

Immersive technologies in the national strategy for greening tourism activities

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Abstract: Immersive technologies are rapidly transforming the tourism industry, offering new possibilities for tourists to experience destinations and for tourism businesses to market their products and services. Governments, as major stakeholders in the tourism industry, can play a significant role in promoting the adoption of immersive technologies by providing financial support, creating a favorable regulatory environment, and investing in infrastructure. This study examines the current state of immersive technology integration in tourism and identifies key areas where government support is needed. By taking these steps, governments can help to accelerate the adoption of immersive technologies in tourism and unlock the full potential of these technologies to transform the industry, increase its sustainability and environmental friendliness in the modern conditions.

1 Introduction

Immersive technologies have the potential to have a significant impact on tourism and tourism activities, transforming (individualizing, developing new consumer properties) tourist services and local tourism products, as well as directly affecting the tourism management system, which is broadly understood (as tourism destination management) includes the state or local government as a subject of management. In this regard, the state should actively support the introduction of immersive technologies in tourism, itself becoming an active user, developer, and promoter of their commercial capabilities. Improving the efficiency of state support and regulation of the sphere of integration of immersive technologies into tourism production will not only contribute to the growth of the quality of the destination's tourism product but will also form additional reserves for increasing its competitiveness in the world or national tourism markets.

The aim of the study is to analyze the directions, prospects, and main problems of integrating immersive technologies into the process of state support for environmental friendliness and sustainability in the countries of the world.

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2 Main focus of the study

The directions of state regulation (stimulation) of the process of integration of immersive technologies into tourism, in many respects, differ little from traditional instruments of support for innovation of local business, the socio-economic system, ensuring conditions for successful generation (as an alternative, import, copying, imitation), commercialization of innovations (which are largely immersive technologies), as well as protection of intellectual property for the results of innovative progress. The following can be identified as the basic areas of state stimulation of the process of integration of immersive technologies into tourism:

2.1 Creating a regulatory framework of investment in immersive technologies (tax breaks, subsidies, and grants for businesses, simplified regulatory requirements for testing and implementing new technologies)

Thus, in the US, the Tax Cuts and Jobs Act of 2017 already includes provisions that encourage investment in augmented and virtual reality; the Canadian government offers tax breaks and grants for companies investing in immersive technologies in tourism through its “Tourism Innovation” program; the European Union provides grants and funding for projects implementing immersive technologies in tourism under the “Horizon Europe” program; the Singaporean government offers similar incentives to innovative tourism businesses through its national “Digital Transformation Grant” program [1-23].

The Copyright Law in the UAE (Federal Law No. 7 of 2022) includes provisions protecting intellectual property related to immersive technologies. The “Saudi Vision 2030” includes initiatives to develop and implement immersive technologies in all sectors, including tourism.

Already, the emirate of Dubai is implementing the “Dubai Metaverse Strategy” initiative, which aims to create a comprehensive metaverse and support the adoption of immersive technologies across all industries.

2.2 Infrastructure investment

The introduction of immersive technologies requires the formation of an efficient and reliable infrastructure (primarily high-speed Internet and on-board networks), investments in which by states provide further unimpeded access for tourists to virtual and augmented reality applications and devices.

Thus, the US National Science Foundation (NSF) awarded a \$10 million grant to the University of Southern California to develop an augmented reality system to improve the tourist experience in Yosemite National Park. The Canadian government has invested \$5 million in the “La Mauricie 360” project to develop an interactive virtual tour of the Mauricie region (data from <https://www.canada.ca>).

The European Union has provided €4.5 million in funding for the “ViTo360” project to develop a virtual platform for cultural tourism (virtual visits to historical sites).

Singaporean authorities have invested \$10 million in the “Sentosa VR” project (an interactive virtual tour of Sentosa Island (data from <https://www.tnc.gov.sg/tourism-development>)). In China, the government has invested billions of dollars in the creation of virtual reality theme parks and museums throughout the country (Beijing Universal Studios Theme Park in Beijing, for example).

The Brazilian Tourism Board fully funded the “Virtual Tour of Rio de Janeiro” project, the Mexican Ministry of Tourism - “Virtual Tour of Teotihuacan”, the Peruvian Ministry of

Culture - “Virtual Tour of Machu Picchu”, and the Colombian Tourism Board supported the project “Virtual Tour of Cartagena”.

