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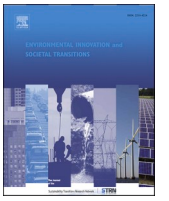

Research article

A participatory systems mapping approach for sustainability transitions: Insights from an experience in the tourism sector in Portugal

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ABSTRACT

The use of participatory modelling approaches in sustainability transition studies has been limited despite its potential contributions to transitions research. In this article, a methodological framework was designed based on a Participatory Systems Mapping (PSM) approach to structure and frame sustainability problems in transition management processes. The framework comprises three phases: 1) transition framing and actor selection, 2) PSM transition workshop, and 3) synthesis and evaluation. In a case study of the Portuguese tourism sector, participants created a shared systems view of tourism sustainability issues, based on the development of causal loop diagrams. Transition concepts, such as landscape-regime and niche-regime interactions, are specified in the diagrams. The PSM approach also provided a collaborative platform for co-creation of shared sustainability visions, thus fostering formalisation of a broad roadmap for desired transition pathways.

1. Introduction

Sustainability transition studies represent an emerging research field focusing on understanding the dynamics and governance of wide and radical shifts in society aiming to address sustainability problems (Köhler et al., 2019; Markard et al., 2012). Köhler et al. (2019) published a research agenda for sustainability transitions, identifying diverse gaps in literature and research pathways, which include potential synergies with other research areas. As a transdisciplinary research field, sustainability transitions studies benefit from the application of methodologies matured in other research fields, which may be adapted to further advance development of transitions theoretical concepts and empirical applications (Markard et al., 2012). For instance, ecological economics and sustainability transitions studies share core principles, such as a systemic perspective and a focus on stakeholder engagement (Costanza, 2020; Köhler et al., 2019), thus supporting the rationale for advancing research on participatory methods in both fields (Halbe et al., 2015; Videira et al., 2017).

Transition Management (TM) scholars have highlighted the role of reflexive governance processes to understand the dynamics of transitions, through learning-by-doing experiments, which enable long-term thinking and adaptation (Kemp and Loorbach, 2006; Rotmans and Loorbach, 2008). A typical TM cycle unfolds different types of governance activities – strategic, tactical, operational and reflexive (Loorbach and Wijsman, 2013). The strategic level, for example, comprises problem definition and co-creation of

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sustainability visions and transition pathways, in the context of a transition arena (Frantzeskaki et al., 2012; Rotmans and Loorbach, 2008). It provides the background for an holistic view of the system to guide experiments (Kemp and Loorbach, 2006; Loorbach et al., 2017; Loorbach and Rotmans, 2010). Nonetheless, the design and organisation of participatory processes supporting transition governance activities remains a challenging task as there are still few tried-out guidelines, methods and tools to operationalise such processes (Frantzeskaki et al., 2012; Halbe et al., 2015; Hyysalo et al., 2019).

Against this backdrop, participatory modelling methods are being increasingly studied to understand their role in supporting governance approaches aiming at a purposeful facilitation of sustainability transitions (Halbe et al., 2020, 2015; Holtz et al., 2015). Participatory modelling is hereby generically understood as any type of involvement of stakeholder groups in conceptual and quantitative model building and use (Videira et al., 2017).

Conceptual modelling is useful in the definition of theoretical underpinnings of sustainability transitions studies. It provides an overview of the system, typically through the construction of causal loop diagrams (Halbe et al., 2015; Holtz et al., 2015). Conceptual modelling enables a shared understanding of sustainability problems by addressing complexity, anticipating long term systemic effects and allowing a qualitative analysis of problems across scales and disciplinary fields. The system is represented by a structure that includes elements (which are the nodes) and interactions, represented by the links between the elements, allowing the analysis of the network structure (Holtz et al., 2015). Conceptual modelling has been used to improve the understanding on Multi-Level Perspective (MLP) concepts, such as demonstrated in the application of system dynamics to test specific transition pathways (Papachristos, 2011). In this study, conceptual modelling was used to map a generic, high level representation of key variables, providing a base structure to build a simulation model on the interaction between regime and niche levels. Quantitative modelling often formalises conceptual models so that behaviour over time of variables is computed. For example, Auvinen et al. (2015) have explored the use of system dynamics in the evaluation of different transition policies over time, through simulation models. This type of application allowed to anticipate long-term systemic effects, such as dynamic policy interactions. Both conceptual and quantitative modelling exercises show potential to contribute to the creation of formal descriptions and less abstract definitions of transition concepts, thus reducing their ambiguity (Halbe et al., 2015; Holtz et al., 2015; McDowall and Geels, 2017).

In participatory modelling processes, a necessary preparatory stage of stakeholder identification and selection typically precedes collaborative modelling activities (Videira et al., 2017). Subsequently, selected participants engage in group debates wherein the underlying assumptions of models are made explicit and visible, setting the ground to discuss these assumptions according to different stakeholders' perspectives and values. Differences in the conceptualisation of variables and their interrelationships are brought to light to be openly discussed, allowing identification of roots of disagreement and reaching settlements (Holtz et al., 2015). This process promotes communication and the development of a common language that is instrumental in the creation of shared understanding and social learning in the scope of transition governance processes (Holtz et al., 2015; Loorbach et al., 2017; Rouwette and Vennix, 2006). It also increases the legitimacy and acceptance of the co-produced model among the stakeholders involved (Holtz et al., 2015; Rouwette and Vennix, 2006).

In transition studies, participatory modelling has been recently explored, for example, as an element of the methodological framework developed by Halbe and Pahl-Wostl (2019), aiming to conceptualise sustainability transitions as multilevel learning processes. Despite increasing experimentation with participatory modelling methods, a comprehensive review by Halbe et al. (2020) shows that these approaches are not consistently applied across the different phases of transition governance processes. More specifically, modelling methods are seldom applied at the inception phase of integrated knowledge production and problem definition.

Hence, this paper aims to address this gap by developing and testing a participatory modelling framework to structure sustainability problems in a transition context. We focus in particular on a conceptual modelling approach – Participatory Systems Mapping (PSM) – which has been applied in the context of ecological economics studies using causal loop diagrams to foster learning and knowledge co-creation in framing and defining sustainability problems, as well as designing and assessing possible solutions (Sedlacko et al., 2014; Videira et al., 2009 2017). Our specific goals while exploring the role of participatory modelling are twofold: 1) develop a procedure for iterative problem structuring at a strategical level of TM processes, and 2) using conceptual modelling to specify transition concepts in a participatory setting. Despite focusing on problem scoping tasks, the proposed framework establishes connections to other phases of transition governance processes, namely stakeholder selection and participatory visioning. Concomitantly, a reflection will also be provided in connection to other research gaps in transition studies. These include the criticisms to the focus on frontrunners and challenges in stakeholder selection criteria (Hölscher et al., 2018; Hyysalo et al., 2019; Voß et al., 2009), as well as the weak link between transition studies and learning theories (van Mierlo and Beers, 2020; Van Poeck et al., 2020).

The article is structured as follows: section 2 presents the proposed methodological framework and details the theoretical background supporting its assumptions; section 3 describes the case study of tourism sustainability in Portugal, along with the results from implementation of the methodological framework; section 4 presents the discussion of results; and finally, section 5 summarises key conclusions and further research pathways.

2. From research gaps towards a methodological framework

The proposed methodological framework is anchored on PSM – a participatory modelling approach comprising the development of group model building activities through the engagement of stakeholders in the joint construction of Causal Loop Diagrams (CLDs). PSM typically fosters insights on a specific dynamic problem and promotes knowledge exchange (Sedlacko et al., 2014; Videira et al., 2012). This approach is proposed as a tool to structure problem definition and integrated knowledge production at the strategic level of a transition management process (Halbe et al., 2020; Kemp and Loorbach, 2006; Loorbach and Rotmans, 2010). Traditionally, this level of the TM process is characterised by the selection of frontrunners and constitution of a transition arena where sustainability problems

are discussed, contextualised and structured. Subsequently, actors involved in the transition arena also develop visions on desired futures and define transition pathways in order to achieve envisioned futures (Hyysalo et al., 2019; Kemp and Loorbach, 2006).

PSM usually allows to address complex and unstructured problems, as demonstrated in diverse applications to environmental and sustainability issues. Some examples include mapping maritime problems in collaboration with stakeholders (Videira et al., 2012), generating insights among researchers and policy-makers into sustainable consumption problems (Sedlacko et al., 2014), creating an integrated overview of degrowth proposals and possible transition pathways (Videira et al., 2014) and conceptualising stakeholders perceptions on the provision of ecosystem services (Lopes and Videira, 2015).

