

Repositório ISCTE-IUL

Deposited in *Repositório ISCTE-IUL*:

2022-11-21

Deposited version:

Accepted Version

Peer-review status of attached file:

Peer-reviewed

Citation for published item:

Loureiro, S. M. C., Ferreira, E.S. & Rosário, J. F. (2020). Incorporating VR, AR and related technologies in tourism industry: State of the art. In Sandra Maria Correia Loureiro (Ed.), *Managerial challenges and social impacts of virtual and augmented reality*. (pp. 211-233). Hershey: IGI Global.

Further information on publisher's website:

10.4018/978-1-7998-2874-7.ch013

Publisher's copyright statement:

This is the peer reviewed version of the following article: Loureiro, S. M. C., Ferreira, E.S. & Rosário, J. F. (2020). Incorporating VR, AR and related technologies in tourism industry: State of the art. In Sandra Maria Correia Loureiro (Ed.), *Managerial challenges and social impacts of virtual and augmented reality*. (pp. 211-233). Hershey: IGI Global., which has been published in final form at <https://dx.doi.org/10.4018/978-1-7998-2874-7.ch013>. This article may be used for non-commercial purposes in accordance with the Publisher's Terms and Conditions for self-archiving.

Use policy

Creative Commons CC BY 4.0

The full-text may be used and/or reproduced, and given to third parties in any format or medium, without prior permission or charge, for personal research or study, educational, or not-for-profit purposes provided that:

- a full bibliographic reference is made to the original source
- a link is made to the metadata record in the Repository
- the full-text is not changed in any way

The full-text must not be sold in any format or medium without the formal permission of the copyright holders.

Incorporating VR, AR and related technologies in tourism industry:

State of the art

Sandra Maria Correia Loureiro

Instituto Universitário de Lisboa(ISCITE-IUL) and Business Research Unit(ISCITE-IUL), Portugal

Eduardo Moraes Sarmiento

University Lusófona, Portugal

João Rosário

Instituto Politécnico de Lisboa-Escola Superior de Comunicação Social, Portugal

ABSTRACT

The current chapter intends to expose the importance of tourism in the world economy, (ii) give an overview of what academic and practitioners are doing regarding the use of engagement-facilitating technologies in tourism, and (iii) suggest avenues for further research. Thus, first the authors give insights about the evolution and important of tourism. After that, the chapter presents an overview of the state of the art on the use of engagement-facilitating technologies (mainly virtual and augmented reality) in research. The examples of applications of engagement-facilitating technologies come next. In the end, the authors suggest future research directions and present the conclusions.

Keywords: World Tourism, Virtual Reality, Augmented Reality, Internet of Things, Artificial Intelligence, TAM, SOR

INTRODUCTION

The world is changing with the development of innovative technologies, including Augmented Reality (AR), Virtual Reality (VR), Internet of Things (IOT), Artificial Intelligence (AI), among others, that started to be used by the tourism sector. Overall, these technologies may be designed as engagement-facilitating technologies because they have the capacity to affect humans at leisure and work. These technologies may contribute positively to perform the tasks more easily at work and to expand and extend the tourist experiences or even consumption experiences (Kumar et al. 2016; Verhoef et al., 2017; Ng & Wakenshaw, 2017).

Recently the world assisted to the power of AR through the success of the smartphone game Pokemon Go that induced urban discovery and had impact on perceptions of public spaces and increase place attachment, as examples that can be extended to the tourism sector, in this case through gamification of the user

experiences. Research has also been conducted in aspects such as the impact of AR in enhancing museum experiences and purchase intentions (e.g., Tussyadiah, Wang, Jung, & tom Dieck, 2018; Jung, Chung, & Leue, 2015), mobile AR acceptance in urban heritage tourism (tom Dieck & Jung, 2017) or the impact of Virtual Reality in attitudes toward tourism destinations and visitation intention (Tussyadiah, Wang, Jung & tom Dieck, 2018).

Considering the above examples, these technologies bring new research in topics such as, how to measure and increase their acceptance in tourism, how to measure their effectiveness to induce visit intentions and/or improve location perceptions how to design technology platforms adapted to the tourism sector, among others, whose knowledge will contribute to improve tourism location competitiveness strategies, considering all possibilities that these new technologies bring to this sector.

In this vein, the current chapter intends to expose the importance of tourism in the world economy, (ii) give an overview of what academic and practitioners are doing regarding the use of engagement-facilitating technologies in tourism, and (iii) suggest avenues for further research.

The remainder of the chapter is composed by the background, where we present an overview of the relevance of tourism in the world and the link between tourism and technologies, mainly focused on VR and AR and the state of the art on this subject. Next section is devoted to examples of the real use of such technologies in the tourism industry. Finally, we present suggestions for further research and the conclusions.

BACKGROUND

Tourism Overview

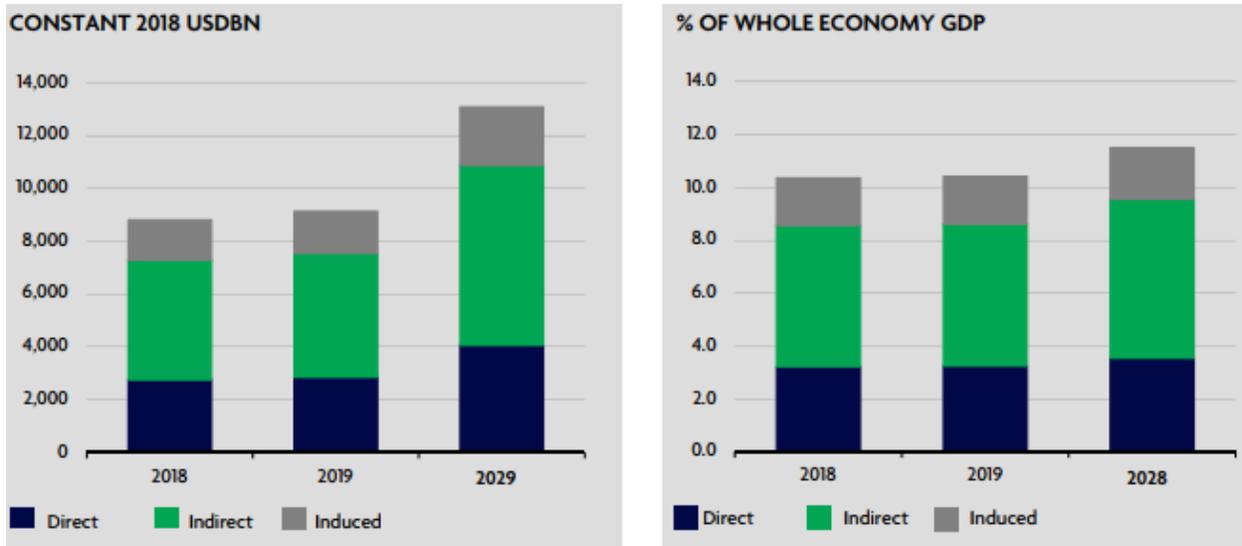
For decades, tourism industry growth has been regarded as an important contribution to economic activity in destinations owing to the new jobs created. Tourism is also associated with the exchange of ideas and culture, which can enrich the local population but can also bring bad habits and behaviours. The increased number of visitors can generate overcrowding, pollution, negative changes in landscape, and impacts on fauna and flora (e.g., Ribeiro, Pinto, Silva, & Woosnam, 2017).

