Journal of Cleaner Production 236 (2019) 117487

Contents lists available at ScienceDirect

Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro

# A socio-technical approach to the assessment of sustainable tourism: Adding value with a comprehensive process-oriented framework

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ARTICLE INFO

*Article history:*
Received 3 March 2019
Received in revised form
27 June 2019
Accepted 28 June 2019
Available online 1 July 2019

Handling Editor: Cecilia Maria Villas Bôas de Almeida

*Keywords:*
Tourism
Sustainability
Sustainable tourism
Cognitive mapping
Choquet integral

ABSTRACT

Despite the increasing interest in sustainable tourism (ST), the actual implementation of sustainability practices within the tourism sector remains sporadic. Performance evaluation has emerged as a viable solution for this problem, but no universal ST assessment model has yet been developed for this purpose. Various authors have proposed different approaches, but these still exhibit limitations, especially regarding criteria selection and weighting. This study sought to create an assessment system for ST by combining cognitive mapping and the Choquet integral (CI), providing a rational, transparent foundation for the selection and weighting of evaluation criteria. The development of the proposed assessment system involved group meetings with a panel of ST experts, as well as a final validation session with a senior representative of the Portuguese Tourism Confederation. The results of a practical application of the system developed show that its process-oriented nature facilitates the ranking of tourism regions according to their degree of sustainability (*i.e.*, Lisbon and Tagus Valley is the Portuguese tourism region with the most ST, whereas Alentejo comes last compared to the other alternatives). No prior research was found that has applied cognitive mapping and the CI in this study context, and new insights into ST can be obtained through an analysis of the cause-and-effect relationships between evaluation criteria. The contributions and implications of the proposed system are also discussed.



## 1. Introduction

Since the mid-twentieth century, the tourism sector has been thriving, set on a trajectory of fast-pace growth on a global scale without showing any signs of deceleration (cf. Smith and Eadington, 1992; World Travel and Tourism Council, 2017). This trend has put excessive pressure on tourism destinations and their resources, which can lead to a gradual deterioration that subsequently compromises their touristic appeal and even these destinations' very existence (Liu, 2003; Michalena et al., 2009; Torres-Delgado and Palomeque, 2014; Carayannis et al., 2018). Developed as a response to this problem, the incorporation of sustainability policies into the strategic planning of tourism activities and entities has become increasingly necessary.

Although a universally accepted definition has not yet been developed for the concepts of sustainability and sustainable development (Fernandes et al., 2018; Govindan et al., 2018), these are hot topics in today's economic activity (cf. Dobrovolskienė et al., 2017; Kannan, 2018), requiring sustainable integrated business networks that enforce decision makers to consider, simultaneously, economic, social and environmental aspects in their decision-making processes (Darbari et al., 2019; Shankar et al., 2017; Li et al., 2018). This means that, in the context of the triple bottom line (*i.e.*, economic equity, environmental preservation and social justice), the main notions behind the idea of sustainable development, as a long-term process of continuous improvement, rely on individuals' ability to act whilst being fully conscious of the impacts of their actions, to ensure the needs of both present and future

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https://doi.org/10.1016/j.jclepro.2019.06.318
0959-6526/

generations can be met (cf. World Commission on Environment and Development, 1987; Ko, 2005).

Kernel (2005) argues that evaluating sustainable tourism (ST) is a challenging endeavor mainly because of its multi-dimensional nature and multi-stakeholder environment, which often involves conflicting interests, thus making ST evaluation a complex decision problem. Indeed, ST has a significant impact on a wide range of different stakeholders – governments and societies included – and one should bear in mind that these stakeholders' perceptions often conflict, for instance, when budget restrictions negatively affect a region's desirable environmental conduct. Given this context, a comprehensive, integrative approach to ST assessment is required and should be a welcome addition to current ST assessment practices.

According to Budeanu et al. (2015), researchers need to explore new methodologies within ST contexts to overcome specific limitations and contribute to advances in this field. Specifically, the current practices used to evaluate ST regions still display limitations in how these assessment models identify the criteria to be incorporated in evaluation mechanisms (cf. Carayannis et al., 2018). Another issue is the calculation of trade-offs between decision criteria, which remains unclear due to the lack of knowledge on the cause-and-effect relationships between criteria and ST dimensions (cf. Franzoni, 2015; Pérez-Gálvez et al., 2017; Reis et al., 2019). In this context, the following questions require an answer:

- How can ST regions be assessed?
- What qualitative and quantitative criteria and metrics can be used to do so, and how can their cause-and-effect relationships be analyzed?
- How can a synthetic indicator of tourism sustainability be obtained?

The present study, therefore, sought to create an assessment model for ST by applying multiple criteria decision analysis (MCDA) methods, whose main purpose is to identify explicitly the relevant criteria and integrate them into decision-making processes (Belton and Stewart, 2010).

This choice of methodologies was based on MCDA's ability to deal with highly complex decision problems, which usually involve multiple stakeholders with conflicting perspectives – as appears to be the case with ST. Within the MCDA approach, cognitive mapping techniques were selected in order to structure the decision problem at hand and identify the key evaluation criteria for ST assessment. The Choquet integral (CI) was also used as a non-additive aggregation operator to measure criteria interaction and then calculate global scores for selected alternatives (*i.e.*, Portugal's tourism regions and/or destinations). By modeling the criteria's interactions, this method identified possible synergetic effects between subsets of criteria.

The potential benefits of using MCDA in ST contexts have already been reported in the literature (cf. Munda, 2005), including a few practical applications (*e.g.*, García-Melón et al., 2012; Aminu et al., 2013). However, a review of the literature revealed no prior use of the above-mentioned combination of methods regarding this specific topic. By using this dual methodology, we were able to bring added realism into the ST evaluation framework, as the use of cognitive mapping brought new insights to the evaluation processes based on experts' know-how, which would not have been detected through the use statistical methods alone. The CI, in turn, allowed for the modeling of the interdependencies between criteria, resulting in the design of a transparent, simple and well-informed system, comprising both objective and subjective components. We believe that these two methods' integrated use is a novel proposal in the field of ST assessment, reinforcing the interest of the management science/operational research (MS/OR) approach in sustainability-related fields.