Diagrams such as CLDs are systems thinking tools able to represent group or individual perceptions, mental models and understanding of problems. CLDs allow to conceptualise and frame issues, through the representation of feedback mechanisms using variables and causal chains between variables. Causal relationships can have positive or negative polarities, depending on whether variables change in the same or opposite direction, respectively. Feedback loops are formed by a group of causal relations that contribute to magnify (reinforcing loop) or to stabilise (balancing loop) the initial state (Lane, 2008). The construction of the CLDs follows the sequence proposed by Videira et al. (2012), where participants select a key problem variable and add causes and consequences to the selected central concept. Finally, participants identify feedback loops by linking consequences to causes.

Fig. 1 provides an overview of the proposed methodological framework, in which PSM is adopted as the core method. Dark grey shading identifies the core phases of the PSM approach, while the elements represented in light grey are linked to the relevant gaps in the transitions research field addressed by the framework. Blocks with a full line border detail activities extensively discussed in the following sections, based on the results from the PSM transition case study illustrated in this article. The "multiple learning loops" block (represented with a dashed line) addresses potential contributions of the overall process to research gaps related with learning outcomes, for which a preliminary reflection is provided based on the case study findings (see Section 4). Phase 1 comprises the activities depicted in the block "Stakeholder identification and selection", while the block "Mapping transition concepts" is addressed in both Phase 2 and 3. Blocks "Iterative problem structuring" and "Multiple learning loops" comprise activities cross-cutting all phases of the methodological framework. The following subsections describe into more detail each methodological contribution of the proposed framework.

2.1. Stakeholder identification and selection

This block focuses on the identification and selection of stakeholders considering agency and power issues identified in transition research. It also links to the first phase ("Transition framing and actor selection") proposed in the methodological framework in Fig. 1. Traditionally, transition management processes rely on the contributions of frontrunners. Frontrunners are visionaries, with an open mind and capable of working outside their area of expertise, that are prone to develop creative and innovative ideas for experimenting (Kemp and Loorbach, 2006; Loorbach and Rotmans, 2010). This concept can also be applied to business context, where frontrunners are defined through their strategic approach to sustainability focused on the implementation of innovative practices aligned with the business value proposition, moving far beyond legal compliance and mitigation of negative impacts (Loorbach and Wijsman, 2013; Porter and Kramer, 2006)

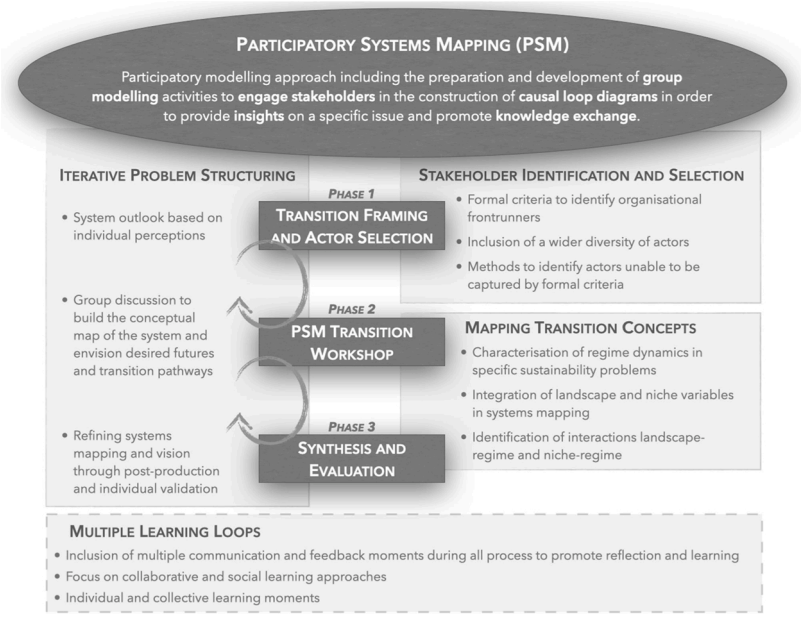


Fig. 1. Schematic representation of the proposed methodological framework, including the three phases of the PSM approach and key contributions to sustainability transitions research.

Critics to transition management approach for overly focusing on frontrunners brought the attention to issues such as stakeholder agency and power (Hölscher et al., 2018). These issues were addressed in the pilot testing of the proposed methodological framework by striving for a more inclusive process of stakeholder identification and selection. Thus, along with frontrunners, other relevant stakeholders to the sustainability problem at hand were considered.

Identifying business frontrunners is a challenging task due to the difficulty of defining criteria that translate innovative approaches towards sustainability. Thus, an iterative process resulting from the combination of two procedures is proposed (Reed, 2008): 1) selection of formal criteria, such as identifying stakeholder groups that have adopted voluntary management tools to improve social or environmental performance and 2) promotion of a snowballing stakeholder identification process. The first procedure allows the identification of organisations committed to at least one dimension of sustainability; while the second contributes to the identification of companies recognised by peers as sustainable businesses working on breakthrough innovations. The same procedure should be applied to other actors included in the process along with frontrunners.

On the one hand, the possible bias of the final selection of actors due to the application of the snowballing method (Reed et al., 2009) is balanced through the use of more independent criteria. On the other hand, the possible lack of local contextualisation and ability of these formal criteria to identify disruptive innovations is balanced by the snowballing peer-referral approach.

The snowballing method is operationalised during preparatory interviews with invited stakeholders from business sectors, non-governmental organisations (NGOs), and governmental agencies (Reed et al., 2009). Interviewees are asked about additional relevant actors to be considered for the PSM transition process, as well as for suggested background documents and regulatory frameworks setting the institutional context. A free-form analysis may be applied to the results from the preparatory interviews, such as described in Harding and Whitehead (2012). Other methods for qualitative data analysis may be used to perform this task.

Combining different methods in stakeholder analysis and selection increases the consideration of a greater diversity of perspectives, providing a richer environment to structure sustainability problems. Broadening the scope to include other relevant actors beside frontrunners sets the ground to a more inclusive process (Reed, 2008). Also, developing a detailed analysis of stakeholders, supported by preparatory interviews and document analysis, sets the background to foster social learning throughout the process (Pahl-Wostl, 2006).

2.2. *Mapping transition concepts*

Modelling processes and participatory models potentially contribute to deepen the understanding on sustainability transitions through, respectively: the creation of a common language that is clear, explicit and systematic; and, increased understanding on elements of dynamics in complex systems, such as feedback, causal loops and time delays (Holtz et al., 2015; Videira et al., 2012). Thus, system dynamics is a promising modelling approach to further study sustainability transitions (Papachristos, 2019), providing tools to both deepen the understanding of transitions theories and expand the impact of research (Halbe et al., 2015; Holtz et al., 2015).

In this context, the contribution of participatory modelling to sustainability transition studies has been underexplored, in particular, to facilitate learning in articulation with TM and MLP (Halbe et al., 2015; Holtz et al., 2015; Köhler et al., 2019). Aiming to explore this potential, the methodological framework fosters the inclusion of core sustainability transition concepts in the structure of

Table 1
Definitions of regime, landscape and niche applied in the methodological framework.

Regime	• Represents the mainstream and institutionalised way of delivering societal functions, relying on a set of shared cognitive routines and rules embedded in knowledge, practices, organisational governance structures, manufacturing processes and product characteristics. • Comprises incumbent actors. • Is characterised by a dynamic stability, based on incremental and path dependent innovation, which may be destabilised by landscape tensions.	(Geels, 2002; Geels and Schot, 2007; Papachristos, 2011; Smith et al., 2010; Sorrell, 2018)
Landscape	• Represents the external structure or context, including heterogeneous physical, political, economic and cultural factors. • Change processes are beyond the direct influence of actors. • Influences the regime usually through gradual change but also through short-term shocks.	(Bui et al., 2016; Geels, 2002; Geels and Schot, 2007; Papachristos, 2011; Smith et al., 2010; Sorrell, 2018)
Niche	• Represents a protected incubation space, characterised by radical innovation emerging unstable and unable to compete in markets, due to relatively low performance and high costs. • Comprises diverse types of learning processes (learning by doing, learning by using and learning by interacting) and innovation (technological, social or/and organisational). • Are supported by small, unstable and fragile networks following flexible and contested rules. • Actors have more agency and freedom, though less power, so need to be more persuasive. • Frontrunners are key actors in the creation of innovation spaces and networks.	(Bui et al., 2016; Geels, 2002; Geels and Schot, 2007; Loorbach and Rotmans, 2010; Smith et al., 2010; Sorrell, 2018)

the workshop exercises (linking to phase 2 "PSM Transition Workshop" of the methodological framework in Fig. 1). Thus, a clear definition of regime, niche and landscape must be provided to participants, as detailed in Table 1.