Indeed, several destinations worldwide have opened up to, and invested in, tourism, turning it into a key driver of socio-economic progress through the creation of jobs and enterprises, export revenues, and infrastructure development (UNWTO, 2017).

Tourism has been one of the main activities worldwide, even though it has suffered from an international crisis, terrorism, insecurity among other issues. In 2017, a total of 1.326 million international tourist arrivals were recorded around the world (see graph 3). This situation was a direct consequence of the global economic upswing as well as a recovery of outbound demand from Brazil and the Russian Federation after several years of decline. The ongoing rise of India also contributed to inbound economic growth of many destinations (UNWTO, 2018). By region, Africa (8.6%) and Europe (8.4%) grew above world average (7%) (UNWTO, 2018).

This tourist performance can be measured by some major different indicators. One of the most important indicators is the economic contribution. In terms of economic contribution to GDP it achieved a total amount of USD 8, 811 billion (10.4% of GDP) in 2018, a total of USD 9,126.7 billion (10.4% of GDP) in 2019 and it is forecast to rise by 3.7% pa to USD 13.085 billion (11.5% of GDP) in 2029 (see Figure 1).

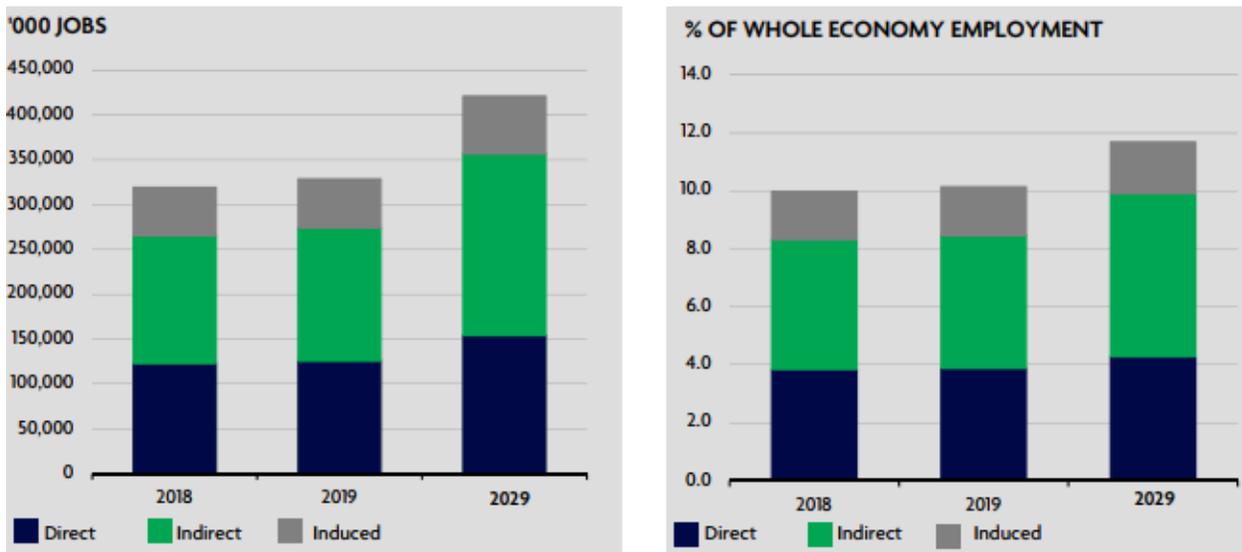
Figure 1. World total contribution of Travel & Tourism to GDP



Source: WTTC (2019) (All values are in constant 2018 prices & exchange rates)

In relation to employment, in 2018 this activity was responsible for 318,811,000 jobs (10% of total employment), 328,208,000 jobs in 2019 (10% of total employment) and it is forecast support 420,659,000 jobs in 2029 (11.7% of total employment) (WTTC, 2019) (see Figure 2).

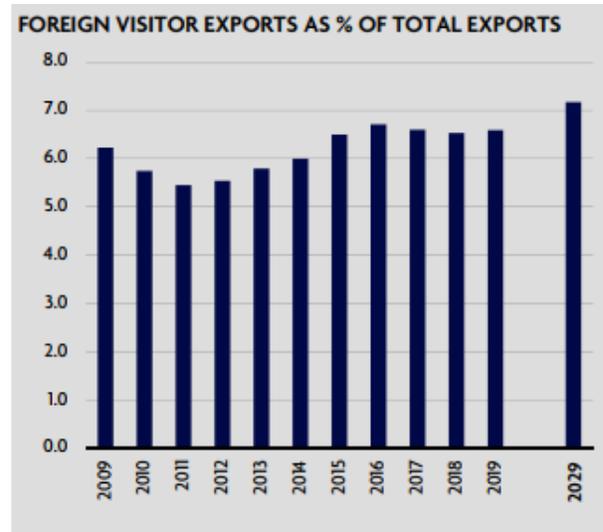
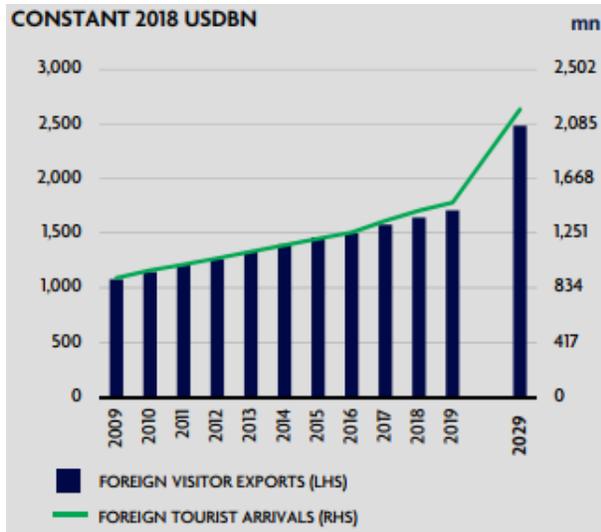
Figure 2: World total contribution of Travel & Tourism to employment



