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The impact of Augmented and Virtual Reality for Sustainable Tourism

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Abstract

Tourism is one of the least developed industries, in terms of environmentally sustainable practices, while at same time faces huge economic challenges, and from which communities all around the world depend on. At same time, Augmented and Virtual Reality applications are expected to grow significantly in the short-term, and impact many traditional markets. Considering that only a small portion of studies examine how the introduction of technologies can enable a more sustainable development route in the Hospitality and Tourism sector, this study aims to provide an overview on the state of literature and to uncover emerging topics, which could lead to a future research agenda for this domain. A bibliometric analysis is employed on articles from both Web of Science and Scopus databases, and findings reveal four major thematic groups for the future, in what are still at the moment, two separate, unrelated research streams. Managerial perspectives are derived, and a set of new research questions is proposed as guidance for future scholars, dedicated to the outcomes of digital disruption on sustainable tourism.

Keywords: bibliometric analysis; sustainability; tourism; virtual reality; augmented reality; future trends

1 Introduction

Technology innovations are often game changers, which can disrupt many traditional markets - such as Hospitality and Tourism (H&T) - and change its competitive forces rapidly (de Kervenoael et al., 2020; Golja & Paulišić, 2021). Yet, other authors describe digital transformation in H&T as a future topic instead and emphasize the lack of attention given by scholars and practitioners to the present day (de Carlo et al., 2021; Lalicic & Weismayer, 2021).

H&T is in fact considered the largest industry in the global economy (Choi et al., 2015; Loureiro, Guerreiro, et al., 2021; Untaru et al., 2016), providing income for local communities all around the world, but facing huge risks aggravated by economic uncertainty, Covid-19 lockdowns (Sung et al., 2021), and the urgent need to tackle its massive environmental impacts (Filimonau et al., 2018; Kim & Park, 2017).

Projected to grow over 30 times until 2025 (Alsop, 2022), Augmented (AR) and Virtual Reality (VR) technologies could foster the sector's economic growth (Loureiro, 2020a), generate new market opportunities (Loureiro, 2021) and create more memorable, environmentally sustainable touristic experiences (Bec et al., 2019).

Considering such opportunities, the present study aims to examine the under-studied role of AR and VR technologies on the challenges of sustainable tourism and explore what appear to be (so far) mostly unrelated themes in academic literature (Loureiro & Nascimento, 2021). A bibliometric study and content analysis are conducted to: (i) identify the most pertinent contributions; (ii) examine the publication network and uncover emerging topics; (iii) elaborate on future research questions, for further advancing knowledge about the influence of AR/VR technologies in the context of specific industries. This investigation offers a new approach, by combining bibliometric analysis' techniques with a review of major trends related to the opportunities and outcomes of AR and VR technologies for the H&T industry, which provides relevant managerial implications, and a set of actionable research questions and work streams, aimed to inspire future scholars, to dedicate further attention to the connection between technology and the grand challenges of sustainable tourism.

2 Theoretical background

Sustainable tourism is defined by (Johnston, 2015) as taking account of “current and future economic, social and environmental impacts, addressing the needs of visitors, the industry, the environment and host communities”, which implicates all three dimensions of sustainability (e.g., economic, social, and environmental). The development of sustainable tourism plays an essential role in the achievement of Sustainable Development goals (Spencer, 2021), but - at same time - a huge transformation challenge, when taking into account: (a) the size of the H&T sector, with unprecedented growth rates prior to the eruption of Covid-19 crisis, and a huge global impact on economy and society (Loureiro, Guerreiro, et al., 2021; Untaru et al., 2016); (b) severity of the current economic challenges, facing the consequences of Covid lockdown to travelling and new travelling safety concerns (Sung et al., 2021); (c) the observed slow adoption rate of pro-environmental practices, despite the industry's heavy environmental footprint, accountable for massive carbon emissions, waste generation, water and air pollution, and damage to natural ecosystems (Choi et al., 2015; Filimonau et al., 2018).

With regards to the latest technological advancements, mobile device usage, especially when enhanced by AR and VR features, can significantly expand customer engagement and satisfaction (Loureiro, 2020b; Loureiro, Japutra, et al., 2021; Sharmin et al., 2021), including its potential benefits for the tourism customer. VR is an immersive 3D-simulated setting that allows consumers to have the feeling of being in a real-world environment (Guttentag, 2010), amplified by VR gears, e.g., Dataglove and the EyePhone head-mounted display (Loureiro et al., 2020).

On the other hand, AR is defined as a technology which relates purely virtual to purely real environments, where the observer is seeing the real world, but can also visualize virtual objects overlaid on it, usually by wearing see-through displays, or

interacting with their own mobile devices. VR and AR can both be used to promote a touristic site or destination, by providing an immersive stimulation to tourists, and for improving the experience when visiting the selected destination (Loureiro, 2021).