After these concepts are explained, participants are invited to identify in the CLD variables related to the concepts of landscape and niche. The direct application of these concepts in the construction of CLD may require a narrower approach to the concepts, due to their particular applicability in a specific context. The remaining variables characterise a regime configuration regarding a specific problem, exploring the dynamics associated to that problem and providing a dynamic characterisation of the regime.

Supporting documents are provided to participants aiming to facilitate the understanding on the transition concepts transmitted and to inspire the integration of landscape and niche variables in the developed CLDs. The elaboration of these supporting materials should follow clear rules to avoid misleading participants. For example, supporting materials related to the landscape may be developed according to scientific and policy literature on major global and regional trends, while those regarding the niche may be anchored on the results from the preparatory interviews, through the identification of relevant initiatives aiming to promote sustainability. During the application of the framework it is relevant to keep in mind that supporting materials should remain a source of inspiration and illustration of transition concepts, although they may not cover the full spectrum of the theoretical concepts initially presented to participants.

The identification of landscape and niche variables and their integration in the CLDs reduces the level of abstraction of these concepts, allowing participants to internalise the theoretical concepts underpinning sustainability transitions. In some cases, landscape and niche variables may have been included already in the CLD built during the initial workshop exercise. In those cases, this may lead to a repositioning of the variables along the landscape-regime-niche layout (see Fig. 4). In other cases, participants may include new variables in the initial CLD associated to landscape or niche levels. This integration requires a discussion and the identification of causal relations between regime variables and both landscape and niche variables. This activity potentially builds ground to analyse niche-regime and landscape-regime interactions from a new perspective, bringing to light hidden causal relations and feedback loops.

Additionally, systems diagramming with differentiated landscape and niche variables provide a smooth transition between problem structuring and the subsequent backcasting exercise, where participants are invited to develop a desired future vision for the sustainability issue under study and the roadmap to achieve such vision. The introduction of MLP concepts in the construction of CLD may force participants to reflect on key factors influencing the regime. Thus, at the end of the conceptual diagramming process, participants may not only have co-created a diagnosis on the current state of the system, but also discussed potential stabilising or/and changing drivers. This reflection, along with leverage points exercise are expected to contribute to an holistic view of sustainability problems that leads to more informed and structured future visions.

2.3. *Iterative problem structuring*

Participatory modelling approaches, such as PSM, are commonly developed in three phases: preparation, workshop and follow-up (Videira et al., 2017). Thus, the proposed methodological framework includes in each phase activities aiming at structuring and contextualising sustainability problems, by adopting diverse methods to collect, gather and analyse information.

The initial collection of key information is obtained through the set of preparatory interviews with multiple stakeholders (Pahl-Wostl, 2006; Videira et al., 2012). The main goals of these interviews are twofold: 1) acknowledge different perspectives on sustainability issues, through the identification of stakeholder perceptions on major challenges, problems, causes, consequences and initiatives; 2) collect actors' contribution to the identification of key sectorial actors to involve in the process (Videira et al., 2012), as discussed in subsection 2.1. The analysis of the results obtained in the preparatory interviews rounds up the first step of problem contextualisation and structuring process by providing an overview of sustainability problems based on stakeholders' contributions. These activities are comprised in the "Transition framing and actor selection" phase of the methodological framework (Fig. 1).

The "PSM transition workshop" phase (Fig. 1) comprises the organisation of a participatory modelling workshop, where stakeholders are invited to discuss the sustainability issues characterised in the interviews' results, through the construction of CLDs (Kallis et al., 2006; Videira et al., 2012). Participants are divided into thematic groups tackling the relevant sustainability issues identified in preparatory interviews (Videira et al., 2014, 2012). In a first round of systems mapping, results from the interviews are used as input and guidance to the identification of major problems, causes and consequences. A second round of CLD co-creation is foreseen after introducing MLP concepts to participants. In this round, the goal is the identification of landscape and niche variables, inspired by major trends and initiatives influencing the problems modelled in the initial round. More details on mapping transition conceptsare are provided in Section 2.2. Finally, participants vote on leverage points, identifying key places where a small change potentially produces a broader change in the whole system (Meadows, 1999).

The participatory modelling workshop includes also a backcasting exercise, aimed at eliciting visions of desired futures and transition pathways towards sustainability. Backcasting is a useful method to deal with complex problems by looking into major system changes in a long-term horizon (Dreborg, 1996). Participatory backcasting promotes deliberative choices and has been applied in diverse contexts (Vergragt and Quist, 2011). As an example, Robinson et al. (2011) describes the application of different tools in participatory backcasting exercises to involve citizens in vision development.

The methodological framework proposes a backcasting procedure that includes an initial visioning exercise to build a desired future vision, followed by the definition of an action plan or roadmap based on goals, risks and uncertainties, measures, instruments, and key actors. This simplified approach is in line with the modular participatory backcasting framework proposed by Pereverza et al. (2019). The flexibility of their modular framework allows to adjust the backcasting exercise to socio-cultural contexts and project limitations, such as time availability. The development of possible future scenarios fosters social learning (Pahl-Wostl, 2006) and consequently has potential to improve understanding on the sustainability problem being discussed.

The "Synthesis and evaluation" phase (Fig. 1) is composed by two activities: 1) evaluation of the process and outcomes of the participatory modelling workshop; 2) post-production of the results obtained in the participatory modelling process (Lopes and Videira, 2015; Sedlacko et al., 2014; Videira et al., 2017).

For evaluation purposes, a group reflection and a post-workshop questionnaire are proposed to collect participants' feedback on the PSM event, process and results (Lopes and Videira, 2015; Videira et al., 2017). Post-production is an iterative process encompassing alternation between inputs from participatory events and inputs outside these events (Sedlacko et al., 2014). This activity aims at improving the quality and usefulness by refining and consolidating workshop results (Lopes and Videira, 2015; Sedlacko et al., 2014). Post-production includes both format and content editing: the former through the digitalisation of the CLD and results from the backcasting exercise; and the latter by the introduction of small changes to better translate group discussions into the CLDs. The modified versions of the CLD should then be validated again by participants to guarantee its alignment with group discussions and allowing the reflection on the overall results, while accommodating potential additional contributions to those collected in the workshop. Validation also includes a second round on the identification of leverage points (Lopes and Videira, 2015; Videira et al., 2012). The final step of the post-production is the analysis of the final version of the CLD, along with the results from the backcasting exercise.

2.4. Multiple learning loops

From a sustainability transitions perspective, learning is a key outcome in multiple stages of the transition, such as the facilitation of transition arenas and niche experimentation (van Mierlo and Beers, 2020). Transition arenas are key elements at the strategic level of the transition management process, where actors are challenged to frame and structure sustainability problems, as well as build visions and transition pathways (Kemp and Loorbach, 2006; Loorbach and Rotmans, 2010), which are the tasks included in the proposed methodological framework.

The PSM approach extends the timeframe of analysis of sustainability issues during the participatory process so that one of the expected outcomes is collaborative learning on problem dynamics (Videira et al., 2017). The learning process relies on a dichotomy between individual and collective learning. Individual learning is promoted through communication of the results from preparatory interviews, and validation of workshop results in the CLD post-production process. Providing feedback on interviews' results to stakeholders before the participatory workshop allows them to confront their perceptions with a wider pool of perspectives on the system. In the validation process, stakeholders receive a final version of the CLDs drafted during workshop exercises. They are granted opportunity to reflect on preliminary results and acknowledge causal relationships and feedback loops which were eventually underexplored during group discussions.

Although learning is a key expected outcome in PSM approaches, it should be noticed that the case study presented below focuses on the evaluation and discussion of outputs from phases 1–3 of the proposed methodological framework. A thorough evaluation of the outcomes related with the 'multiple learning loops' component is outside the scope of this article.

3. Applying the methodological framework to a case study

3.1. Case study description

The methodological framework (Fig. 1) was applied and tested in the tourism sector in Portugal, through the organisation of a PSM exercise envisioning a sustainability transition and aiming to validate the assumptions underlying its development. The illustrative application of the methodological framework focuses mainly on the elements "Iterative problem structuring" and "Mapping transition concepts", while providing reflections on the implementation of the components "Stakeholder identification and selection" and "Multiple learning loops".