The next section provides a brief overview of the relevant literature. Section three presents the methodology. The fourth section presents the model building and analyses and validates the results of its practical application. The last section concludes the paper with a discussion of the study's main implications, which offer opportunities for further research.

## 2. Literature review and research GAP

The United Nations World Tourism Organization (UNWTO) (2005: 11) defines ST as "*tourism that takes full account of its current and future economic, social and environmental impacts, addressing the needs of visitors, the industry, the environment and host communities*". This conceptualization of ST embodies the above-mentioned notion of sustainability, clearly stating that the concept of ST seeks to apply the ideal of sustainability to the development of tourism-related activities. Notwithstanding the growing concern regarding tourism's negative impacts, the actual implementation of sustainable practices in the sector has been quite slow (Lansing and De Vries, 2007; Simão and Partidário, 2012; Torres-Delgado and Palomeque, 2014; Mihalic, 2016; Atsalakis et al., 2018). Most of the concern displayed regarding this issue exists only at a superficial level, creating a gap between affirmations and real practices.

Following this, many authors appear to agree that any potential solution to this problem depends on the development of tools for evaluating sustainability in tourism contexts (Liu, 2003; Munda, 2005; Torres-Delgado and Palomeque, 2014; Carayannis et al., 2018). In this sense, given the importance of assessing sustainability levels within tourism contexts, researchers' interest in this topic has increased in recent years. As a result, several proposals have appeared in the literature related to ST monitoring and assessment (cf. Torres-Delgado and Saarinen, 2014; Franzoni, 2015), mostly offering sets of indicators or index systems obtained through different methodologies and applied in different contexts. As pointed out by Torres-Delgado and Saarinen (2014) and Franzoni (2015), various authors have sought to develop assessment parameters that facilitate the operationalization of ST principles.

One should bear in mind, however, that the literature does not offer a universally accepted process and/or model of ST assessment (Kozic and Mikulic, 2014), and the existing proposals have failed to provide an adequate analysis of the evolution of sustainability practices. In addition, comparisons are still needed between ST in alternative contexts (*e.g.*, tourism regions and/or destinations) (Fernández and Rivero, 2009; Mihalic, 2016).

Agyeiwaah et al. (2017) argue that the tourism sector currently suffers from an excessive number of options in terms of sustainability performance indicators. Various methodological limitations to current ST assessment systems also have been widely verified, especially regarding the selection and aggregation of evaluation criteria, as well as the weighting method used (cf. Carayannis et al., 2018). This means decision makers tend to adhere solely to the most convenient ones due to the overwhelming volume of choices. This, in turn, has contributed to a propensity to establish core topics that are vaguely understood but applicable to many settings, leaving room for specific indicators to be set for each context (cf. Twining-Ward and Butler, 2002; Agyeiwaah et al., 2017). In view of the conflicting approaches available, assessing ST has emerged as an overly complex endeavor, which has prompted researchers to call for the identification of common, objective dimensions that permit comparative analyses and a standardization of procedures (Fernández and Rivero, 2009; Torres-Delgado and Saarinen, 2014).

Miller and Twining-Ward (2005: 16) also point out the need for a constant revision of assessment models and their respective evaluation criteria. The "*evolutionary nature of sustainable development* [… means] *policies and actions need to be continually modified and adapted to evolving conditions*".

In line with these arguments, Twining-Ward and Butler (2002), Pérez-Gálvez et al. (2017) and Kapera (2018) contend that the ST assessment process, instead of merely identifying indicators, needs to focus on three tasks. The first is to clarify the meaning of the sustainable development of tourism activities in given contexts. The second task is to select technically effective indicators whose application is feasible and attractive to decision makers. The last is to guarantee that the obtained information is comprehensible and act accordingly, as well as scheduling regular revisions and adjustments to the evaluation model to ensure it remains relevant.

A significant milestone in the field of ST assessment was UNWTO's (1993) development of a set of indicators, which had an international scope and which were meant to support tourism organizations' decision-making processes. However, this model attracted some criticism that drew attention to various important issues such as the absence of stakeholders during the model's development process and the lack of transparent reasoning regarding the selection of indicators. In addition, critics pointed out the need for a bridge between the information provided by the indicators and any managerial implications (Twining-Ward and Butler, 2002). The UNTWO's (1993) indicators thus served as a catalyst for new proposals of ST performance assessment tools and models. A summary of previously proposed models and applied methodologies is provided in Table 1, which highlights their main contributions and limitations regarding the assessment of sustainability in tourism contexts.

As can be observed, Table 1 provides an overview of developments made in the ST research field, including their methodological orientation and main limitations. This is important not only to support the research gap but also to position the present study considering the extant literature, making clear that the aim is not one of substitution of previous methods or models, but rather their augmentation. That said, an analysis of the studies presented in Table 1 reveals various recurring limitations, especially in the methods used to select and articulate the decision criteria and calculate their weights (*i.e.*, trade-offs). In addition, as noted by Franzoni (2015) and Carayannis et al. (2018), most proposals also apparently fail to acknowledge the cause-and-effect relationships between criteria and ST dimensions.

Because these limitations have an impact on the accuracy of the results, it seems clear, therefore, that the following questions are yet to be answered: "How can ST regions be assessed?"; "What qualitative and quantitative criteria and metrics can be used to do so, and how can their cause-and-effect relationships be analyzed?"; and "How can a synthetic indicator of tourism sustainability be obtained?".

In light of this reasoning, there would seem to be advantages to using multiple criteria structuring and evaluation techniques to provide answers to these questions, since these techniques have been reported to be able to clarify complex decision problems (cf. Belton and Stewart, 2010). Indeed, MCDA methods have a constructivist epistemological basis and facilitate the combination of objective and subjective elements in complex and multidimensional decision situations. Considering that the aim is to add to the existing evaluation methods and not to replace them, allowing for a transparent and well-informed ST evaluation mechanism, the present research sought to overcome or reduce some of the limitations identified in the ST literature through the combined use of cognitive mapping and the CI. Cognitive maps provide an explicit, comprehensive structuring of decision problems. The CI facilitates the calculation of an overall score for each alternative, taking into account the effects of criteria coalition. The next section provides the methodological background for the techniques used.

