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Development of a maturity assessment model for sustainable tourism

Hannah Carolin Franz ^a and Ana Rita Cruz ^{a,b}

^aCinTurs- Research Centre for Tourism Sustainability and Well-being, University of Algarve – Faculty of Economics, Faro, Portugal; ^bDINÂMIA'CET-Iscte, Centre for Socioeconomic and Territorial Studies, Iscte-University Institute of Lisbon, Lisbon, Portugal

ABSTRACT

Sustainability has become one of the most pressing worldwide concerns for the tourism sector. Destination managers face the challenge of developing strategies and assessing their success in pursuing sustainable development. However, the concept of sustainability is still vague, and existing measurement frameworks are complex and fail to sufficiently include relevant factors such as digitalisation. This article adopts a design science research (DSR) approach to address these issues, creating a conceptual solution for assessing sustainability in tourism destinations and providing directions for destinations' future development based on a maturity model concept. Objectives for this conceptual solution are developed by critically reviewing relevant literature and existing assessment models for sustainable tourism and operationalised by designing a maturity assessment model for sustainable tourism. To validate this model, interviews with tourism experts and stakeholders are conducted in the Algarve region, Portugal. The study concludes by acknowledging limitations and offering directions for further research.

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maturity assessment model;
destination management;
digitalisation; indicators;
design science research

1. Introduction and motivation

Over the past decades, before the COVID-19 pandemic, tourism has become one of the largest and fastest-growing economic sectors worldwide (UNWTO, 2021). With an increase of 6% compared to the prior year, 2019 marked the tenth consecutive year of growth in international tourism (UNWTO, 2021), and post-pandemic statistics indicate a rapid return to previous trends (WEF, 2023). With this ongoing increase in demand, tourism practitioners have the crucial responsibility to manage growth effectively so that it aligns with the needs of local communities, the environment and tourists alike (Liu, 2003). Sustainable tourism development has been widely acknowledged as a means to mitigate adverse impacts and ensure destinations' long-term viability and competitiveness (Bramwell & Lane, 1993; Simpson, 2001). Destinations must devise strategies and policies that balance utilising (natural) resources while safeguarding the territory and well-being of local communities, and based on these, design tools and approaches that enable continuous monitoring and timely corrective interventions (Marinello et al., 2023). Consequently, assessing existing and potential sustainability levels leveraging benchmarks becomes crucial to guide decision-making for future development (Ceron & Dubois, 2003).

CONTACT Ana Rita Cruz  arcruz@ualg.pt

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Because sustainability and sustainable development have been a focus of the academic literature for decades, one could assume that a consensus about the term and its definition has been established. However, somewhat paradoxically, the opposite seems to be true: the concept of sustainability is still criticised as vague or confusing, varying from concept to philosophy, process or product in the context of tourism (Bloyer et al., 2004; Wall, 1997). Research reveals that this imprecision and ambiguity of the concept lends itself to misinterpretation and misuse (Butler, 1999) and inhibits effective monitoring of the successful implementation of sustainable tourism development plans within destinations (Bloyer et al., 2004). While several tools and practices have been developed for the evaluation and control of tourism activities (Marinello et al., 2023; Schianetz et al., 2007), no universal set of sustainable tourism indicators has been established (Alfaro Navarro et al., 2020), which leads to even more complexity for tourism stakeholders due to choice-overload, lacking clarity and description of metrics (Agyeiwaah et al., 2017; Marinello et al., 2023; Punzo et al., 2022). Simultaneously, while digitalisation has started to rapidly transform the tourism industry, even before the Covid-19 pandemic (Buhalis & Law, 2008), existing tourism assessment models show limited integration regarding its potential as a sustainability driver (Ivars-Baidal et al., 2023; Shafiee et al., 2019). Given these circumstances, Estêvão et al. (2019) note that properly implementing practices to foster sustainability remains sporadic within the tourism sector.

Employing a Design Science Research (DSR) approach (Hevner et al., 2004), this article addresses this research gap by developing a contemporary and comprehensive maturity assessment model for sustainable tourism incorporating digitalisation potentials. Thus, we aim to offer an operational framework to enable practitioners to address sustainable development challenges in their location by assessing their destinations' current maturity state and developing a vision, priorities and course of action towards a more sustainable future. Additionally, this article seeks to contribute to the existing literature on measuring sustainable tourism and inspire more extensive research into maturity assessment models for sustainable tourism. The remainder of this article is structured firstly by explaining the research method used. Secondly, a literature review of the main underlying concepts of sustainable tourism, the measurement of sustainable tourism and existing assessment models is conducted to formulate objectives for the conceptual solution. Next, the research results in the form of the designed and validated maturity assessment model for sustainable tourism are presented and discussed. The final considerations and direction for further research conclude the article.

2. Research methodology

2.1. Design science research (DSR)

Design Science Research (DSR) is dedicated to creating innovative artefacts, such as constructs, models, methods and instantiations, to resolve human or organisational challenges (Hevner et al., 2004). Formularendende DSR is centred around addressing complex and relevant real-world issues from a solution-oriented perspective, leveraging scientific reasoning such as forecasting, recognising or clarifying phenomena (van Aken & Romme, 2009). Its focus on practical problem-solving for human challenges makes DSR especially useful for the research gap previously identified.