The tourism sector in Portugal has been cornerstone in the country recovery after a long period of economic and social crisis, through the promotion of economic development and increasing its weight in the Portuguese economy (Statistics Portugal, 2019). Also, the national tourism authority – Turismo de Portugal – has elaborated in 2017 a strategy integrating sustainability goals for the sector toward 2027 (Turismo de Portugal, 2017). This strategy provides a blueprint for the transition of the sector towards sustainability. It was elaborated with the participation of several stakeholders through focus groups, strategic labs and public consultation. The strategy envisages promotion of the country as a competitive and sustainable destination, setting targets for selected social, environmental and economic indicators.

From the transitions research point of view, the tourism sector has been scarcely studied. The sector is deeply connected to key socio-technical systems, such as transportation, construction or energy production. The structural dependency on other systems confers an unique profile when focusing on the potential to explore multi-regime interactions. The development of multi-regime perspectives on transition studies is a gap needing further exploration (Köhler et al., 2019; Papachristos et al., 2013), despite initial work already developed, such as described by Raven and Verbong (2007).

Regarding the sustainability agenda, tourism has been growing in the last decades at a global level, with evidences of building environmental and social pressures (Penz et al., 2017). Greenhouse gases emissions from travelling, as well as increased levels of pollution and pressures on ecosystems are associated with high inflow of tourists (Boley, 2015). As a consequence of local accommodation expansion in cities, real estate and rentals prices increased, forcing residents to move out of city centres (Fletcher et al., 2019). The inclusion of specific indicators and targets for tourism in the 2030 Agenda and Sustainable Development Goals (SDGs) from the United Nations is an evidence of the relevance of the sector in transitions towards sustainability. Goals 8, 12 and 14 ("Decent work

and economic growth", "Responsible consumption and production" and "Life below water", respectively) pinpoint tourism directly, although the sector contributes to many other SDGs indirectly (World Tourism Organization, 2019).

Along with the integration of tourism in the international sustainability agenda, the sector provides a rich background to support sustainability debates. First, a great share of tourism services are connected to nature or rely on ecosystem services, reinforcing the need for sustainable approaches, as discussed by Panzer-Krause (2018). Second, the sector is characterised by a high number of small businesses, that compete with each other while being mutually interconnected to provide a quality service to tourists (McKercher, 1999). This type of business environment associated to the reinforcement of tourism as a response to the 2008 global economic crisis led to the rise of new ways of doing business, such as digital platforms (Fletcher et al., 2019). Third, the relevance of the sector is transversal to multiple geographical scales, from local to global levels. Dilemmas emphasising the relation between local and global dimensions are common, such as tourists travelling to a distant location looking for local experiences, while contributing to the loss of identity in the visited places as described by Fletcher et al. (2019). Fourth, tourism relies on a wide range of other sectors to assure services demanded by customers, thus increasing the level of complexity in the transition towards sustainability (Dimitrios, 2000; McKercher, 1999).

Due to the wide range of activities included in the sector, the scope of the study was narrowed to the accommodation subsector. This is characterised by a wide diversity of organisations, ranging from large hotel chains to local accommodations (Styles et al., 2013), which are recognised in the Portuguese legislation. Despite of this narrower scope, the interlinkages and dynamics established with organisations in other tourism subsectors were not excluded from the analysis.

3.2. Case study results

As depicted in Fig. 2, the case study development was organised along the three key phases of the proposed methodological framework which are described in more detail below: 1) transition framing and actor selection, 2) PSM transition workshop, and 3) synthesis and evaluation.

3.2.1. Transition framing and actor selection results

The initial task of the process was the identification of key actors from the Portuguese tourism sector through the analysis of sectorial documentation (step 1.1. in Fig. 2), leading to the inclusion of the following groups of stakeholders: public administration at multiple levels (national, regional and local), business and tourism associations, accommodation companies with sustainability related values or certifications, and academics developing scientific work on the topic.

Stakeholders were invited for a preparatory interview (step 1.2. in Fig. 2) according to the criteria detailed in Fig. A.1 (Supplementary document). A proximity criterion was applied, prioritising frontrunners and other actors operating in the Lisbon district to facilitate in-person activities between researchers and stakeholders (i.e. conducting interviews and workshop participation). Nevertheless, frontrunners and actors from other regions were also considered mostly when recommended through the snowballing procedure.

The preparatory interviews aimed at understanding stakeholders' perceptions on the current state of sustainability in the tourism sector; identifying other relevant stakeholders, through snowballing; and providing background information for structuring the PSM

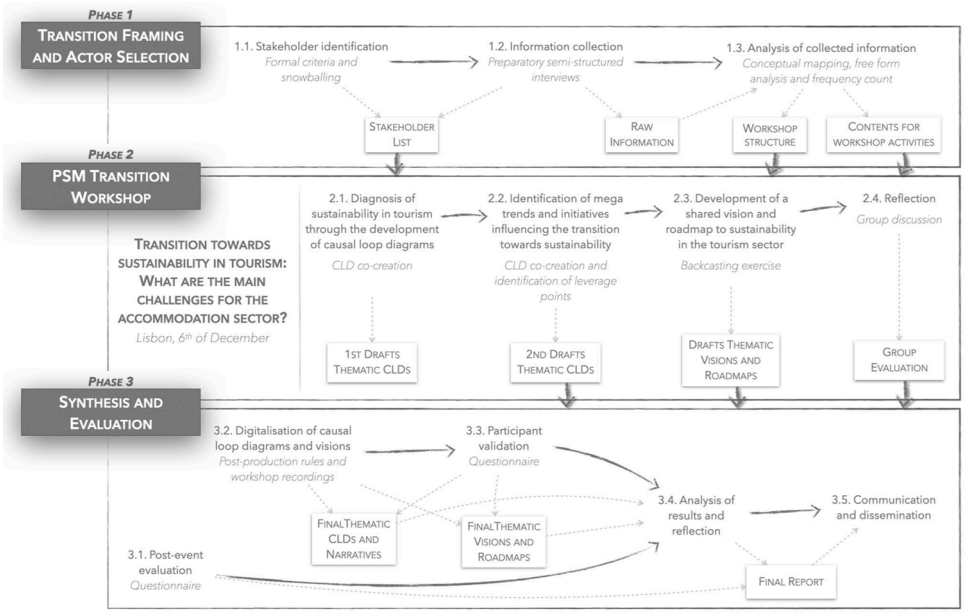


Fig. 2. Step-by-step implementation of the methodological framework in the case study of the tourism sector in Portugal.

workshop. Interviews followed a semi-structured format, allowing interviewees to explore relevant sustainability issues, while ensuring that information about sustainability initiatives, key actors, problems, causes, consequences and solutions to sustainability issues was collected.

Information gathered in preparatory interviews (step 1.3. in Fig. 2) was categorised and clustered through the application of a free form analysis (Harding and Whitehead, 2012). This analysis relies on line-by-line coding, defining meanings in paragraphs, categorisation and conceptual ordering, providing a detailed picture on sustainability issues and key tourism actors. Sustainability themes mentioned by interviewees were used to organise sustainability problems in the sector, their causes and consequences, as well as niche initiatives. Frequency count allowed the identification of the more problematic sustainability themes from the stakeholders' perspective, as well as of the key tourism actors to include in the process (Figs. A.2 and A.3, Supplementary document). Based on these results, the workshop was structured around three main sustainability themes: 1) water, energy and waste; 2) business ethics and management; and, 3) destination management.

The invitation for the workshop was sent to all stakeholders identified through formal selection criteria or snowballing. A reminder was sent in the week before the workshop, which also included a detailed agenda and a preliminary report on the interviews' results. The PSM workshop took place on the 6th of December of 2019 in Lisbon, gathering 15 participants, from which 7 had been previously interviewed (Fig. 3). Other 29 tourism actors have been interviewed in Phase 1 and were unable to attend the workshop. The preparation phase contributed to the inclusion of a wider diversity of perspectives and worldviews, considering that not all interviewees were able to participate in the PSM workshop.

With the typical PSM goal of representing as much diverse mental models as possible, the added value of the proposed stakeholder identification approach is observed by the diversity achieved in organisational types, ranging from public administration entities to accommodation businesses and academia, as well as by the spread on geographical distribution of participants, despite the initial focus on the Lisbon region.

