Transition, Innovation, and Sustainability Environments (TISE)

Transdisciplinary Research Project

Green and Digital Transformation: Touristic Competitiveness and Business Enhancement in São Miguel, Azores

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1. Introduction

The Azores archipelago, situated in the heart of the Atlantic Ocean, boasts a unique blend of natural beauty and cultural richness. São Miguel, the largest island in this Portuguese autonomous region, stands as a testament to this allure, captivating adventurers and explorers alike with its diverse landscapes and attractions (Guerreiro, 2019). Amidst this backdrop of natural splendor, the island has emerged as a burgeoning hub for adventure tourism, drawing attention from renowned international publications such as Bloomberg, BBC, and Forbes (Ponte et al., 2018). The liberalization of air transport in 2015 ushered in a new era of accessibility, spurring a surge in tourist arrivals and catalyzing profound shifts in the local market dynamics (Couto et al., 2017).

However, amidst the burgeoning tourism sector lies a complex web of challenges, ranging from infrastructure limitations to environmental sustainability concerns. The distance from major economic centers, coupled with the fragmented internal market and low education levels, presents formidable obstacles to sustainable tourism business development (Couto et al., 2017). Furthermore, insufficient strategic planning and inadequate human resource capacity further exacerbate these challenges, stifling the island's entrepreneurial competitiveness and hindering its ability to meet global standards of quality. Balancing São Miguel's need to be a competitive nature-based and adventure tourism destination while preserving its delicate fragile ecosystems is a multifaceted and complex challenge.

In response to these challenges, there is a growing recognition of the need for innovative approaches to drive sustainable tourism entrepreneurship and business activity on the island. Among these approaches, digital and green transformation may have the potential to chart a new course toward inclusive and resilient tourism development in São Miguel (Muench et al., 2022). However, it is unknown what specific factors influence local tourism entrepreneurship and business, and what challenges the implementation of digital and green transformation poses in the pursuit of a more attractive, resilient, and financially sustainable tourism ecosystem.

1.1 Guiding Question and Vulnerability Space

Given this context, our study endeavors to explore the synergies between green and digital transformations in enhancing tourism competitiveness and business activity in São Miguel. Through a transdisciplinary lens informed by complexity science, we aim to unravel the intricacies of the tourism ecosystem, identify vulnerabilities, and unlock untapped potentialities.

By integrating insights from diverse stakeholders and adopting a holistic approach, we aspire to pave the way for a more sustainable and prosperous future for São Miguel's tourism sector.

São Miguel navigates the complexities of balancing developing a competitive nature-based tourism business ecosystem with the imperative to preserve its paradisiacal yet fragile environment. In response, our study embarked on a transdisciplinary exploration to uncover synergies between digital and green transformations. In this regard, our initial guiding question (GQ) for our study inquired:

GQ: "How can coupled digital and green transformation enhance local businesses and entrepreneurship, fostering both touristic competitiveness and social development capabilities in São Miguel, Azores?"

To provide an answer to this question, our research design contemplated a complex system analysis integrating interdisciplinary applied research and a multistakeholder discourse. Collaborative work and the integration of perspectives from (a) Practitioners, and (b) Scientists, provided a comprehensive understanding of the potentialities and vulnerabilities of the system to re-imagine the future of the local tourism business sector on the island. The main aim of our study was to generate and evaluate scenarios in which digital and green transformation can provide innovative and sustainable eco-smart opportunities for touristic entrepreneurship and sustainable development possibilities in São Miguel.

This report provides an overview of the stages of our transdisciplinary project, focusing on São Miguel Island. It delves into the region's peculiarities, vulnerabilities, and opportunities. Additionally, it explores the role of digital and green transformations in shaping the future of tourism entrepreneurship and business activity. Furthermore, our stakeholder management, methodology, system mapping, and crucial components in understanding the dynamics at play are presented. Moving forward, our findings will shed light on the guiding question and insights gathered from stakeholder activities, facilitating a deeper understanding of the subject matter.

2. Background: A glimpse to São Miguel Island's Context

The Azores, one of Portugal's autonomous regions, is an archipelago of nine islands located in the middle of the Atlantic Ocean. Its position is ultra-peripheral from Europe, with the largest island, São Miguel, covering 744.7 km². São Miguel is home to more than half of the Azores population, with 137,220 inhabitants (SREA, 2020). In connection with its geographic

position, it encounters several challenges, including remoteness and isolation. Furthermore, the region's economic prosperity is limited given its lack of resources and its reliance on mainland Portugal (OECD, 2023).

Since Portugal entered the European Union, the Azores have faced an advancement in different domains. However, it still faces certain obstacles; when contrasted with all of Portugal, the Azores have the lowest level of education and the highest percentage of poverty. These factors contribute to a lack of vision, innovation, young adult immigration, and an aging population, among other issues (OECD, 2023).

The region's GDP per capita has risen over time, with the most recent data available from 2020 reaching 19,100 euros (SREA, 2024). The primary economic activities are services, including tourism, which has witnessed growth in previous years. In this manner, the region has strengthened its conditions to become renowned as a tourist destination and, more importantly, a sustainable tourism region (OECD, 2023).

In 2019, the Azores were recognized as a Sustainable Tourism Destination, the first archipelago in the world, by EarthCheck. “The EarthCheck Sustainable Destinations Program provides a scientific framework to measure and monitor environmental and social impact and to track destination performance against both the Sustainable Development Goals (SDGs)” (EarthCheck, 2019). With this recognition, Azores want to bring economic prosperity to the region without damaging the nature that characterizes it or its people. To accomplish this, the Regional Government of the Azores created a Sustainability Charter. The program enables the successful implementation of sustainable initiatives among public, private, and non-governmental organizations (Guerreiro, 2019; Regional Secretariat for Tourism, Mobility and Infrastructure, 2024). Additionally, Azores, committed to long-term growth, is following the initiatives from the European Union to achieve sustainable development. Recent studies demonstrate the benefits of employing a digital and green transition to accomplish this goal. Azores is adopting the required measures to prepare for this transformation (Regional Secretariat for Tourism, Mobility, and Infrastructure, Azores, 2019; European Commission. Joint Research Centre, 2022).

According to Couto and Ponte (2009) the Azores lacked an entrepreneurial culture until 2009, the year the paper was written. Due to the nonexistence of recent papers, we cannot verify if the pattern has been changed. However, it was possible to analyze different actions the government had taken to stimulate entrepreneurial endeavors, through training programs or financial support; as it is known entrepreneurship ventures can gear a beneficial social change, resulting in better economic attainment. The rise of tourism led to an increase in entrepreneurship initiatives, but the majority of Azores entrepreneurs are still small and

medium-sized businesses (SMEs) (Fonseca, 2019; Governo dos Açores, 2023; Avelar et al., 2024).

2.1. Peculiarities, Vulnerabilities, and Opportunities

Peculiarities

The Azores, which are situated in the North Atlantic, have unique geographic quirks. Azores is exposed to the subtropical anticyclone due to its location, causing high humidity, thermal comfort, low insolation, regular rainfall, and strong winds. A study by Carvalho (2020) notes that increased CO_2 presence since 2016 has been linked to heightened vulnerability to natural disasters, temperature rise, and altered precipitation patterns. These cyclones and intense rainfall could have significant ramifications for people and/or commodities throughout the entire year (Carvalho et al., 2020). Additionally, the geology of the Azores is highly unstable due to the numerous earthquakes and volcanic eruptions that have occurred. The administrative center of São Miguel was submerged in a catastrophic convulsion, such as in 1563 from Fogo Volcano or the 1630 eruption from Furnas Volcano (Nunes, 2014). Due to that, a volcanic rock, basalt, is commonly used for building block construction within the island.

São Miguel island has 35 lakes, thermal waters, and hydrothermal fields (Nunes, 2014), which produce heat. One of them is *Furnas,* which is a valley with hot mineral springs and fumaroles with hot water, called *caldeiras das Furnas*, and the pride of São Miguel. These *caldeiras* are a popular picnic spot, where their heat is substantial enough for cooking. While local residents often use it to cook snacks like corn in boiling *caldeira* water (Calleja, 2017), it creates unique cultural sightseeing experiences for tourists.

On the other hand, various crops like tea, tobacco, sweet potatoes, and pineapple were introduced to boost the economy in the middle of the 1800s. It resulted in the fact that the climate of São Miguel Island was ideal for tea cultivation, and the practice gradually spread throughout the island. Under the guidance of specialists, tea manufacturing emerged as an integral sector on the island, attaining its zenith during the 1950s, and the tea industry has continued until now (Moura, 2015).

All of the aforementioned aspects contribute to a distinctive allure for tourism and to a more diversified tourism sector, such as nature-based tourism and adventure tourism (Ponte et al., 2018), for instance, climbing, sea kayaking, snorkeling, wildlife watching, and others.

Vulnerabilities

One of several vulnerabilities that São Miguel Island possesses has the potential to affect the economic sustainability and community development of its community. Firstly, the geographical setting presents an obstacle in the form of isolation, which can impede activities such as commodity exchanges (Castanho et al., 2021). Adding to these challenges is the potential threat of volcanic eruptions, notably from Fogo volcano. According to a study by Medeiros et al. (2021), those situated on the flanks of the volcano and other remote areas will be profoundly affected by the eruption. In this manner critical infrastructure, including main roads and fishing ports like Vila Franca do Campo, would be adversely affected, which undoubtedly has long-term economic repercussions for the island.

In addition, climate sensitivity, particularly with regard to the risk of anticyclone weather, has an impact on the tourism industry, which is an integral part of the local economy. The fact that many visitors prefer to travel during the summer months can make these unexpected weather conditions a constraint on the number of tourists. This dynamic introduces income uncertainty for local entrepreneurs and, to some extent, creates instability in employment. Compounding this issue, local entrepreneurs encounter a shortage of employees during the summer season. This tandem challenge is conflicting; as the influx of visitors escalates in the summer, the number of personnel providing services remains limited.

Development challenges in the meantime still persist because of the archipelago's geographic location, necessitating additional costs for goods and services. These encompass various costs, notably logistics expenses (Azevedo, 2017). This is consistent with the limited public transportation that currently exists in São Miguel. Local residents often rely on their personal vehicles for their daily mobility. In contrast, tourists are advised to opt for car rentals during their stay to facilitate their exploration of the island.

Being local entrepreneurs, they must bear the additional costs associated with logistics and telecommunication, resulting in elevated prices for their products and services. Consequently, local residents end up paying higher prices for products and services compared to those in mainland Portugal. Conversely, one may choose to utilize regionally sourced raw materials; nevertheless, such an approach is not without its constraints. Weather conditions, for instance, can impact production and pose challenges to local entrepreneurs and producers.

Last but not least, balancing traditional production methods, local livelihoods, and environmental conservation with the imperative to enhance the local economy for global competitiveness poses a considerable challenge as well (Azevedo, 2017). All these make the Azores, particularly São Miguel Island, vulnerable to responses to crises that may arise.

Opportunities

Owing to their geographical location, the Azores, especially São Miguel, are endowed with unparalleled natural beauty, diverse botanicals, and wildlife. This gives the Azores an abundance of opportunities to develop their nature-based tourism and adventure tourism as well. This is evident in the richness of natural resources São Miguel possesses, and this makes the island very attractive for tourism. For instance, a study by Dillingham (2023) suggests that one natural resource that São Miguel can capitalize on for eco-tourism is its thermal water. Furnas, a village in São Miguel, is known for its natural hot springs and thermal pools. These thermal waters provide opportunities for eco-friendly wellness tourism, where visitors can enjoy therapeutic baths while also appreciating the natural beauty of the area (Geeky, 2024). This natural beauty could be digitalized and showcased through virtual tours, online guides, and immersive experiences, allowing people from around the world to explore and appreciate the unique landscape of São Miguel.

Studies reveal that São Miguel is home to a diverse range of geo-food products, including pineapples, tea, and unique vegetables (Valenti, 2023; Paolinelli, 2021). The unique geo-food resources of the island contribute greatly to the development of ecotourism. As a result of this, it is recommended that tourism policies that promote and highlight these geo-food resources be strengthened to attract tourists and contribute to the local economy while also promoting sustainable agricultural practices. Also, Trelease (1897) stated that the Azores have a mild, moist climate, which is favorable for the growth of a great variety of plants of subtropical origin. This offers great possibilities for the development of a thriving horticulture industry. This has a direct impact on tourism, as many tourists are interested in visiting places known for their diverse plant life. As we strive for digital transformation, entrepreneurs and other local authorities in São Miguel could capitalize on this opportunity by creating virtual tours or online platforms that display the rich diversity of plants in São Miguel. This can attract more tourists and boost entrepreneurship on the island.

The geostrategic position of São Miguel offers some great advantages to the island (Azevedo, 2017). Since it is an Atlantic link to other continents, many tourists find it easy to access and explore the island's valuable natural and cultural heritage. This cultural heritage includes traditional architecture, historical sites, and unique local customs and traditions. This makes it an ideal location for entrepreneurs to leverage the natural beauty and resources of the island to develop innovative and sustainable business models.

2.2. Digital and Green Transformation

The world we know is shaped by the “information and communication revolution” (World Bank, 2023). While digital technology advancements present environmental concerns, they also present opportunities to address them. One of these opportunities is the application of “twin transformation”. In order to increase productivity, competitiveness, and environmental responsibility, digital and green transformation (DGT) or “twin transformation”, is understood to refer to the simultaneous adoption of digital technologies and sustainable practices.

DGT can be considered with different initiatives that are either greening by or greening of IT and touch different enablers such as intelligence, infrastructure, and transformation either way. They are driven by concrete indicators such as environmental monitoring and data analysis to optimize resources, cloud computing to reduce the physical footprint, and the integration of renewable energies to reduce emissions (European Commission. Joint Research Centre, 2022). These enable companies in the tourism industry to become more competitive. By using real-time data on tourist behavior and environmental impact, destinations could personalize their experiences, minimize waste, and attract environmentally conscious travelers. This not only promotes economic growth but also contributes to social development by creating sustainable practices that benefit local communities and preserve cultural heritage for future generations.

Taking on the two significant challenges for sustainability, the digital and green transitions, a change toward digital and green twins is required (European Commission, 2024). By combining them in DGT, nations may fight climate change and discover innovative solutions that boost productivity across a wide range of processes, activities, and services. Therefore, the EU is looking into voluntary and mandatory policies to assist the private sector in becoming climate-neutral and utilizing more renewable resources. In addition to that, they are also working on other research projects, such as the Green Deal Industrial Plan and the European Green Digital Coalition, to mention some examples.

Also, the Joint Research Centre of the European Commission set up key requirements for a successful twin transition in the European Union (Muench et al., 2022). Thereby, they include the social, technological, environmental, economic, and political sectors, and within, they issue a variety of requirements for a holistic management of the twin transition. Their aim is to reach a wide acceptance of green-digital solutions by making the transition just and thereby preventing a rebound effect. To name all ten key areas of action that were identified for a successful twinning in the Strategic Foresight Report of 2022: resilience and open strategic autonomy, green and digital diplomacy, supply of critical materials and commodities, economic and social cohesion, education and training systems, additional future-proof

investment, monitoring frameworks, future-proof regulatory framework for the Single Market, a global approach to standard-setting, cybersecurity and a secure data sharing framework (European Commission. Joint Research Centre, 2022).

The Azores, which are confronting particular opportunities and difficulties, can benefit from a DGT. In their 2019-2030 Action Plan for Sustainability (2019), they have 23 sustainable commitments and 132 actions highlighted, fostered by 9 Green Teams, including a Regional Directorate for Science and Digital Transition as one of their entities. Besides, digital tools are taken into account, especially for their sustainable development in societal, cultural, and economic aspects. For the aim of a more sustainable future, they want to create an environment in which "*the territory can be appreciated and cared for collectively by the local community, government entities, and tourist flows, in compliance with a commitment to reduce the environmental impact, and value economic, cultural, and social aspects*" (Regional Secretariat for Tourism, Mobility, and Infrastructure, Azores, 2019).