2.3 Promoting cooperation and knowledge transfer

States can facilitate cooperation between tourism businesses, technology providers, and research institutions in the form of trade fairs, conferences, and educational programs.

2.4 Support for innovation and research

States can support research and innovation in the field of immersive technologies by funding research and development projects, creating specialized incubators and accelerators, and providing access to grants and venture capital.

States actively fund universities, research institutes, and private companies to conduct R&D in the field of immersive technologies (technology monitoring, development of new applications, modernization of existing systems).

In the US, these functions are performed by the National Science Foundation (NSF) (Data: <https://www.nsf.gov>), which, for example, awarded a grant to the University of California, Berkeley to develop new methods of using virtual reality for training and education.

The European Union funds research projects in the field of immersive technologies through the “Horizon Europe” program (for example, the “VIRTe” project).

The Japan Science and Technology Agency (JST) provides funding for research projects in the field of immersive technologies through the “ImPACT” program (for example, the development of a new virtual reality headset with high resolution and wide viewing angle).

The Chinese government invests in research and innovation in the field of immersive technologies through its “Virtual Reality Industry Development Plan”. For example, active financial support for national virtual reality laboratories and companies developing virtual reality technologies.

The South Korean government is implementing the “Metaverse Industry Development Plan” (creation of metaverse research centers, support for companies developing meta-technologies).

States can provide grants and venture capital to startups and businesses working on cutting-edge immersive technologies, helping them overcome initial barriers and accelerate the development and adoption of new products; create programs that encourage collaboration between industry and academia in the field of immersive technology research (funding joint research projects, creating centers of excellence that bring together researchers, engineers, and industry professionals).

For example, the European Union has funded the “ViTo360” startup (virtual cultural tourism platform) under the “Horizon Europe” program; the Spanish government provides funding for projects implementing immersive technologies in tourism under the “Smart Tourism” program. (For example, “Virtual Alhambra” received funding to develop an interactive virtual tour of the Alhambra complex in Granada (Data: <https://www.sepe.es/HomeSepe>)).

Singapore-based Sentosa Development Corporation has received funding to develop an interactive virtual tour of Sentosa Island, and Florida State University (USA) has received funding to develop a virtual reality system to train students in tourism.

The Dubai Virtual Museum (UAE), Saudi Heritage VR (Saudi Arabia), Qatar Immersive Museum (Qatar), and Bahrain Augmented Reality Tourism (Bahrain) projects have received major grants from national governments.

2.5 Protection of intellectual property

States should create a robust intellectual property protection system for immersive technologies, thereby providing researchers and businesses with confidence in the future, stimulating their further research and development.

The most popular IP protection tools for immersive technologies in the world include patents, copyright, trademarks, and trade secrets. IP protection in the field of immersive technologies will contribute to: stimulating innovation, protecting investment, preventing unfair competition, and increasing cooperation (protecting the contribution of the investor, co-founder).

For example, the US has a strong IP protection system that includes both federal and state laws, and the US Patent and Trademark Office grants patents for inventions, including virtual reality devices for virtual tours (Data: <https://www.uspto.gov>). The EU has a single IP protection system, the EU Intellectual Property Office (EUIPO) (Data: <https://euipo.europa.eu/en>) registers trademarks and industrial designs related to immersive technologies in tourism.

Japan has some of the strictest IP laws in the world and effectively protects copyrights, patents, and trademarks (Data: <https://www.jpo.go.jp/en>). The Korean Intellectual Property Office (KIPO) (Data: <https://www.kipo.go.kr/en>) and the Intellectual Property Office of Singapore (IPOS) (Data: <https://www.ipos.gov.sg>) are also among the most effective in the world in granting patents and registering trademarks for virtual and augmented reality technologies used in tourism.

2.6 Financial and fiscal policy

Governments can provide financial incentives, such as tax breaks or grants, to businesses that implement immersive technologies in their tourism offerings.