## 3. Methodology

ST evaluation is a complex endeavor that involves multiple stakeholders who often have diverging perspectives. Various authors have thus drawn attention to MCDA techniques' potential contribution to sustainability assessment (*e.g.*, Munda, 2005; Cinelli et al., 2014; Diaz-Baltero et al., 2017; Fernandes et al., 2018; Rita et al., 2018; Brito et al., 2019; Reis et al., 2019) and, more specifically, ST evaluation (*e.g.*, García-Melón et al., 2012; Aminu et al., 2013). The current study combined cognitive mapping and the CI to develop an ST assessment system.

### 3.1. Problem structuring and cognitive mapping

The JOintly Understanding Reflecting and NEgotiating strategY (JOURNEY) Making approach was introduced by Eden and Ackermann (1998), falling within the scope of problem structuring methods (PSMs). According to Ackermann and Eden (2001: 26), JOURNEY Making's main purpose is "*providing a device that can be used to facilitate managing the messiness of deciding on* [an] *action*". This approach typically involves a group of decision makers who contribute to the model building by sharing their individual perspectives and ideas – which often conflict – regarding a given topic or issue (Eden and Ackermann, 1998). These are then shared and discussed in a group session in which one or more facilitators coordinate the negotiation process within the group, thereby promoting knowledge sharing and learning to reach a final, joint understanding of the issue being discussed (Eden and Ackermann, 1998; Hjortsø, 2004; Mingers, 2011). This consensus is translated into a visual model that structures the issue under analysis using cognitive mapping techniques (Eden, 1988), which offer a holistic representation that integrates several different perspectives on the decision problem at hand (Eden and Ackerman, 1998; Belton and Stewart, 2010).

Eden (2004) introduced the cognitive mapping approach into decision-making processes based on Kelly's (1955) theory of personal constructs. This theory consists of mapping the way in which an individual – or group of individuals – perceives an issue by means of constructs. The latter are defined by Eden (1994: 264) as "*chunks of language used to construct an argument or line of argument, where the line of argument is depicted by a string of arrows*". Thus, a cognitive map is a network of nodes connected by arrows, which in turn express any existing positive or negative causality among the concepts (Eden, 2004).

Cognitive mapping has proved to be extremely useful when structuring complex decision problems, serving as a formal modeling tool that facilitates the organization and understanding of issues' underlying ideas (Eden and Ackermann, 2002; Eden, 2004; Hjortsø, 2004; Mingers, 2011). In the present study, cognitive mapping was used to identify the evaluation criteria for ST assessment, further clarifying concepts by identifying and analyzing their cause-and-effect relationships.

### 3.2. Choquet integral

The CI was introduced by Choquet (1953) as an information aggregator whose main function is to synthetize the partial scores of each evaluation criterion into one single overall score for a given alternative (Krishnan et al., 2015). According to Grabisch and Labreuche (2004) and Krishnan et al. (2015), the CI can be classified as a fuzzy integral because of its ability to model fuzzy

**Table 1**
ST performance measurement – methods, contributions, and limitations.

| Authors | Methods | Contributions | Limitations |
|---|---|---|---|
| UNWTO (1993) | Set of indicators and two assessment indexes based on traditional statistical approaches | - Starting point for other ST assessment models;<br>- Recognition of the importance of "micro" contexts in indicator selection. | - Lack of clear reasoning in criteria selection;<br>- Absence of stakeholders from the model development process;<br>- Lack of managerial implications. |
| Miller (2001) | Literature review and a Delphi survey | - Importance of stakeholders' perceptions to sustainability implementation;<br>- Wide coverage of sustainability aspects. | - Excessive subjectivity;<br>- Potential absence of significant indicators from the survey used. |
| Twining-Ward and Butler (2002) | Traditional statistical approaches | - Indicator based on targets;<br>- Importance of stakeholders and experts' participation in assessment processes;<br>- Focus on the interpretation of results and resulting actions. | - Purely statistical analysis;<br>- Equal weights for all indicators. |
| Kernel (2005) | Corporate ST development model based on collaboration theory | - Suggestion of a four-step model to achieve sustainability in tourism corporations;<br>- Inclusion of stakeholders. | - Corporations only partially responsible for the process;<br>- Biased sample of corporations. |
| Michalena et al. (2009) | Principal component and multi-criteria analysis | - Exploration of causal links between renewable energy technologies and the development of ST;<br>- Application of multi-criteria analysis. | - Focus on a single dimension of ST;<br>- Small number of non-weighted indicators;<br>- Only qualitative data used. |
| Fernández and Rivero (2009) | Composite weighted index based on factor analysis | - Importance of weighted indicators in assessing ST;<br>- Higher level of consistency compared with previous models. | - Assumption of data availability;<br>- Only static analysis of data;<br>- Requires homogenous and systematic data. |
| Castellani and Sala (2010) | Sustainability performance index based on the 1995 European Charter for Sustainable Tourism in Protected Areas | - Assessment of current levels of sustainability and effectiveness of implemented policies. | - Non-comparability to standardized international models;<br>- Lack of validation. |
| García-Melón et al. (2012) | Analytical network process (ANP) and Delphi survey | - Greater transparency and participation in decision-making processes;<br>- Adaption possible to other contexts. | - Assumption of criteria independence. |
| Aminu et al. (2013) | ANP | - Exploration of several scenarios and strategies;<br>- Attention paid to tourism, economic, and preservation development;<br>- Inclusion of multiple criteria. | - Basis in underdeveloped data. |
| Torres-Delgado and Palomeque (2014) | Literature review and a Delphi survey | - Practical applicability of the framework in study cases contributing to its functionality. | - Application of indicators strongly dependent on available data quality and quantity;<br>- Lack of a global perspective. |
| Franzoni (2015) | Multi-dimensional, multi-level guideline-type framework | - Focus on the complexity of interdimensional relationships of tourism systems;<br>- Use of indicators in three areas (*i.e.*, social, economic, and competitive) and three levels (*i.e.*, community, destination, and autonomous organizations);<br>- Guideline-type proposal. | - Only suggestions of possible indicators;<br>- Non-weighted indicators. |
| Agyeiwaah et al. (2017) | Meta-analysis and a compilation of indicators from related literature | - Wider scope that allows for more flexibility and adaptability of an assessment model to a specific context. | - Basis in a non-exhaustive number of studies<br>- No formal guidance in the grouping and labeling process. |
| Torres-Delgado and Palomeque (2018) | Composite index at the municipal level | - Focus on the municipal level at which decisions have a more immediate impact compared to a national scope, thereby facilitating more efficiency. | - Risk of losing a global perspective on the issue;<br>- Possible unwanted trade-offs between different impacts. |

measures.