2.3. Touristic Competitiveness and Social Development

In the globalized world, competition is global as well. The same is true for the tourism sector, as tourism competitiveness refers to the ability of a destination or a tourism industry to attract visitors in a global market and to stay profitable while doing so. It encompasses various factors such as the attractiveness of natural and cultural resources, the quality of infrastructure, the effectiveness of marketing strategies, and the overall appeal of the destination to different target markets. Essentially, it involves creating an environment where a destination can effectively compete with other destinations to attract tourists and generate revenue (World Tourism Organisation, 2024).

Social development, on the other hand, refers to the process of improving the well-being, opportunities, and quality of life of individuals, communities, and societies as a whole. It involves addressing social issues and enhancing social cohesion and inclusiveness. As the quality of life depends on many factors, social development can be seen in various aspects as well, including employment, social security, community participation, but also health care, housing, and education (United Nations, 2024).

One could assume that the relationship between economic competitiveness and social development capabilities is characterized by a trade-off, which means that attempts to be, e.g., more inclusive will come at the cost of losing competitiveness. However, if we are looking at the digital and green transformation, we might be seeing a new situation where a more digital and green business structure comes together with advanced competitiveness while at the same time offering better living conditions and social development. Bringing these two

dimensions into balance with the DGT taking on the role of a mediator seems to be possible, but not certain. In our research, we therefore would like to investigate exactly that: are touristic business competitiveness and social development compatible, and will the introduction of a digital and green transformation benefit the local people?

The case of São Miguel and the Azores is specifically interesting in this regard, as we are looking at a remote island in one of the outermost regions of the European Union, which is heavily dependent on services (accounts for >70% of regional GDP and employment), especially in the tourism sector (OECD, 2023). At the same time, we see that the Azores have already adopted several steps regarding the digital and green transformation, e.g., smart community concepts and a shift to ecotourism (Castanho et al., 2020; Avelar, 2020). São Miguel, as the biggest and economically most important island, is suitable as a focus for our research.

3. Methodology: Transdisciplinary Research Design

3.1. Research Process Conceptualization

The depiction of our research design process can be found in Figure 1, which has been adapted from Yin (2009) but tailored to meet our needs. Our research methodology unfolded across three key stages: the Define and Design stage, Stakeholder Activity 1, and Stakeholder Activity 2. Each stakeholder activity encompassed data preparation, collection, analysis, and ultimately, the synthesis of results. Stakeholder Activity 1 involved conducting individual interviews for data collection, whereas Stakeholder Activity 2 entailed facilitating a scenario workshop involving all stakeholders. Subsequently, we embarked on the analysis of the gathered data to draw informed conclusions.

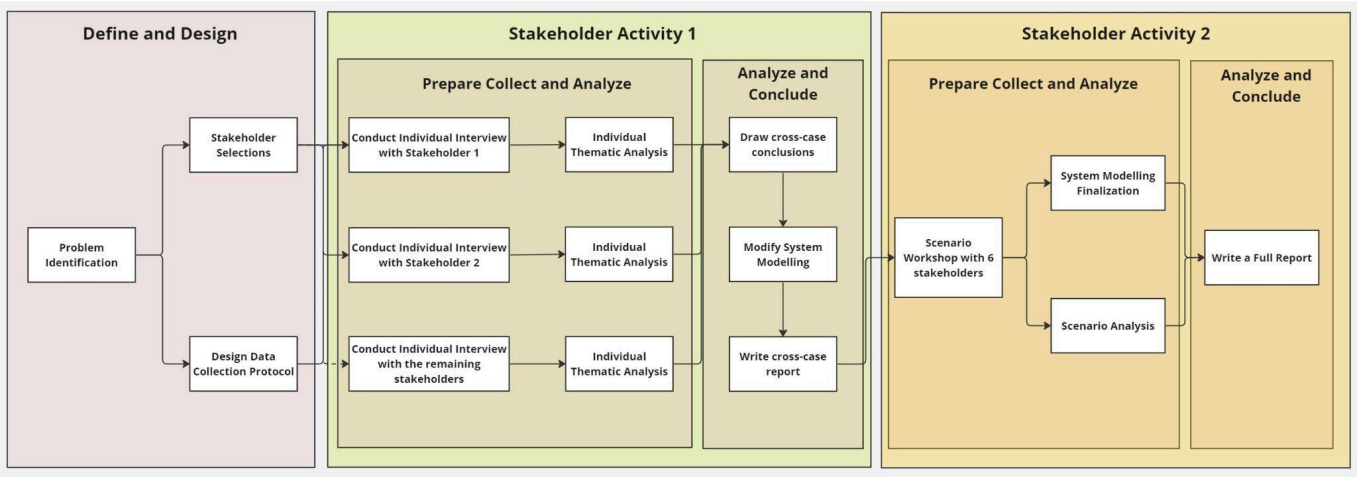

Figure 1. Conceptualization of the Transdisciplinary Research Process
Adaptation from Yin (2009).

3.2. Define and Design Stage

Stakeholder Selection

A) Stakeholder Mapping

Figure B.1 in the appendix depicts the stakeholder map showing the most relevant stakeholders to our study. We divided the map into four groups: responsible, accountable, consultants, and informed. The first group identified businesses, the second government and financial-related, the third field of experts, and the fourth important stakeholders to keep informed. This stakeholder map served as a crucial guide for the recruitment of experts for our study and contributed to the initial system development.

B) Sampling Strategy and Selection Criteria

The participant selection process for the study employed a combination of "snowball sampling" and "purposeful sampling" methodologies. This dual approach enabled the research team to target a diverse array of individuals, relevant to the research objectives, according to their background, interests, or expertise, and capable of offering valuable insights aligned with the study's focus. Key criteria guiding participant selection included:

1. Ensuring heterogeneity in backgrounds, interests, and fields of expertise to capture a representative spectrum reflective of the complexity of stakeholder and system mapping.
2. Maintaining a balance between experts in academic and practical domains.
3. Considering years of experience within their respective fields, in the context of São Miguel, Azores, or Portugal.
4. Assessing the relevance of participants' areas of activity to the key concepts under investigation, including Coupled Digital and Green Transformation, Tourism Entrepreneurship, Business Competitiveness, and Social Development.

C) Recruitment of experts

Various stakeholders from diverse fields, including entrepreneurs, academia, community representatives, and government officials, were contacted via email or LinkedIn to participate in the transdisciplinary research project from February 15th to February 29th, 2024 (see Appendix B for details). Notably, six participants agreed to contribute and provide their insights, drawing upon their respective areas of expertise. The six participants encompassed two (2) entrepreneurs, two (2) participants from academia from a sustainable tourism and technology perspective, one (1) non-governmental organization offering community-oriented insights, and one (1) participant representing the government point of view.

Design of Data Collection Instruments for Stakeholder Activity 1

As a preparation for activity 1, interview protocols were meticulously crafted to provide a standardized and structured framework for conducting initial interviews with designated stakeholders. Given our objective of engaging a diverse array of stakeholders from various fields, we developed four distinct types of interview protocols (refer to Appendix C.1), each tailored with specific open-ended questions pertinent to our guiding question. The interview protocols adhered to a specific structure, comprising a succinct project introduction, details about the interviewing researcher, socio-demographic inquiries, subject matter exploration, and a conclusive segment outlining follow-up procedures.

Furthermore, in adherence to ethical research principles, all participants were diligently asked to review and sign an informed consent form, ensuring compliance with the GDPR (General Data Protection Regulation), as detailed in Appendix C.2. This informed consent form elucidated the voluntary nature of participation, minimal potential risks, study benefits, confidentiality assurances, and robust data management protocols. Participants were also apprised of their responsibility to maintain the confidentiality of any personal information or communications shared by fellow participants during the study. To safeguard participant identities, pseudonyms were assigned, and all personal and contact information, consent forms, and any audio-visual materials generated during the activities were securely stored in an encrypted folder accessible only to members of the research team. Any Personally Identifiable Information (PII) present in shared documentation was promptly deleted to uphold confidentiality standards.

3.3. Stakeholders Activity 1: Interviews

Individual Interviews

Qualitative semi-structured interviews were conducted based on open-ended questions to allow the interviewee to freely express any opinions they may have (Quivy & Campenhoudt, 2005). Interviews aimed to gather initial insights from stakeholders, including confirming our main guiding question, legitimizing our initial system model, and conducting in-depth research about São Miguel Island context relevant to stakeholders' fields of expertise, and the vulnerability space of our delimited system under study.

Each interview lasted 45 to 60 minutes and was divided into two parts. First, demographic questions, then subject-matter questions. Further, the subject-matter questions covered research question validation, system modeling, the specific context of digital and green transformation, and touristic entrepreneurship challenges and potentialities in São Miguel. As we joined experts from different fields, questions were adapted for the

subject-matters section, related to the expertise of each stakeholder. The interviews were recorded, and an artificial intelligence tool, namely Fireflies, was employed to simplify the transcription process. Table B.4 of the appendix summarizes the six stakeholders we interviewed, along with the date, time, and duration of each interview.

Data Analysis: Thematic Analysis

For the data analysis process, the researchers opted for Thematic Analysis (TA) to analyze the data provided in the interviews. Data analysis for the first stage of this research study was undertaken employing Braun and Clarke's (2017) comprehensive six-step thematic guide, ensuring a rigorous and systematic approach to uncovering meaningful insights from the collected data. During the process researchers identified, analyzed, and interpreted patterns of meaning ('themes') within qualitative data, aiding to approximate an answer to the guiding question.

3.4. Stakeholders Activity 2: Scenario Analysis Workshop

The second Stakeholder Activity consisted of a 2-hour scenario analysis workshop conducted via Zoom designed to facilitate the creation of a collaborative environment aimed at fostering knowledge integration and innovation among stakeholders. The workshop comprised two interactive sessions: the first session involved a final validation of our guiding question and system map, while the second focused on scenario analysis. The design of the Scenario Analysis Workshop drew inspiration from scenario analysis theory (Scholz et al., 2002; Takam & Scholz, 2021), participatory design fictions theory (Lyckvi et al., 2018), and applied improvisation techniques (Zenk et al., 2022). Scenario analysis and participatory design fictions theories served as conceptual frameworks for the development of the scenarios, while the conceptual incorporation of applied improvisation techniques facilitated experimental active interaction during the sessions[1].

During the initial interactive session, stakeholders were presented with the updated version of the guiding question and the system model obtained from stage 1. Stakeholders were invited to provide feedback on specific factors that might require further adjustment, definitions of unclear variables, and potential gaps in the model. As such, the consensus and dissent of participants were duly noted for subsequent consideration.

The second interactive session explored potential future scenarios prepared beforehand by the research team, representing both extreme conditions of the system's evolution. The first scenario outlined the ideal execution of digital and green transformation

[1] For more information about the agenda and content of the workshop please refer to slides https://bit.ly/3vBxPQT.

aimed at augmenting touristic entrepreneurship performance and fostering social capability development in São Miguel. Conversely, the second scenario depicted a suboptimal implementation of DGT, resulting in adverse effects on touristic entrepreneurship performance, social development capabilities, and environmental impact. A formal quantitative evaluation criterion for the scenarios was omitted, as our emphasis lay in utilizing them as a vehicle for experiential learning, thereby facilitating the formulation of socially robust orientations (SROs) for the future. Instead, we emphasized other qualitative aspects, such as stakeholder engagement in discussions, interaction, comprehension, contribution, insights, expression of sentiments, and agreement or disagreement regarding potentialities and challenges.

4. Results and Analysis

4.1. Initial System Map

We used the findings of our desk research to design an initial version of the complex system model, which we then refined further in the individual interviews with the stakeholders. To serve our guiding question, we set very explicit boundaries for the model in order to minimize complexity and focus on the essentials. These system boundaries are:

- Geographical: São Miguel Island
- Environmental: São Miguel Ecosystems
- Economical: Local Tourism Business and Entrepreneurship
- Technological: Digital and Green Transformation (Twin Transformation)
- Political: Local and regional policies and decision-making institutions linked to our GQ.
- Social: Social development in São Miguel and related institutions.

The resulting system model can be seen in Figure 2. The starting points are the factors "Touristic Entrepreneurship Social Development Capabilities" and "Touristic Entrepreneurship Competitiveness" shown in pink, which are intended to reflect our Guiding Question. Based on this, we have added further factors that have an impact on the two core factors or that are influenced by the core factors - such as the "Number of ecotourists". Other factors, such as "Research Intensity in Green and Digital Transformation", only have an indirect influence on the initial factors, but bring the other dimensions of our Guiding Question into the picture due to their correlation with the other factors. We can see that our system model explains the relationship between social development capabilities and economic performance indicators - these in turn are largely determined by the competitiveness of the tourism sector, which in turn is largely determined by the attractiveness of São Miguel's natural environment and its accessibility (through low-cost flight offers).

At this stage, we identified one balancing (B) and six reinforcing (R) loops. The balancing loop explains a relationship between the number of ecotourists, their negative impact on conservation of nature, which is a defining force behind São Miguel's touristic competitiveness. Too many tourists would lead to a less conserved nature, which then would make this touristic destination less attractive which leads nature to recover → a balance should be reached. The reinforcing loops show several implications. To sum up some insights, it can be said that improvements regarding the digital and green transformation lead also to improvements in other factors, like competitiveness etc. This might then attract more tourists or financial inflows like in the form of public private partnerships which further accelerates the transformation. An overview about the identified loops and explanations of the individual factors can be found in the glossary in Appendix A.

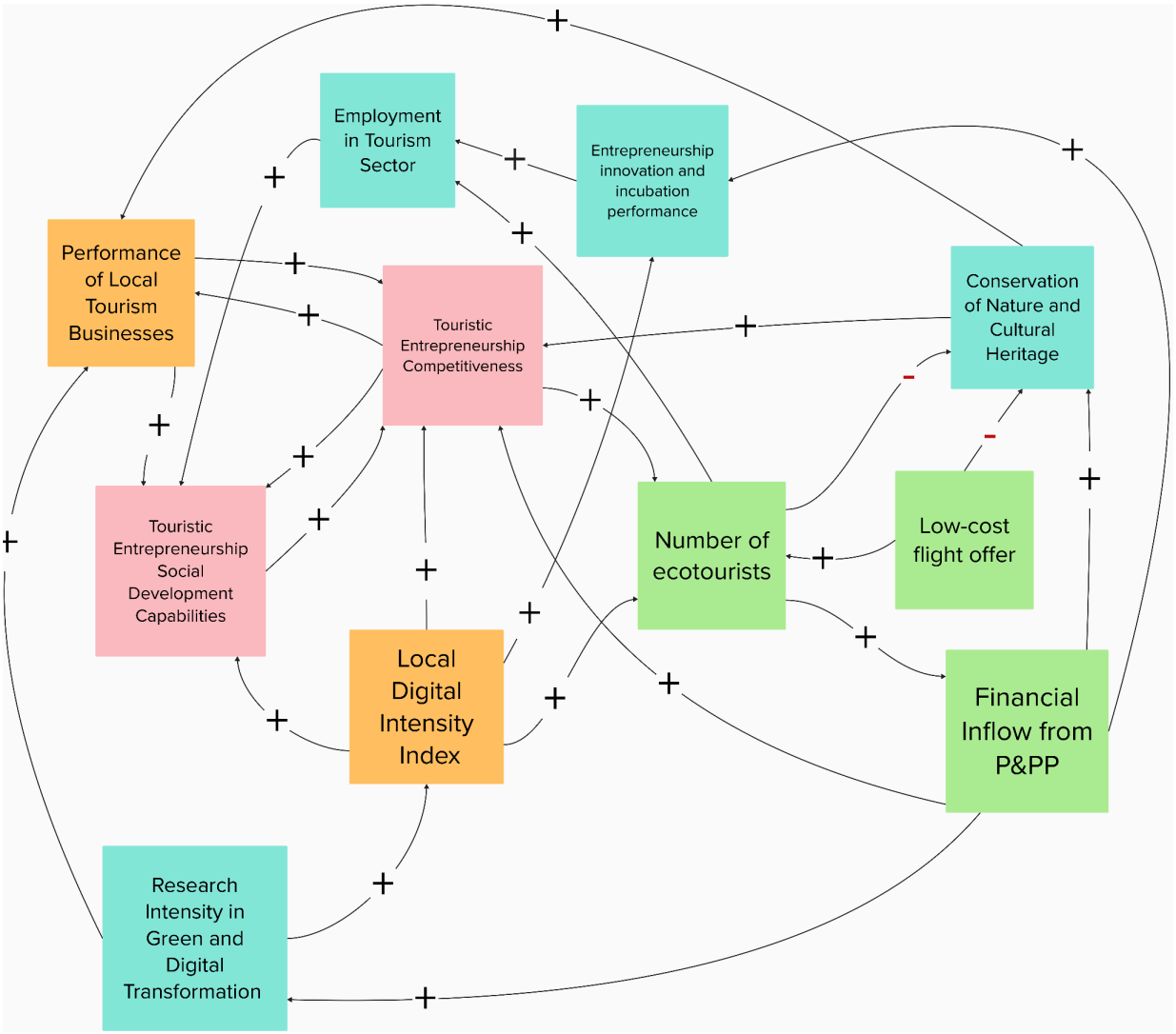

Figure 2. Initial System Map

4.2. Stakeholder Activity 1: Individual Interviews

4.2.1. Validating the Guiding Question

As part of our ongoing research focused on understanding how coupled digital and green transformation might enhance local businesses and entrepreneurship, fostering both touristic competitiveness and social development capabilities in São Miguel, Azores, we sought feedback from stakeholders through interviews to validate our guiding research question. The question under research is: ***"How can coupled digital and green transformation enhance local businesses and entrepreneurship, fostering both touristic competitiveness and social development capabilities in São Miguel, Azores?"***

This feedback process involved engaging with a diverse set of stakeholders within and outside São Miguel, including entrepreneurs, government officials, community organizations, and academic experts in the field of green and digital technology as well as tourism. During the engagement, a series of interviews were conducted to gather their perspectives on the research question. Generally, all the stakeholders interviewed revealed that our guiding question is very relevant and did not suggest any modifications. For instance, the feedback from stakeholder 1 (TD-S1) emphasized that in order to remain competitive, businesses must align with the evolving tourism landscape and adopt sustainable practices. Also, stakeholder 2 (TD-S2) agreed that our research question is relevant and accurate for the study. The feedback suggests that businesses need to check how well they're performing with sustainability and set goals they can reach through the implementation of digital tools. Additionally, stakeholder TD-S6 revealed that our research question is interesting, and the fact that we are focusing on the integration of digital technology with green practices makes it really important.