Grants: are non-repayable funds provided to businesses to cover the costs associated with implementing immersive technologies. For example, the Singapore government offers grants to tourism businesses to develop and implement immersive tourism experiences (Data: <https://www.tnc.gov.sg/tourism-development>). The Canadian government offers grants to tourism businesses to implement immersive technologies through its “Tourism Innovation” program, the European Union - under the “Horizon Europe” program (for example, the “iTour” project received a grant to develop a virtual reality platform for cultural tourism). In South Korea, grants for tourism businesses implementing immersive technologies are distributed through the “Smart Tourism” program.

In parallel with targeted grants, countries around the world can hold national competitions for the best immersive technology (including in tourism), the winners of which, in addition to marketing support and distinctive marks, receive a certain amount of funding or simplified access to the grant program.

In the US, the “Auggie Awards” honors the best augmented and virtual reality technologies in tourism. The competition is organized by the Augmented and Virtual Reality Association (AVR). The “Immersive Tech Awards” recognizes outstanding achievements in immersive technologies in the UK (organized by Immersive Tech Weekly). The “Turismo Inmersivo” award from the Spanish Association of Virtual and Augmented Reality (ASEBIR) recognizes the best projects using immersive technologies in the tourism sector. The “Canadian Tourism Innovation Awards” (presented by the Canadian Tourism Association (CTA)) also includes a category dedicated to immersive technologies. The Singapore Tourism Board (STB) “Singapore Tourism Awards” also has a category dedicated to innovation and technology.

Subsidies: funds provided to businesses to offset part of the costs associated with implementing immersive technologies. For example, the French government offers subsidies to tourism businesses to purchase virtual and augmented reality equipment.

Tax breaks: tax breaks allow businesses to reduce their tax liability by investing in immersive technologies. For example, the UK government offers tax breaks for research and development costs related to immersive technologies.

Government authorities can introduce a more preferential tax regime for companies that develop or implement immersive technologies, including in the tourism sector. The most popular tools of tax support for the progress of immersive technologies in the world are: increasing coefficients of attribution of development costs (purchase, installation, maintenance) of immersive technologies or elements of their infrastructure (equipment, software) to the current expenses of companies (in which case the costs can be taken into account in an amount multiple to the real ones - increasing coefficients from 1.5 to 5), accelerated depreciation of equipment associated with the development or implementation of immersive technologies in commercial activities. These measures allow businesses to legally increase expenses and reduce taxable profits.

In addition, governments actively use tax breaks (reduced tax rates, tax holidays, simplified tax schemes, tax deductions, and refunds of taxes paid) in the sphere of fiscal stimulation.

Thus, the Canadian government offers tax breaks for companies investing in research and development in immersive technologies, such as augmented and virtual reality. The European Union provides grants and tax breaks for projects related to immersive technologies under the “Horizon Europe” program. The Singaporean government offers tax breaks and grants to companies investing in immersive technologies and their application in various industries, including tourism, education, and healthcare.

The South Korean government provides tax breaks and subsidies for companies implementing immersive technologies in their products and services, and also invests in creating immersive technology infrastructure, such as 5G networks and data centers.

The US Tax Cuts and Jobs Act of 2017 includes provisions that encourage investment in augmented and virtual reality.

Low-interest loans: are provided to businesses at low interest rates to cover the costs associated with implementing immersive technologies. For example, the Spanish government offers low-interest loans to tourism businesses to invest in digital technologies, including immersive technologies.

Venture capital: provides funding to businesses that develop and implement immersive technologies in tourism. For example, the Saudi Tourism Development Fund invests in startups that offer immersive tourism experiences.

2.7 Promoting the accessibility of immersive technologies

Governments should strive to make immersive technologies accessible to all tourists (providing subsidies for equipment and software, creating affordable educational programs, and promoting inclusive tourism offerings).

Governments can partner with community organizations to provide access to immersive technologies in tourism for underrepresented groups, such as people with disabilities or tourists from low-income backgrounds.

Governments can encourage resource sharing among tourism businesses to make immersive technologies more affordable (creating shared libraries of equipment or software, organizing events where tourists can experience immersive technologies without having to purchase their own); support research and development aimed at creating more accessible and user-friendly immersive technologies (funding projects that explore new

ways of interacting with virtual and augmented realities, and developing devices and software that are optimized for use by people with disabilities).

