworks of analysis (Buhalis & Amaranggana, 2013; Lamsfus & Alzua-Sorzabal, 2013) collected only the main characteristics or dimensions of the STDs, but not all the possible applications. The framework is very flexible because the user may provide different weights to the indicators and define different aggregation policies.

The case study, in which the framework has been tested on five destinations, shows that it is useful for the analysis of destinations with very different characteristics and resources, regardless of their smartness. It also allows creating a ranking of smart destinations taking into account the different dimensions of smartness.

Despite it seems that technology has a high cost and smart development is only accessible to big destinations with many resources, the study shows that small destinations can also develop smart actions with few resources, such as a good management of social media or tourism management with the collaboration of public and private stakeholders. Destinations with less resources are limited in the development of smart infrastructures, a powerful transport network or free wi-fi in all the destination, because it is expensive. However, big destinations with many resources have more difficulties in achieving the collaboration among all the tourism stakeholders.

This framework of analysis and the ranking of smart destinations will be useful for destination managers, to evaluate their smartness development, and also for academics in the Smart Destination field, as it provides a guide towards the concrete indicators to be measured in the destination to achieve smartness. Moreover, the proposed methodology could also be applied to create a national ranking of STDs.

However, the study has some limitations. The main one is that the (SA)6 framework is based on the six A-dimensions of a successful destination (Buhalis, 2000), and some key indicators (such as sustainability) do not play a prominent role. It is also worth mentioning that it is not easy to obtain all the data required to evaluate all the indicators defined in our model. In our case study it was hard to obtain most of the information, so it could be the case that some efforts of the studied destinations were not properly considered.

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