3.2.2. PSM transition workshop

The PSM transition workshop was structured around three major tasks: 1) diagnosis of sustainability problems in tourism through the development of causal loop diagrams; 2) identification of mega trends and initiatives influencing the transition towards sustainability; 3) development of a shared vision and roadmap to sustainability in the tourism sector.

The first task was preceded by a presentation from the research team, which conveyed relevant results from the interviews to frame discussions, and explained the theoretical background and methodological steps to be followed in the creation of CLDs (step 2.1. in Fig. 2). Support materials were delivered to participants with examples of problems, causes and consequences associated to each sustainability theme collected during interviews. Most participants selected start variables among the list of problems provided as support materials. Two working groups selected more than one inital variable and identified causal relations between them; while the other developed two separate CLDs around two different initial variables.

Previously to the second exercise, the research team introduced MLP and transition concepts of regime, niche and landscape. Participants were asked to identify and introduce new variables at landscape and niche levels, in their thematic CLDs (step 2.2. in Fig. 2). To inspire and guide participants in this task additional supporting materials were distributed: 1) a list of megatrends, inspired by the European Environment Agency (2015) report and 2) initiatives tackling sustainability in the tourism sector mentioned in preparatory interviews. Voting on leverage points provided a smooth transition between CLD construction and the backcasting exercise, by shifting the mindset from problem mapping to thinking on interventions and solutions. A group rotation was included in step

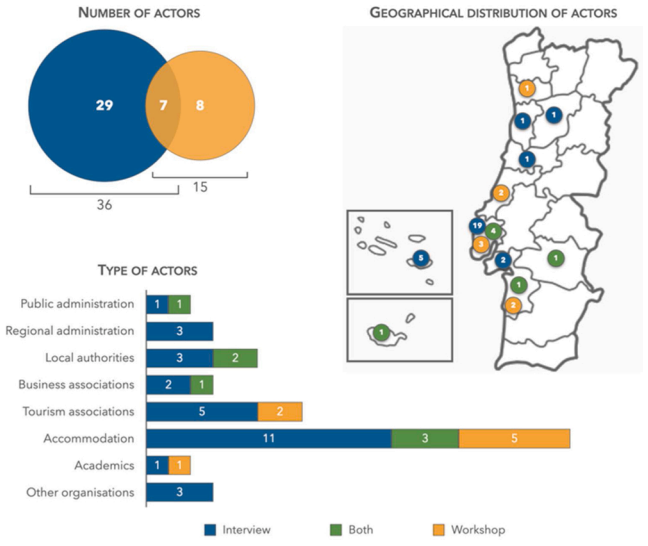


Fig. 3. Characterisation of the participants in the whole process of testing the methodological framework.

2.1., allowing participants to contribute to more than one theme and complement the first-round of discussion. After leverage points voting, participants returned to their original thematic group and performed the backcasting exercise based on the iterated CLD.

The backcasting exercise (step 2.3. in Fig. 2) comprised two key steps: 1) group debate on a shared sustainability vision for the theme, to be achieved by 2040, and 2) sketching a roadmap to achieve the vision, including specific goals, measures, risks and key actors to be engaged in two time periods– i.e. from 2019 to 2030 and from 2030 to 2040. The outputs from this exercise, as well as the CLD produced in the previous exercises are presented in subsection 3.2.3. as a final version (after participants' validation).

The final workshop activity included a plenary group reflection about the methods used in the workshop and how they have contributed to promote learning, systemic thinking and participants' capacity of evaluating sustainability strategies (step 2.4. in Fig. 2). Feedback on the method was very positive with highlights on its interactive nature, which allowed idea exchange among participants. Participants also emphasised the structured and iterative approach followed, which created a logic progression from the initial problem scoping to the operationalisation of solutions discussed in the backcasting exercise. Stakeholders also perceived group rotation as a positive aspect, which enabled complementing CLDs of each discussion group with fresh ideas and perspectives. With respect to the outcomes of the workshop, participants mentioned that the process reinforced the importance of sustainability in tourism and helped to structure problems by representing causal relations and interactions among variables, thus improving systems thinking about transitions. This positive assessment reveals that the proposed methodological framework was found helpful in structuring problems and understanding the consequences of major trends, as well as in the evaluation of sustainability strategies.

3.2.3. Synthesis and evaluation

3.2.3.1. Synthesis. The results from these exercises were digitalised and reviewed after the workshop in a post-production phase (step 3.2. in Fig. 2). The revision of the CLDs was supported by audio recordings of each thematic group discussion and results from preparatory interviews. This led to the calibration of the conceptual diagrams by adjusting some variables and identifying variables, causal relationships and feedback loops which had not been represented in the workshop CLDs. Additionally, CLDs were reviewed according to the transition concepts of regime, landscape and niche, to improve matching of the conceptual elements of each level and the understanding of their interactions. As shown in Fig. 4, the CLD regime structure (i.e. variables, causal links and feedback loops) is represented in black, landscape structure in blue and niche structure in green. Variables framed by a rectangle were identified in the regime building exercise and after classified as being part of the landscape or niche CLD structure.

The workshop small-group discussions led to the identification of more than one problem in each theme, and in most cases, problems were interlinked, as pictured in Fig. 4. This portrays the complexity of the problems at study and made evident the existence of time delays for some causal relationships to materialise. That is the case for the relation between the overload of touristic attractions and locations and the loss of local identity and authenticity, considering for example changes in the type of local market stores due to continuous and excessive tourists flows in a specific place.

The final version of the CLD has multiple feedback loops, identified in the evaluation and synthesis phase. Some of these feedback

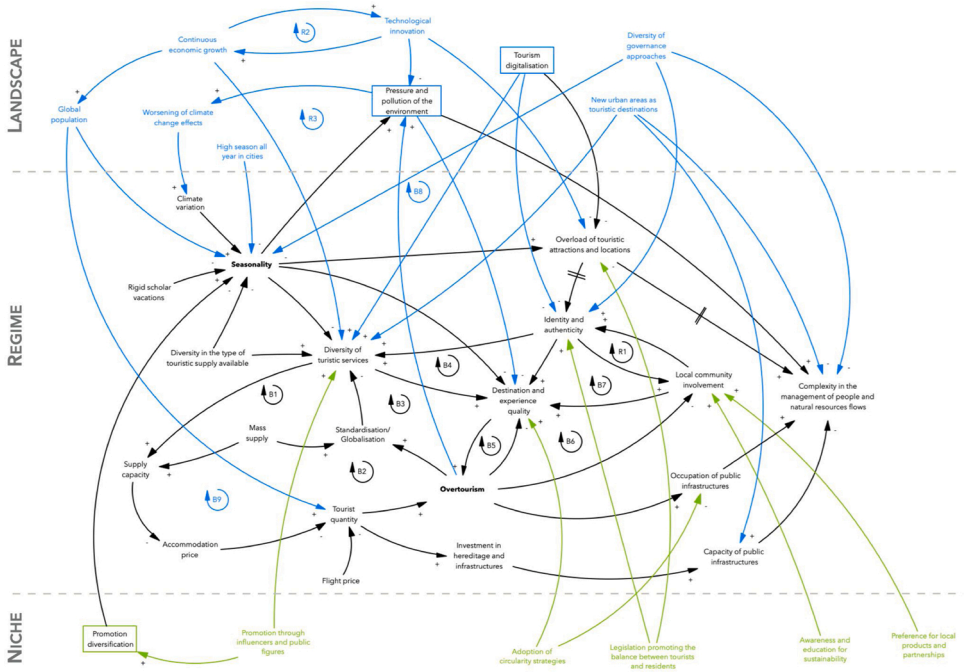
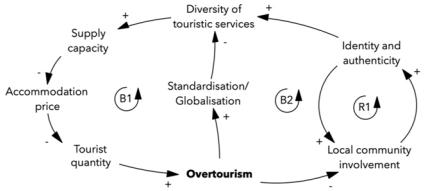
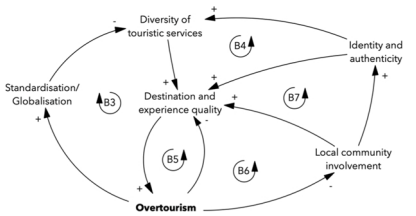
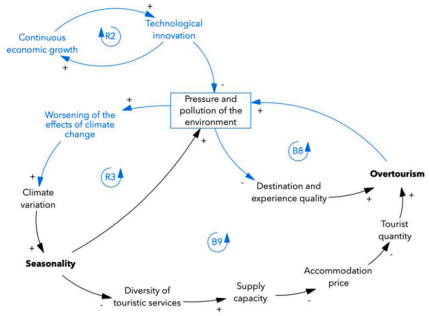


Fig. 4. Final CLD for the theme 'Destination Management'.

loops portray dynamics within the landscape or interactions regime-landscape, providing some insights on how the regime can interact or influence structural trends. The niche level is characterised by exogenous variables (i.e. not dependent of other variables and not structurally included in a feedback loop) influencing the regime. This is a characteristic that is shared among almost all CLDs produced (cf. Figs. B.1 and B.3, Supplementary document), with exception to the diagram on "Food waste" (cf. Fig. B.2, Supplementary document), possibly due to the characteristics of niche experiments. More details on the CLDs co-created under the themes "Water, energy and waste" and "Business ethics and management" are presented in Appendix B (Supplementary document).