Following the sequential phases of the DSR approach highlighted by Vaishnavi and Kuechler (2007), awareness of the problem, suggestion, development, evaluation, and conclusion, our approach began with a literature review for related solution approaches, i.e. existing assessment models for sustainable tourism, their integration of technological aspects, and the potential of maturity models (Section 3) to inform the formulation of the conceptual solution's objectives and its development, described in Section 4. Evaluation of the design artifact is an essential part of DSR as it provides essential feedback on the design process and the developed product (Hevner et al., 2004). Qualitative methods, such as interviews, field or case studies are hereby potential methods to underpin the rigor and study socio-technical characteristics such as usefulness of a designed artifact (Hevner & Chatterjee, 2010). In our study, validation of the model was obtained

using semi-structured interviews with tourism experts and stakeholders in the region of Algarve, Portugal. In the last step, policy recommendations and implications for tourism agencies conclude the process (Section 5).

2.2. Literature review process

This article undertook an extensive literature review, encompassing academic-natured documents accessible on Scopus, b-On, Google and Google Scholar and associated with the relevant field of study. To include influential institutions' sustainability assessment models, such as those of the UNWTO, and non-scientific sources, such as websites, were reviewed. Articles that include keywords relevant to the research domain, such as *sustainable tourism*, *maturity assessment*, *maturity model*, *sustainability maturity model* and *smart tourism*, in either title, keywords or abstract, and that were published between January 2004 and December 2022 were selected for the review based on the perceived relevance for the defined research scope. Publications not related to the research scope and publications not written in English were excluded. In the last step, the final set of publications was analysed to extract relevant sustainability dimensions and sub-domains and to identify missing concepts or links to be addressed in the subsequent model design. To select existing assessment models as a sub-process of the general literature review, the following general criteria were applied: (i) the model needs to state that it is measuring tourism destination sustainability clearly; (ii) sufficient detailed information about indicators and underlying methodologies of the model had to be available online; (iii) the model should be widely used and well-known.

Publications related to the models were scrutinised in three stages, i.e. by title, abstract and full-text, meaning that the titles of the models were evaluated, the abstracts (if available) were reviewed to ensure the model fit the desired scope, and finally, the full-text of each model was thoroughly reviewed using the inclusion and exclusion criteria. At each stage, publications that did not satisfy the abovementioned criteria were excluded (Meade & Richardson, 1997). It must be noted that the researchers performed this screening independently. A total of four models were selected for further analysis based on this approach.

3. Gaps and potentials in measuring tourism sustainability

3.1. Reviewing existing assessment models

In the past two decades, several operational tools and frameworks around tourism indicators have been created by various institutions (EC, 2016; GDSD, 2019; GSTC, 2019; UNWTO, 2004; WEF, 2022), as well as researchers in the tourism domain (e.g. Choi & Sirakaya, 2006; Crotts et al., 2022; Gato et al., 2021; Punzo et al., 2022; Schianetz & Kavanagh, 2008). Consequently, many sustainability indicators exist, which are poorly aligned and do not follow a pattern (Agyeiwaah et al., 2017; Marinello et al., 2023; Santana et al., 2019).

Based on the aforementioned screening process, four models were selected for a deeper analysis regarding their features, dimensions and sub-domains of sustainable tourism: '*Indicators of Sustainable Development for Tourism Destinations*' (UNWTO, 2004), '*European Tourism Indicators System – ETIS*' (EC, 2016), '*GSTC Destination Criteria*' (GSTC, 2019) and '*Global Destination Sustainability Index – GDSI*' (GDSD, 2022).

When reviewing the four models in detail, significant overlaps were identified regarding the chosen dimensions centred around socio-cultural, environmental and economic sustainability, along with a view on governance (Table 1). Consequently, the models are in line with prevailing literature on the dimensions of sustainable tourism destinations (Asmelash & Kumar, 2019; Blancas et al., 2010; Farrell & Twining-Ward, 2004; Postma et al., 2017). What can be seen from the selected models, however, is that they differ in the total number of indicators and their distribution across the dimensions. While the dimension of socio-cultural sustainability has an equal weight of around 30%

Table 1. Overall levels of the developed maturity assessment model.

Author(s), Year	Indicators (total)	Dimensions	Indicators (per dimension)	Indicators (% of total*)
UNWTO, 2004	716	Limiting Environmental Impacts of Tourism Activity	56	8%
		Managing Scarce Natural Resources	31	4%
		Protection of Valuable Natural Assets	12	2%
		Health and Safety	101	14%
		Wellbeing of Host Communities	84	12%
		Community Participation in Tourism	27	4%
		Sustaining Cultural Assets	10	1%
		Capturing Economic Benefits from Tourism	149	21%
		Destination Planning and Control	112	16%
		Designing Products and Services	69	10%
		Tourist Satisfaction	23	3%
		Sustainability of Tourism Operations and Services	5	1%
		Controlling Tourist Activities	36	5%
EC, 2016	43	Environmental Impact	17	40%
		Social and Cultural Impact	13	30%
		Economic Value	10	23%
		Destination Management	3	7%
GSTC, 2019	174	Environmental Sustainability	65	37%
		Socio-economic sustainability	32	18%
		Cultural Sustainability	26	15%
		Sustainable Management	51	29%
GDSM, 2022	169	Environmental Performance	32	19%
		Social Progress Performance	21	12%
		Supplier Performance	24	14%
		Destination Management Performance	92	54%