On a technical level, Choquet (1953), Shieh et al. (2009), Tan and Chen (2010), Ferreira et al. (2018b), Brito et al. (2019) and Silva et al. (2019) affirm that a fuzzy measure in $X$ refers to a function $\mu : P(X) \rightarrow [0, 1]$ if – and only if – it complies with conditions (1) and (2):

$$\mu(\varnothing) = 0,\ \mu(X) = 1 \text{ (limit condition)} \quad (1)$$

$$\textit{If } A,\ B \in P(X) \textit{and } A \subseteq B,\ \textit{then } \mu(A) \leq \mu(B) (\textit{monotonicity condition}) \quad (2)$$

Ralescu and Adams (1980) argue that, for $\mu$ to be considered a non-additive measure, premises (3) and (4) should also be taken into account:

$$\{A_n\} \subseteq P,\ A_1 \subseteq A_2 \subseteq \ldots \subseteq A_n \in P \Rightarrow \mu\left(\cup_{n=1}^{\infty} A_n\right) \lim_{n \to \infty} \mu(A_n) \quad (3)$$

$$\{A_n\} \subseteq P,\ A_1 \supseteq A_2 \supseteq \ldots \supseteq A_n \in P \Rightarrow \mu\left(\cap_{n=1}^{\infty} A_n\right) = \lim_{n \to \infty} \mu(A_n) \quad (4)$$

In addition, Torra et al. (2016) and Brito et al. (2019) state that $\mu$ refers to a submodular non-additive measure if $\mu(A) + \mu(B) \geq \mu(A \cup B) + \mu(A \cap B)$ and to a supermodular non-additive measure if $\mu(A) + \mu(B) \leq \mu(A \cup B) + \mu(A \cap B)$ for any $A,\ B \subseteq P$, respectively. In this sense, the CI of $f$ in relation to $\mu$ in $A$ is referred to as $(C) \int_A f d\mu$ and defined according to formula (5) (Ouyang and Li, 2004):

$$(C)\int_A f d\mu = \int_0^{\infty} \mu(A \cap F_\alpha) d\alpha \quad (5)$$

in which $f$ represents a non-negative, measurable function of real value defined in $X$ and $F_\alpha = \{x | f(x) \geq \alpha\}$, for any $\alpha > 0$.

If $(C)\int_A f d\mu < \infty$, $(C)$ is said to be integrable (Wang, 2011). Consequently, if $(X, P, \mu)$ represent a fuzzy measure space with $\{f_1, f_2, ..f_n\} \subseteq F$ and $A,\ B \in P$, $Fx$ is the set of all non-negative measurable functions of real value defined in $X$. The CI will have the following properties (6) to (11) (Wang, 2011):

$$if\ \mu(A) = 0,\ \text{then}\ (C)\int_A f d\mu = 0 \quad (6)$$

$$(C)\int_A c d\mu = c.\mu(A) \quad (7)$$

$$if\ f_1 \leq f_2,\ \text{then}\ (C)\int_A f_1 d\mu \leq (C)\int_A f_2 d\mu \quad (8)$$

$$if\ A \subset B,\ \text{then}\ (C)\int_A f d\mu \leq (C)\int_B f d\mu \quad (9)$$

$$(C)\int_A (f + c) d\mu = (C)\int_A f d\mu + c.\mu(A) \quad (10)$$

$$(C)\int_A c.f d\mu = c.(C)\int_A f d\mu \quad (11)$$

in which $c$ represents a positive constant.

As pointed out by Wang (2011), since the CI integrates a set of monotone, non-additive, and non-linear integrals, the most important property of the CI is the non-additivity of $\mu$ as defined by formula (12):

$$(C)\int_A (f + g) d\mu \neq (C)\int_A f d\mu + (C)\int_A g d\mu \quad (12)$$

in which $f$ and $g \in F$. Finally, Murofushi and Sugeno (1991) state that the underlying monotony of the CI can also be defined by formula (13):

$$(C)\int_A f d\mu \leq (C)\int_A g d\mu,\ \text{whenever f} \leq \text{g}. \quad (13)$$

One of the CI's key characteristics is its ability to deal with criteria coalition (*i.e.*, interdependence between assessment criteria). This means that more informed, realistic results can be obtained as the CI allows for the aggregation of cardinal information (Krishnan et al., 2015; Ferreira et al., 2017; Brito et al., 2019). That said, other aggregation operators exist, but there are substantial differences between them and the CI. For instance, employing additive operators such as the simple arithmetic average (SA) or the simple weighted average (SWA) to aggregate the performance scores of an alternative can lead to faulty results as these operators assume independencies among criteria and/or attributes, which seems to be fallacious in real-world decision situations. As a fuzzy measure, the CI allows for the modeling of variables interdependency. In addition, it is known that other methods that allow rankings of alternatives to be obtained in the context of criteria interdependency – *e.g.*, analytic network process (ANP) or the decision-making trial and evaluation laboratory (DEMATEL) – are unable to consider the aspiration level of alternatives as in the CI (cf. Brito et al., 2019). Although this integral is not without its weaknesses, Demirel et al. (2010) maintain that it is an excellent instrument when addressing complex multidimensional decision problems that include interlinked qualitative and quantitative decision criteria, which is the case for the assessment of ST.

In broad terms, we applied cognitive mapping techniques to define and structure the decision problem (i.e., structuring phase in section 4.1). For this purpose, we followed the guidelines of the JOURNEY Making approach – also known a Strategic Options Development and Analysis (SODA) (Ackermann and Eden, 2001), which allowed the opinions of different experts to be aggregated, creating a holistic framework that was shared by all, and within which cause-and-effect relationships between decision criteria could be detected and understood. It is worth noting that SODA presents two variants, namely: (1) SODA I, where individual cognitive maps are developed in 1-to-1 interviews with participants; these maps are then merged to create a group map which provides the starting point for a facilitated group meeting; and (2) SODA II, where participants are jointly involved in creating a shared model in a facilitated workshop. In our study, due to the decision makers' limited availability, we started directly with group meetings (i.e., SODA II). The CI, in turn, was used for modeling criteria interdependency, fostering informed and conscious decision making based on the performance profiles of the tourism regions evaluated (i.e., evaluation phase in section 4.2). This dual methodology allowed the methodological limitations identified in prior studies to be addressed, creating greater transparency in what regards both the identification of the components of the framework (*i.e.*, the determinants of ST), and the calculation of the trade-offs between them.