However, stakeholder TD-S5, when asked to share his opinion on our guiding question, expressed his reservations due to his lack of expertise regarding green and digital technologies in the specific context of the tourism sector. Despite this, the stakeholder provided insightful information about his broader expertise in digital transformation that enhanced our comprehension of the field. Additionally, it is worth noting that all the stakeholders unanimously expressed satisfaction with and affirmed the accuracy of our guiding question.

Taking the feedback of our stakeholders into consideration, we are confident in the clarity, relevance, and usefulness of our research question in addressing the objective of the study.

4.2.2. Multi-stakeholders System Mapping Integration

Considering the leading question, the system model (SM) was built, where different factors were identified. The question that led our literature analyses and the system map revolved around the following two central themes: “Business and Entrepreneurial Competitiveness”, and “Social Development”. Our focus lies in elucidating how Digital Green Transformation can serve as a nexus and mediate sustainable tourism in the Azores.

In an early phase, the initial SM outlined eleven main factors. After conducting the interviews, the research team opted to enhance the SM, where the invited stakeholders provided valuable input. In this way, it was possible to reflect on their feedback, therefore, some elements were eliminated and other aspects were added. For comparison, the initial SM can be found in Figure 2, identified loops can be seen in Appendix A Figure A.1.

At this stage, and after breaking down our analysis into thirteen main factors as illustrated in Figure 3, we identified one balancing (B) and eight reinforcing (R) loops detailed in Appendix A Figure A.2. The critical factors that were missing, from the stakeholder perspective, were public participation, as they are the main affected parties, the education of citizens and tourists, and finally, the digital and green transformation that is only possible with the implementation of sound policies. In this manner, factors such as “Community Active Involvement”, “Green and Digital Education”, “Green and Digital Transformation” and “Quality of Policy-Making” were added.

Taking into consideration the opinions of the stakeholders, the specific factor “Number of Social and Responsible Tourists” was initially created as “Number of Ecotourists”. Some stakeholders perceive socially and environmentally responsible tourists as an expectation they aspire to fulfill. This underscores the importance of education, as it catalyzes the number of social and responsible tourists. Simultaneously, the quality of policy-making is also crucial to ensuring the alignment of regulations and incentives with sustainability goals, thereby incentivizing responsible tourism practices.

However, there are some concerns due to its specificity and measurement, particularly in quantifying the number of social and responsible tourists, and evaluating the effectiveness of policies implemented. This is particularly relevant in the case of São Miguel, Azores, where efforts are to be made to regulate the types of tourists accommodated in the region. Besides, its relation to the factor “Conservation of Nature and Cultural Heritage” elicited additional differing opinions among stakeholders and researchers, with no complete consensus being achieved. On the one hand, because of the reference to the specific type of tourists, its rise would not decrease the conservation of nature and cultural heritage due to their essence. On

the other hand, individual actions have a long-term impact on society and the environment, and even in a responsible manner, they may ultimately decrease the conservation of these resources.

Furthermore, the two factors that were removed were “Low-cost flight” and “Entrepreneurship Innovation and Incubation Performance” components. Some stakeholders expressed uncertainty about low-cost flights increasing the number of eco-tourists (initial component name). The participants prioritize quality over quantity among the tourists. Hence, attracting mass tourists through low-cost flight offers is not a primary objective for Azores tourism. Meanwhile, the exclusion of "Entrepreneurship Innovation and Incubation Performance" was predicated on its absence from stakeholder discussions, indicating its perceived lack of relevance in this context. The absence of perspectives from innovation and entrepreneur hubs limits our understanding of entrepreneurship and incubation performance.

The following outlines 8 reinforcing loops and 1 balancing loop.

- **R1:** Quality of Policy Making → Performance of Local Tourism Businesses → Employment in Tourism Sector → Touristic Entrepreneurship Social Development Capabilities → Community Active Involvement
- **R2:** Quality of Policy Making → Green and Digital Education → Research Intensity in Green and Digital Transformation
- **R3:** Quality of Policy Making → Green and Digital Education → Performance of Local Tourism Businesses → Employment in Tourism Sector → Touristic Entrepreneurship Social Development Capabilities → Community Active Involvement
- **R4:** Quality of Policy Making → Green and Digital Education → Touristic Entrepreneurship Social Development Capabilities → Community Active Involvement
- **R5:** Quality of Policy Making → Financial Inflow from PPP → Research Intensity in Green and Digital Transformation
- **R6:** Quality of Policy Making → Number of Social and Responsible Tourist → Financial Inflow from PPP → Research Intensity in Green and Digital Transformation
- **R7:** Green and Digital Transformation → Performance of Local Tourism Businesses
- **R8:** Number of Social and Responsible Tourists → Financial Inflow from PPP → Conservation of Nature and Cultural Heritage → Touristic Entrepreneurship Competitiveness
- **B1:** Number of Social and Responsible Tourists → Conservation of Nature and Cultural Heritage → Touristic Entrepreneurship Competitiveness

The loops outlined a series of interconnected relationships that reinforce certain aspects while also balancing others. It can be seen that the quality of policymaking plays an essential role in many aspects, including performance of local tourism businesses, green and digital education, financial inflow from PPP, and number of social and responsible tourists. As a result, these components drive research, innovation, and competitiveness in the business and tourism sector. Meanwhile, embracing green and digital education enhances business performance, research, and social development capabilities. However, the balancing loop reminds us of the importance of maintaining equilibrium between responsible tourism, conservation efforts, and entrepreneurship competitiveness.

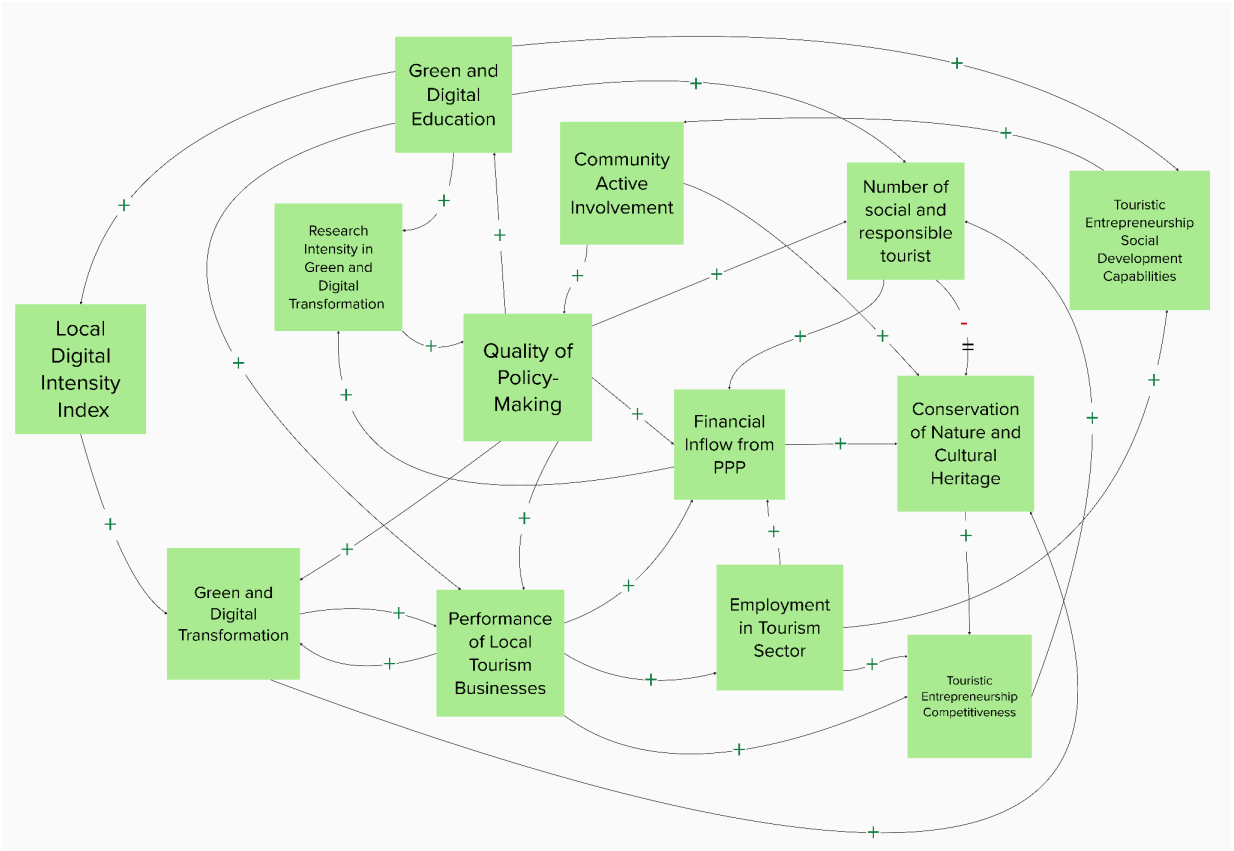

Figure 3. Refined System Model after Stakeholder Activity 1: Individual Interviews

Digital and Green Transformation (DGT)

The Digital and Green Transformation differ in their essence and dynamics, but both create favorable conditions to address modern issues, such as climate change, environmental degradation. The European Union is promoting initiatives to couple digital technologies and sustainable practices to strengthen people and businesses (European Commission. Joint Research Centre, 2022). The DGT is perceived as a means to achieve sustainable

development, by the stakeholders. Nonetheless, the interviewees mentioned more the venture of digital transformation; refering that it can enhance the businesses, namely the efficiency of communication, inventory management, and human resource management.

A different perspective, from stakeholder 3 consider the employment of DGT *"will be very important to accompany this monetization and implementation of other goals and initiatives that will benefit and improve, and will promote improvements in the sustainability"* in the Azores, and its maintenance of the certification as a Sustainable Tourism Destination.

Additionally, the stakeholder 3 also referred to the importance of the transparency of the operations of the business, particularly in a company's sustainability report, where it "*proves that they have neutral impact or positive impact in the environment and people*"; the digital transformation can optimize the process of these reports. In this sense, it demonstrates the benefit of coupling digital and green concepts to the businesses. The European Union is currently working on the transition to be implemented in 2026 for the big companies; currently two of the big companies in the Azores already launched their ESG reports, such as SATA, Finançor. Both employ methods of digital transformation, which are intrinsic to green transformation (SATA, 2024; Finançor, 2024).

However, this transition is also associated with negative consequences, and in order to minimize them, it is essential to conduct an impact study and to coordinate different factors, namely include the citizens in the process, because in the end they are going to be influenced by this transition: *"The public participation (..) people only care what they know. If they do not feel part of something, they don't care. (..) If you have the population, you are halfway to success."* - TD_S2

The stakeholders demonstrated they are concerned with the digital skills of the citizens and their respective value they can add to this transition. Stakeholder 4 emphasized the continuous need of digital education, the access to cyberspace is recently new and open to everyone, but the benefits and consequences of its uses are still unclear for the vast majority of society. As stakeholder 5 mentioned, we live in an automated world, and to follow this path the society must be educated for this effect, in order to properly maximize its benefits.

On the other hand, some participants affirm that the Azores is ready for this transformation and is currently working on the transition. Yet, it was not agreed by everyone, where stakeholder 1 highlighted the endeavors of the regional government of the Azores towards a DGT, but it remains visible the current constraints, such as the lack of digital literacy of the citizens, insufficient support to establish the transition, and the size of the business, where it is more difficult to encourage the transition.

Community and Social Development

Community and social development are crucial for the well-being and progress of societies, as they focus on improving the quality of life and promoting inclusivity and empowerment among community members (Lee et al., 2015). Undoubtedly, community development initiatives that embrace green and digital transformation have the potential to create a sustainable impact, benefiting both the community and businesses. In light of this, we engaged with the stakeholders of our research and solicited their views on how green and digital transformation could promote community and social development in São Miguel, thereby fostering touristic competitiveness and business development capabilities.

In terms of promoting community and social development, the stakeholders unanimously stress the importance of green and digital transformation in this regard. For instance, stakeholder 6 stated, "*Digital transformation offers more than just economic sustainability; it fosters mental health, connectivity, and increased competitiveness."* This underscores the importance of providing access to digital platforms and resources that support mental well-being, such as online therapy services and mental health apps (Stawarz & Coyle, 2019), thereby strengthening the resilience of the Azores community. Also, this enhances entrepreneurship and business development in São Miguel. For instance, entrepreneurs and businesses can leverage the opportunities provided by digital platforms and technologies to create innovative solutions that address community needs and contribute to social development.

Our findings also recognized that local engagement is essential for the success of community and social development in São Miguel. This includes involving stakeholders such as local companies and the community itself in decision-making processes. In this regard, the stakeholder 3 said that, "*what I mean by this is to involve more the local population and raise awareness about this project. Because we still feel that there are many people on board.*" Involving local stakeholders and raising awareness about sustainability projects not only fosters a sense of community support for development initiatives but also lays the foundation to promote business and entrepreneurship development. By involving the community in decision-making processes, there is an opportunity to identify and support local entrepreneurs who are driving innovation and economic growth. This support can come in the form of access to funding, training programs, and networking opportunities. In line with this, stakeholder 6 placed an emphasis on talent retention and employee engagement to promote community and business development.

One critical aspect of community and social development is preservation of cultural values and heritage (Murzyn-Kupisz & Działek, 2013). Our stakeholders provided their views on how green and digital transformation could promote the cultural heritage of the Azores. Stakeholder 6 affirmed that, *"Preserving our identity is paramount amidst rapid development; green and digital initiatives must align with our cultural values."* Stakeholder 4 also affirmed this by saying that, *"we need to continue to preserve our identity. (..) It's not the kind of tourism [mass tourism] that we should develop in the Azores, it should be a tourism that helps us to develop our activities, but at the same time to preserve what we really have."* Also, stakeholder 3 mentioned that, *"the most important ones for me are the conservation of nature and cultural heritage (..) it's our authenticity, it's what makes the Azores."* This shows how it's important to preserve the culture of São Miguel while embracing green and digital transformation. To do this, the natural beauty and cultural values of São Miguel could be digitalized to allow people from around the world to explore and appreciate the unique culture of São Miguel.