Note: sequence of dimensions has been adjusted to facilitate readability, ratios calculated prior to further data treatment, such as clustering

*Minor deviations are a result of rounding

Source: Own elaboration

of associated indicators in the models of ETIS, UNWTO and GSTC, this aspect is relatively underrepresented in the GDSI model, with a mere 12% related to the indicators of *Social Progress Performance*, not specifically addressing culture. Environmental sustainability is the highest represented dimension in the models of ETIS and GSTC, with 40% and 37% of all indicators, respectively, while only accounted for 19% in the GDSI model and 14% in the model of UNWTO. Economic sustainability is attributed with moderate importance of around 20% in the models of UNWTO and ETIS but only 7% in the GSTC model. The GDSI model focuses on supplier performance instead of an overall economic dimension and attributes 14% of indicators to this topic. Finally, the dimension concerned with governance and sustainable management of destinations has only a minor share of 7% of indicators in the ETIS model. However, it holds a share of around 30% in the GSTC and UNWTO models and even represents 54% of indicators of the GDSI model.

What is interesting to note is that none of the models specifically emphasises aspects related to technology or data analytics. Indicators included in the GDSI and GSTC models are phrased rather vaguely (e.g. around a *system to monitor and respond to socio-economic, cultural and environmental issues and impacts arising from tourism*) and disproportionate to the remaining dimensions and sub-domains.

As noted before, there is some general criticism of the overall concepts of indicators for sustainable tourism from the literature. When reviewing the four selected models in detail, some

shortcomings can be identified that align with the general criticisms, along with gaps in the model design that may hinder the applications of these models by tourism practitioners.

The often-criticised complexity and ambiguity of indicators that may inhibit a broad adaption of sustainable tourism practices (Agyeiwaah et al., 2017; Jovicic, 2014; Marinello et al., 2023) is demonstrated in at least three of the models, ranging from 169 to over 700 indicators. The UNWTO (2004) suggests its model to function as a 'menu', allowing destinations to select relevant indicators. However, despite the definition of twelve baseline indicators, non-expert stakeholders may find the number of options challenging to handle in practice. Additionally, there is a notable variation in the granularity and concreteness of indicators across and within models. Without a weighting system, this may distort assessment results, potentially biasing certain aspects without theoretical justification (Ivars-Baidal et al., 2023). The GDSI model attempts to rectify this issue with precise definitions and a scoring system yet fails to provide a transparent rationale for applying weighting logic. Divergent levels of granularity and concreteness create many indicator variations on similar topics, further preventing the emergence of clarity and unambiguity regarding the sustainability concept (Tanguay et al., 2013).

Santana et al. (2019) criticise that existing sustainability assessment models often fail to provide clear definitions for the indicators' aspired targets, numerical values or thresholds that limit their practical value. This critique applies in part to the four models under investigation. While the UNWTO model gives general recommendations regarding suitable benchmark data, the GDSM model provides numerical ranges for quantitative indicators for the assessment and provides benchmarks upon results analysis. However, the GSTC and ETIS models do not detail targets or thresholds.

To allow for an intuitive interpretation and understanding of assessment results by different stakeholders, a model's assessment methodology, as well as underlying assumptions and meanings of indicators, needs to be explained and graphically represented, highlighting how they compare to the past and future goal or benchmarks (Waldron & Williams, 2002). In addition, an action framework or guidance that translates the information from indicators into suitable management actions is crucial for successfully implementing the models in practice (Agyeiwaah et al., 2017; Twinning-Ward & Butler, 2002). While the literature review did not reveal any details about the presentation of the GDSI result and related recommendations, it can be said that the other three models do not include any features for a clear display and communication of assessment results or a translation of the assessment results into management actions.

3.2. Digitalisation and its reflection on existing assessment models

Information and communications technology (ICT) research shows how the tourism industry has been forever altered by digitalisation. Buhalis and Law (2008) argue that technology will remain one of the most significant influences to drive change within tourism. The Covid-19 pandemic further exacerbated this development, with tourism businesses adapting to the demands of the 'new normal' as a critical factor for future competitiveness and survival, e.g. through the adaptation of intelligent means such as AI, robotics, sensors, digital marketing or booking services (Cheng et al., 2023). This rapid digitalisation of the industry, accelerated by cloud technology, has enabled unprecedented capabilities regarding big data, bridging the existing information gaps between all stakeholders in the tourism ecosystem (Rahmadian et al., 2022). While the contribution and potential exploitation of ICT to support the development of sustainable tourism had long remained an under-explored gap in tourism research (Ali & Frew, 2014a; Dao et al., 2011; Melville, 2010), it is becoming a dedicated research stream with significant potential (Ali & Frew, 2014b; Goessling, 2017; Rahmadian et al., 2022) that runs in parallel with research focusing on smart tourism destinations (Buhalis & Amaranggana, 2013; Gretzel et al., 2015). Ali and Frew (2014a) note how ICT can drive environmental sustainability through its application in managing and controlling tourism development and identifying sensitive areas. In terms of economic sustainability, ICT can be leveraged to better manage and provide fast, accurate and up-to-date information, and map and monitor economic impacts. In the