## 4. System development and application

Various authors have referred to three phases in the decision-making process in an MCDA context: structuring, evaluation, and recommendations (cf. Bana e Costa et al., 1997; Ensslin et al., 2000; Belton and Stewart, 2010; Ferreira et al., 2011; Faria et al., 2018). In the present study, the research was conducted by implementing the JOURNEY Making approach in the structuring phase and the CI in the evaluation phase. A validation session was held in the last phase.

To implement the methodological procedures, a group of decision makers was assembled, which was comprised of specialists with practical know-how in ST. The literature does not mention an ideal number of members for decision groups, but the general consensus is somewhere between 5 and 12 (cf. Bana e Costa et al., 2002). After taking into account the availability of the experts invited, the panel included a total of eight individuals who occupy different positions in tourism, hospitality, and sustainability organizations. More specifically, the members were the chief executive officer of a travel operator, the executive secretary of a hospitality association, the founder of a non-profit organization for ST, the executive director of a tourism and hospitality group, the director of a hotel, the director of a travel agency, the duty manager of a hotel, and the tourism director of a private tourism foundation.

During the panel constitution process, an effort was made to ensure that the participants occupied significant positions and represented pertinent and diverse stakeholder categories, whilst simultaneously taking into consideration the panel's gender and age diversity. These criteria were meant to maximize the credibility

and representativeness of the panel, thereby allowing different perspectives to emerge (Eden and Ackermann, 2001). However, the participants were primarily selected not to guarantee representativeness but rather to maintain a strong focus on process (Ormerod, 2013). Although this means that the results of the present study are context-specific, the steps followed could work equally well with different people and in varied contexts (cf. Bell and Morse, 2013; Ferreira et al., 2017; Brito et al., 2019).

Two group sessions were held for 4 h each, for a total of 8 h of group work. The first session was dedicated to structuring the ST assessment system and the second to evaluating alternatives.

### 4.1. Collective cognitive map

The first session started with a brief explanation of the methods provided by the facilitators to prepare the panel for the exercises and clarify their intended purpose. Next, the brainstorming process was begun with the following trigger question: "*Based on your professional experience and personal values, which factors or characteristics influence the sustainability of tourism destinations?*". This encouraged multiple contributions to emerge. These ideas were registered using the "post-its technique", which is a variant of the oval mapping technique introduced by Eden and Ackermann (2001).

The underlying process of the "post-its technique" required the panel members to write on post-it notes all the factors and characteristics that these experts believed answered the trigger question. These ideas became the basic criteria for the ST evaluation model. Each post-it note held a single criteria, and, when this was considered to have a negative impact on the sustainability of tourism destinations, the note was marked with a negative sign (−) representing negative causality (Faria et al., 2018; Rita et al., 2018; Miguel et al., 2019). As they were created, the post-it notes were placed on a whiteboard throughout the entire process, promoting transparency and serving as stimuli for new and related criteria.

Next, the panel was asked to organize the resulting criteria by topics, creating clusters or areas of interest. At this stage, the participants could eliminate or add criteria, if necessary. The final exercise of this group session required the experts to order the criteria within each cluster from most to least important. After the session, a group cognitive map was created using the Decision Explorer software (http://www.banxia.com), thereby offering a visual representation of the results. This cognitive map was then analyzed and validated by the expert panel, who made adjustments as needed. Fig. 1 shows the final version of the group cognitive map.

An analysis of the cognitive map generated revealed that it comprises a high number of evaluation criteria and clusters. Overall, the map encompasses a larger number of criteria compared with other assessment models in the literature. Another notable feature is the number of cause-and-effect relationships between criteria, which underlines the complexity of ST assessment.

The last step in the structuring process comprised identifying fundamental points of view (FPsV) (see Bana e Costa et al., 2002), which are the aspects considered essential by experts in ST assessment. After following Keeney's (1992) procedural guidelines, six FPsV emerged. The first was labeled "Religion, Society, and Culture" and then subdivided into three elementary points of view (EPsV) (*i.e.*, Religion, Society, and Culture, respectively). The second FPsV was called "Safety", the third "Marketing and Services", the fourth "Environmental Factors", the fifth "Political-Economic Factors", and the last "Infrastructure and Accessibility". The next subsection describes the application of the CI in the evaluation phase of this study.

### 4.2. Aggregation, evaluation and results

The CI was applied during a second group session with the expert panel. After a brief explanation of the session's purpose, the panel was asked to attribute a value to each possible combination of the FPsV. Given that the EPsV had to be individually accessed, all their possible combinations were also scored. Each combination refers to a hypothetical tourism destination to be scored on a 10-point scale, in which 0 is a completely undesirable situation and 10 is a completely desirable situation.

The experts were presented with a matrix table containing all the possible combinations between the three EPsV, considering that each can be classified as "bad" (*i.e.*, unfavorable) or "good" (*i.e.*, favorable). According to Choquet (1953), the number of combinations requires the specification of $2^n$ parameters, which, in the case of the EPsV, presumes the existence of 8 possible combinations (*i.e.*, $2^3 = 8$). To complete the last column shown in Table 2, the facilitators posed various questions to the participants (*e.g.*, "*How would you assess the hypothetical scenario of a tourism region and/or destination, in which only EPV1 (i.e., Religion) is evaluated as good while the rest of the criteria are rated as bad?*"). Table 2 presents the scores given by the experts after much discussion and negotiation.

The same procedure was then carried out for the FPsV. In comparison to the above table, the number of combinations was much larger − a total of 64 combinations (*i.e.*, $2^6 = 64$). Table 3 contains some combinations and scores, but the scores for all 64 combinations can be obtained from the corresponding author upon request.

The scoring of these combinations was a crucial step as it allowed the panel to consider synergetic effects between criteria (*i.e.*, multi-criteria coalition). Once the combinations were evaluated, the second part of this session consisted of testing the resulting model by assessing real alternatives. In this case, the alternatives assessed are the seven Portuguese tourism regions: Lisbon and the Tagus Valley; Alentejo; Algarve; Center; Oporto and North; Madeira; and Azores. These regions were defined by Portuguese law in 2013.