A review of scientific literature is warranted to determine to which extent, the fields of AR and VR technologies contribute towards influencing academic knowledge and facilitating the development of sustainable tourism.

3 Methods

Bibliometric analysis was employed to achieve the study's objectives, as it permits to explore large datasets efficiently (Donthu et al., 2021). These quantitative techniques are applied in the measurement of bibliographic data, emerging as a legitimate scientific method, used nowadays across a wide variety of disciplines (Broadus, 1987; Pereira & Bamel, 2021). Science mapping was used to illustrate relationships between contributors and uncover the knowledge structure in the AR/VR domains applied to H&T.

Data were extracted on November 2021, from both Web of Science (WoS) and Scopus databases, applying the following query to title, abstract and keywords: ((“virtual reality” OR “augmented reality”) AND (“sustainab*” AND “tourism”)). The inclusion criteria considered only published articles in English language, in business, management, economics, social and environmental science domains.

VOSviewer 1.6.17 was selected for conducting data analysis, due to the wide recognition earned among scholars, and powerful capabilities for generating bibliometric maps (van Eck & Waltman, 2010). Citation, co-citation, co-authorship, bibliographic coupling, and co-word analysis were used to examine relationships among contributors and uncover the leading topics and research constituents (Donthu et al., 2021), after completing the required coding and verification procedures.

4 Results

From an original set of 139 hits (after merging the WoS and Scopus databases, and removing duplicates), mentioning either AR, VR, *or* sustainability/tourism, only 18 articles were identified mentioning *both* designated search terms. The co-wording analysis results show that AR and VR are both positioned in the top-left corner, a peripheral role in the network, suggesting a low prevalence in the dataset (see Fig. 1). Conversely, *artificial intelligence* is the dominant topic in this research community, as can be concluded by both the central position occupied and the largest dot in the keyword co-occurrence frequency mapping. *Technology* and *Sustainability* terms are frequently employed, related and close to each other, meaning that they do often co-occur frequently, but neither is related to H&T in specific. *Internet of things*, *big data analytics*, *circular economy*, *machine learning*, *blockchain*, and *industry 4.0* also deserve mentioning.

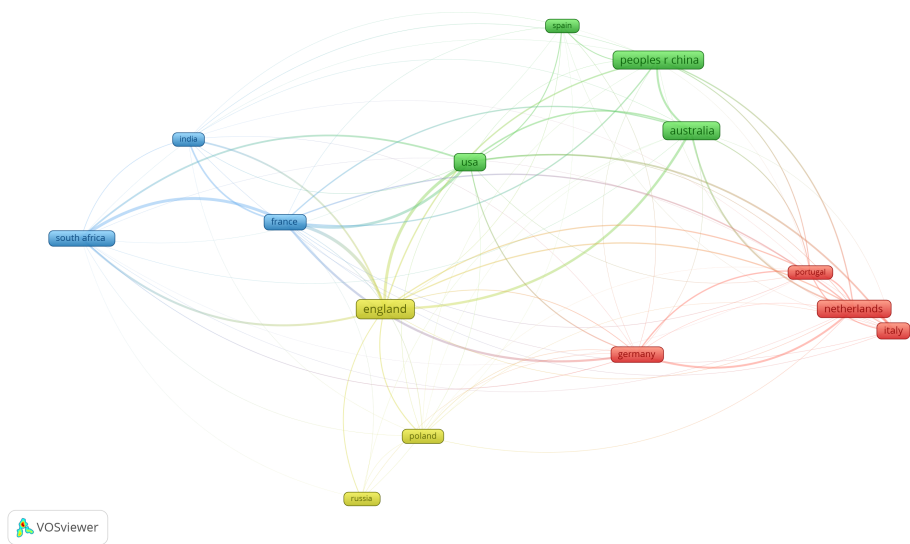


Fig. 2. Cooperative network of authors' countries of affiliation.

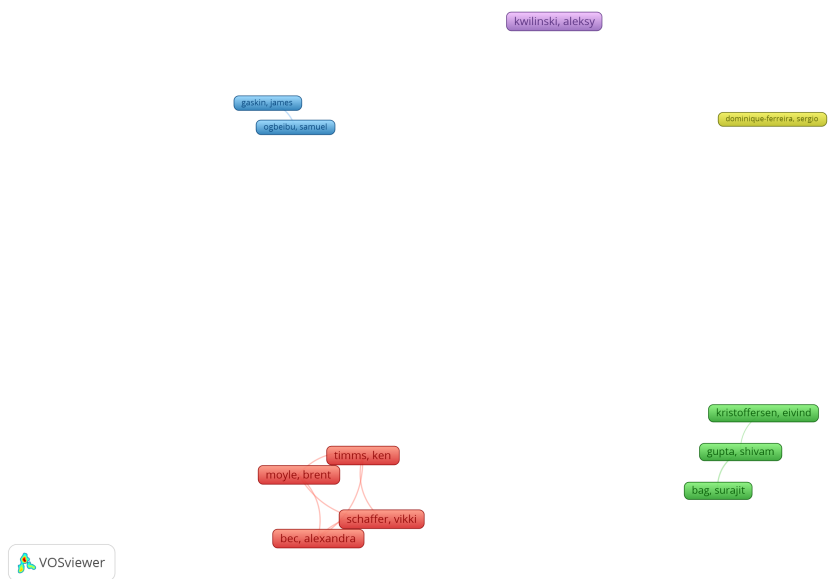


Fig. 3. Cooperative network of authors.