One of the indirect measures to promote the availability of immersive technologies, including in tourism, is the modernization of educational standards, with the training of specialists who are not only capable of initiating the development of industry immersive technologies but also actively consuming existing ones (stimulating demand for an immersive technological tourism product).

2.8 Promotion of immersive tourism

Governments can actively promote immersive tourism domestically and internationally by creating marketing campaigns, having a presence on social media, and partnering with travel agencies.

Governments can launch marketing campaigns to raise awareness of immersive technologies and their benefits for tourism. These campaigns can use a variety of channels, such as television, print, social media, and online advertising, to reach a wide audience.

Governments can use social media to engage with tourists and promote immersive technologies, including posting about tourist destinations that use immersive technologies, running contests and giveaways, and answering questions and providing information to tourists; can partner with travel agencies to promote immersive technologies as part of tour packages; organize events dedicated to immersive technologies in tourism (technology demonstrations, panel discussions, and opportunities for attendees to experience immersive experiences firsthand); and can collaborate with other countries to promote immersive technologies in tourism (sharing best practices, developing joint marketing campaigns, and organizing international events).

The promotion of immersive tourism in the leading countries of the world allows us to determine its most effective strategies: partnership with travel agencies and operators; use of social networks and influencers; creation of virtual tours and demonstrations; participation in tourism exhibitions and events; development of marketing campaigns based on data.

3 Problems of state stimulation of the integration of immersive technologies and tourism production

Although immersive technologies demonstrate significant potential for use in tourism, they also have several problems, the solution of which should also be in the zone of priority state regulation (Table 1).

Table 1: Main problems of integration of immersive technologies in tourism (Source: results of the authors' survey)

Immersive technologies		
Augmented reality		Virtual reality
equipment	confidentiality of information	getting to know the device
Internet access	reduction of communication with the real object	data availability
systematic feedback	user tracking	spatial placement

Firstly, there may be a lack of compatibility between the platforms of the devices used [10] - AR is not used in all operating systems, although there are many frameworks and toolkits for application development. Secondly, some AR applications require an Internet connection to receive data from the server [8], but some tourists (especially from less

technologically advanced countries) find mobile Internet expensive, and not all tourist areas or cities provide free Internet access.

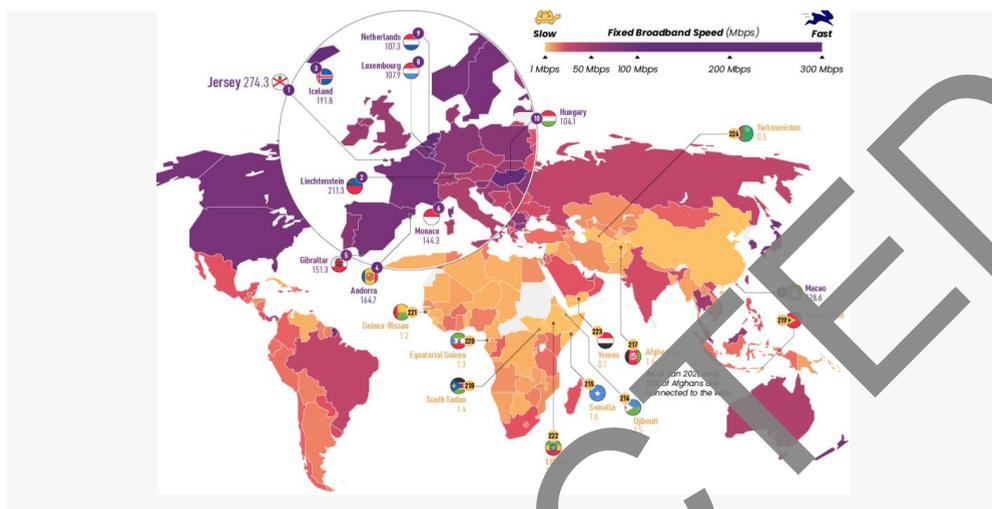


Fig. 1. Data transfer rate via mobile connection and Wi-Fi in the world (visualcapitalist.com data), 2021

The third problem is the physical size of AR devices. Thus, the participants of the study [3] complained about the heavy tablet used for drawing, indicating that a smaller device, such as a smartphone, would be more suitable for use as a guide. In other studies, the disadvantages of guides using wearable devices were the battery life [19,20] and the cost of the device [5].