One of the key challenges highlighted is the lack of interest of the younger generation in engaging in activities related to green and digital transformation. This disinterest stems from their perception that their new and special digital skills are not effectively utilized in these activities, hindering their engagement in economic development. Stakeholder 4 expressed this viewpoint, stating, *"The youngest people don't want to be involved in these kinds of activities because they don't feel that they can use their new skills and special digital skills to develop these activities, economic activities."* Addressing the disinterest of the younger generation in green and digital transformation activities is crucial for fostering community and social development.

Touristic Competitiveness

Tourism is one of the major factors in the development and growth of the Azores (Santos et al., 2012), which includes São Miguel Island. This statement reflects the viewpoint of stakeholders, highlighting the crucial importance of tourism in promoting sustainable development, diverging slightly from the profit-oriented approach often associated with tourism competitiveness from World Tourism Organization's definition. Despite the differences, stakeholders prioritize the preservation of natural and cultural assets, recognizing their importance in attracting visitors and ensuring long-term viability in the competitive tourism industry.

The allure of São Miguel's stems from its natural beauty, such as Sete Cidades Lake, Lagoa do Fogo, and thermal springs, complemented by cultural traditions such as the local culinary practices in Caldeiras das Furnas. These elements collectively form the primary attractions for tourists and serve as a foundation of the unique selling proposition of São

Miguel Island. A significant milestone for the Azores was achieved in 2021 when the region was designated as a "Sustainable Tourism Destination." This recognition underscores the efforts and collaboration of multiple stakeholders in upholding sustainability principles, setting the Azores and São Miguel Island apart in the tourism industry. They acknowledge that sustainability can simultaneously give advantages to the local community as well.

"But sustainability is an ongoing process. It's not something that you can do from one day and in the other day you will see the results. So the next level for Azores is to continue this process, to see improvements in the indicators." - TD_S3

Albeit the paramountcy of sustainability, visitor satisfaction remains one measurement in encouraging them to return (Ponte et al., 2021). Green and digital initiatives can significantly contribute to ameliorating visitor satisfaction by improving operational efficiency and enriching overall tourist experience, such as through online booking systems. Moreover, these initiatives benefit not only tourists but also the local community, particularly local entrepreneurs who utilize digital tools to enhance their business operations. Nonetheless, green initiatives remain the foremost concern in order to safeguard both the environment and cultural heritage. Local entrepreneurs can leverage this as an additional business opportunity, highlighting them as another focal point of São Miguel's tourism.

By integrating digital innovation and placing sustainability as a top priority, São Miguel has the potential to enhance its standing as a leading tourism destination while also contributing to the economic and social progress of the local community. Ultimately, we should acknowledge that these efforts can contribute to enhanced touristic competitiveness solely with the support of good quality policymaking and the involvement of all bodies within São Miguel’s system towards sustainable tourism.

Policies & Regulations

Stakeholders engaged in discussions regarding regulation and governmental initiatives, emphasizing the importance of both current measures and future developments in promoting digital and green transformation.

Stakeholders highlighted existing governmental efforts aimed at promoting sustainability and digital transformation. These include programs incentivizing sustainable business practices, such as the Sustainability Card Charter of the Azores and funding opportunities for training and partnership projects. Additionally, stakeholders noted upcoming EU regulations mandating ESG reporting for businesses, indicating a growing focus on sustainability governance. Despite government efforts, there appears to be a lack of understanding and readiness among businesses. Stakeholder 1 emphasized, most would

ignore surveys on green and digital transformation, indicating a potential gap in awareness and engagement. Stakeholder 4 expressed skepticism about the readiness of governmental structures to implement policies effectively. They highlighted bureaucratic challenges within the public services and doubted the government's preparedness for sustainability reporting directives.

Regarding future developments and hopes, stakeholders expressed a desire for more comprehensive and effective policies to drive digital and green transformation. They emphasized the need for stricter regulations to ensure businesses' accountability for their environmental footprint, as seen in initiatives like the proposed "Greener Act." Stakeholders also advocated for increased collaboration between government and external partners to strengthen commitments to climate change action and foster innovation in sustainable practices.

Suggestions also include actively engaging tourists in conservation efforts to foster deeper connections with the destination. Efforts are made to secure funding from the European Union for sustainability projects and to develop carbon measurement programs and digital tools for managing natural parks. Another important aspect was an expressed need for higher digital literacy and skills through education reform, starting from basic levels. There shall also be a need for increased investment and training to prepare individuals and businesses for the digital and green transformation.

Looking ahead, Stakeholder 3 expressed optimism about the government's commitment to fostering sustainability and digital transformation. They discussed ongoing efforts to prepare regional companies for ESG reporting and digitalization, indicating proactive steps towards compliance with upcoming regulations. Stakeholder 3 emphasized the need for robust data collection and analysis tools to inform decision-making and drive progress in sustainability governance. In addition to that, the government plans to implement a tourism territory plan. This plan aims to regulate tourism inflows by defining the number of available beds, thereby limiting the influx of tourists to sustainable levels. Furthermore, Stakeholder 3 outlined a strategic marketing plan that includes the distribution of tourism flows across all nine islands, aiming to promote dispersion and alleviate pressure on heavily visited areas like São Miguel and Terceira islands.

4.3. Stakeholder Activity 2: Multi-stakeholder Workshop

4.3.1. Final System Review

A final system review conducted during the Scenario Analysis Workshop made it possible to improve our system model in alignment with our guiding question. An improvisational method transformed our review into a space for active stakeholder

participation and creative thinking. This approach led to richer discussions beyond simple answers. Stakeholders enthusiastically elaborated on their perspectives, providing valuable insights that not only validated six impacting key factors for our model, but also enriched the conversation. This deeper understanding has then been identified in key themes, as detailed in Appendix E.1.

A first key challenge identified is the need for better Community and active involvement (community, businesses, and government). Supported by TD-S1, TD-S3 and TD-S6, it was common sense not just to foster collaborative governance but also stronger community engagement and empowerment to reach a well-functioning DGT. As mentioned by TD-S1: "*Yes, and if there is community involvement, things are working much better for the community*". This was then supported by TD-S3, coming from the political side, saying that they are already working on that because of this recognition. Adding to that, TD-S6 was calling for an open dialogue format "*between all the parties involved, not only in managing tourism but also in doing tourism*", whereby, also the second factor, Quality of Policy making, was emphasized.

Third, Green and Digital Education was coherently supported by TD-S3, TD-S5, and TD-S6, whereby two of them had some remarks for improvement. TD-S5 was hinting at the importance of defining in which situation which target group would be addressed if locals or tourists are the ones to whom education is directed and explained that this concept intersects with cultural traits and societal preferences. TD-S6 agreed with this and added the note that especially digital education would be missing in companies and would, if covered, benefit the clients in return. In general, this stakeholder mentioned that sustainable principles would have to be kept as a base when applying education. Only TD-S3 did not have suggestions for improvement but pointed to a gap in data collection for education and a lack of environmental awareness.

Fourth, Employment in the Tourism Sector had clearly been identified as a factor for improvement by two stakeholders. TD-S4 pointed out that employment on the Atores needs expansion on the valuation of professions through salaries, professional development, and an expansion of the range of available jobs. Instead, TD-S5 highlighted the changing landscape of employment through new technologies coming along with digital transformation. Thereby, businesses would, on the one hand, be more efficient and performative, but on the other hand, sources of employment might be lost.

The fifth factor, mentioned by two stakeholders, was Performance of Local Tourism Businesses. As being *"related to many factors that support economic resilience,"* the significance of shifting one's perspective on business to one that supports profit and firms rather than

pushing against it is in order for them to actively participate in bringing about social change. Thus, it was underscoring its power for economic resilience and business integration. In the perspective of TD-S5 instead, this would be more of a balancing act that needs to take into consideration the number of visitors attempting to enter local tourism establishments, since capacity affects performance.

Conservation of Nature and Cultural Heritage as the sixth and last factor is stressed as being extremely tied to all the other variables and providing identity. This is accomplished by means of education, community involvement, and sound policymaking once more, but without the assistance of the local tourism industry. Finally, it reinforces environmental sustainability and cultural identity of the Azoreans. Figure 4 depicts the final system model of the Business Digital and Green Transformation for Touristic Competitiveness and Social Capabilities Enhancement in São Miguel, Azores. This final system integrates the perspectives and insights provided by the stakeholders during our scenario analysis workshop.

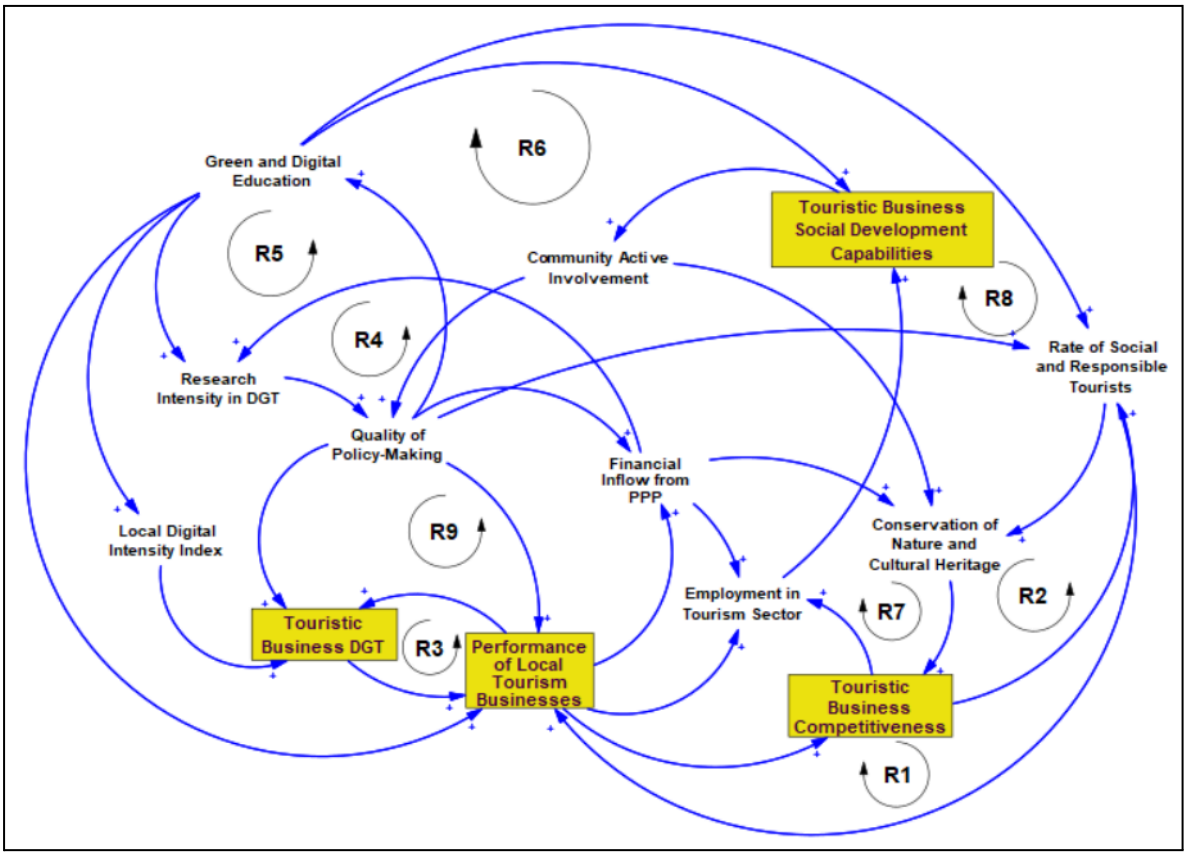

Figure 4. Final system model of the Business DGT for Touristic Competitiveness and Social Capabilities Enhancement in São Miguel, Azores.

Limitations of the Touristic System Performance

Together with an assessment of the system model's components, TD-S5 offered insights into the system's limitations and how they impact the system's performance. This stakeholder states that the "capabilities" of the tourism business (the system) determine the "performance" of both entrepreneurship and the tourism industry. According to him, "performance" of touristic business is a variable clearly interdependent on the capabilities of the business-socio-environmental system. For example, the number of people and resources a firm can handle is finite and limited by the capacity of the business-socio-environmental system. Ignoring this might lead to a "disaster" for the system. Additionally, he stated that the social development capabilities of the business system might be limited by the kinds of DGT implementations taken into consideration and specific system dynamics, which should be in line with the kind of tourist market that is being targeted. In his opinion, a given DGT intervention (cars/buses, for example) will inherently include and exclude groups of people based on their preferences, hence limiting the social developing capabilities of the tourist business system.

4.3.2. Scenario Analysis

Drawing inspiration from scenario analysis theory and future design methodology, two potential future scenarios were crafted and presented to stakeholders, illustrating extreme conditions of the system's evolution. Both scenarios refer to the optimal and non-optimal implementation of DGT for touristic business performance and social capabilities enhancement (Appendix E.2). During the session, improvisation techniques helped to promote high stakeholder engagement, interaction, contribution, and expression of sentiments. The optimal scenario was presented to stakeholders in a 1:03 min video format, with background music, and clips and subtitles following the scenario narrative (Figure E.3 in the Appendix). The narrative of the non-optimal scenario was read to stakeholders mimicking a meditation session. Both scenarios served as a tool for promoting fertile discussion and generate socially robust orientations (SROs).

A) Evaluation of scenarios based on sentiments and group dynamics:

An atmosphere of enjoyment, agreement, and shared perspectives among stakeholders was always prevalent during the workshop. Collaboration was evident as participants integrated and expanded upon each other's viewpoints, rather than opposing or contesting them. This high level of understanding, mutual learning, and knowledge integration among stakeholders can be exemplified by the following statements: *"What TD-S1 said is super*

important", "Probably TD-S3 would speak better about this… I'm going to try to translate it", "So if we, as TD-S6 as well was saying…", "I think TD-S2 was the one that mentioned earlier on that…" "and because of what TD-S2 mentioned before.." "for example, TD-S3 has been mentioning, and I agree with that, and TD-S6 does too".

Most of stakeholders had an open attitude when presented the scenarios, as reflected by some of their comments: "*I think it's a very interesting video to present internal meetings and incentivize decision-makers to act towards that scenario…*","*… if the place becomes more sustainable, then it will be a greater place to visit… that automatically came to my mind when I saw the video".* Some of them also show some skepticism or disbelief: "*it is not telling the truth, the whole truth*", *"whoa, this would be so great if this video matched the reality of the Azores".* This was taken as an opportunity to integrate their perspective about the complexities not being considered in the scenarios, especially the technological and infrastructure complexities, and challenges that needed to be integrated in such a reality.

When asked stakeholders to provide a word to summarize what they got from the workshop and the whole transdisciplinary multi-stakeholder research they answered: Thankful, Knowledge, Mindful, Potential, and Contribution. Stakeholders remain highly interested in getting the final report of the study, the audiovisual material of scenarios, and to provide further contribution.

B) Socially Robust Orientations (SROs):

The discussions surrounding both optimal and suboptimal scenarios provided a rich and insightful exploration of multiperspective orientations to steer the implementation of digital and green transformation for enhancing touristic competitiveness, business performance, and social impact in São Miguel Island. Some of these multiperspective orientations are summarized in the Appendix E.4 and E.5.

Stakeholders unanimously recognized the pressing need to expedite efforts towards achieving optimal DGT implementation in São Miguel, ensuring alignment with sustainability principles to enhance touristic business practices. Following a thorough thematic analysis of the workshop scenario discussions, a comprehensive set of Socially Robust Orientations (SROs) emerged, outlined below:

1) **Develop a Unified Vision for DGT:** Establish a cohesive vision for the tourism sector and DGT, crafted collaboratively with stakeholders and leveraging governmental resources to amplify the transformative potential of tourism in the Azores.
2) **Strengthen Political Framework:** Implement effective legal policies and frameworks at both regional and local levels to support DGT and tourism businesses, enhancing regional autonomy within the Portuguese Republic and European Commission regulations.