The experts were asked to score each alternative according to the identified set of criteria, using the aforementioned 10-point scale. Since the EPsV had been assessed individually, their scores were aggregated into a global score for FPV1 (*i.e.*, Religion, Society, and Culture). After obtaining all the necessary partial scores, CI calculations were done in order to obtain an overall score for each alternative. This calculation required some intermediate steps that integrated the previously obtained interaction scores. Examples are provided in Tables 4 and 5 with regard to Lisbon and Tagus Valley and FPV1. In this calculation, we normalized the final result by dividing the result by 10 in order to maintain the 10-point scale.

Lisbon and Tagus Valley scored 10 for EPV3 (*i.e.*, Culture), 8 for EPV2 (*i.e.*, Society), and 6 for EPV1 (*i.e.*, Religion), which translates to a positive partial evaluation for all criteria. The CI calculation scored Lisbon and Tagus Valley 7 for FPV1. Next, the overall score for this alternative was calculated using all six FPsV, as shown in Table 5.

An analysis of the results obtained for the Lisbon and Tagus Valley Tourism Region showed that its evaluation was quite positive for all the assessed criteria. It obtained the highest score (*i.e.*, 10) for FPV3 (*i.e.*, Marketing and Services). In contrast, the lowest score was given for FPV1 (*i.e.*, Religion, Society, and Culture) (*i.e.*, 7). Since all the scores are quite positive, Lisbon and the Tagus Valley's results appear to be close to the ideal scenario of ST, in which all the FPsV are considered "good". This partial performance appraisal procedure was carried out for the remaining alternatives, revealing that the system created should be seen as a learning mechanism and allow decision makers to know where to intervene and what

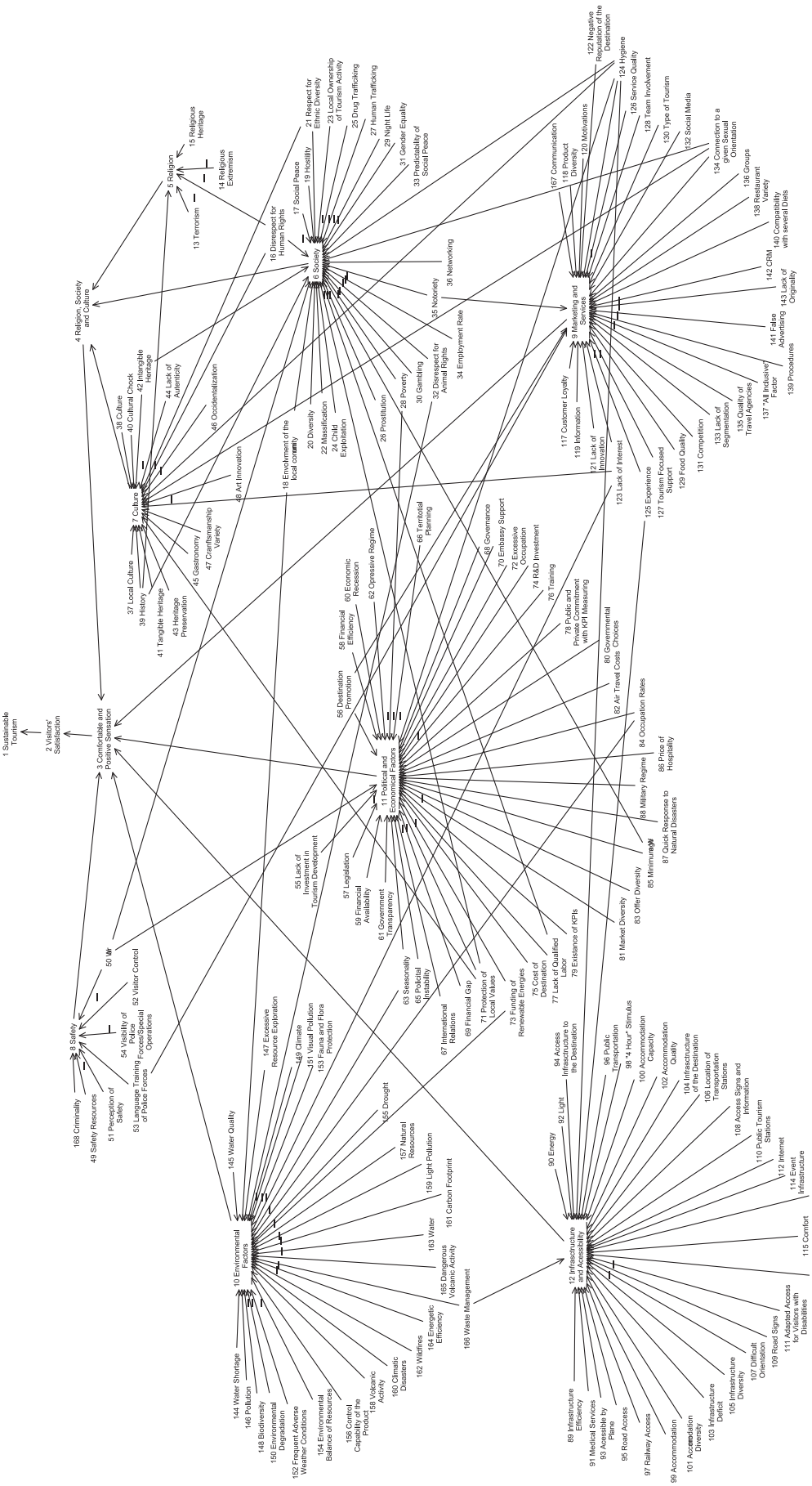


**Fig. 1.** Group cognitive map.

**Table 2**
Matrix of EPsV interactions.

| Interaction | EPV1 | EPV2 | EPV3 | Evaluation |
|---|---|---|---|---|
| 1 | Bad | Bad | Bad | 0 |
| 2 | Good | Bad | Bad | 2 |
| 3 | Bad | Good | Bad | 1 |
| 4 | Bad | Bad | Good | 2 |
| 5 | Good | Good | Bad | 6 |
| 6 | Good | Bad | Good | 8 |
| 7 | Bad | Good | Good | 3 |
| 8 | Good | Good | Good | 10 |