Table 2
Narrative and feedback loops of the Destination management CLD.

Regime	In the context of destination management, four core problems were addressed: seasonality, overtourism, maintenance of local identity and authenticity, and complexity in the management of people and natural resources flows. As depicted in the CLD (Fig. 4), participants payed more attention to the conceptualisation of seasonality and overtourism mechanisms. We isolated the feedback loops in Fig. 4 and drew simplified CLDs including only the variables integrating the selected loops. The overtourism increases the standardisation and globalisation, reducing the diversity of touristic services in the destination and consequently its supply capacity. This reduction increases the accommodation price, which leads to a decrease in the number of tourists, reducing the overtourism effect (Balancing loop B1). The loss of diversity of touristic services is also caused by increasing overtourism, considering its negative impact in the involvement of the local community and in the identity and authenticity of the destination (B2). These two variables are interrelated since the loss of destination identity and authenticity leads to reduced involvement of the local community and vice-versa (Reinforcing loop R1). Increased standardisation and globalisation also contribute to the reduction of the diversity of touristic services, leading to less overtourism through a decrease on the destination and experience quality (B3). Overtourism contributes to a lower destination and experience quality, which decreases overtourism (B5). The reduction of overtourism through the reduction of destination and experience quality have three possible causes: decreasing local community involvement (B6), loss of local identity and authenticity (B7) and lower diversity of touristic services (B4).   Overtourism raises the occupation of public infrastructures, such as mobility systems, increasing the complexity in the management of people and natural resources flows. On the other hand, higher number of tourists leads to more investment in heritage and public infrastructures, reducing the complexity of managing of people and natural resources flows. Seasonality is increased by non-flexible scholar vacation periods, low diversity in touristic offer and destination promotion (e.g. predominance of beach destinations), and high climate variation. Destinations with low levels of variation in temperature and rain and temperate weather are able to maintain a constant level of tourism throughout the year. Higher seasonality increases the pressure and pollution on the environment, as well as the overload on touristic locations and attractions, increasing the complexity in the management of people and natural resources flows. The raise in overload on touristic locations and attractions reduces the identity and authenticity of the location, decreasing the destination and experience quality and the diversity of touristic services available for tourists, which also are direct consequences of seasonality. The reduction on the diversity of touristic services is a consequence of the low level of diversity in touristic offer and also decreases the destination and experience quality.
Landscape	Increasing pressure and pollution in the environment worsen the effects of climate change, increasing climate variation, which contributes to higher levels of seasonality in the affected destinations (R3). Higher seasonality also leads to a reduction on the diversity of touristic services, and consequently from the supply capacity. Thus, accommodation prices rise, decreasing the number of tourists in the destination and consequently overtourism and environmental pressure and pollution (B9). Increased environmental pressure and pollution contributes to the reduction of destination and experience quality, leading to a reduction in overtourism and consequently a reduction of the pressure and pollution in the environment (B8).  Increasing technological innovation, such as information technologies, reduces the overload on touristic locations and attractions, as well as environmental pressure and pollution, while contributing to increasing economic growth. In its turn, continuous economic growth increases technological innovation (R2) and the global population. Increasing population leads to more tourists in destinations and consequently, overtourism; however, it reduces seasonality by maintaining high levels of tourism all over the year. This effect is seen in European cities, which have reduced seasonality. Another landscape trend is the increase of digitalisation in tourism, which increases the diversity of touristic services and reduces the overload of touristic locals and attractions, as well as destination identity and authenticity. This variable is raised by digitalisation, through the reduction of touristic locals and attractions overload. The increase of new urban areas as touristic destinations increases the diversity of touristic offer, as well as the capacity of infrastructures, reducing the complexity in managing people and natural resources flows. This complexity is also reduced by the diversity in governance approaches (e.g. articulation between tourism actors), which also reduces seasonality and increases local identity and authenticity.
Niche	At niche level, more promotion of alternative business through public figures and influencers increases the diversification in promotion and reduces seasonality, as well as increases the diversity of touristic services. The adoption of a circularity strategies (e.g. resources reuse and waste separation) increases the destination and experience quality and optimises the occupation of infrastructures. More legislation promoting the balance between tourism and residents reduces the overload on touristic locations and attractions, increasing local authenticity. Increasing sustainability awareness and deduction and the preference for local products and partnerships contributes to a wider involvement of the local community.

Following the revision of workshop CLDs, a narrative was written to facilitate analysis of key causal relationships and feedback loops characterising transition elements. As illustrated in Table 2, this narrative breaks down the feedback loops in each CLD to provide a step-by-step presentation of depicted causal links. One interesting example in the "Destination management" CLD is the balancing loop B9 (which is represented in detail in a graph in Table 2), where the two major problems identified – overtourism and seasonality – are interconnected through landscape variables (climate change). Despite overtourism and seasonality were identified as isolated sustainability problems, the PSM approach allowed the identification of a set of causal relationships that link both problems. Also, this balancing loop was only identified when introduced landscape variables, emphasising the importance of including in the exercise transition concepts, such as regime, niche and landscape. Narratives detailing causal relationships and feedback loops of other themes are included in Appendix B (Supplementary document).

The co-creation of the CLDs provided an holistic perspective on sustainability problems based on hidden causal relationships, while structuring the debates in each theme. Final CLDs provided an integrated view on the current and mainstream sustainability practices in the Portuguese tourism sector to the majority of workshop participants; however, this result is not consensual. The diversity of actors and consequently, backgrounds and worldviews, sets the ground to have different perceptions on the results obtained, including the contributions of the results to the understanding of the regime.

The identification of mega trends facilitated the adoption of a systemic view to most participants, while the integration of niche variables in the CLD contributed to the identification of leverage points to promote the sustainability transition. The value of CLDs in the operationalisation of both landscape and niche concepts is acknowledged by participants, as portraited in Fig. 5.

Participants developed visions for each theme encompassing the diversity of issues beyond the specific sustainability problems mapped in the CLDs, as illustrated in Fig. 6. Stakeholders working on the theme "Water, energy and waste" focused on energy consumption and food waste issues. Their desired vision, however, focused also on issues of resources and energy flows management, including other types of waste and water management.

Goals were mostly focused on increasing efficiency through the definition of quantitative targets and the implementation of measures that were also considered in the CLDs. In this specific case, it is interesting to notice that the risk pointed for the time period between 2030 and 2040 corresponds to a niche variable in the Energy CLD, which is in line with the uncertainty usually associated to niche experimentation. In relation to actors, the emphasis is on public actors, despite including a reference to private actors, which is in line with the results from the preparatory interviews (Fig. A.3 in Appendix A, Supplementary document). Visions and roadmaps developed under the themes "Business ethics and management" (Figure B.4) and "Destination management" (Figure B.5) are presented in Appendix B (Supplementary document).