3) **Empower Governmental and Non-Governmental Actors:** Foster empowerment and autonomy among governmental and non-governmental entities, fostering collaboration with businesses and communities while minimizing political influence.
4) **Implement Strategic DGT Framework:** Develop a tailored strategic framework for DGT implementation, aligning objectives with the island's unique characteristics and balancing nature preservation, social development, and business performance.
5) **Enhance Management Practices:** Improve tourism management through comprehensive planning, robust development of adaptive strategies, and integration with other sectors, guided by a specialized committee to anticipate evolving needs.
6) **Upgrade Communication Systems:** Integrate digital tools to enhance communication, mitigate isolation, and foster cohesion across the Azores, while transparently communicating tourist business performance and other critical sector updates.
7) **Invest in DGT Research:** Intensify investment and research in DGT for tourism businesses to deepen understanding of benefits and challenges associated with DGT implementation.
8) **Foster Institutional Credibility:** Promote coherence and transparency in governmental, corporate, and community dialogues concerning DGT in São Miguel, enhancing institutional credibility.
9) **Provide Comprehensive Training:** Offer comprehensive training programs for businesses, from owners to employees, focusing on sustainability and impactful practices rather than sheer numbers.
10) **Streamline Business Support:** Reduce bureaucratic hurdles for companies to ensure financial sustainability and enable them to prioritize social and environmental responsibilities.
11) **Improve Business Performance through DT:** Implement DGT solutions to enhance tourism business performance, decrease costs, reduce carbon footprint, and enhance client experiences and business profitability.
12) **Promote DGT as Entrepreneurial Opportunity:** Position DGT as an opportunity for touristic entrepreneurship, in connection with other DGT-based business models based on agriculture, culture, and blue economy sectors.
13) **Enhance Regional Promotion:** Develop robust marketing plans and strategies to attract more tourists, fostering collective action among stakeholders on the island.
14) **Enhance Stakeholder Engagement:** Increase stakeholder accountability and engagement through active community involvement and synchronized efforts across all stakeholders.

15) **Prioritize DGT for Health Systems:** Incorporate DGT solutions for effective health systems catering to both locals and tourists, optimizing healthcare delivery.
16) **Implement DT for Education:** Utilize DGT solutions to improve education systems, minimize school dropout rates, and foster social development across the islands.
17) **Develop Strategic Approaches for Tourism Corporations:** Implement effective governmental strategies to optimize outcomes of large tourist corporations' operations, balancing risks and opportunities while prioritizing local nature and community well-being.
18) **Mitigate Deforestation through DGT:** Utilize DGT to address deforestation challenges associated with farming fields, improve resource management, and preserve ecosystems.
19) **Leverage DGT for Touristic Information:** Utilize digitalization to provide visitors with enhanced communication and information, enriching their overall touristic experience.

5. Conclusion

Our research was conducted to explore how digital and green transformation (DGT) might enhance local businesses and entrepreneurship, thereby fostering touristic competitiveness in São Miguel, Azores. It provides an account of various digital and green initiatives and offers some recommendations for future practice. Through a collaborative effort, we discovered a number of important findings that highlight how digital and green initiatives, sustainability, innovation and community involvement collaborate to shape the future trajectory of tourism in São Miguel.

From our research, it is evident that green and digital initiatives might enhance tourist satisfaction and support local entrepreneurs. Integrating digital and green initiatives and sustainability can optimize business processes and the social development capabilities of the community, thereby elevating São Miguel's tourism status. By leveraging the natural beauty and cultural values of São Miguel through digitalization, while simultaneously integrating successful local traditional practices, the island can attract visitors while maintaining its unique identity.

However, our research also shed light on several challenges and areas for improvement. Despite significant advances in sustainability, there remains a need for comprehensive education and training programs to ensure widespread adoption of digital and green practices among locals and businesses in São Miguel. Moreover, stakeholders across various sectors underscored the critical importance of robust regulations, concerted efforts

involving government bodies, businesses, and external stakeholders and proactive governmental initiatives to expedite the progress in green and digital transformation. Additionally, leveraging partnerships with migrants offers promising pathways to facilitate the digital and green transformation. Embracing digital innovations such as AI, automation, and IoT holds the potential to revolutionize customer experiences and operational efficiency for tourism enterprises.

Although our research has offered valuable insights into how digital and green transformation might boost tourism and business in São Miguel, Azores, we need to recognize some limitations. First, the sample size was only six experts, which limited us from getting an in depth perspective of the research variables. Also, due to the sample size, we did not get detailed input from key sectors like business, digital transformation, and tourism, so our understanding from this regard is not as detailed as it could be. Moreover, we had limited time – less than three months – to do this research, which meant we could not dive as deep as we wanted to. Again, the research lacking quantitative and empirical analysis hinders our understanding of the specific drivers of tourism and business enhancement in São Miguel. These limitations underscore the need for further research to provide a more comprehensive understanding of the drivers of tourism and business enhancement in São Miguel.

We would like to take this opportunity to express our heartfelt gratitude to all the participants and supervisors who played a crucial role in making this research possible. Without their invaluable contributions, guidance, and support, this study would not have been possible. We are extremely grateful for their time, effort, and willingness to participate in the interviews. Their insights, perspectives, and expertise have greatly enriched the findings of this research.

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Appendix A

A.1 Glossary of System Model Factors:

1. **Performance of Local Tourism Businesses:** A measure of how effectively local tourism businesses operate and succeed, including their profitability, customer satisfaction.
2. **Touristic Entrepreneurship Social Development Capabilities:** The ability of tourism entrepreneurs to contribute to social development, including job creation, and community well-being.
3. **Touristic Entrepreneurship Competitiveness:** The ability of tourism entrepreneurs to innovate, offer more value, and effectively compete with other businesses.
4. **Employment in Tourism Sector**: The number of jobs created by the tourism industry, which can indicate the sector's health and its importance to the local economy.
5. **Research Intensity in Green and Digital Transformation:** The number of academic and practical research efforts in the areas of green practices and digital technologies within the tourism industry.
6. **Number of ecotourists:** The number of tourists visiting Azores specifically for its ecological attractions and sustainable tourism practices.
7. **Local Digital Intensity Index:** Digital intensity index measures how many digital technologies / services a business is using (no matter which branch). E.g. businesses which use digital platforms, cloud services or even AI have a high digital intensity index. A hotel/restaurant etc. whose operations run completely digital has a high digital intensity index, a hotel/restaurant etc. whose operations rely on books, pens and paper has a low digital intensity index.
8. **Entrepreneurship innovation and incubation performance**: Evaluation of the effectiveness and success rate of initiatives fostering the development and growth of innovative startups and businesses.
9. **Financial Inflow from Public-Private Partnership (PPP):** Funds generated through collaborative projects between governmental and private entities, facilitating investment in public infrastructure or services.
10. **Conservation of nature and Cultural Heritage:** Actions aimed at protecting and preserving natural resources, habitats, and biodiversity.
11. **Low-cost flight offer:** Number of available flights for affordable prices.

A.2 Initial System Model's loops

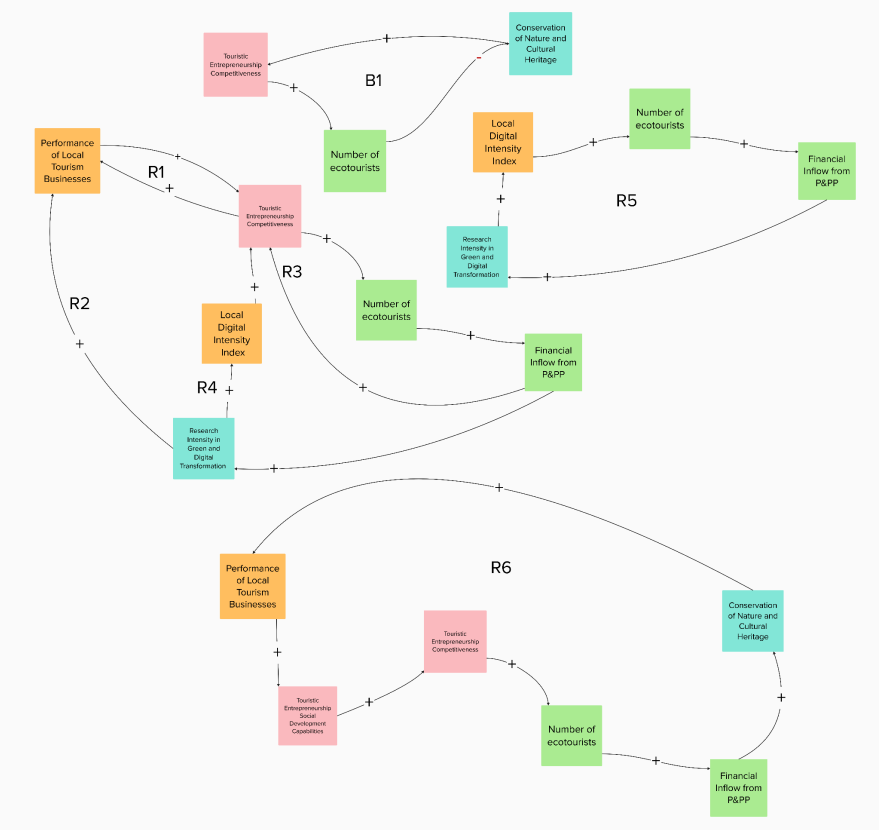


Figure A.2. Initial System Model's loops

A.3 Refined System Model's loops after Stakeholder Activity 1

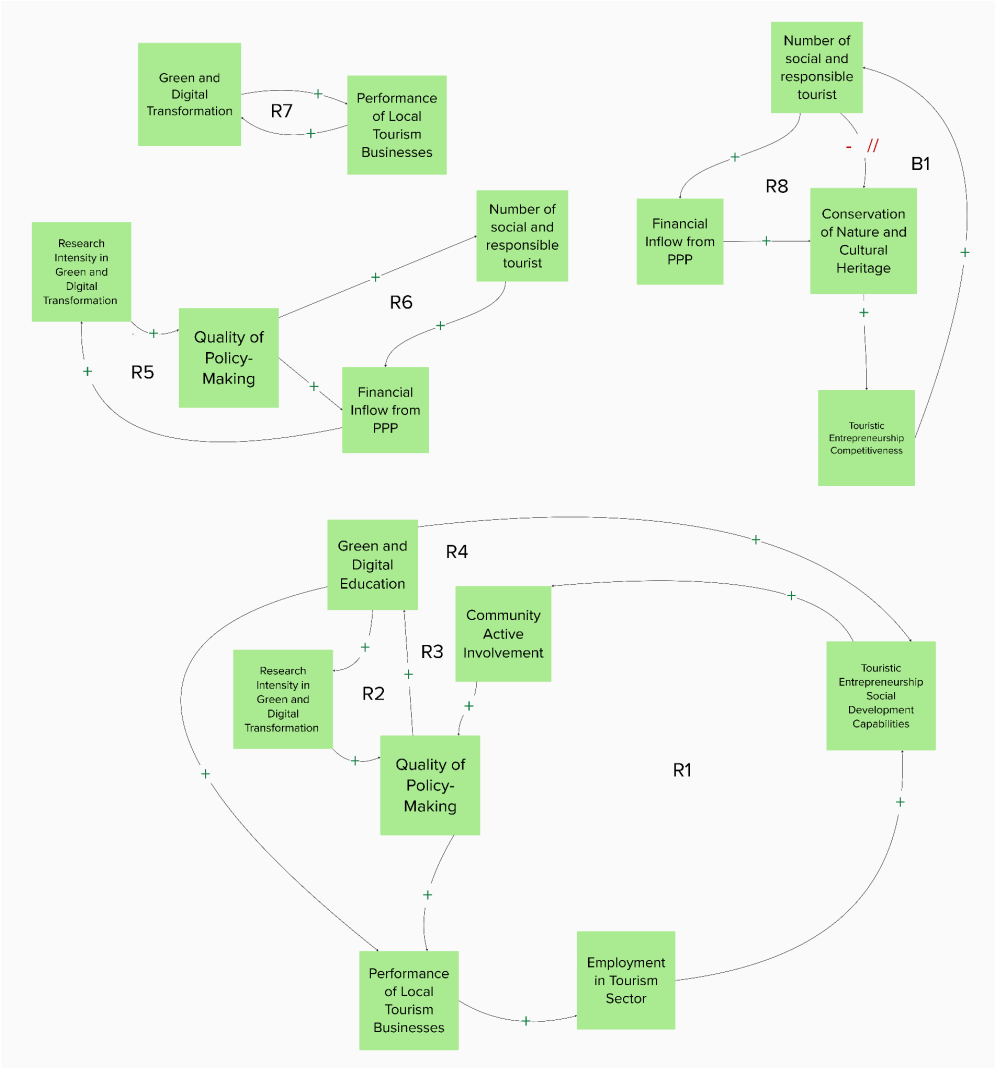


Figure A.3. Refined System Model's loops

Appendix B

Recruitment and Engagement with Stakeholders

B.1. Stakeholder Mapping

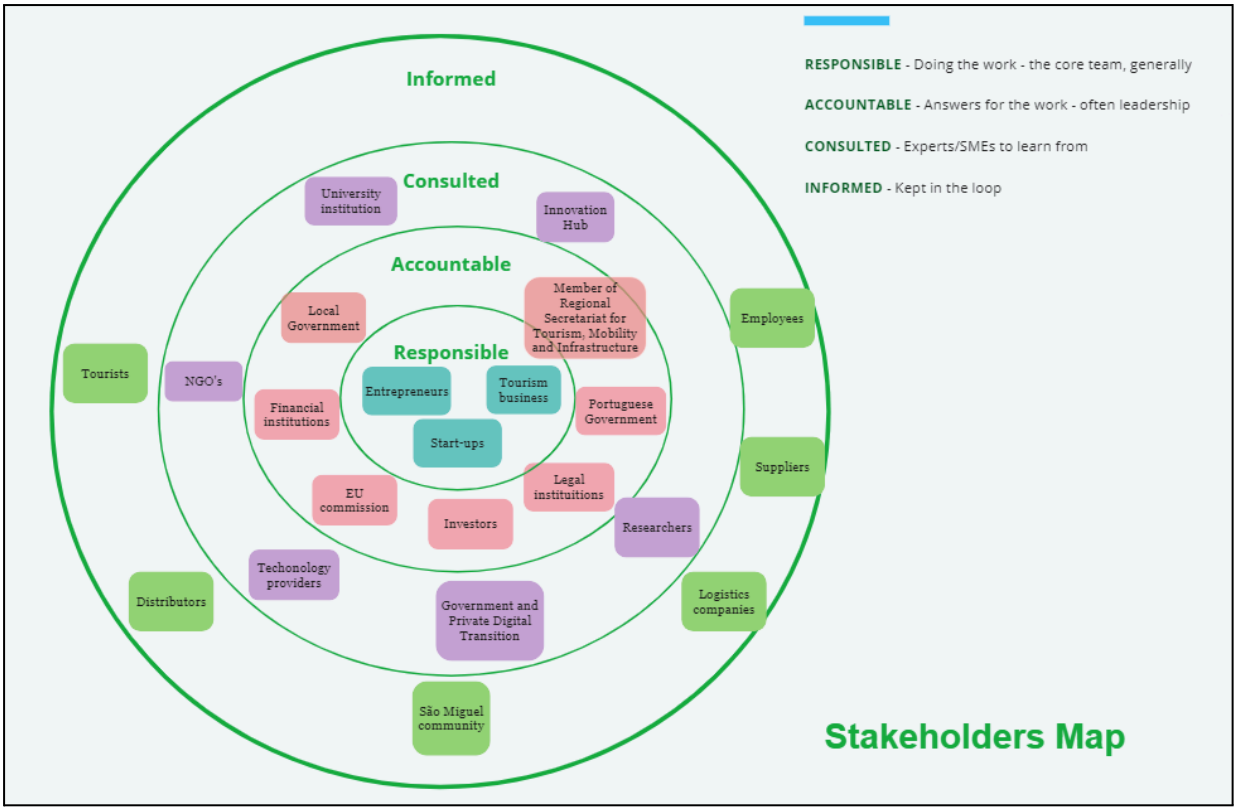
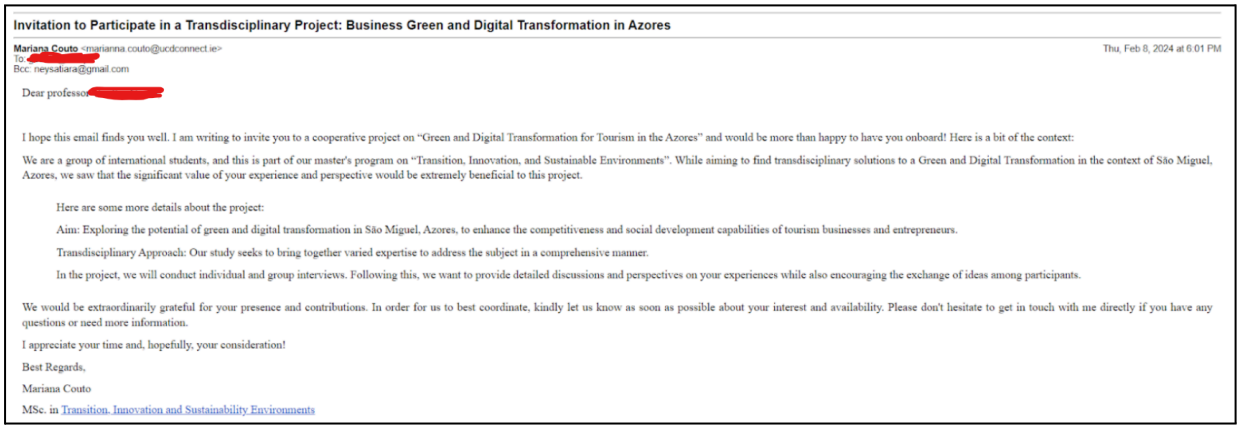


Figure B.1. Stakeholders Map

Note: Figure B.1 depicts the stakeholder map showing the most relevant stakeholders to our study. We divided the map into four groups: responsible, accountable, consultants, and informed. The first group identified businesses, the second government and financial-related, the third field of experts, and the fourth important stakeholders to keep informed.