**Table 3**
Matrix of FPsV interactions.

| Interaction | FPV1 | FPV2 | FPV3 | FPV4 | FPV5 | FPV6 | Evaluation |
|---|---|---|---|---|---|---|---|
| 1 | Bad | Bad | Bad | Bad | Bad | Bad | 0 |
| 2 | Good | Bad | Bad | Bad | Bad | Bad | 2 |
| 3 | Bad | Good | Bad | Bad | Bad | Bad | 0 |
| 4 | Bad | Bad | Good | Bad | Bad | Bad | 0 |
| 5 | Bad | Bad | Bad | Good | Bad | Bad | 1 |
| 6 | Bad | Bad | Bad | Bad | Good | Bad | 0 |
| 7 | Bad | Bad | Bad | Bad | Bad | Good | 0 |
| 8 | Good | Good | Bad | Bad | Bad | Bad | 4 |
| 9 | Good | Bad | Good | Bad | Bad | Bad | 4 |
| 10 | Good | Bad | Bad | Good | Bad | Bad | 4 |
| … | … | … | … | … | … | … | … |
| 64 | Good | Good | Good | Good | Good | Good | 10 |

improvement actions should be taken in each tourism region evaluated. After all the calculations were concluded, the Portuguese tourism regions could be ranked. The final ranking is presented in Table 6.

As can be seen in Table 6, Lisbon and Tagus Valley is the most sustainable Portuguese tourism region, with an overall score of 86, closely followed by Oporto and North with an overall score of 84. On the other end of the spectrum, Alentejo is the alternative with the lowest level of sustainability in tourism, with a score of 59. Notably, a deeper assessment of each alternative's ST is made possible by an analysis of the partial scores, which can facilitate decision-making processes by identifying areas needing improvement, as well as appropriate sustainability measures. Furthermore, because our approach allows for the addition of new information over time (cf. Faria et al., 2018; Ferreira et al., 2018a; Pires et al., 2018), the proposed model is not only robust, but also versatile. This means that the use of the dual methodology proposed in this study allowed for the construction of a different, but complementary model to those already existing, and resulted in the design of a transparent, simple and well-informed system, comprising both objective and subjective components. In the next phase, the proposed model and its results were submitted to external validation in order to obtain potential recommendations for improvement.

### 4.3. Validation, discussion, implications and recommendations

Once the evaluation phase was completed, a final work session was held to validate the results and obtain recommendations for how to improve the model. In order to ensure an impartial validation of the model and its potential applicability, this session involved an expert who was not present during the structuring and evaluation phases. The meeting took place in the Portuguese Tourism Confederation headquarters, and the interviewee was a senior staff member responsible for project assessment and development within this institution.

The session was approximately 1 h long, starting with a brief presentation of the proposed model, in which a concise overview was given of the applied methodology, including its potential contributions and limitations. Next, the methods' implementation was described, focusing on the group sessions and the resulting cognitive map and matrix tables. Finally, the facilitators presented the main results of the alternatives assessment, as well as the final analyses. The remaining time was dedicated to the expert interviewee's analysis of the model, culminating in comments and recommendations that were meticulously documented.

The expert first indicated that "*the methodology used is important and appears to be appropriate*" (in his words), thereby agreeing with its applicability and usefulness. In particular, the expert highlighted the advantage that the integrated methods offer because of their ability to combine objective and subjective elements "*through consulting and including individuals experienced in this area*" (also in his words), especially given the subjectivity surrounding ST assessment.

Regarding the proposed assessment model, the interviewee praised the inclusion of multiple dimensions and stated that other existing models – at least within Portuguese contexts – focus excessively on the environmental dimension. Thus, this model's "*main contribution is changing that aspect*" given that the

**Table 4**
CI calculation for lisbon and tagus valley and FPV1.

| EPsV Ranking | | Interaction Values | | CI Calculation |
|---|---|---|---|---|
| EPV | Alternative's Score | EPV | Value | $CI_{Lisbon\ and\ Tagus\ Valley} = [(10-8)*2+(8-6)*3+(6-0)*10]/10 = 7$ |
| EPV3 | 10 | EPV3 | 2 | |
| EPV2 | 8 | EPV 3 + 2 | 3 | |
| EPV1 | 6 | EPV 3 + 2+1 | 10 | |

**Table 5**
Lisbon and tagus Valley's overall score.

| FPsV Ranking | | Interaction Values | | Overall Score |
|---|---|---|---|---|
| FPV | Alternative's Score | FPV | Value | $IC_{Lisbon\ and\ Tagus\ Valley} = [(10-9)*0+(9-9)*2+(9-9)*3+(9-8)*7+(8-7)*9+(7-0)*10] = 86$ |
| FPV3 | 10 | FPV3 | 0 | |
| FPV5 | 9 | FPsV 3 + 5 | 2 | |
| FPV6 | 9 | FPsV 3 + 5+6 | 3 | |
| FPV2 | 9 | FPsV 3 + 5+6 + 2 | 7 | |
| FPV4 | 8 | FPsV 3 + 5+6 + 2+4 | 9 | |
| FPV1 | 7 | FPsV 3 + 5+6 + 2+4 + 1 | 10 | |

**Table 6**
Ranking of alternatives.

| Sustainability Ranking of Portuguese Tourism Regions | | |
|---|---|---|
| Ranking | Tourism Region | Overall Score |
| 1 | Lisbon and Tagus Valley | 86 |
| 2 | Oporto and North | 84 |
| 3 | Madeira | 79 |
| 4 | Center | 73 |
| 5 | Azores | 65 |
| 6 | Algarve | 63 |
| 7 | Alentejo | 59 |

"*sustainability of a destination is also the sustainability of its businesses*" (interviewee's words). The great number of criteria in the model was also applauded by the expert, who suggested that "*small companies do not understand what sustainability is, and a detailed model helps them to comprehend this* [concept] *and its practical implementation*" (in his words). In addition, the expert stated that the assessment model "*can translate exactly what might constitute sustainability in tourism destinations*" (also in his words).