context of socio-cultural sustainability, the use of smartphone and sensor data can help to manage tourist flows, optimise parking sites and disperse tourists away from congested areas, thereby tackling overtourism, preserving historical attractions and improving residents' quality of life (Lawson, 2006; Soares et al., 2022). Regarding sustainable destination management and governance, ICT and open data can enhance stakeholder collaboration and decision-making processes (Soares et al., 2022). In addition, DMOs can leverage real-time visitor data to understand their customers' needs better and, therefore, enhance the tourism experience, improve business operations and drive competitiveness (Shen et al., 2020).

While all of these potential benefits of ICTs on sustainable tourism are noted in theory, it is interesting to see that hardly any of the existing smart city or smart destination concepts translate this into measurable actions (Hoejer & Wangel, 2015; Ivars-Baidal et al., 2023). Ivars-Baidal et al. (2023), therefore, formulate the need for researchers, policymakers and planners to redesign indicator systems to fully account for sustainability aspects and integrate these into smart city and smart destination agendas, models and continuous management.

3.3. Using maturity models to assess tourism sustainability

Originating from Information Systems (IS) research and the so-called '*Capability Maturity Model*' (Paulk et al., 1993), maturity models (MMs) have proliferated across various domains. They are most commonly applied in business practice by software companies and consultancies (Poeppebuss & Roeglinger, 2011). MMs generally assume that organisational development follows predictable patterns of evolution and change (Gottschalk, 2009). In an MM, these patterns are conceptualised in terms of linear, evolutionary stages or levels that indicate how capabilities progressively evolve along a desired, expected, or logical maturity path from an initial stage of development towards total maturity with high performance (Poeppebuss & Roeglinger, 2011; Warnecke et al., 2019).

Maturity models are commonly applied as a strategic tool to perform comparisons of current and desirable maturity levels, to determine a path or roadmap for each level depending on existing maturity gaps and eventually to control the progress of their implementation (Becker et al., 2010). A characteristic of MMs is that they are mainly applied in defining, delimiting and accounting for new and emerging social or technological phenomena (such as digitalisation) and their impact on organisations or other entities (Bley & Schoen, 2019). Regarding the sustainability domain, a small number of MM applications can be found in the literature, mainly focused on organisations' supply chain and environmental management capabilities (Aguiar et al., 2021). MM applications in the context of tourism are scarce and usually follow the IS perspective by focusing on smart tourism. Lim et al. (2019) build upon existing applications for smart to develop a capability maturity framework for smart tourism destinations. Imboden et al. (2022) apply the principles of smart destinations to develop a maturity model for lesser-known, peripheral mountain resorts. Afonso et al. (2015) use public data mining to define a regional maturity model to measure and assess differences in smart cities in Brazil and propose managerial mechanisms to improve policy-making based on these findings. What can be seen from these few applications is that MMs have the potential to go beyond an assessment of a current state of performance metrics, like is the case for indicator models, and add value for practitioners by guiding improvement measures, required for further development within a given domain.

4. Designing the maturity model

Based on the literature review on gaps and potentials regarding the measurement of sustainable tourism, it can be concluded that different methods, such as indicator models, have been developed to assess the sustainability of tourism destinations. However, existing models provide a high level of complexity and ambiguity within a narrow focus, hence needing more clarity regarding

implementation, deduction of management actions and communication. A maturity model concept can help compare current and desirable developmental stages and provide relevant guidance to derive and prioritise suitable improvement measures and courses of action for future development. Consequently, the objectives of the conceptual solution can be summarised as follows: To provide an operational tool for the assessment of tourism destinations with regards to sustainability, we aim to develop a model that provides usefulness for tourism managers in the evaluation of the current and desired maturity levels of their destination and deduction of a potential development path (*Usefulness*). The model should provide actionable guidance for destinations and allow for further prioritisation and planning of measures to develop their sustainability maturity (*Implementation*). While compiled from objective, research-funded indicators on all relevant dimensions for sustainable tourism under consideration of technology integration (*Coverage and Completeness*), the model should balance theoretical complexity and practical ease of use. Finally, the tool should include data visualisation features to support the communication of assessment results and the translation of assessment results into actions (*Simplicity*).

4.1. Implementation

Following the approach suggested by Agyeiwaah et al. (2017) for the composition of indicator models, the model design commenced with an initial formulation of dimensions and sub-domains based on a documental analysis of the existing tourism sustainability indicator models selected in Section 3.1. All indicators and their related sub-domains identified from the models were collated in one long list in Excel. Indicators were then reviewed and mapped to the four sustainability dimensions identified in the literature review, i.e. an environmental, economic, socio-cultural and destination management dimension. Each dimension’s long list of indicators was reviewed to eliminate duplicates from synthesising the different models. Common themes for the sub-domains of indicators were identified and updated as new items emerged from the analysis of the remaining models. This updating process continued until saturation, upon which new data categories were fit into existing ones.