Source: WTTC (2019)

Another vital effect of tourism is the money spent by visitors since this money must be considered as a major component of exports. In 2018, this activity generated USD 1,643 billion in visitor exports. In 2019, it is expected to attract 1,484,910,000 tourist arrivals. By 2029, international tourist arrivals are expected to reach 2,196,090,000, meaning that expenditures will rise to USD 2,483.9 billion, which is an increase of around 4% pa (WTTC, 2019) (see Figure 3).

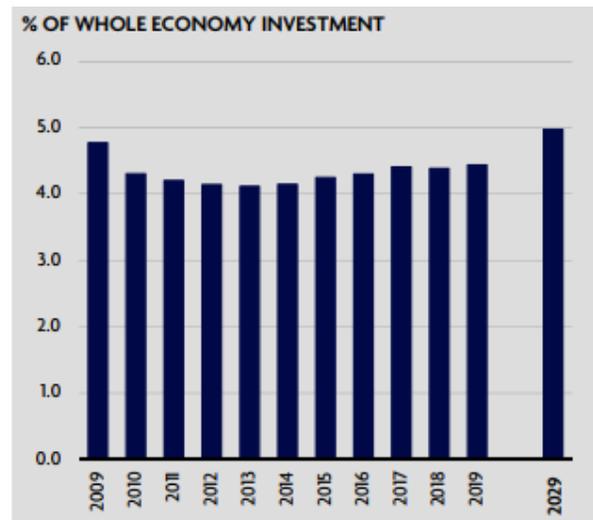
Figure 3: World visitor exports and international tourist arrivals



Source: WTTC (2019)

The final major component of this activity is investment. In 2018, Travel & Tourism attracted USD 941 billion. It is expected to rise by 4.4% in 2019 and forecast to achieve a total amount of USD 1,489.5 billion (5%) in 2029 (WTTC, 2019) (see Figure 4).

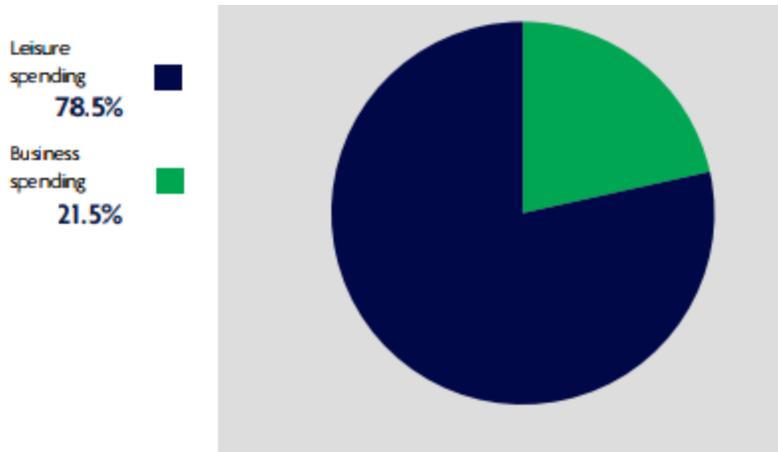
Figure 4: World capital investment in Travel & Tourism



Source: WTTC (2019)

Before concluding this characterization, it is important to notice that leisure has been the major motivation to travel. In 2018, leisure spending achieved 78.5% (USD 4,475.3 bn) against 21.5% in business spending (USD 1,228 bn). Leisure travel spending is expected to growth 4% pa and achieve a total amount of USD 6,781 bn in 2029. On the other hand, business travel spending is expected to growth by 3.2% pa to USD 1,735.1 bn in 2029 (see Figure 5).

Figure 5: World Travel & Tourism contribution to GDP: business vs leisure, 2018



Source: WTTC (2019)

Indeed, it is also important to rank the world's top international tourism destinations both in international tourist arrivals and international tourist receipts. From Figure 6, we can conclude that seven out of ten top destinations appear in both lists (arrivals and receipts), which is an important achievement for them (UNWTO, 2018).

Figure 6: International tourist arrivals, 2017 (million) - International tourism receipts, 2017 (USD billion)



Source: UNWTO (2018)

Finally, the last important issue concerns the top spenders. China has gone up and keeps leading the output expenditure travel. It is important to notice that the Russian Federation rebounded around 30% after several years of decline. All the other destinations also recorded increases, mainly the Republic of Korea (9th place), Italy (10th place) and Canada (7th place) (UNWTO, 2018) (see Figure 7).

Figure 7: Top spenders 2017 (USD billion) Change, 2017 (local currencies, current prices, %)



Source: UNWTO (2018)

Tourism and Technologies

VR and AR reshaping the way tourists see the world and live experiences (Williams & Hobson, 1995; Guttentag, 2010). A VR environment means a completely synthetic world that could be completely new, unknown environment or a real-life mimicry. AR is an interactive experience of a real-world environment where tourists can see the objects of the real-world "augmented" by computer-generated perceptual information, sometimes across multiple sensory modalities, such as visual or hearing (Milgram, Takemura, Utsumi, & Kishino, 1994; Loureiro et al., 2018). Thus, in AR, tourists experience both the real world and virtual objects overlaid, usually by wearing see-through displays (e.g., Milgram et al., 1994; Bimber & Raskar, 2005).