B.2 Stakeholder's Engagement



Invitation to Participate in a Transdisciplinary Project: Business Green and Digital Transformation in Azores

Mariana Couto <marianna.couto@ucdconnect.ie> Thu, Feb 8, 2024 at 6:01 PM
To: [redacted]
Bcc: neysatiara@gmail.com

Dear professor[redacted]

I hope this email finds you well. I am writing to invite you to a cooperative project on "Green and Digital Transformation for Tourism in the Azores" and would be more than happy to have you onboard! Here is a bit of the context:

We are a group of international students, and this is part of our master's program on "Transition, Innovation, and Sustainable Environments". While aiming to find transdisciplinary solutions to a Green and Digital Transformation in the context of São Miguel, Azores, we saw that the significant value of your experience and perspective would be extremely beneficial to this project.

Here are some more details about the project:

Aim: Exploring the potential of green and digital transformation in São Miguel, Azores, to enhance the competitiveness and social development capabilities of tourism businesses and entrepreneurs.

Transdisciplinary Approach: Our study seeks to bring together varied expertise to address the subject in a comprehensive manner.

In the project, we will conduct individual and group interviews. Following this, we want to provide detailed discussions and perspectives on your experiences while also encouraging the exchange of ideas among participants.

We would be extraordinarily grateful for your presence and contributions. In order for us to best coordinate, kindly let us know as soon as possible about your interest and availability. Please don't hesitate to get in touch with me directly if you have any questions or need more information.

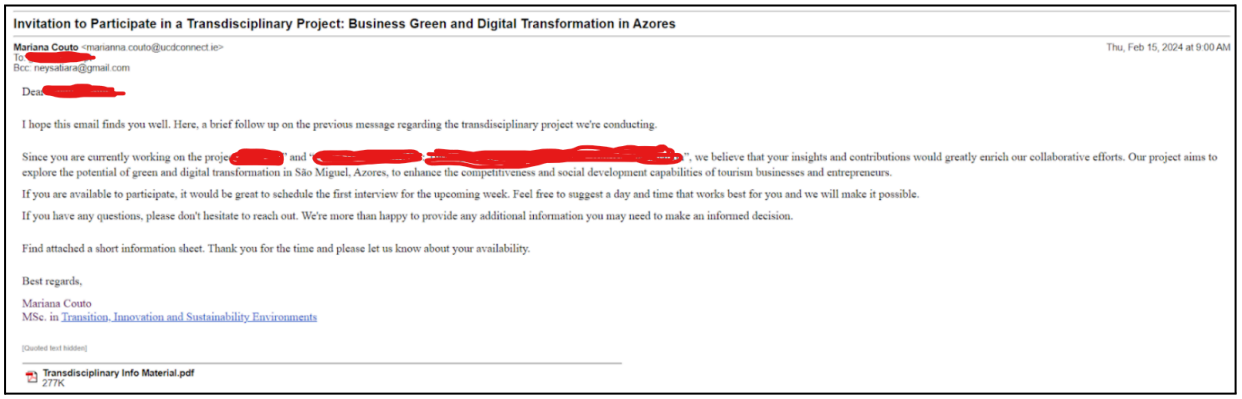
I appreciate your time and, hopefully, your consideration!

Best Regards,

Mariana Couto

MSc. in Transition, Innovation and Sustainability Environments

Figure B.2. First Invitation



Invitation to Participate in a Transdisciplinary Project: Business Green and Digital Transformation in Azores

Mariana Couto <marianna.couto@ucdconnect.ie> Thu, Feb 15, 2024 at 9:00 AM
To: [redacted]
Bcc: neysatiara@gmail.com

Dear [redacted]

I hope this email finds you well. Here, a brief follow up on the previous message regarding the transdisciplinary project we're conducting.

Since you are currently working on the proje[redacted]" and "[redacted]", we believe that your insights and contributions would greatly enrich our collaborative efforts. Our project aims to explore the potential of green and digital transformation in São Miguel, Azores, to enhance the competitiveness and social development capabilities of tourism businesses and entrepreneurs.

If you are available to participate, it would be great to schedule the first interview for the upcoming week. Feel free to suggest a day and time that works best for you and we will make it possible.

If you have any questions, please don't hesitate to reach out. We're more than happy to provide any additional information you may need to make an informed decision.

Find attached a short information sheet. Thank you for the time and please let us know about your availability.

Best regards,

Mariana Couto
MSc. in Transition, Innovation and Sustainability Environments

[Quoted text hidden]

Transdisciplinary Info Material.pdf
277K

Figure B.3. Follow Up Email with Info Material

Figure B.4. Info Material Poster

B.3. Stakeholders Selection Process Results

Category	Description	Status
Entrepreneur	A tea house in Furnas sells local products from nine islands and prepares some items using earth's heat or thermal water.	Participated
Entrepreneur	Tourism company.	Participated
Entrepreneur	The main activity is in the field of parks and nature reserves, through the exploitation of hot springs.	Declined
Academia	University professor of tourism at the University of the Azores. Developed research in the domains of tourism and sustainable entrepreneurship.	Declined
Academia	Professor at the University of the Azores, currently working on tourism projects in the regional level	Declined
Academia	University professor in Poland, head of research projects in tourism in Madeira, Portugal. Have developed different research in the field of tourism in the context of the Azores, and as well sustainability.	Participated
Policy Makers	Responsible for developing, executing, and evaluating the activities required to carry out regional tourist, transportation, infrastructure, and energy policies.	Declined
Policy Makers	Responsible for coordinating and developing actions for the implementation of regional policies in the area of communications, information systems and technologies, cybersecurity and digital transition.	Declined
Governamental - Sustainability focus	The organisation responsible for monitoring the sustainability of the Azores tourism attraction	Participated
Technology	Technology company that focuses on smart tourism, e-commerce, media, and institutional communication, with experience in the development of digital applications in the Azores.	Declined
Innovation Hub	It supports companies in production and service development using digital technologies, focusing on projects to enhance SMEs' competitiveness and digitalization.	Declined
Community	Community focus, social development projects	Participated
Business focus	An NGO whose mission is to encourage a sustainable culture among Azorean businesses.	Declined
Technology	University professor in Poland with more the 30 years of experience in IoT and digital solutions development for smart cities development	Participated

B.4. Stakeholders Interviews' Log

No	Stakeholder	Date and Time	Duration
1	Entrepreneur 1 - Tea House Business	2 March 2024 at 12.00	45 minutes
2	Academia 1 - Sustainable and Tourism Focus	1 March 2024 at 13.00	47 minutes
3	Government representative	12 March 2024 at 17.30	60 minutes
4	Community representative	1 March 2024 at 11.00	52 minutes
5	Academia 2 - Technology Focus	7 March 2024 at 17:24	60 minutes
6	Entrepreneur 2 - Tourism Business	6 March 2024 at 16:30	60 minutes

B.5 Reminder email and agenda for Scenario Analysis Workshop (Activity 2)

Welcome to the TISE Transdisciplinary Workshop!

Dear participant,

The TISE- team thanks you for accepting being part in the Scenario Analysis Workshop!

We are happy to confirm your registration for our online workshop on:
Wednesday, March 20th at **3 pm AZOT/ 5 pm CEST.**

Joining Instructions:

Please fill out the **consent form** beforehand (takes about 5 minutes) and send it back to us.

During the workshop, we will collaborate to validate our guiding question and system model, and evaluate **future scenarios**.
Before Wednesday, we invite you to get familiar with the joint system model.

Contact us if you need any help!

On the day:

Our online workshop will last approximately 2 hrs, so get comfy, fix yourself a drink, and simply click on this link to join the Zoom room (Meeting-ID: 636 7843 7830, PW: TISE).
You can find the agenda below.

Afterwards, if you want, we invite you to informally stay with us to share your feedback. We very much value your input and feedback to help us improve.
This is also a chance to arrange with others for potential cooperation and to network.

We are looking forward to meeting you!

Best wishes,
Your TISE Research Team

Figure B.4.a. Reminder email and agenda for Scenario Analysis Workshop (Activity 2)

Agenda

If possible, come online 5 mins before it starts.

Topic	Time (min)
Welcome & Introduction - Present your field of expertise here.	~15
Interactive Part I. - Short System Model review - With applied improvisation methods	~ 20
5 min break	
Interactive Part II. - Focused Scenario Analysis - With applied improvisation methods	~ 50
Q& A and Closure	~ 30
In total	**= +/- 2 hrs**
Stay if you are interested for informal exchange and connection	**+ ? +**

Updated System Model

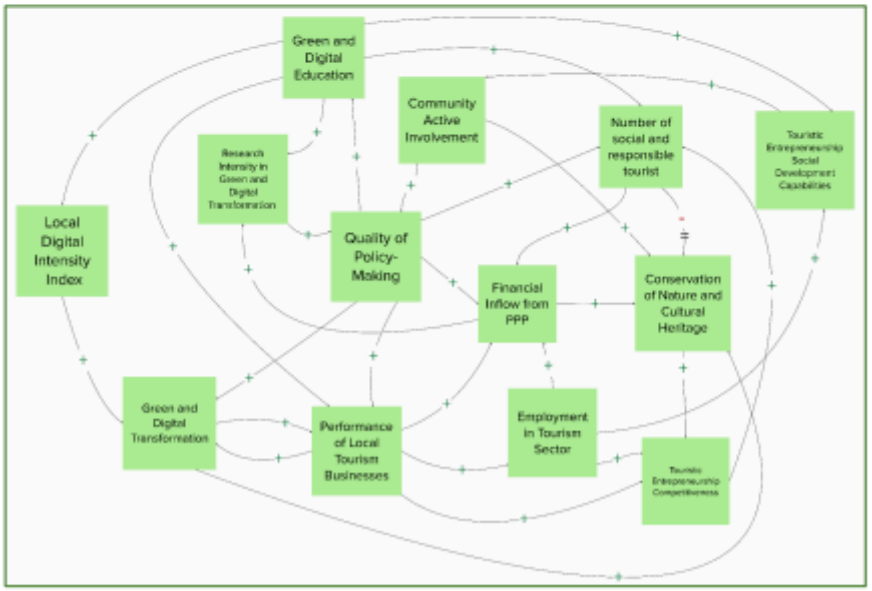


Figure B.4.b. Reminder email and agenda for Scenario Analysis Workshop (Activity 2)

Appendix C

C.1 Interview Protocol (Example used for Technology field stakeholders)

Interview Protocol and Questions

Topic

Green and Digital Transformation:
Touristic Entrepreneurship and Business Enhancement
in São Miguel, Azores

Introductory Information

You have been requested to participate in a transdisciplinary research study. Your involvement occurred through a selection of participants relevant to the study. This research aims to investigate how coupled digital and green transformation enhances local businesses and entrepreneurship, fostering both touristic competitiveness and social development capabilities in São Miguel, Azores**.** This study is being conducted by international master students in Transition, Innovation, and Sustainability Environment, a joint programme run by University College Dublin, Ireland.

Now we will read some basic information about this study and request your consent to participate before we begin the interview.. If you agree to participate in this interview, you will be asked to answer a series of demographic questions, followed by subject-matter questions. This interview is expected to take 30-60 minutes.

Participation in this research study is strictly voluntary. This interview will be recorded by the interviewer for future review and analysis. In this manner, we ask you not to use your name or the specific names of others during this interview to maintain confidentiality throughout the study. You may skip any question that you do not feel comfortable with and/or terminate your participation at any time.

- Do you have any questions about this process before we begin?

  Answer 1: No. Proceed with the study.

  Answer 2: Yes. Answer and resolve any questions.

Statement of Consent

- Has the participant read and agreed to the Informed Consent Form prior to consenting to voluntary participation in this session?

  Answer 1: Yes. Proceed with the study.

  Answer 2: No. If not, provide the consent form and obtain the participant’s signature.

Description of Participant

The participant in this interview must meet these qualifying prerequisites:

- ITEM 1: Have lived/worked in Sao Miguel or are you familiar with the context of São Miguel

- ITEM 2: Has worked with projects or activities related to the tourism sector, entrepreneurial and business development, and digital and green transformation in The Azores, or in another place if relevant to the study

- ITEM 3: is willing to share their views and opinions on digital and green transformation

Has verification of the participant prerequisites occurred?

Answer 1: Yes. Continue with the study.

Answer 2: No. If not, conduct verification of the prerequisites.

Transcript Outline

- Begin recorder

Introduction to Interview

Researcher: Hello and good morning/afternoon. My name is (First Name, Last Name). I am a master student in Transition, Innovation and Sustainability Environment. I am currently conducting a study on how coupled digital and green transformation enhance local businesses and entrepreneurship, fostering both touristic competitiveness and social development capabilities in São Miguel, Azores**.** This session is being conducted by Zoom at ____(GMT-1)_____AM/PM on_____TBD_____ (date). This session is being audio recorded by the researcher, and field notes are being taken; both may be used for future analysis.

To protect the identity of the participant, no names or personally identifiable information will be requested during this interview unless voluntarily provided by the participant. The participants will be identified by the researcher only as "Participant."

Participant, have you previously been given and agreed to consent information to accept the requirements of this research study?

Participant: [Yes/No]. (If yes, continue. If not, complete a statement of consent.)

Researcher: Now that we have recorded your consent, I will begin the interview. Remember that at any time, you may end this session without consequence. All questions are voluntary and may be skipped by the participant if requested. The first section of the interview will gather some demographics. This information will be used to analyze the possible connection of the demographics provided with the subject matter of the research study.

Researcher: What is your age?

Participant: [Answer]

Researcher: Where were you born, and where do you currently reside?

Participant: [Answer]

Researcher: What is the institutional name of your organization?

Participant: [Answer]

Researcher: Can you please say what your profession/ occupation is?

Participant: [Answer]

Researcher: [If meets requirements, move to the next section. If not, the session will cease.]

Researcher: Thank you. This concludes the demographic section of the session. The following questions will allow you to provide answers to questions relating to the key concepts relating to this research. These open-ended questions allow you to express any information you believe can be used to answer the question. If any question is unclear, please ask for clarification. Are you ready to continue?