To account for the potential impacts of technology on the sustainable development of destinations, the defined dimensions and sub-domains were cross-checked against the findings from the literature review and, in particular, the Smart Destination Indicator model (SDRV) defined by Ivars-Baidal et al. (2017, p. 2021a, 2021b). Sub-domains or indicators not previously included in the list were either added as new items or fit into existing data categories within the dimensions. The resulting four sustainability dimensions and 30 sub-domains are summarised in Table 2.

Table 2. Maturity model dimensions and sub-domains.

Dimension	Environmental (9 sub-domains)	Economic (5 sub-domains)	Socio-cultural (6 sub-domains)	Destination Management (10 sub-domains)
Sub-domains	Light and noise pollution; low impact transportation; sewage; solid waste; landscape and biodiversity protection; climate change; emissions; energy; water	Distribution of benefits to all; leakages and linkages; employment; seasonality; competitiveness of destination	Wellbeing of host communities; health and safety; property and user rights; traditional access; inclusion; protecting cultural heritage	Strategy; development control; data, information and monitoring; connectivity; sustainability reporting and communication; visitor satisfaction and interaction; organization and governance; capacity building, knowledge sharing and innovation; destination image, branding and marketing; risk and crisis management

Source: Own elaboration

Four sequential maturity levels were defined, including qualitative or quantitative requirements and indicators that distinguish each level, ranging from 1 to 4: 1-Basic, 2-Progressing, 3-Advanced, and 4-Leading (Table 3). In Level 1, there is a basic understanding of tourism impacts and sustainability requirements in the destination; however, no formalised approach to sustainable tourism development has been implemented, and ICT integration is limited. In Level 4, sustainability is a central guiding principle for tourism development in the destination; continuous planning takes place based on real-time data advanced analytics, and DMO leadership focuses on driving the further development of the destination's sustainability strategy, continuous performance management and active support and information for all tourism stakeholders.

The synthesised list of dimensions and sub-domains was extended based on these common characteristics by adding the four maturity levels. The evaluation criteria for each level and each sub-domain were specified. The resulting maturity assessment model for sustainable tourism uses a matrix-type based on the maturity domains and levels, describing the characteristics and indicators that determine the criteria for each maturity level per sub-domain, as illustrated in Figure 1.

The conceptual model has been developed in Excel. In the input matrices, drop-down menus in each sub-domain enable the rating of as-is and desired to-be maturity level which forms an integral part of the practical implementation of the model. The results from this maturity assessment are provided as a graphical analysis. Figure 2 shows exemplary outputs for the maturity assessment, summarising the average maturity level for each dimension based on the sub-domain results and detailed analyses for each dimension. The radar charts hereby show the as-is maturity state of the destination and the desired to-be maturity state. The table on the left displays the absolute numbers' maturity level and gap in each dimension or sub-domain. The developed model allows the destination to assess their maturity level and compare results across the four dimensions and sub-domains of sustainability easily and intuitively. In addition, it shows a more detailed assessment of current and desired maturity levels and resulting gaps in each sub-domain, both graphically and numerically. To provide practitioners with actionable guidance for the design of measures to address maturity gaps, the results view per dimension includes a section regarding 'Top areas for

Table 3. Overall levels of the developed maturity assessment model.

	Maturity Level	Description
1 – BASIC	Basic understanding of tourism impacts and sustainability requirements in the destination. No formalized approach to sustainable tourism development. ICT integration is limited.	
2 – PROGRESSING	Principles of sustainable development are acknowledged. Basic initiatives towards sustainable tourism development have been implemented. Initial concepts for the integration of technology have been developed. Initial sustainability-related objectives have been documented and performance is measured.	
3 – ADVANCED	Sustainability impacts of tourism are being regularly measured and evaluated. Strategic planning and implementation of concepts to foster sustainable tourism development. Advanced integration of ICT to measure, analyse and publish relevant data and information to tourism stakeholders. Active stakeholder engagement in the development of plans, regulations and activities. Stakeholder feedback is used for continuous improvement of the tourism experience and DMO operations.	
4 – LEADING	Sustainability as major guiding principle for tourism development in the destination. Continuous planning for sustainable tourism development takes place based on real-time data, advanced analytics, and the integration of all stakeholders through active knowledge exchange. DMO focuses on driving the further development of the destination's sustainability strategy through continuous performance management and active support and information for all tourism stakeholders.	