Comments on the final versions of visions and roadmaps, provided by participants during the validation process (step 3.3. in Fig. 2), highlighted the need for deeper reflection on issues such as pandemic outbreaks, public health and the capacity of public health

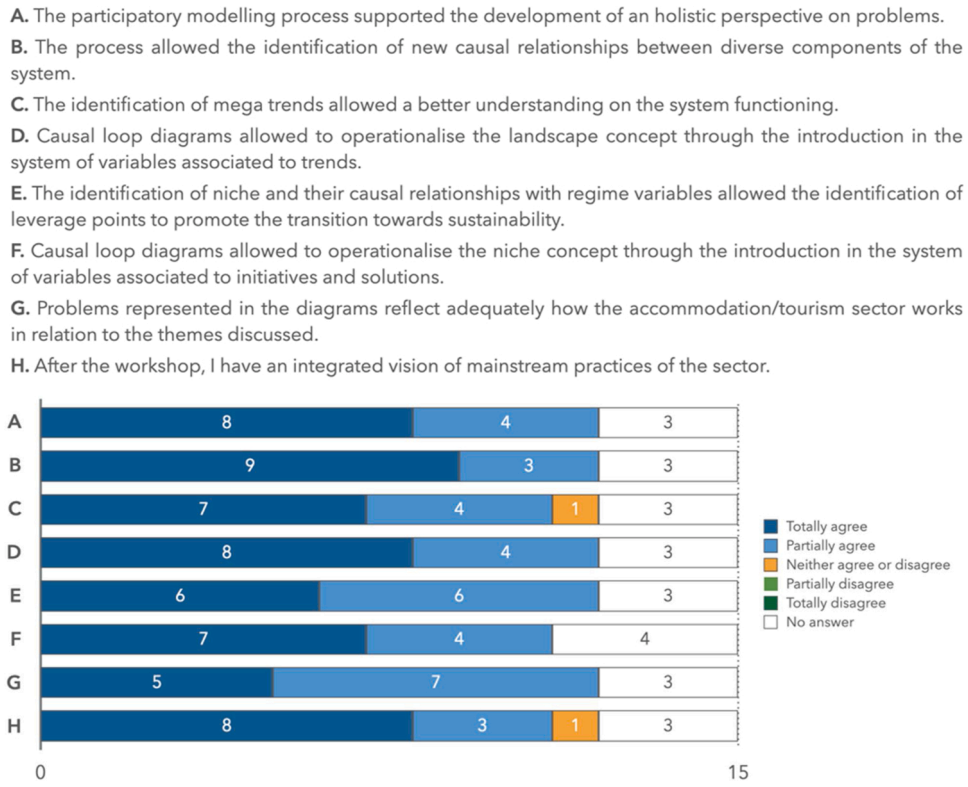


Fig. 5. Participants' feedback on the application of transition concepts during the workshop.

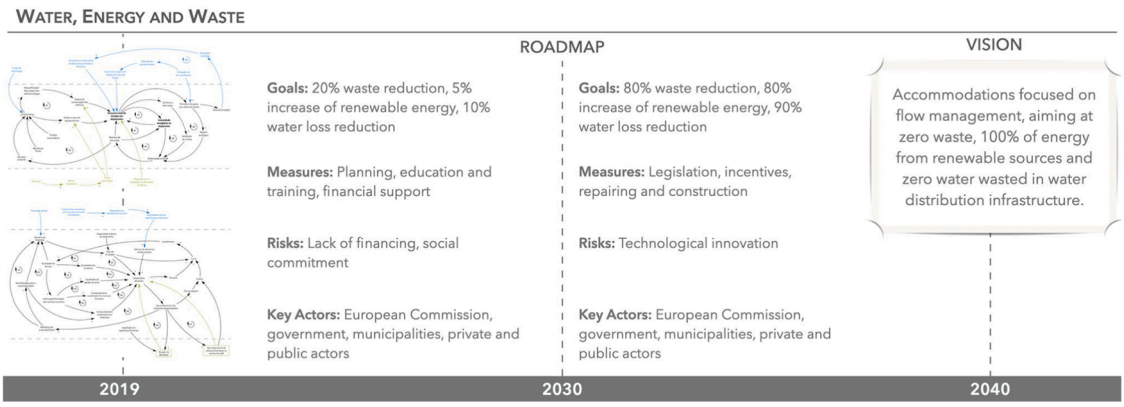


Fig. 6. Final vision and roadmap for the theme "Water, energy and waste".

systems (Table C1, Supplementary document). These issues were barely discussed during the workshop; however, validation took place during the lockdown to control the Covid-19 pandemic, raising the awareness on this type of risks. Further details on the results from the validation questionnaire are described in Appendix C (Supplementary document).

3.2.3.2. Evaluation. The evaluation of the workshop was performed in two distinct moments: at the end of the event, where participants were invited to reflect in a round-table format on the tasks developed and evaluate the whole process (step 2.4. in Fig. 2); and during the post-production stage, through an online questionnaire sent after the meeting (step 3.1. in Fig. 2). The questionnaire was structured into three sections: overall reaction, process and methods applied during the event, and workshop products. Fig. 7 shows selected results of the evaluation questionnaire, while Appendix D (Supplementary document) provides full questionnaire results.

Questionnaire results are in line with the comments received in the reflection moment at the end of the workshop, which was evaluated overall as a positive experience. Suggestions on possible improvements were focused on time management (i.e. more time allocated to each task was suggested), limit the number of tasks planned for each exercise, and integrate more sustainability innovations applicable to the tourism sector. On one hand, there was a perception that more could be done in terms of in-depth debate on the sustainability problems and further development of an implementation plan to achieve the co-created visions. On the other hand, the ambitious number of tasks led to fatigue of participants, who suggested allocating more time to finalise each of the proposed workshop exercises. Regarding positive aspects, respondents mentioned the methodology used and the stakeholders turnout, which allowed to debate different perspectives on the problems due to participants' different backgrounds and experiences. Another positive aspect was the interaction among participants, sharing information and ideas, while thinking collectively in problem framing and

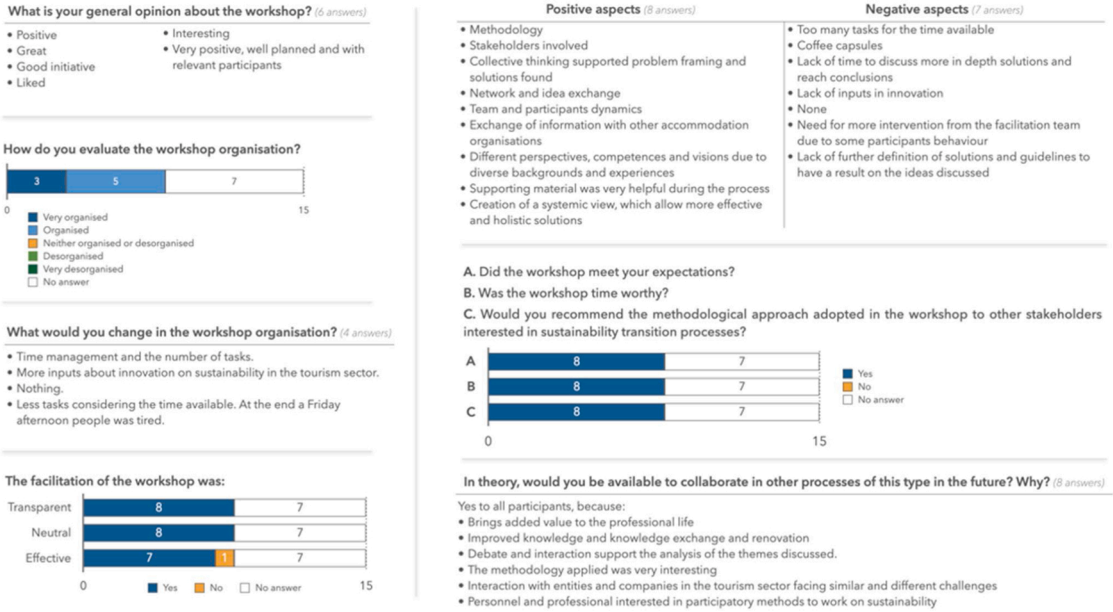


Fig. 7. Key results of the workshop evaluation questionnaire.

structuring and co-creating a systemic view on tourism sustainability transitions. Additionally, supporting materials were mentioned as very helpful to build the CLDs.

Finally, workshop results were gathered into a final report and sent to all the actors involved in process, either through the interviews or the participation in the workshop (step 3.5. in Fig. 2). Along with the acknowledgement of their contributions, was expressed the possibility of further comment on the results and overall process.

4. Discussion

The development and implementation of the 3-stage PSM approach was cornerstone to address the research gaps underpinning the motivation for this study. Preparatory interviews allowed to enlarge the pool of contributors in the participatory transition experiment through the integration of their perceptions in multiple time periods (e.g. workshop structuring and supporting material, CLD revision and validation). The progressive integration of transition frameworks in the discussions allowed participants to assimilate underlying concepts (e.g. regime, landscape and niche) and deal with sustainability transitions complexity. The multiple interaction loop with actors aimed to foster individual and collective learning. Additionally, the interactive PSM approach contributed not only to structuring sustainability issues, as suggested by Halbe et al. (2020); but it also provided a methodological framework to specify transition concepts in the context of the case study.