Although AR date back to the 1960's, with the first head-mounted display (HMD) developed for research purposes by Ivan Sutherland (Carmigniani et al., 2011), the commercial development began in the 1990's (Javornik, 2016). VR and AR have had huge influence on the tourism industry (Guttentag, 2010; Tussyadiah, Jung, & tom Dieck, 2017). For instance, tourists can learn more about iconic landmarks without a tourist guide, or a museum or an art gallery through the smartphone applications (e.g., Skyline, 2018).

VR technologies are immersive and has been successfully employed in several industry (Wang, Yu, & Fesenmaier, 2002), such as architectural (Arafa 2017), medicine (Rizzo et al., 2011), military (Manojlovich et al., 2003), or commerce (van Herpen et al., 2016), but has been more and more applied in tourism and hospitality context (e.g., Williams & Hobson, 1995; Cheong, 1995; Guttentag, 2010). Indeed, hotels restaurants, museum, attractions are using these technologies (e.g., Hwang, Yoon, & Bendle, 2012; Tussyadiah et al., 2017; Tussyadiah, Wang, Jung, & tom Dieck, 2018).

From the scientific point of view, we may claim that the first article is due to Musil and Pigel (1994), who present their study on the discussion if tourism can be replaced by Virtual Reality technology at the International Conference Information and communications technologies on tourism in Innsbruck, Austria. The researchers argue that public panic of polluted nature and social isolation may drives them to virtual worlds. They give the example of sport tourism as an application of VR. Tourists can practice sports indoor (e.g., golf or bicycle in mountains) without having to be concerned with the weather and travel to the destination to play.

In the first decade of 21th Century most of the article are published in conference proceedings, mainly associated to computer science and technologies for Multimedia Applications, or information visualization. These articles are devoted to new devices and application of VR to different context connected to tourism (e.g., virtual storytellers in destinations, virtual museum, sport tourism, Virtual Tourism Teaching System). From 2011 to 2019 academics tend gradually to publish more in scientific journals.

The first two articles published in top-tier tourism journals date back to 1995. They are short paper (research notes) giving the first glimpse of VR and related issues in tourism context. Williams and Hobson (1995) present VR as a tourism tool, where they can choose and tailor their experiences in a degree that has not been possible in 20th Century. Three key elements are pointed out: visualization (e.g., stereoscopic vision in three dimensions), immersion into the experience and interactivity involved in the experience (meaning the degree of control tourists have over the experience). Cheong (1995) claims the possible threat of VR to the travel industry because it can reduce the impacts of tourism and can also operate as a marketing tool, where tourists have the opportunity to experience previews of destinations and their respective attractions and facilities.

Until the end of the 20th Century one may find three more articles concerned with Sustainable tourism (Dewailly, 1999), where VR can promote tourism destination, giving to the mass tourism greater sustainability or contribute to the analysis and prediction of visitor location and movement pattern (Bishop & Gimblett, 2000).

In the first ten years of 21th Century, the journals dedicated to computation and technology are still leading the publications on the topic, but emerged three articles published in the field of tourism. Guttentag (2010)

is the first to give an overview of the conceptualization of VR and its application within the tourism sector. He defines VR as the use of “computer-generated 3D environment – called a ‘virtual environment’ (VE) – that one can navigate and possibly interact with, resulting in real-time simulation of one or more of the user’s five senses” (Guttentag, 2010, p.638). In a strictest sense VR is different from AR (Augmented Reality), where AR may be regarded as the projection of computer-generated images onto a real-world view. Yet, in *latus* sense AR and VR are related. Following Gutiérrez et al. (2008), VR comprises two important aspects, that is, has the capacity to provide physical immersion (participant is isolated from the rest of the world) and physical presence (when participants behave in a VR in a way close to how they behave in a similar real-life situation

The number of research articles published increased from 2011 to 2019. As an example, Hwang, Yoon and Bendle (2012) employ VR to analyze approach/avoidance responses of crowding in a restaurant waiting area. Huang, Backman, Backman and Moore (2013) attempt to extend the Technology Acceptance Model (TAM) and Hedonic Theory to the virtual world of Second Life and its opportunity as a tool for tourism communicating marketing. Other studies also deal with the integration of TAM and VR to understand customer experience (Huang, Backman, Backman, & Chang, 2016) in wine tourism (Martins, Goncalves, Branco, Barbosa, Melo, & Bessa, 2017), historic visitor attractions (Lagiewski & Kesgin, 2017), golf sport (Han, Hwang, and Woods, 2014) or cultural heritage sites (tom Dieck & Jung, 2017).

The S(stimuli)–O(organism)-R(response) framework is another theoretical tool used to support VR studies. Here, stimuli are the starting point of a process that leads to emotional and cognitive internalization and, consequently, to behaviours (approach or attachment and avoidance) (Roschk et al., 2017). For instance, Yeh, Wang, Li and Lin (2017) extend the S-O-R model to incorporate tourists' responses, namely attention, interest, desire, and action (AIDA).

Tourism mobility and new technologies such as VR and AR are becoming a subject of interest for tourism research. Nobilities involve the movement of tourists and the whole range of material and things. This process is associated to the use of technology for geographical location (Hannam, Butler, & Paris, 2014) and may create sustainable problems resulting from the excessive number of people in movement. In this context VR can also contribute to avoid some of these movements allow to have a virtual experience without being in the place.

EXAMPLES OF APPLICATIONS OF VR, AR AND RELATED TECHNOLOGIES

Applications of Virtual Reality (VR) and Augmented Reality (AR) have increased in the last years with application in several tourist contact points, like in AR, offering enhanced booking experience, museum interactivity, destiny browsers, experience through gaming, augmented services in restaurants, re-living historic life and events, hotel experience, augmented transportation, augmented reality translation and participative destination management (Buhalis, & Yovcheva, 2013). Usually AR applications are more common because they are easier to implement. An app and a tablet or smartphone are the only needs in AR, while VR solutions need specific locations, hardware and software to be implemented.