Source: Own elaboration

A - Environmental									
Overall Maturity Index		Summary Environmental		Current State Heatmap		Economic		Socio-cultural	
SUB-DOMAIN		RATING AS-IS	RATING TO-BE	GAP	1-BASIC	2-PROGRESSING	3-ADVANCED	4-LEADING	COMMENTS
A1	Light and noise pollution			1	There is no monitoring of light or noise pollution in the destination. Complaints are being followed-up on an ad hoc basis.	There is a basic understanding of potential sources of light and noise pollution related to tourism in the destination, but there are no formally defined guidelines or regulations or they are not communicated consistently.	The destination has identified potential sources of light and noise pollution related to tourism and has produced guidelines and regulations to minimize these effects. Guidelines and regulations have been communicated to key stakeholders. There are increased efforts to follow-up on complaints, however there is no monitoring process in place.	The destination has identified potential sources of light and noise pollution related to tourism and has produced guidelines and regulations to minimize these effects. Guidelines and regulations are publicly available and tourism businesses have received respective communication measures. System is in place to monitor compliance with these regulations. There are mechanisms and follow-up actions in place for residents to report noise and light pollution.	
					Initial concepts to adapt public lighting to higher efficiency standards (LED lights) have been implemented.		Public lighting in most areas has been adapted to higher efficiency standards (LED lights).	All public lighting has been adapted to higher efficiency standards (LED lights).	
A2	Low impact transportation	Please choose: 1 2 3 4		1	Initial investments in more sustainable transport infrastructure, including public transport, mainly focused on residents.	First concept towards promoting more sustainable transportation for residents and visitors has been implemented for designated routes (e.g. travel to/from the airport or to/from certain tourist attractions), however no destination-wide mobility plan has been developed.	Destination has developed a mobility plan for residents and visitors with the main focus to reduce transport emissions from travel to and within the destination. Plan includes the use of low-carbon public transport. Information on alternative transport options to and within the destination can be found online.	Destination has implemented and integrated mobility plan to improve health for residents and visitors and to reduce transport emissions from travel to and within the destination. Plan includes the use of low-carbon public transport public transport vehicles powered by renewable energies and soft mobility (i.e. walking, bicycles on trains, electrical car rental from airports). Plan considers transport affordability for residents, tourists and same-day visitors. Information on alternative transport options to and within the destination is actively promoted to visitors.	
					Data on usage/ modes of transportation of tourists and same-day visitors is scattered and of limited use for stakeholders.		Data on usage/ modes of transportation of tourists and same-day visitors is being gathered and monitored using basic technologies. Initial concepts for the use of sensors are being developed.	Destination has set targets for the use of low-impact transportation. Sensors have been implemented to monitor public transport and traffic in real-time and to initiate actions for efficiency improvements.	
A3	Sewage			2	Not only basic guidelines in place regarding wastewater treatment. <39% of the destination's wastewater receives centralized treatment to at least secondary level. Large number of tourism	Initial guidelines regarding wastewater treatment have been set up. Monitoring/ testing of discharge from septic tanks and wastewater treatment systems occurs on an ad hoc basis. 60-79% of the destination's wastewater receives centralized	Advanced guidelines regarding wastewater treatment have been implemented. Treatment, reuse and release of wastes is infrequently monitored/ tested. 60-79% of the destination's wastewater receives centralized	The destination has clear and enforced guidelines in place for the siting, maintenance and testing of discharge from septic tanks and wastewater treatment systems. Proper treatment, reuse and release of wastes is regularly monitored/ tested to prevent adverse impacts on the local population and the environment.	
A. Environmental B. Economic C. Socio-cultural D. Destination Management 0 Current State Heatmap 01 Summary Overall A Summary Environmental B Sub									

Figure 1. Matrix-type maturity model (exemplary ratings).

Source: Own elaboration.

improvement’, which gives an inventory of relevant metrics for those sub-domains with the numerically highest difference between current and desired maturity level.

4.2. Validation

In order to support the construct validity of the designed model and to ensure that the incremental development of the model held practical relevance, semi-structured interviews with tourism experts and stakeholders were conducted.

The number of necessary interviews in qualitative research is difficult to quantify as the variable is experience-based, varying across research domains and objectives (Kurz et al., 2007). Moreover, interviewee availability and willingness within the designated timeframe can affect the required number of interviews (Glaeser & Laudel, 2010). Based on the availabilities during the validation period, a final number of six participants from the fields of tourism administration, regional planning and sustainable tourism research was achieved.

The interview process was designed as follows. Before the individual interviews, participants were provided with a pre-read to familiarise themselves with the background and design of the maturity assessment model. The interviews themselves were set up in two parts. The first part included an introduction of the participants. A presentation of the maturity model followed this introduction. The second part used a semi-structured interview guide to gather participants’ feedback on the model across the categories of *Simplicity*, *Coverage and Completeness*, *Usefulness* and *Implementation*. It can be noted that a saturation regarding three of the four assessed dimensions was achieved in these interviews, where redundancy signalled that data collection was ceasing. For the fourth dimension of *Coverage and Completeness*, relevant insights were achieved. However, a larger sample would be required to assess common themes and similarities in the interviewee’s replies, as highlighted in the limitations in Section 6.