Regarding the results, the interviewee noted that, although most of them match those produced by current evaluation practices, the proposed system takes into account the underutilization of resources and heritage assets. This means that, although grounded on a different methodological combination, our findings are consistent with the results of Franzoni (2015) and Carayannis et al. (2018) in what pertains to the importance of resources and heritage assets to achieve ST. Notably, while most of the criteria included in the cognitive map developed in this study are not new, the completeness of the cognitive structure created allowed important details to be detected, which might otherwise easily be overlooked. For instance, dangerous volcanic activity, or language training of police forces (cf. Fig. 1). Indeed, the interviewee agreed with the fact that some of the criteria included in the cognitive structure created are rarely considered in current ST frameworks, but that the proposed model-building process allowed for their identification and characterization. This resulted in some surprises in the final ranking, such as Alentejo being the alternative with the worst performance. From the expert's perspective, this implies that the model adds new and more detailed insights into ST assessment.

As a potential limitation – and opportunity for future research – the interviewee emphasized the lack of geographical diversity in the expert panel, from which stemmed this expert's main recommendation for how to improve the model. He suggested that similar group work sessions should be held for each one of the Portuguese tourism regions, given that "*potentially, individuals who are more familiar with different regions can have different perceptions compared with the current panel*" (in his words).

Notwithstanding the above recommendation and the previously mentioned limitations inherent to the methodology (in this regard, see also Brito et al. (2019) and Silva et al. (2019)), all the participating experts appeared to agree on the proposed model's contributions to the field of ST assessment. The participants underlined as particularly advantageous the model's inclusion of stakeholders and their subjective and conflicting perspectives, the model's multi-dimensional character, the quality of the results, and the wide selection of criteria. The latter is a key feature in the model's applicability in real-world contexts, allowing decision makers to focus on specific areas that need improvement and thus stimulating the effective implementation of sustainability practices within the tourism sector.

Following this, we believe the present study has important theoretical and managerial implications. Regarding the findings, although context-specific, they can be an important starting point for other researchers and practitioners hoping to classify tourism regions; and should be used to complement previous studies in the ST field. From the methodological perspective, the contribution is two-fold: it comes both from the integration of the methods used, which we believe to be novel in the context of ST assessment; and from the description of the process followed, which can allow for replications in other contexts or with different participants, due to the process-oriented nature of the framework (cf. Bell and Morse, 2013; Oliveira et al., 2018).

## 5. Conclusion

Over the past decades, tourism has been experiencing continual, fast-paced expansion, which can be fruitful in terms of the economic development of tourism destinations and their communities. However, unplanned expansion puts intense pressure upon destinations and their resources, even endangering their long-term existence. Thus, the need to combine sustainability concerns with strategic planning of tourism activities has attracted much attention and led to a lively debate about ST. Despite the increasingly intense discussion of this issue, practical implementations of sustainability measures in the tourism sector are still insufficient.

In light of this situation, methods for assessing ST-related performance have emerged as a potential solution that could stimulate the implementation of policies and achievement of sustainability targets. Various researchers have already explored this question, but a review of a selection of these studies revealed that limitations are still frequently present and that they need to be addressed to provide a more robust model for ST assessment. ST evaluation is highly complex not only because of its fuzzy boundaries but also because of its multi-dimensional character and connections to multiple stakeholders who often have conflicting interests.

In response to these challenging characteristics, the present study proposed the integrated use of cognitive mapping and the CI to develop an assessment system for ST. The resulting assessment model produced a transparent, coherent evaluation system with practical applicability in the classification of tourism regions, and the results of its practical application indicate that the proposed approach overcomes some of the most common limitations of current practices, namely, the way in which evaluation criteria are identified and selected, and the method of calculating criteria weights (*i.e.*, trade-offs). Specifically, cognitive mapping techniques were applied to define and structure the decision problem under analysis and the CI was used to model the effects of criteria interdependency. Through the combination of these two methodologies, a multiple-criteria information system for the assessment of ST regions was built, allowing the first research question posed (*i.e.*, How can ST regions be assessed?) to be answered. By bringing together a knowledgeable and experienced group of experts to formulate new insights and reflect on the determinants obtained from the application of cognitive mapping techniques, the second research question posed (*i.e.*, What qualitative and quantitative criteria and metrics can be used to do so, and how can their cause-and-effect relationships be analyzed?) was also addressed. Finally, the application of the CI allowed the third question (*i.e.*, How can a synthetic indicator of tourism sustainability be obtained?) to be answered. To the best of our knowledge, this combination of methods has never been applied in this research context. Therefore, this research adds significantly to the existing literature on ST assessment and MS/OR.

To apply the proposed techniques, eight expert decision makers were recruited to participate actively in the development of the model, which directly reflects their expertise and perceptions. The panel of participants provided extremely positive feedback on the process and resulting model, highlighting the inclusive and

dynamic techniques used to produce this well-informed, wide-ranging assessment system. In this study, six FPsV were identified: Religion, Society, and Culture; Safety; Marketing and Services; Environmental Factors; Political-Economic Factors; and Infrastructure and Accessibility. These evaluation references were used to assess the seven Portuguese tourism regions, whose scores were calculated using the CI. The results indicate that Lisbon and Tagus Valley is the Portuguese tourism region with the most ST, whereas Alentejo comes last compared to the other alternatives.

As with every study, the proposed methods and model have some limitations. In this research context, our reliance on an expert panel, although advantageous, represented the study's main challenge mostly due to both the experts' conflicting agendas and the time-consuming sessions. In addition, the necessary convenience of recruiting experts within close geographical proximity also affected the panel selection process.

These limitations imply some recommendations for further research, starting with the possible replication of the methods with different expert panels or in other regions, thereby facilitating a comparison between results and analyses and increasing their generalizability. Future studies may also want to consider applying other methods and combinations within the MCDA approach (Govindan et al., 2019), further exploring its potential impacts on ST assessment. In this regard, although not an objective of the present study, we recognize the importance of methodological comparisons and strongly encourage them. Any additional contributions will certainly be of value to the process of assessing tourism sustainability.

## Acknowledgments

The authors gratefully acknowledge the outstanding contribution of the panel members: Anabela Correia, Diogo Pinto, Francisco Pais, Joana Jacinto, João Figueira, João Correia, Marta Pires, and Rosário da Barra. We are also grateful to António Silva Pina, senior staff member responsible for project assessment and development at the Portuguese Tourism Confederation, for his availability and the important insights he provided during the validation phase.

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