In Portugal, museums like RTP Museum (RTP is Portugal state TV channel) includes the application of both technologies (RTP, 2018). The visitor can interact with a RTP Exterior Van vehicle from the 50s using Augmented Reality in tablets or smartphones (application available) but also, exclusively inside the museum installations, have the 360° experience of a car trip through the RTP grounds with Virtual Reality (RTP Museum, 2019) (see figure 8).

Figure 8. Museum RTP



Source: RTP (2018)

Other multimedia technologies are being used, like in the PO.RO.S museum. The museum “allows visitors to experience and interact with virtual environments from the Roman era, for a better understanding of the customs and way of life of one of the largest settlements of the Roman Empire in Portugal”. It received the Heritage in Motion Best Achievement Award 2018 (europanostra, 2018) and the prize in the category “Interactive Applications and Experiences” (see Figure 9).

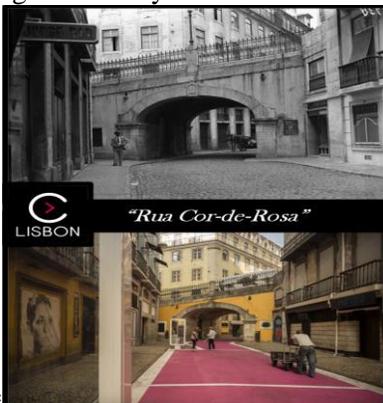
Figure 9. PO.RO.S museum



Source: europanostra (2018)

Several apps of Augmented Reality are already available, allowing a better knowledge by the tourist of their destination. From Rewind Cities Lisbon where it is possible to compare a city location with the same location in the past (Rewind Cities Lisbon, 2019) or the location and navigation app tagSpace-Lisboa Secreta (see Figure 10). It’s an augmented reality location and navigation platform that acts as an interactive window into the city, showing the principal city points and trendy spots, with also a city tour proposed by the app (Lisboa Secreta, 2019) (see Figure 11).

Figure 10. City Lisbon



*

Source: Rewind Cities Lisbon (2019)

Figure 11. Secret Lisbon



Source: tagSpace-Lisboa Secreta

To attract the tourist that are also gamers, companies are also introducing special VR gaming locations, like Virtuaplay which opened in Porto city a virtual gaming space with all kind of games, solitaire and multiplayer games (Virtuaplay, 2019) (see Figure 12).

Figure 12. Virtuaplay Porto



Source: Virtuaplay (2019)

Several locations like big malls and theme parks also want to attract more visitors with more sophisticated VR experiences, mainly gaming, where the visitor can be part of the history. Companies like Void (2019), with themes like Star Wars (a Disney franchise) (see Figure 13), supply these experiences in several

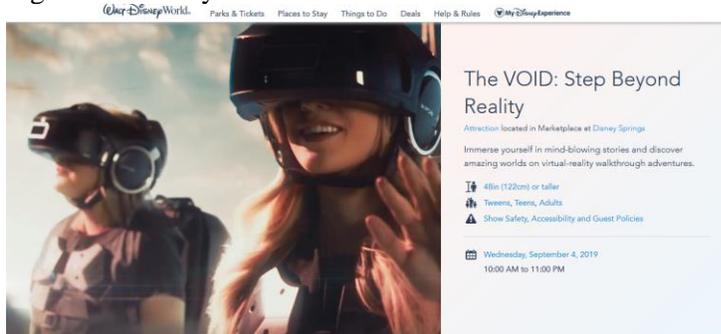
locations in the world. Theme Parks like Disney World offer that VR experiences in their Disney Springs complex (Disney, 2019) (see Figure 14).

Figure 13. Star Wars



Source: Void (2019).

Figure 14. Disney



Source: Disney World

FUTURE RESEARCH DIRECTIONS

With the shift in the logic of living the tourism experience four main aspects should be explored:

First, researchers and managers should be focused in understanding how the technology create value with tourists. So, what are the benefits and risks for tourists in using these technologies? And what about firms?

How can managers, marketers and tourists join forces and communicate together in order to create value? How to standardize and personalize products/services that emerge from these technologies?

Second, the transformation operated by the technologies will demand for new models and frameworks that could explain the approach/avoidance and acceptancy. Thus, what other model and frameworks will emerge? And what about to understand the tourist consumption?

Third, the amount of data that it is possible to collect and analyze may expose problems of data access and protection? Thus, laws about data protection show be investigated and created. Understand how long tourists are able to do not mind giving personal information (and be aware of that) to enhance the research on this field.

Finally, researchers need to investigate how different cultures, tourist personality traits and religions see the use and evolution of engagement-facilitating technologies.

CONCLUSION

VR and AR are becoming important to (i) promote destinations, lodgings or places, (ii) complement visits or be used as a substitution of visits and (iii) possibly be a way of remembering the holidays. As a promotional too, VR can create an imaginary to what tourist could expect at the destination (e.g., Stangl & Weismayer, 2008; Buhalis & Amaranggana, 2013; Buhalis & Amaranggana, 2015).

At the destination, VR and above all AR can extend the experience in using virtual objects to complement the real world, which can entertain the tourist or even contribute to learn more about the place, for instance what existed in the past in the same location (e.g., Buhalis & Amaranggana 2015). Using VR one can have an experience without being at the destination. This avoid individuals to be exposed directly to diseases, terrorism or natural disasters (Boes, Buhalis, & Inversini, 2015). The immersive experience can also encourage donations and other support for the destination having troubles (e.g., Manojlovich, Manojlovich, Chen, & Lewis, 2003), changing attitudes and be more pro-active helping (Tussyadiah, Wang, Jung, & tom Dieck, 2018). AR extends the experience at the destination providing more up to date information about streets, restaurants, attractions and other sites.

In the future, with evolution of the technologies, it will become easier to make VR films. Thus, tourists could prepare their own VR movies (as they do with photographs today) for later recall. VR can gain importance as a way of remembering and recommendation to peers and family, sharing such tourist experiences.