For each interview, a synopsis of the results was done, and content analysis was applied as an objective approach to analyse and summarise the data and identify similarities and differences in the participants’ feedback (Krippendorff, 2004). The interviews held in the validation stage can be described as confirmatory or feedback-oriented because they were aimed at evaluating a given tool (Warnecke et al., 2019). However, experts were asked to provide suggestions for improvement

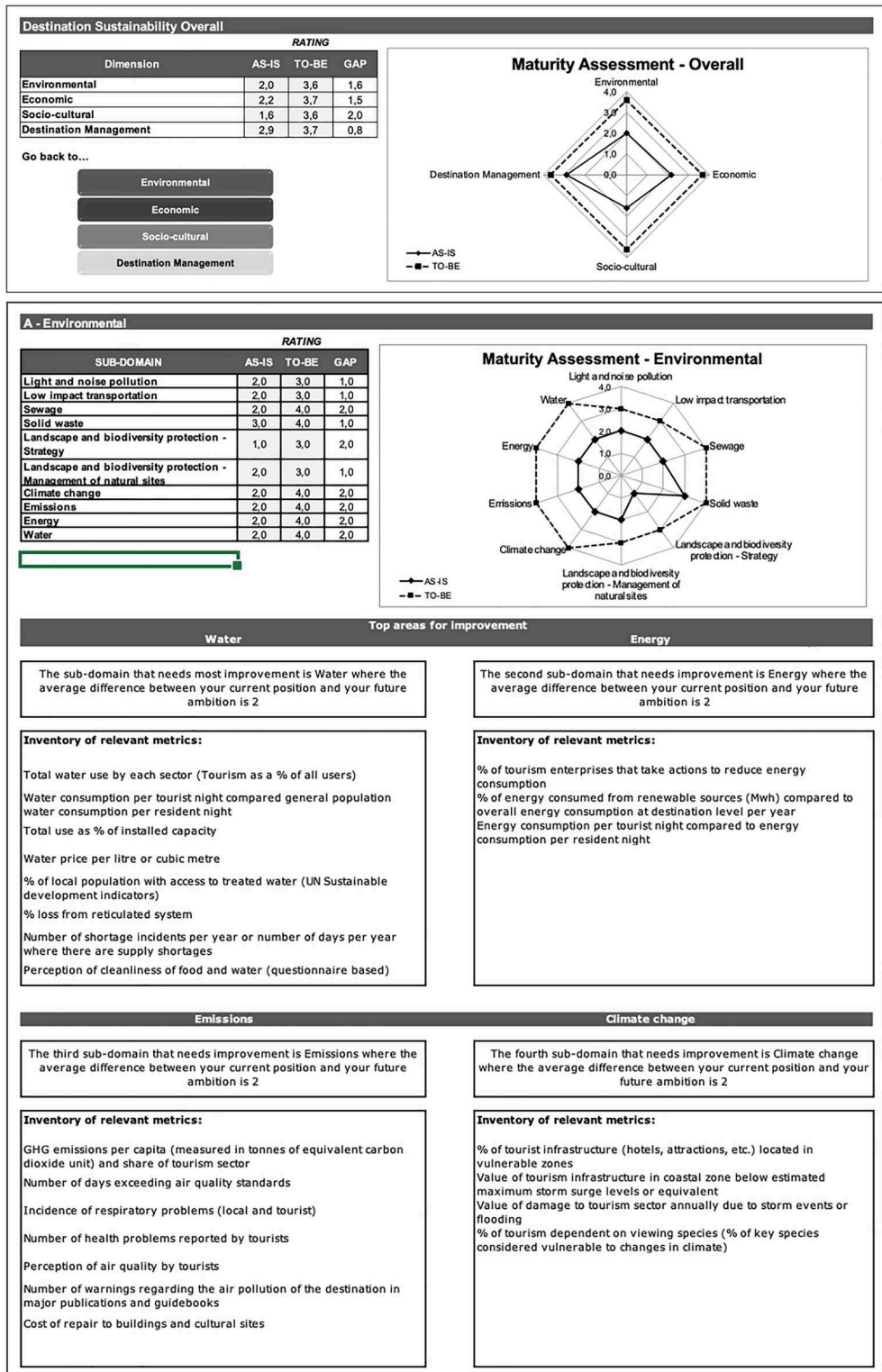


Figure 2. Maturity assessment output: Maturity radar charts (exemplary ratings).

Source: Own elaboration, metrics collated from EC (2016); GDSM (2022); GSTC (2019); Ivars-Baidal et al. (2021); UNWTO (2004).

and constructive criticism to inform potential needs for further refinement of the model in the future. Finally, additional qualitative information gathered during the interviews (e.g. regarding potential risks and challenges for implementation) was used to identify potential directions for future research and further development of the model.

In terms of *Coverage and Completeness*, the interviewees agreed that the model covers the relevant scope of sustainable tourism for different types of destinations and shows alignment with international sustainability agendas. The separation of the Destination Management dimension gained specific support as it emphasises the governance and management of destinations. The inclusion of technology as a transversal factor gained broad agreement due to its significance for developing destination capabilities nowadays. Additionally, the maturity levels were supported by all interviewees to depict a delineated and adequate developmental path for destinations.

Concerning the model's *Usefulness*, interviewees rated it as a highly valuable operational tool for managing tourism destinations, particularly regarding planning and evaluation. All participants praised the model's innovative application of a maturity concept to sustainable tourism for its potential for industry and academia. Its dynamic approach was highlighted as instrumental in fostering a holistic perspective on sustainability and prioritising all relevant dimensions beyond economic growth.