Participant: [Yes/No] If not, please let me know when you are ready to continue.

Subject Matter (Probing questions listed)

Researcher: This study aims to investigate how coupled digital and green transformation enhances local businesses and entrepreneurship, fostering both touristic competitiveness and social development capabilities in São Miguel, Azores.

The first question I have for you is:

Are you familiar with the concept of digital and green transformation?

Participant: [Yes/No]

Researcher:

> [If yes] How do you define digital transformation in the context of local business?
>
> [If no] [In your opinion, what role do you think technology and environmental sustainability play in shaping the future of businesses and industries?]

Participant: [Answer]

Researcher: How do you define green transformation in the context of local business?

Participant: [Answer]

Researcher: How familiar are you in terms of business/entrepreneurial activities?

Participant: [Answer]

Researcher: Are you aware of tourism business activities in Sao Miguel or in other relevant contexts?

Participant: [Answer]

Researcher: Now, let's dive into some additional questions. How familiar and comfortable are you with using different types of digital technologies in your tourism or business-related activities or operations?

Participant: [Answer]

Researcher: That's great to hear. Which digital tools do you know already that could be integrated into the tourism activities in São Miguel to attract more visitors?

Participant: [Answer]

Researcher: How can digital technologies benefit the tourism business or entrepreneurial related activities in São Miguel, Azores?

Participant: [Answer]

Researcher: How can technology be used to improve the visitor experience while also minimizing the environmental impact of tourism activities in São Miguel?

Participant: [Answer]

Researcher: What are the challenges of using digital technologies in tourism or for business and entrepreneurial activities?

Participant: [Answer]

Researcher: Have you observed any innovative uses of technology, such as mobile apps or online platforms, to promote sustainable tourism practices in São Miguel?

Participant: [Answer]

Researcher: What barriers or challenges do you see in the adoption and implementation of digital technologies by small and medium-sized enterprises (SMEs) in the tourism sector?

Participant: [Answer]

Research Question Validation

Researcher: **What is your opinion about our guiding question? - "*How can coupled digital and green transformation enhance local businesses and entrepreneurship, fostering both touristic competitiveness and social development capabilities in São Miguel, Azores?*"**

Participant:

Researcher: How do you perceive the importance or relevance of this research question?

Participant:

Researcher: What potential outcomes or implications do you foresee arising from addressing this research question?

Participant:

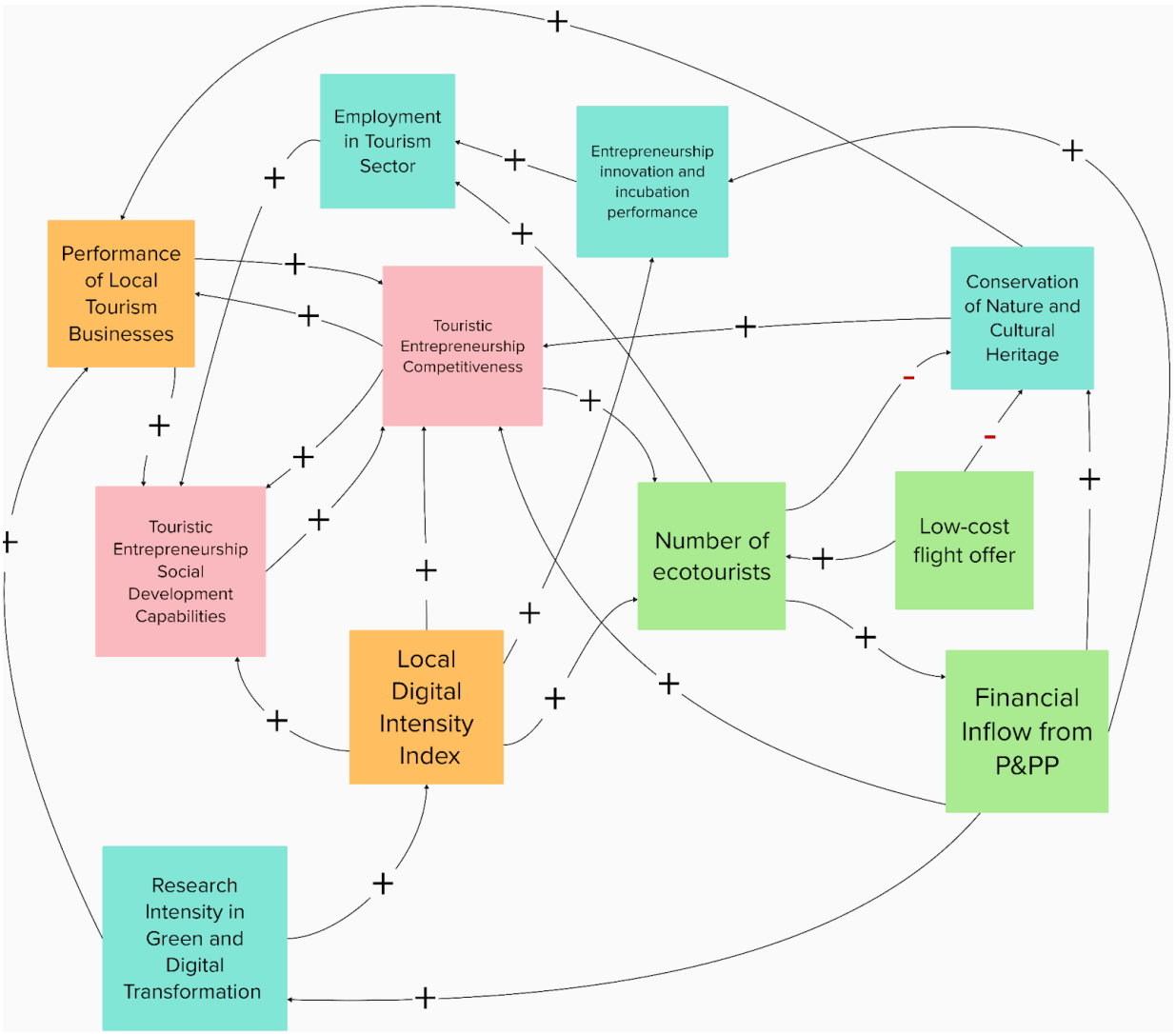
Researcher: Do you think Azores, or in the case of São Miguel, is prepared for this transformation?

Participant:

System Modeling

Researcher: **Now we are going to present to you the methodology that we use for this research: causal loop diagrams, also known as system modeling. This system model is a visual representation of the various factors and their interconnections, which aim to answer our research question. We identify twelve factors that are related to the guiding questions.** The model helps us to understand the complex interactions of the phenomenon and how they contribute to competitiveness in the tourism sector and social development capabilities.

Show the diagram



The model uses "+" and "-" signs to show the directions of two connected variables/components. It shows '+' if two components have the same direction (e.g. Tourism Business Adaptation Strategy ↑, Performance of Local Tourism Businesses ↑). And vice versa, it's '-' if two components have a different direction (e.g. Low cost flight-offer ↑, Health of environment ↓).

Looking at our causal loop diagrams, and emphasizing the factors with the tourism/ sustainability , namely:

Performance of Local Tourism Businesses: A measure of how effectively local tourism businesses operate and succeed, including their profitability, customer satisfaction.

Touristic Entrepreneurship Social Development Capabilities: The ability of tourism entrepreneurs to contribute to social development, including job creation, and community well-being.;

Research Intensity in Green and Digital Transformation: The number of academic and practical research efforts in the areas of green practices and digital technologies within the tourism industry.

Entrepreneurship innovation and incubation performance: Evaluation of the effectiveness and success rate of initiatives fostering the development and growth of innovative startups and businesses.

→I give a few moments to think.

Participant: [Let the participant proceed the diagram]

Researcher: From this model, we want to understand your point of view. Are the interconnections correct? Are they significant?

Participant:

Researcher: Do you think some factors in the model can be modified? What are the most important ones to you?

Participant:

Researcher: Do you think there are signs that should be different from your perspective?

Participant:

Researcher: Do you have any other critical components in mind that you feel are essential but may have been forgotten or missed from this model?

Participant:

Conclusion

Researcher: That is the end of the scheduled session questions. Do you have any comments or questions for me now that we have concluded?

Participant: [Yes/No]. If yes, [Answer].

Researcher: Okay. I want to thank you again for your participation in this session. I will now stop the recording of this interview.

- Turn off the recorder

I will now review the information provided to ensure clarity of the data and proper interpretation.

[Conduct review; provide clarification in field notes.]

Wrap-Up

This concludes this portion of the research study. I would like to thank you for assisting in better understanding how coupled digital and green transformation enhances local businesses and entrepreneurship, fostering both touristic competitiveness and social development capabilities in São Miguel, Azores**.**

Please contact me at (email) if you have any questions or concerns that may arise. As a reminder, you may also contact our professor Günther Schreder (guenther.schreder@donau-uni.ac.at) for any issues regarding the ethical review process. Thank you again. Your participation is greatly appreciated!

C.2. Informed Consent

INFORMED CONSENT FORM – INTERVIEW

TITLE OF STUDY

Green and Digital Transformation: Touristic Entrepreneurship and Business Enhancement in São Miguel, Azores

RESEARCH TEAM

Members:

1. Armando Carias (armando.cariashenriques@ucdconnect.ie)
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PURPOSE OF STUDY

You are being asked to take part in a research study. Before you decide to participate in this study, it is important that you understand why the research is being done and what it will involve. Please read the following information carefully. Please ask the researcher team if there is anything that is not clear or if you need more information.

The purpose of this study is to understand how the synergies between green and digital transformation can enhance tourism entrepreneurship and business activity in São Miguel, Azores. By employing a transdisciplinary method and integrating perspectives from several practitioners and scientists, this study aims to answer the primary question: "*How can coupled digital and green transformation enhance local business and entrepreneurship, fostering both touristic competitiveness and social development capabilities in São Miguel, Azores?*" Through this, the research seeks to understand the specific factors influencing local tourism entrepreneurship and business, as well as the challenges associated with implementing digital and green transformations, contributing to the envisioning of a more attractive, resilient, and financially sustainable tourism ecosystem while considering ecosystem preservation.

STUDY PROCEDURES

If you volunteer to participate in this study, you will follow the following steps:

1. Participate in an **individual preliminary interview** (45-60 minutes)

2. Participate in a **focus group discussion** involving 5-8 people from different backgrounds (2 - 3 hours).

The individual interview and focus group discussion will be conducted virtually via Zoom and audio transcript will be retrieved.

The researchers will save transcripts from the individual interview and focus group discussion on a Google Drive, password-protected and secured for safekeeping.

RISKS

No more than minimal risks or harms are expected for participating in this study.

You may decline to answer any or all questions, and you may terminate your involvement at any time if you choose.

BENEFITS

Participating in this study offers valuable insights into how to foster a competitive nature-based tourism business ecosystem and preserve the environment of São Miguel, Azores. Your involvement will contribute to a comprehensive understanding of the potentialities and vulnerabilities of the system by integrating perspectives from practitioners and scientists. By generating and evaluating the system, this research aims to uncover possibilities of integrating green and digital uses for enhancing touristic entrepreneurship and elevating social development capabilities. We highly value your involvement in developing a tourist ecology that is more appealing, robust, and economically viable, while also taking into account island preservation.

CONFIDENTIALITY

Your participation in our research will be disclosed as being an anonymous member of your institution. All personal information contained in the interview will be kept completely confidential, your specific personal responses to this interview and focus group discussion will be kept anonymous and only be used for this research purpose. Every effort will be made by the researcher to preserve your confidentiality, including the following:

- All information received will be kept strictly confidential and will be safeguarded.
- Pseudonyms will be assigned to participants and used on all research notes and documents.
- The results of the study might be published by our universities. There is a possibility that what you share with us will be included in these publications. You will only be identified by pseudonyms, and your identity will not be revealed.

- Notes, interview transcriptions, and any other identifying participant information will be saved on a Google Drive, kept inside for one year then destroyed at the end of this period.

Participant data will be kept confidential, except in cases where the researcher is legally obligated to report specific incidents. These incidents include, but may not be limited to, incidents of abuse and suicide risk.

CONTACT INFORMATION

If you have questions at any time about this study, or if you experience adverse effects as a result of participating in it, you may contact the research team whose contact information is provided on the first page. If you have questions regarding your rights as a research participant, or if problems arise that you do not feel you can discuss with us, please contact one of the researchers.

VOLUNTARY PARTICIPATION

Your participation in this study is voluntary. It is up to you to decide whether or not to take part in this study. If you decide to take part in this study, you will be asked to sign a consent form. After you sign the consent form, you are still free to withdraw at any time and without giving a reason. Withdrawing from this study will not affect the relationship you have, if any, with the researcher. If you withdraw from the study before data collection is completed, your data will be returned to you or destroyed.

CONSENT

I have read, and understand the provided information, and I have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and without cost. I understand that I will be given a copy of this consent form. I voluntarily agree to take part in this study.

Participant's signature _____ Date _____

Investigator's signature _____ Date _____

Appendix D

Individual Thematic Analysis Results

Individual thematic analysis was conducted following the transcription of the interviews and subsequent familiarization with the contents. Researchers then processed the coding stage to develop patterns. This allowed for the creation of the interview's main themes, where six main themes were identified, such as Green Transformation, Digital Transformation; Community Development; Sustainability; Local Entrepreneurs; and Policy and Regulations. For reference, two approaches to thematic analysis were employed: one using Google Sheets, and the other using Google Docs in developing the codes and themes.

Individual thematic analysis is discussed in more detail in the following.

a. TD-S1: Entrepreneur 1 - Tea House Business

The participant underscores the crucial importance of digital and green transformation in the Azores, particularly for local businesses. Although businesses are becoming more aware of the importance of these developments, there is still a noticeable lack of preparedness on their part because of a lack of literacy in these domains. Efforts from the government to support companies in this transition are noted, but many businesses struggle to understand and accept these initiatives. Overall, the integration of digital tools and sustainable practices not only optimizes business operations but also enhances the region's attractiveness to responsible tourists, contributing to community development and the preservation of nature and cultural heritage.

Table D.1. Entrepreneur 1 Thematic Analysis

No	Main Theme	Sub-theme
1	Green Transformation	1. Green transformation definition 2. Green transformation opportunities a. Enhance effectiveness b. Promotion of Sustainable Development
2	Digital Transformation	1. Digital transformation definition 2. Digital Transformation Opportunities a. Enhance effectiveness c. Diversify job opportunities 3. Digital Transformation Challenges a. Access to Digital tools
3	Community Development	1. Social Development Capabilities a. Employment and Livelihoods b. Preservation of Cultural and Local Traditions c. Characterisation of the São Miguel community 2. Community Involvement 3. Communication and Connectivity 4. Tourism and Community Development

		a. Tourism contextualization i. Problem Arising due to Tourism ii. Tourism Opportunity
4	Sustainability	1. Importance of Sustainability 2. Azores Sustainable Tourism Destination
5	Local Entrepreneurship	1. Entrepreneurship Situation a. Dimension of the business 2. Entrepreneurship Opportunity
6	Policy and Regulations	1. Involvement from the Regional Government 2. Policy and Regulations Implementation

b. TD-S2: Academia 1 - Sustainable and Tourism Focus

Table 3 shows the interview themes using thematic analysis. To reduce the negative effects of massification and guarantee the preservation of the Azores' distinctive natural heritage, stakeholders stressed the significance of teaching both local citizens and tourists about environmental conservation. Furthermore, the government is committed to sustainability in legislation and regulation, as seen by current initiatives like the planned Greener Act, which aims to make entrepreneurs accountable for their carbon footprint in the tourism sector.