A key contribution of the methodological framework application was the insights provided about the use of participatory modelling approaches to facilitate stakeholder engagement in a TM process. As suggested by Holtz et al. (2015), the participatory modelling approach allowed the creation of a shared language and an increased understanding on causal relations, leading to structured and systemic view of sustainability problems. This contribution is supported by the feedback received from participants through the evaluation questionnaire (cf. Fig. 5 and Fig. D.1 in Appendix D). These achievements contributed to a structured problem definition, which provided the background to the creation of sustainability visions and pathways (Loorbach and Rotmans, 2010).

During the group reflection moment, participants stated that CLDs were useful to provide insights to the discussion and creation of future visions and pathways. This was enhanced by a sequential design of workshop activities, which aimed to launch an initial debate on specific sustainability problems, compel collaborative idea structuring translated into CLDs, and finally, envision possible problem solutions and pathways.

The co-creation of CLDs, visions and roadmaps was achieved through debate and conciliation of different perspectives into a shared final result, through the identification of a compromise among participants and their different views on sustainability in tourism (Fig. D.1 in Appendix D). The dynamic of each group was different; however, none of the groups required the intervention of facilitators to help to conciliate their different perspectives. The development of shared visions based on consent and compromise solutions is a characteristic of social learning processes valued in transition processes since it sets the ground for the development of diverse experiments (Pahl-Wostl, 2006; van Mierlo and Beers, 2020). The variety of perspectives about the issues discussed was a result of the diversity of actors and points of view, which is an essential feature to deal with the complexity of the sustainability problems, according to Beers et al. (2016) and Pahl-Wostl (2006).

The implementation of an approach combining formal criteria and snowballing allowed the integration of a wide range of actors, considering both the type of organisations and their geographical location. The iterative approach adopted, which included a preparatory stage with exploratory interviews and then the organisation of a workshop, was instrumental to enlarge the pool of actors, collecting and integrating contributions in different formats and increasing the diversity of perspectives and worldviews in the creation of the final results, as discussed in Smith and Stirling (2010).

Enlarging the pool and the diversity of contributors to map sustainability problems and envision sustainable futures and pathways allows the participation of regime actors and incumbent organisations in this process. These actors may hinder the development of disruptive sustainability visions and transitions pathways due to their embeddedness in the regime and hidden agendas (Loorbach and Rotmans, 2010; Smith and Stirling, 2010). In the described case study, some participants reported that the workshop had no effect on their sustainability related capacities (Table D.1 in Appendix D, Supplementary document), which may be an evidence on the loss of disruptive outcomes due to the enlargement of the pool of contributors. However, this result is balanced by the shared perception on the representativeness of workshop participants, in relation to the key actors involved in the sustainability transition of the tourism sector (Fig. D.1 in Appendix D, Supplementary document). The workshop was also perceived as an opportunity for networking and establishing future collaboration relationships. This contribution is in line with the creation of a transition arena as a key feature of a TM process, where a network of actors is engaged in the transition with the goal of structuring and framing sustainability problems and developing transition experiments (Hyysalo et al., 2019; Kemp and Loorbach, 2006).

The case study also provided insights on the potential of the PSM approach to put into practice in a specific context transition concepts of regime, niche and landscape, which are usually perceived as abstract concepts (Halbe et al., 2015). Introducing landscape and niche variables in CLDs, framing the final result into the MLP and identifying feedback loops contributed to understanding dynamics of each level, as well as possible niche-regime and landscape-regime interactions.

Identifying causal relations and feedback loops connecting landscape and regime variables in a given case and local context, provides insights on how landscape and regime elements are mutually influenced. In the case of relationships between niche-regime variables, the potential of niche innovations on changing the regime can be more explicitly highlighted. Where feedback loops are identified, it is also possible to acknowledge how the regime and niche variables are reinforcing or counterbalancing each other. These type of insights is promoted through the proposed approach, thus evidencing the contribution of PSM to the operationalisation of relationships between elements of the MLP framework. Such analysis is yet underexplored in the literature, with the exception of a few studies, such as the one described by Papachristos (2011).

The contribution to a deeper understanding of niche-regime and landscape-regime interactions is particularly interesting in the context of envisioning desirable futures or developing transition experiments. Framing sustainability problems in a transitions perspective, allows the identification of hidden dynamics of the system, which may support scenario development. These insights might be useful for the creation of desirable futures, and most importantly, in the definition of transition pathways. Nevertheless, further work on the application of MLP concepts in conceptual modelling processes is needed to provide more insights on the operationalisation of the proposed approach.

The contribution of the methodological framework to learning outcomes along the stages of a TM process was was not the main focus of the analysis, although the case study application allowed to reflect on some findings. For instance, the settings of collaborative learning described by van Mierlo and Beers (2020) were only partially achieved since the definition of multiple, well-defined tasks was not enough to create a balance between the amount of tasks and time available. Thus, during the evaluation participants mentioned the difficulty in finishing the set of tasks due to fatigue; and the lack of time to deepen the debates and to networking. Regarding the facilitation, the organising team was considered transparent and neutral for all participants and effective for the majority. Participants' perceptions on the creation and exchange of knowledge that occurred during the event are in line with the concept of single loop learning defined by de Kraker et al. (2011). Moreover, the identification of causal relationships and feedback loops was perceived by some participants as a more systemic and structured approach to study sustainability problems, leading to a reframing, which is consistent with the definition of double loop learning presented by de Kraker et al. (2011). This is also consistent with an action research way of doing science (Greenwood and Levin, 2007; Köhler et al., 2019). Further applications of the framework focusing on measuring learning outcomes will be instrumental to provide more detailed insights on this topic.

Despite the positive evaluation received from participants in relation to the methods applied during the workshop, the claim to have additional time for a more in-depth debate suggests the need to reconsider the time frame applied. Two possibilities for improvement can be considered in further experiences: increasing the workshop duration to one full day or splitting the workshop into two parts on two half-days. Both options would require an increased stakeholder commitment in terms of time dedicated to the process. However, considering the positive feedback provided by participants regarding their expectations and the availability to participate in this type of events (Fig. 7), this seems practical and feasible to implement in future applications. The intention of participants to use the workshop results in their work context (Fig. D.2 in Appendix D, Supplementary document) reflects the usefulness of the exercise, as well as the possibility of constituting a guiding reference for experimenting in the tourism sector in Portugal, as described in a TM process (Loorbach and Rotmans, 2010).

5. Conclusions

Participatory modelling methods have been discussed in sustainability transition literature as valuable tools in multiple contexts, namely in the development of strategic activities in TM processes. These activities include problem definition and the co-creation of sustainability visions, as well as transition pathways.

In this study, we have built and tested a methodological framework based on a PSM approach, which allowed to explore the role of conceptual modelling in facilitating initial scoping stages of transition governance processes. The application of the PSM framework allowed to effectively structure and contextualise sustainability problems, while specifying transitions concepts of regime, niche and landscape. The case study developed in the accommodation sector illustrates how the goals proposed for the study were achieved. It was also found that process design may support social learning considering its iterative nature, while allowing the participation of a large spectrum of actors.

From the application of the PSM framework resulted holistic and systemic overview of three key sustainability themes for the Portuguese tourism sector. The CLDs co-created identify regime, landscape and niche variables along with their causal relations. Another finding was the usefulness of these diagrams to set ground for the co-creation of desirable future visions, as well as detailed roadmaps identifying goals, measures, risks and key actors to achieve these visions. These elements represent possible starting points and guidelines for the development of transition experiments, particularly at an organisational level, which constitutes the next stage of our research programme.

Since the application of the methodological framework focused on "Iterative problem structuring" and "Mapping transition concepts", it would also be relevant to further explore both "Stakeholder identification and selection" and "Multiple learning loops". In the case of "Stakeholder identification and selection", scanning for and testing innovative approaches to this phase could provide insights on the influence of PSM framework on balancing agency and power relations in TM processes. To explore "Multiple learning loops", introducing formal measurement procedures throughout and after the conceptual modelling process would allow to extensively understand the learning outcomes of the approach. Also, further experimentation in different sectorial, geographical or governance contexts would enrich and develop each feature of the framework. Further replication and use of presented results in the development of future transition experiments is also recommended to consolidate the proposed methodological framework.

Declaration of Competing Interest

The authors report no declarations of interest.

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Appendix A, B, C and D Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.eist.2021.01.002.

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