Feedback on assumed challenges and success factors for the *Implementation* of the model revealed a common concern regarding stakeholder coordination and management, including a potential resistance to change and lack of acceptance of assessment results, especially from the side of policymakers. While the model design cannot solve these concerns, this feedback informs recommendations for practical implementation in the next section.

5. Discussion and implications

The proposed maturity assessment model, including the application of technology, offers valuable potential for destinations, particularly those with limited resources, to prioritise areas for development strategically and, based on that, allocate public funds efficiently, thereby enhancing tourism planning and management (Punzo et al., 2022). The model's outcomes can contribute to effective governance for sustainable tourism through various means, including the definition of rules and guidelines, policy evaluations, establishment of adequate regulatory and legal frameworks, destination and site management plans, contingency plans, standards and practices to monitor safety and security, and policies promoting socially beneficial tourism initiatives (Punzo et al., 2022; UNWTO, 2004).

The model's specific emphasis on destination management can help tourism agencies establish a vision and roadmap for developing capabilities to support other tourism stakeholders with training, capacity building, professional and technical assistance or financial incentives to make changes towards a more sustainable future. Moreover, tourism agencies can use the assessment results to drive further knowledge-sharing and innovation processes by connecting the different stakeholders in the tourism sector or building partnerships or joint venture arrangements (Dwyer & Kim, 2003; UNWTO, 2004), and therefore, move from sustainability as a mere marketing claim towards establishing credibility and public accountability (Ivars-Baidal et al., 2021).

However, successful implementation of the model hinges on a receptive mindset among stakeholders and decision-makers (Dodds, 2007). The use of the maturity assessment model and the related potential for internal and external benchmarking can help as a vehicle to break up old views and institutional patterns. Applying a participatory approach to the implementation of the model, supported by change management, transparent communication and stakeholder engagement, the review and evaluation of the destination should ideally become an intuitive part of continuous improvement and strategic development of the destination instead of a one-time performance assessment (Warnecke et al., 2019).

Global advances in connectivity and data availability pave the way for DMOs and tourism agencies to evolve into data-driven organisations. Embracing technology and building analytical capabilities as part of their development strategy will enable them to become drivers for change

and foster not only a progression towards higher maturity levels but a continuous improvement and sustained competitiveness of their destination.

6. Conclusion and future recommendations

Following a design science research approach, we developed a maturity assessment model for sustainable tourism based on a literature review, which informed the objectives of the model, its dimensions, sub-domains and maturity levels. The eloped Excel tool assesses the sustainability of tourism destinations across four dimensions and related sub-domains and supplies different graphical visualisations of current and desired future maturity levels, resulting in maturity gaps and priority areas for improvement, including potentially relevant metrics. With the first maturity model of this scale developed in its domain, we demonstrate how methods and artefacts from different scientific backgrounds can be combined and leveraged to enhance decision-making and planning for sustainable tourism destinations.

Limitations to the research may be found because the study is conceptual, and more in-depth validation and practical application would be required to iterate and further advance the model design. Empirical testing of maturity models and the underlying assumption of maturity as a linear progression towards the better has so far been problematic in academic research (Becker et al., 2010), hence, findings of current models can only be considered preliminary and tentative conclusions. Despite the rigorous process applied to review existing assessment models, the adoption of a qualitative approach to derive the sustainability dimensions and sub-domains in this study has the inherent risk to introduce subjectivity (Roberts & Tribe, 2008). As such, the model dimensions and sub-domains must not be considered exhaustive. Within the qualitative model validation process, this study conducted multiple interviews with tourism experts and stakeholders in the region of Algarve. Despite the fact that the DSR paradigm approves of the use of a qualitative evaluation of the designed artifact, the results of the validation phase could be regarded as relatively subjective. With time as a scarce resource for the development of the study, the validation had to be limited to a relatively small number of five tourism experts and stakeholders with limited timeframes for each interview. Although the inclusion of academic experts as well as tourism stakeholders intended to blend different viewpoints on the subject of sustainable tourism assessments, the small sample and unitary cultural background implies a limitation on the generalization of the model validation. A next step for the further development of the model would be to expand on the evaluation of the design process, by e.g. conducting interviews with a larger sample of experts and tourism stakeholders, in addition to potential quantitative analyses (Venable et al., 2016). In order to establish the generalisability of the model, the evaluation may entail its deployment and testing in different use cases. Insights into the practical application and whether it truly facilitates destination management and planning need to be fed back into the model design.

As a final note, the topic of sustainability itself as well as the application of ICT for sustainable tourism are fluid and ever-evolving; therefore the developed maturity model will need to be continuously maintained to ensure that the dimensions, sub-domains and definitions of maturity progress and stay relevant over time.

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Data availability statement

Due to ethical reasons, supporting data for this research is not available.

Disclosure statement

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ORCID

Hannah Carolin Franz  <http://orcid.org/0009-0000-3145-402X>

Ana Rita Cruz  <http://orcid.org/0000-0002-3723-4682>

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