Table D.2. Academia 1 Thematic Analysis

No	Main Theme	Sub-theme
1	Green Transformation	1. Green transformation opportunities
2	Digital Transformation	1. Digital Transformation definition 2. Digital Transformation Challenges a. Dependency b. Impact of the Social Media 3. Strategies to implement Digital Transformation a. Digital Education 4. Digital Transformation Opportunities
3	Community Development	1. Community Conditions 2. Social Development Capabilities a. Characterisation of the São Miguel community b. Education c. Preservation of Cultural and Local Traditions 3. Community Involvement 4. Tourism and Community Development a. Tourism contextualization i. Problem Arising due to Tourism
4	Sustainability	1. Azores Sustainable Tourism Destination
5	Policy and Regulations	1. Proposed Policy and Regulations 2. Policy and Regulations Implementation

c. TD-S3: Government Representative

Table 4 illustrates the thematic analysis findings concerning the government's perspective. The predominant theme observed was "Policy and Regulations," with participants emphasizing the significance of incentives in driving green and digital transformations, the government's efforts towards establishing a "Sustainable Tourism Destination," and outlining forthcoming initiatives.

Table 4. Government Thematic Analysis

No	Main Theme	Sub-theme
1	Green Transformation	1. Green transformation definition
2	Digital Transformation	1. Digital Transformation Definition 2. Digital Transformation Opportunities and Their Importance
3	Community Development	1. Social Development Capabilities a. Employment and Livelihood b. Preservation of Cultural and Local Traditions 2. Community Involvement 3. Tourism and Community Development a. Tourism Expectation
4	Sustainability	1. ESG Reporting and Assessment 2. Azores Sustainable Tourism Destination 3. Azores Sustainability Plans
5	Local Entrepreneurship	1. Entrepreneurship Opportunity and Its Importance 2. Entrepreneurs' Situation
6	Policy and Regulations	1. Incentives 2. Green and Digital Transformation Context 3. Entrepreneurship Context 4. Governance and Regional Economy 5. Proposed Policy and Regulations

d. TD-S4: Community representative

The community representative interview's thematic analysis is depicted in Table 5. The interview results underscored the critical importance of community involvement and education in fostering sustainable tourism development in the Azores. Stakeholders highlighted the challenges posed by poverty and limited mobility, emphasizing the need for initiatives to attract and retain the younger generation while preserving local traditions and cultural heritage. Furthermore, they stressed the significance of inclusive tourism practices and the careful management of tourism growth to ensure economic development without compromising social and environmental integrity.

Table D.3. Community Thematic Analysis

No	Main Theme	Sub-theme
1	Green Transformation	1. Green transformation definition 2. Green transformation opportunities
2	Digital Transformation	1. Digital Transformation Challenges a. Access to Digital tools b. Digital Literacy and Skills c. Digital Education 2. Digital Transformation Opportunities
3	Community Development	1. Community Conditions a. Poverty b. Mobilization 2. Young Generation a. Attractiveness b. Challenges to young generations 3. Social Development Capabilities a. Employment and Livelihoods b. Education c. Preservation of Cultural and Local Traditions 4. Community Involvement 5. Communication and Connectivity a. Global connectivity 6. Tourism and Community Development a. Tourism Problems b. Problems arising due to Tourism c. Tourism Opportunity d. Tourism Expectation
4	Sustainability	1. How to be Sustainable 2. Transition to Sustainability
5	Local Entrepreneurship	1. Entrepreneurship Situation 2. Entrepreneurship Opportunity 3. Entrepreneurs' Problem 4. Expectations to Local Entrepreneurs
6	Policy and Regulations	1. Policy and Regulations Implementation 2. Proposed Policy and Regulations

e. TD-S5: Academia 2 - Technology Focus

The thematic analysis summary is portrayed in Table 5. The interview highlights the adoption of green technologies, such as solar panels and heat pumps, in local homes and businesses, emphasizing the role of technology in enhancing sustainability practices and improving tourist experiences. Furthermore, they discussed the challenges and benefits associated with digital transformation, including the need to balance traditional and digital service offerings to cater to diverse client preferences and the potential for technology to empower local businesses.

Table D.4. Academia 2 Thematic Analysis

No	Main Theme	Sub-theme
1	Green Transformation	1. Definition and Understanding of Green Transformation 2. Personal Experience with Green Technologies
2	Digital Transformation	1. Definition and Understanding of Digital Transformation 2. Role of Technology in Business Evolution 3. Benefits of Digital Transformation 4. Challenges of digital transformation
3	Community Development	1. Community Involvement 2. Challenges in Implementing Community Development Initiatives 3. Local Engagement
4	Sustainability	1. Environmental Impact of Tourism Activities 2. Barriers to Implementing Sustainable Practices 3. Sustainable Practices
5	Local Entrepreneurship	1. Challenges Faced by Local Businesses a. Dependence on Online Booking Platforms b. Competition and Pricing Pressure c. Limited Business Autonomy
6	Policy and Regulations	1. Need for Policy Regulation in the Tourism Sector

f. TD-S6: Entrepreneur 2 - Tourism Business

The importance of digital and green transitions for local enterprises and community development in the Azores is shown by the thematic analysis of the interviews in Table 6. Stakeholders emphasized how incorporating technology may promote stakeholder involvement, advance sustainable practices, and spur economic growth. To retain talent, create social impact, and protect the environment, they also stressed the significance of combining digitalization with sustainability initiatives while negotiating legal and governmental frameworks to support these efforts.

Table D.5. Entrepreneur 2 Thematic Analysis

No	Main Theme	Sub-theme
1	Green Transformation	1. Definition of Green Transformation 2. Benefits of Green Transformation 3. B Corp Certification 4. Carbon Footprint Reduction 5. Challenges of Green and Digital Transformation a. Resistance to Change and Diversity Management b. Interpersonal Dynamics and Communication c. Security and Dependence on External Factors
2	Digital Transformation	1. Definition of Digital Transformation 2. Benefits of Digital Transformation 3. Preparedness for Digital Transformation 4. Data Transformation and API Integration 5. Whaling Boat Project

3	Community Development	1. Benefits of Coupled Digital and Green Transformation for Community Development 2. Social Development 3. Talent Retention and Employee Engagement 4. Social Impact and Engagement
4	Sustainability	1. Integration of Sustainability in Business Practices 2. Social Sustainability 3. Awards and Recognition 4. Environmental Preservation
5	Local Entrepreneurship	1. Role of Local Businesses in Economic Growth 2. Supporting Local Economy 3. Investment in Local Workforce 4. Collaboration with Stakeholders and Partnerships 5. Challenges of Change Management
6	Policy and Regulations	1. Quality of Policy Making 2. Compliance and Reporting Requirements 3. Evaluation of Government Initiatives 4. Government Initiatives

Appendix E

Stakeholder Activity 2: Scenario Analysis Workshop

E.1 Outcomes of the Final System Review (with the stakeholder) and identified Themes

Stake holder	Factor	Sentence	Themes
TD-S1	Community Active Involvement	Yes, and if there is community involvement, things are working much better for the community.	Well-functioning; Crucial; Empowerment
TD-S3	Community Active Involvement	Yes, and we are already doing this because we see the importance.	Collaboration;
TD-S3	Digital and Green Education	Yes, education is the main challenge for the sustainable development of the region. Green: large share of the population still needs more education regarding environmental issues, also for digital: community is lacking “data collection culture”	Data collection gap; Environment Awareness lack;
TD-S4	Employment in Tourism Sector	Yes, but it needs more valuation in salaries, professional training and enhancement of offers.	Expansion; Investment;
TD-S5	Performance of Local Tourism Businesses	Yes, but important to include: Number of tourists trying to access local tourist businesses as performance depends on capacity.	Balancing act; Sustainability;
TD-S5	Green and Digital Education	Yes, but keep in mind to whom it is addressed tourists or to locals.	Targeting Education
TD-S5	Employment in Tourism Sector	Yes, but through new technologies the employment landscape changes.	Jobevolution; Green and Digital Education
TD-S6	Green and Digital Education	Yes, it is as important for the clients as it is for the local community and missing digital education in companies, would help to get to the clients. And it needs to align with the sustainability principles.	Client Needs; Business Viability; Green Business Practices
TD-S6	Community active involvement	Yes, important. And actively connecting companies with the community, and with the government, in open dialogue between all the parties involved, not only in managing tourism but also in doing tourism.	Collaborative Governance; Community Engagement
TD-S6	Quality of policy making	Yes, and more open dialogue formats and involvement.	Collaborative Governance
TD-S6	Performance of Local Tourism Businesses	Yes, and related to many factors that support economic resilience. And change the mindset to work with profit, companies and business in a good way instead of being	Economic Resilience; Business

		against it, so that they can become an active member of change in our society.	Integration
TD-S6	Conservation of Nature and Cultural Heritage	Yes, super connected, and gives identity. This is done through education, is done with the community being involved, again with good policy making, but without the performance of local tourism businesses.	Cultural Identity; Environmental Sustainability

E.2. Scenario Analysis Narratives

Optimal Scenario	Non-Optimal Scenario
“We are in a hypothetical future in Sao Miguel, where a strong regional political vision towards eco-smart tourism, generates excellent policy-making and decisions. Green tourist entrepreneurial activity is highly performative, leveraged by the best socio-environmentally caring digitalization, combined with an elevated community sense of rootedness, pride, and connection to the unique ecosystems, history, and culture of Sao Miguel. In this situation, Sao Miguel Island becomes a global reference for its idyllic eco-smart touristic offer, backed by a high research intensity in business digital and green transformation. Entrepreneurial activity and natural and cultural conservation are in optimal balance, promoting a scenario in which Sao Miguel's tourist business provides a highly competitive offer and a positive socio-environmental development in Sao Miguel.”	“In a dystopian future in Sao Miguel, poor policy-making and decisions, combined with a limited financial inflow and a lack of community engagement, has become a reality. In this scenario, a very low level of digitalization and knowledge in society leads to a low performance of local tourism businesses and the worsening of Sao Miguel's ecosystems. Low quality education and low academic research intensity in the green and digital transformation of businesses lead to irresponsible implementation of digital technologies, environmentally abusive tourist activities, and a scarcity of entrepreneurial intentions. Sao Miguel is not considered anymore in the world's top rankings due to poor conservation of nature, loss of cultural heritage, and unappealing tourist offers. The tourism sector is in crisis; providing low employment opportunities and attracting tourists becomes a challenge, leading to a touristic entrepreneurship sector fighting with lower levels of competitiveness and socio-economic development capabilities"

E.3. Optimal Scenario Video

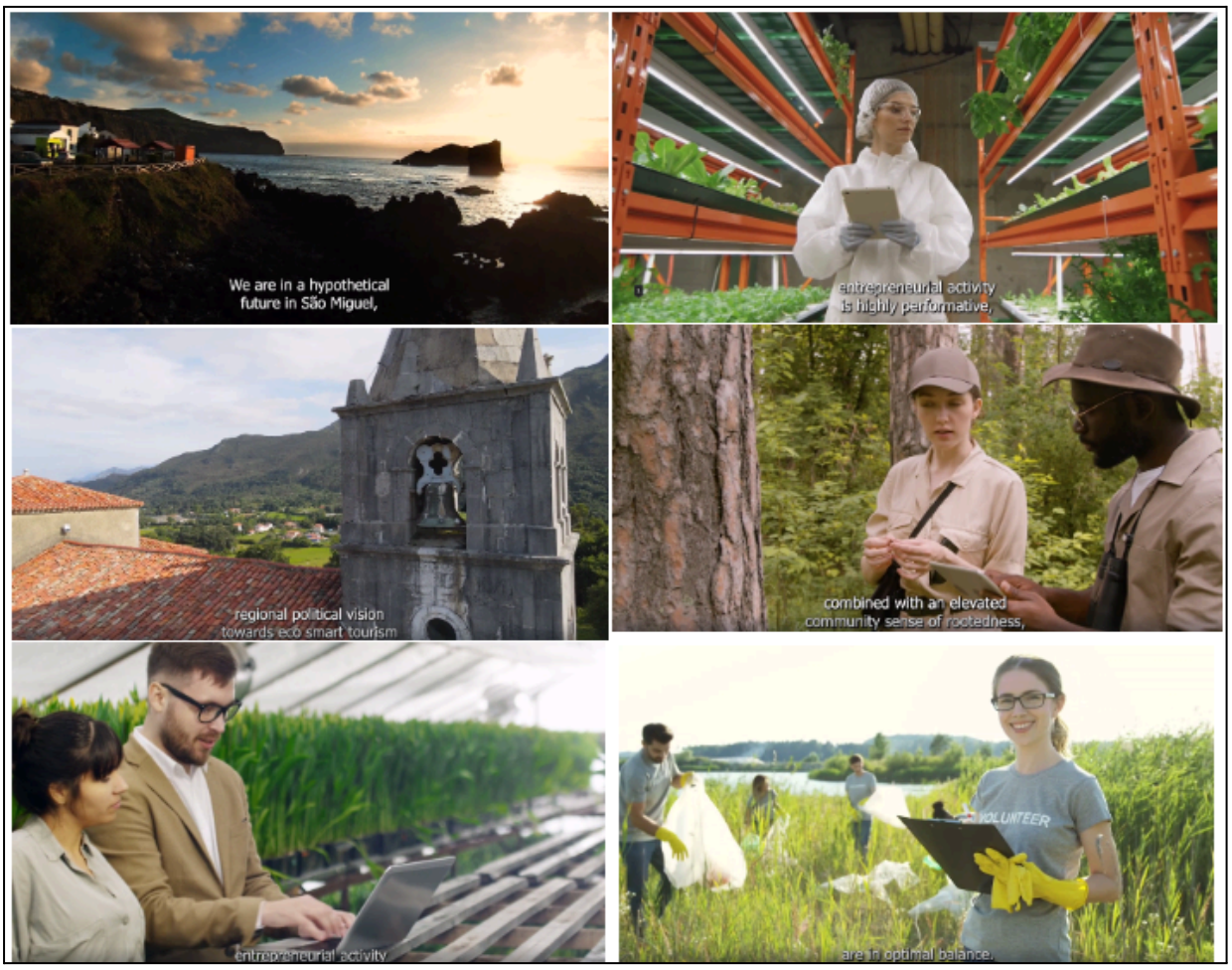

Figure E.1. Optimal Scenario: *"São Miguel: A Green and Digital Entrepreneurial Island"* (Link Video: https://youtu.be/S__MDPq9gj8)

E.4 Contributions of Stakeholders during the Scenario Analysis Workshop, to elaborate Socially Robust Orientations (SRO)

Socially Robust Orientations				
"... and how to achieve this?" (Optimal Scenario)			"... and how to avoid this?" (Non-optimal Scenario)	
Study case: teaching tools, use as role model for education for all over the world	Training for impact not training for numbers	Political framework - it is important to boost all this through less bureaucracy and to help financial sustainablity	Being pepared and have a plan	Have continued information flow on how things stand
			All stakeholders should be engaged	Local policies need to help to prevent this scenario
Sustainable agriculture, sustainable fishing as a role model that can be shown to the people that are coming to visit	Making the most of the ressources that we have - digital transition would help here a lot	Training for companies - is something what was lost. It is important to bring it back	Consideration of the impact of large foreing touristic companies in the internal market	Sustainability for both nature and people: Preserving nature should also enable a place for social development
Won some awards, but some people feel unhappy about what tourism brings. Better planning to avoid badly managed tourism	A place is only worth to visit if it is worth to live there - less farming feelds more forest	Reduce drop-out rates in schools - well educated should find opportunities	If we don't have companies that are thriving we will not be able to educate people to have a positive environmental impact	Education is super important for all communities to thrive
			Involvement of local community & data driven decision making	Health care system needs to work properly, for the locals but also for the tourists!
Giving more credibility to the institutions that are responsible	Dedication to the ocean - jobs that are related to it need to be valued	Greater autonomy towards the Portuguese republic - things that should be added to the school curriculum cannot be done currently	Important to preserve the most valuable which is nature	

E.5 Additional contributions during the Scenario Analysis Workshop

Anything to add?			Successful DGT cases to consider	
Digital transformation extremely important to reduce carbon footprint, increase literacy and decrease cost	Interaction with visitors and give information requires literacy for digital technologies	Walk that pass fast to achieve good results	Airbnb business model migth be replicated to support local accommodation buiness: technical base for companies / suppliers of one type of service	Improved highways and road management in connection with forestry, birds migration and bees preservation, and collaboration with honey makers in Azores
Big companies: can be a risk or help (attract tourists)	Governmental marketing is very important - like the video which we saw before, this cannot be done by one single company		Data collection and analysis has helped to make decision toward the green transformation of the water management system in Azores	