REFERENCES

- Arafa, M. N. (2017). Achilles as a marketing tool for virtual heritage applications. *International Journal of Architectural Research: ArchNet-IJAR*, 11(3), 109-118. doi:10.26687/archnet-ijar.v11i3.1385
- Bimber, O., & Raskar, R. (2005). *Spatial Augmented Reality Merging Real and Virtual Worlds*, Cambridge, MA: A K Peters.
- Bishop, I. D., & Gimblett, H. R. (2000). Management of recreational areas: GIS, autonomous agents, and virtual reality. *Environment and Planning B: Planning and Design*, 27(3), 423-435. doi: 10.1068/b2637
- Boes K., Buhalis D., Inversini A. (2015) Conceptualising Smart Tourism Destination Dimensions. In: Tussyadiah I., Inversini A. (eds) *Information and Communication Technologies in Tourism 2015*. Cham: Springer~
- Buhalis, D., & Yovcheva, Z. (2013). Augmented Reality in Tourism. 10 Unique Applications Explained. *Digital Tourism Think Thank – thinkdigital.travel*. Retrieved from: <https://thinkdigital.travel/wp-content/uploads/2013/04/10-AR-Best-Practices-in-Tourism.pdf> (accessed on 3of September 2019)
- Buhalis D., & Amaranggana A. (2013). Smart Tourism Destinations. In: Xiang Z., Tussyadiah I. (eds) *Information and Communication Technologies in Tourism*. Cham: Springer
- Buhalis D., & Amaranggana A. (2015). Smart Tourism Destinations Enhancing Tourism Experience Through Personalisation of Services. In: Tussyadiah I., Inversini A. (eds) *Information and Communication Technologies in Tourism 2015*. Cham: Springer
- Carmigniani, J., Carmigniani, J., & Furht, B. (2011). *Handbook of Augmented Reality*, New York, NY: Springer.
- Cheong, R. (1995). The virtual threat to travel and tourism. *Tourism Management*, 16(6), 417-422. doi: 10.1016/0261-5177(95)00049-T
- Dewailly, J. M. (1999). Sustainable tourist space: from reality to virtual reality?. *Tourism Geographies*, 1(1), 41-55. doi: 10.1080/14616689908721293
- tom Dieck, T. M. C., & Jung, T. H. (2017). Value of augmented reality at cultural heritage sites: A stakeholder approach. *Journal of destination marketing & management*, 6(2), 110-117. doi: 10.1016/j.jdmm.2017.03.002
- Disney. (2019). Retrieved from: <https://disneyworld.disney.go.com/en-eu/attractions/disney-springs/void-step-beyond-reality/> (accessed on 3of September 2019)

- Europanostra. (2018). Winners of the Heritage in Motion Awards 2018 announced in Aarhus, Denmark. Retrieved from: <https://www.europanostra.org/winners-of-the-heritage-in-motion-awards-2018-announced-in-aarhus-denmark/> (accessed on 3of September 2019)
- Gutierrez, M. A., Thalmann, D., & Vexo, F. (2008). *Stepping into virtual reality: A practical approach*. London: Springer.
- Guttentag, D. A. (2010). Virtual reality: Applications and implications for tourism. *Tourism Management*, 31(5), 637-651. doi:10.1016/j.tourman.2009.07.003
- Han, H., Hwang, J., & Woods, D. P. (2014). Choosing virtual–rather than real–leisure activities: An examination of the decision–making process in screen-golf participants. *Asia Pacific Journal of Tourism Research*, 19(4), 428-450. doi: 10.1080/10941665.2013.764333
- Hannam, K., Butler, G., & Paris, C. M. (2014). Developments and key issues in tourism mobilities. *Annals of Tourism Research*, 44, 171-185. doi: 10.1016/j.annals.2013.09.010
- Huang, Y. C., Backman, S. J., Backman, K. F., & Moore, D. (2013). Exploring user acceptance of 3D virtual worlds in travel and tourism marketing. *Tourism Management*, 36, 490-501. doi: 10.1016/j.tourman.2012.09.009
- Huang, Y. C., Backman, K. F., Backman, S. J., & Chang, L. L. (2016). Exploring the implications of virtual reality technology in tourism marketing: An integrated research framework. *International Journal of Tourism Research*, 18(2), 116-128. doi: 10.1002/jtr.2038
- Hwang, J., Yoon, S.-Y., & Bendle, L. J. (2012). Desired privacy and the impact of crowding on customer emotions and approach-avoidance responses: Waiting in a virtual reality restaurant. *International Journal of Contemporary Hospitality Management*, 24(2), 224-250. doi:10.1108/09596111211206150
- Javornik, A. (2016). Augmented reality: Research agenda for studying the impact of its media characteristics on consumer behaviour. *Journal of Retailing and Consumer Services*, 30(May), 252–261. doi:10.1016/j.jretconser.2016.02.004
- Jung, T., Chung, N., & Leue, M. C. (2015). The determinants of recommendations to use augmented reality technologies: The case of a Korean theme park. *Tourism Management*, 49, 75-86.
- Kumar, V., Dixit, A., Javalgi, A., & Das, M. (2016). Research framework, strategies, and applications of intelligent agent technologies (IATs) in marketing. *Journal of the Academy of Marketing Science*, 44(1), 24-45.
- Lagiewski, R., & Kesgin, M. (2017). Designing and implementing digital visitor experiences in New York State: The case of the Finger Lakes Interactive Play (FLIP) project. *Journal of destination marketing & management*, 6(2), 118-126. doi: 10.1016/j.jdmm.2017.03.005
- Lisboa Secreta. (2019). Retrieved from: <https://lisboasecreta.co/a-app-que-te-mostra-o-melhor-da-lisboa-secreta-em-realidade-aumentada/> (accessed on 3of September 2019)
- Loureiro, S.M.C., Guerreiro, J., Eloy, S., Langaro, D., & Panchapakesan, P. (2018). Understanding the use of Virtual Reality in Marketing: A text mining-based review. *Journal of Business Research* (Available online 9 November 2018).doi:10.1016/j.jbusres.2018.10.055
- Manojlovich, J., Manojlovich, J.M., Chen, J., & Lewis, M. (2003). UTSAF: a multi-agent-based framework for supporting military-based distributed interactive simulations in 3D virtual environments. In S. Chick, P. J. Sánchez, D. Ferrin, & D. J. Morrice (Eds.), *Proceedings of the International Conference on Machine Learning and Cybernetic* (pp. 960–968). North Bangkok: King Mongkut's University of Technology. doi: 10.1109/WSC.2003.1261517
- Martins, J., Gonçalves, R., Branco, F., Barbosa, L., Melo, M., & Bessa, M. (2017). A multisensory virtual experience model for thematic tourism: A Port wine tourism application proposal. *Journal of destination marketing & management*, 6(2), 103-109. doi: 10.1016/j.jdmm.2017.02.002
- Milgram, P., Takemura, H., Utsumi, A., & Kishino, F. (1994). Augmented Reality: A class of displays on the reality-virtuality continuum. *Systems Research*. In H. Das (Ed.), *Telem manipulator and Telepresence Technologies* (Vol. 2351. pp.282–292). Boston: Photonics for Industrial Applications. doi: 10.1117/12.197321