Evaluating the most influential studies, the article entitled '*A model of acceptance of augmented-reality interactive technology: the moderating role of cognitive innovativeness*' (Huang & Liao, 2015) stands-out due to the level of citations obtained. A few more recent contributions, such as the work on *Digitalization as solution to environmental problems? When users rely on augmented reality-recommendation agents*" (Joerß et al., 2021) are also trending up regarding the volume of citations.

The most frequently occurring topics were also examined, using text mining and content analysis techniques, mainly capturing the leading theories, frameworks, and emerging concepts, employed in relation to AR, VR, and sustainable tourism. *Digital humans* emerge as a prevalent topic, with *designing collaborative strategies*, *auto-contractive mapping*, *behavioural reasoning theory*, *fuzzy-set qualitative comparative analysis*, and *ANN* (Artificial Neural Networks) also uncovered in the dataset.

5 Conclusions

Results demonstrate the lack of research addressing the challenges of technology adoption and environmental sustainability for tourism, as AR/VR, sustainability, and tourism research fields rarely intercept each other, which suggests a lack of understanding on how these innovative technologies can impact the development of sustainable tourism. Nevertheless, a few scarce, yet insightful examples, provide implications from adopting VR and AR technologies in education, manufacturing, and retail sectors (Earle & Leyva-de la Hiz, 2021; Joerß et al., 2021; Zabel & Telkmann, 2020), which may also benefit H&T, and accelerate the transition to more a sustainable business paradigm.

5.1 Managerial implications

The impacts of VR are currently more concerned with avoiding the destruction of natural destination sites and reducing risks of overcrowded attractions (Bec et al., 2021; Coghlan & Carter, 2020; Martins et al., 2021), illustrated by immersive visualizations instead of being there (Streimikiene & Korneeva, 2020), such as implemented during COVID-19 pandemic crisis. However, for the future, VR can mean much more for the H&T industry, given the possibility of tourists to conduct trial runs (during the pre-trip phase), interacting with augmented booking services, and enjoying in-flight VR entertainment experiences. A new level of immersive exploitation is offered by technologies such as *Google Earth VR* or *IMMERSE*, while marketers seek to unleash the potential of VR immersive, interactive marketing to promote destination sites, hotels, and experiences. With regards to AR, five major trends emerge from literature, with high-potential business applications: new navigation features, educational AR guides for tourists (*e.g., city tours, museum*

guides), language support, innovative AR experiences, and interactivity (*e.g., gamification, advertising, beacon/push notifications*).

5.2 A future research agenda

By combining previously unrelated research streams, a new set of questions for the future is proposed, organized around four main thematic groups: (i) Theories and frameworks for accelerating the innovation roadmap; (ii) Strategic and competitive advantages for organizations; (iii) Impact of new technologies for Sustainable Development Goals; and (iv) Customer attitudes, motivations, and engagement.

From these leading themes, a set of research questions is offered, to further advance knowledge on the role of AR, VR technologies for sustainable development in H&T:

- What relationship between digitalization and internationalization, and how can this affect organizational *sustainability readiness*?
- What are the reasons for or against adopting co-creation platforms, and how to increase their relevance?
- How will the new global digital ecosystems (*e.g., EU digital market*) relate to the achievement of Sustainable Development Goals in H&T?
- How can technology boost the competitiveness of H&T market players, through augmented customer experiences?
- Which areas of customer experience should be prioritized?
- Which stakeholders should be involved in the process of designing collaborative strategies?
- Which factors can enable or inhibit technology adoption, in H&T organizations? Do these vary across type of destination or stakeholder?
- How can leadership, technological, environmental competences drive success?
- What are the key success factors for entrepreneurs and SMEs to recognize AR/VR benefits without compromising their identity?
- What is the relationship between personal values-beliefs-norms, and customer willingness to use AR or VR-enabled H&T service agents?
- What are the expectations and propensity to interact with VR or AR-enabled experiences, and preferred ways of interaction?
- What are consumer attitudes towards digital humans?

In summary, the H&T sector faces fundamental challenges for both the economic turnaround and implementing more environmentally sustainable practices, for which AR, VR innovations can offer significant opportunities, as long as further attention is given to the specific impact for sustainable tourism in the nearby future.

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