- Ng, I. & Wakenshaw, S. (2017). The internet-of-things: Review and research directions. *International Journal of Research in Marketing*, 34(1), 3-21
- Musil, S., & Pigel, G. (1994). Can Tourism be Replaced by Virtual Reality Technology. In Proceedings of the International Conference in Innsbruck, Austria, Springer Verlag.
- Rewind Cities Lisbon. (2019). https://www.facebook.com/pg/rewindcitieslisbon/about/?ref=page_internal (accessed on 30 of September 2019)
- Ribeiro, M. A., Pinto, P., Silva, J. A., & Woosnam, K.M. (2017). *Residents' attitudes and the adoption of pro-tourism behaviours: the case of developing island countries*. *Tourism Management*, 61, 523-537.
- Rizzo, A., Requejo, P., Winstein, C.J., Lange, B., Ragusa, G., Merians, A., Patton, J., Banerjee, P., & Aisen, M. (2011). Virtual reality applications for addressing the needs of those aging with disability. *Studies in Health Technology and Informatics*, 163 (Medicine Meets Virtual Reality, 18), 510-516. doi:10.3233/978-1-60750-706-2-163
- Roschk, H., Loureiro, S.M.C., Breitsohl, J. (2017). Calibrating 30 years of experimental research: A meta-analysis of the atmospheric effects of music, scent, and color. *Journal of Retailing*, 93(2), 228-240. doi: 10.1016/j.jretai.2016.10.001
- RTP (2018). Museu RTP aposta na realidade aumentada e na realidade virtual. Retrieved from: <http://media.rtp.pt/extra/pessoas/museu-rtp-aposta-na-realidade-aumentada-na-realidade-virtual/> (accessed on 30 of September 2019)
- RTP Museum. (2019). Retrieved from: <https://museu.rtp.pt/en/virtual-tours/exterior-van-virtual-reality> (accessed on 30 of September 2019)
- Skyline (2018). Retrieved from: <https://crokepark.ie/ericsson-skyline-app> (accessed on 12 of February 2019)
- Stangl, B., & Weismayer, C. (2008). Websites and virtual realities: a useful marketing tool combination? An exploratory investigation. In P. O'Connor, W. Höpken, & U. Gretzel (Eds.), *Information and communication technologies in tourism 2008* (pp. 141-151). New York: Springer.
- Virtuaplay. (2019). Retrieved from: <https://virtuaplay.pt/> (accessed on 30 of September 2019)
- Void. (2019). Retrieved from: <https://www.thevoid.com/> (accessed on 30 of September 2019)
- Tussyadiah, I. P., Jung, T. H., & tom Dieck, M. C. (2017). Embodiment of wearable augmented reality technology in tourism experiences. *Journal of Travel Research*, 57(5), 597-611.
- Tussyadiah, I. P., Wang, D., Jung, T. H., & tom Dieck, M. C. (2018). Virtual reality, presence, and attitude change: Empirical evidence from tourism. *Tourism Management*, 66, 140-154. doi:10.1016/j.tourman.2017.12.003
- UNWTO (2018). *Tourism Highlights – 2018 edition*. WTO: Madrid.
- van Herpen, E., van den Broek, E., van Trijp, H.C.M., & Yu, T. (2016). Can a virtual supermarket bring realism into the lab? Comparing shopping behavior using virtual and pictorial store representations to behavior in a physical store. *Appetite*, 107, 196-207. doi:10.1016/j.appet.2016.07.033
- Wang, Y., Yu, Q., & Fesenmaier, D. R. (2002). Defining the virtual tourist community: implications for tourism marketing. *Tourism Management*, 23(4), 407-417. doi: 10.1016/S0261-5177(01)00093-0
- Verhoef, P.C., Stephen, A., Kannan, P.K., Luo, X. et al. (2017). Consumer connectivity in a complex, technology-enabled, and mobile-oriented world with smart products. *Journal of Interactive Marketing*, 40, 1-8.
- Williams, P., & Hobson, J. S. (1995). Virtual reality and tourism: fact or fantasy?, *Tourism Management*, 16(6), 423-427. doi:10.1016/0261-5177(95)00050-X
- World Travel & Tourism Council [WTTC] (2019). *Travel & Tourism Economic Impact 2019 – World*. WTTC: United Kingdom.
- Yeh, C. H., Wang, Y. S., Li, H. T., & Lin, S. Y. (2017). The effect of information presentation modes on tourists' responses in Internet marketing: the moderating role of emotions. *Journal of Travel & Tourism Marketing*, 34(8), 1018-1032. doi: 10.1080/10548408.2016.1276509

ADDITIONAL READING

- Abbott, L. (1955). *Quality and Competition*. New York: Columbia University Press.
- Benckendorff, P., Sheldon, P., & Fesenmaier, D. R. (2014). *Tourism Information Technology*. Oxford, UK: CAB International.
- Boes, K., Buhalis, D., Inversini, A. (2016). Smart tourism destinations: ecosystems for tourism destination competitiveness. *International Journal of Tourism Cities*, 2(2), 108-124, doi: [/10.1108/IJTC-12-2015-0032](https://doi.org/10.1108/IJTC-12-2015-0032)
- Buhalis, D., & Law, R. (2008). Progress in information technology and tourism management: 20 years on and 10 years after the Internet-the state of eTourism research. *Tourism Management*, 29(4), 609–623. doi: [10.1016/j.tourman.2008.01.005](https://doi.org/10.1016/j.tourman.2008.01.005)
- Calatrava Moreno, M., Hörhager, G., Schuster, R., & Werthner, H. (2015). Strategic E-tourism alternatives for destinations. In I. Tussyadiah & A. Inversini (Eds.), *Information and communication technologies in tourism 2015* (pp. 405–417). Heidelberg, Germany: Springer.
- Disneyworld (2019). Retrieved from <https://disneyworld.disney.go.com/en-eu/> (accessed on 15 of April 2019).
- Howard J. A., & Sheth J. N. (1969). *The Theory of Buyer Behaviour*. New York: J. Wiley and Sons.
- Huang, C. D., Goo, J., Nam, K., Yoo, Ch. W. (2017). Smart tourism technologies in travel planning: The role of exploration and exploitation, *Information & Management*, 54(6), 757-770, doi: [10.1016/j.im.2016.11.010](https://doi.org/10.1016/j.im.2016.11.010)
- Hunter, W.C., Virtual Reality. In J. Jafari (Ed.), *The Encyclopedia of Tourism*, 2nd Edition. NY: Springer.
- Hunter, W. C., Chung, N., Gretzel, U., and Koo, Ch. (2015). *Constructivist research in smart tourism*. *Asia Pacific Journal of Information Systems*, 25 (1) 105-120. doi: [10.14329/apjis.2015.25.1.105](https://doi.org/10.14329/apjis.2015.25.1.105)
- Kumar, V., Bhaskaran, V., Mirchandani, R., & Shah, M. (2013). Creating a Measurable Social Media Marketing Strategy: Increasing the Value and ROI of Intangibles and Tangibles for Hokey Pokey. *Marketing Science*, 32(2), 194–212. doi:10.1287/mksc.1120.0768
- Leeflang, P. S., Verhoef, P. C., Dahlström, P., & Freundt, T. (2014). Challenges and solutions for marketing in a digital era. *European Management Journal*, 32(1), 1-12. doi:10.1016/j.emj.2013.12.001
- Loureiro, S.M.C., & Guerreiro, J. (2018). Psychological behavior of generation Y: living between real and virtual reality. In M. Gerhardt & J. V.E. Peluchette (Eds.), *Millennials: Characteristics, Trends and Perspectives* (chapter 3, pp.67-90). New-York: NOVA science publishers, Inc.
- Loureiro, S.M.C. & Roschk, H. (2014). Differential Effects of Atmospheric Cues on Emotions and Loyalty Intention with Respect to Age under Online/Offline Environment. *Journal of Retailing and Consumer Services*, 21(2), 211–219. doi:10.1016/j.jretconser.2013.09.001
- Loureiro, S.M.C., & Sarmiento, E.M. (2017). Tourist engagement: the role of place attachment and place authenticity. In A. Pizam, & Y. Wang (Eds.) *Conference book proceedings of the 4th world research summit for tourism and hospitality: Innovation, Partnerships and Sharing* (accepted), 8-11 of December, Rosen College of Hospitality Management, University of Central Florida, Orlando, Florida, USA.
- Loureiro, S.M.C, & Sarmiento, E.M. (2018). Engaging visitors in cultural and recreational experience at museums. *ANATOLIA: An International Journal of Tourism and Hospitality Research*, 29(4), 581-592. doi:10.1080/13032917.2018.1484378
- Moors, A., Ellsworth, P. C., Scherer, K. R., & Frijda, N. H. (2013). Appraisal theories of emotion: State of the art and future development. *Emotion Review*, 5(2), 119-124. doi:10.1177/1754073912468165
- O'Connor, P., Höpken, W., Gretzel, P. (2008). *Information and Communication Technologies in Tourism 2008*. Proceedings of the International Conference in Innsbruck, Austria, 2008. Innsbruck: Springer.
- Prahalad, C.K., & Ramaswamy, V. (2003). The New Frontier of Experience Innovation. *MIT Sloan Management Review*, 44(4), 12–18.
- Schmitt, B. H. (1999). *Experiential Marketing*. New York, NY: Free Press.

- Verhoef, P. C. (2003). Understanding the Effect of Customer Relationship Management Efforts on Customer Retention and Customer Share Development. *Journal of Marketing*, 67(4), 30–45. doi:10.1509/jmkg.67.4.30.18685
- Verhoef, P. C., Lemon, K. A., Parasuraman, A., Roggeveen, A, Tsiros, M., & Schlesinger, L. A. (2009). Customer experience creation: Determinants, dynamics and management strategies. *Journal of Retailing*, 85(1), 31-41. doi:10.1016/j.jretai.2008.11.001
- Xiang, Z., & Gretzel, U. (2010). Role of social media in online travel information search. *Tourism Management*, 31(2), 179–188. doi: [10.1016/j.tourman.2009.02.016](https://doi.org/10.1016/j.tourman.2009.02.016)

KEY TERMS AND DEFINITIONS

Tourism: UNWTO defines tourism as indicated below:

"Tourism comprises the activities of persons traveling to and staying in places outside their usual environment for not more than one consecutive year for leisure and not less than 24 hours, business and other purposes." Tourism can be domestic or international, and international tourism has both incoming and outgoing implications on a country's balance of payments (UNWTO, 2018).

Virtual Reality: A technology that provides an immersive experience that an individual can navigate and possibly interact with, resulting in real-time simulation of one or more of the user's five senses.

Augmented Reality: AR is an interactive experience of a real-world environment where tourists can see the objects of the real-world "augmented" by computer-generated perceptual information, sometimes across multiple sensory modalities, such as visual or hearing.

Internet-of-Things (IOT): a system of interrelated computing devices, people, animals, objects and mechanical and digital machines and the ability to transfer data over a network without human-to computer or human-to human interaction.

Artificial Intelligence: intelligent behavior, learning, and adaptation in machines, robots and body-less computer programs.

Technology Acceptance Model (TAM): is a theory that intend to explain how users accept and use technologies.

S-O-R Framework: stimuli - organism - response. The framework intends to describe the individual behavior through the stimuli creating cognitive and emotional states, which, in turn, lead to responses.