The fourth problem is the possibility of AR tracking when using the camera as a sensor. The AR camera tracking system, whether markerless or marker-based, must take into account the amount of light and the angle at which the camera is looking at the marker, image, or object. System response or feedback, is the fifth task of AR.

The system should notify users of feedback errors to indicate the system's operation [11] and create personalized navigation [19,20]. Another problem identified in AR for tourism is the user's interaction with a real object or environment. In an experimental design study (Tom Dieck et al., 2018), participants encountered a new augmented reality technology that caused them to focus more on the device information than on the paintings they were observing [12,18].

This means that the application developer must ensure that the information projected at a given time is not overloaded and, therefore, does not distract from leisure. Finally, user privacy is another problem associated with the use of AR in tourism. The advantage of personalizing content or a context-dependent system provides the user with more relevant content.

However, if the system increasingly requests more personal data about the user, the risk of losing or misusing this data increases.

The problems that VR poses in tourism are different from those that AR poses.

The first problem of using virtual reality in tourism is getting acquainted with the device [14]. argued that it can take a long time for a user to become familiar with virtual reality devices. In addition, the authors suggested combining the basics of virtual environment design with the natural interaction of hands and gestures, which provides enough time flexibility to obtain information.

The second problem lies in the relationship between physical information from a real tourist destination and virtual information in a virtual reality environment. [14] argued that using information obtained from the physical environment should help the user delve deeper into the information in the virtual reality environment. Similarly, information from a virtual environment can help users learn about related tourist sites or situations.

The third problem with using virtual reality in tourism is data availability. When presenting a virtual object, environment, or scenario from the past, the most realistic image presented in virtual reality depends on the availability of data.

4 Conclusions

The state, as the main stakeholder and beneficiary of the progress of the implementation of immersive technologies in the tourism industry, can and should support the introduction of immersive technologies in the industry, becoming an active user, developer, and promoter of commercial opportunities for augmented and virtual reality technologies in tourism services, production, and trade [1,22,23].

The following were considered as the basic areas of state stimulation of the process of integration of immersive technologies into tourism: creation of a favorable regulatory framework, state infrastructure investments, measures of state support for innovations and research in the field of tourism services, state assistance in intersectoral and international knowledge transfer, active financial state support for the processes of implementation of immersive technologies (tax benefits, concessional financing and lending, support grants, and so on), modernization of intellectual property protection tools, introduction of uniform progressive standards (especially in the field of data protection, security of virtual and augmented reality technologies), as well as active promotion of the growth in demand for an immersive tourism product (increasing the availability of immersive services for visitors and local residents, promoting immersive tourism).

Despite all the designated advantages of integration of immersive technologies into tourism, in the presence of effective positive experience of state stimulation of the processes of introducing immersive technologies into tourism production and management (for example, in the countries of Europe, Asia-Pacific region), the state should overcome the limitations and problems of deepening the industry application of immersive technologies (topical, including in the countries of technological and tourist avant-garde), for example, such as:

- insufficient financing (development and implementation of immersive technologies are usually expensive, especially for small and medium-sized tourism enterprises, which actualizes state support for the industry in the form of grants, subsidies, or tax benefits);

- far from all tourism enterprises have access to the latest immersive technologies and equipment, which requires the state to provide access to advanced technologies and equipment through research centers, innovation centers, or rental programs;

- shortage of qualified specialists, unwillingness of tourism professionals to study and implement immersive technologies into practical activities. The development of new immersive technologies requires qualified specialists (in the fields of virtual and augmented reality development, 3D modeling, interactive storytelling), therefore, state support should include training, certification, and skills development programs for training qualified personnel;

- the effective use of immersive technologies in tourism requires a reliable infrastructure, such as high-speed Internet and computing power, which determines the improvement of infrastructure in tourist destinations and ensuring access to high-speed Internet for tourism enterprises as priorities of state stimulation. Finally, the introduction of immersive technologies may encounter legislative and regulatory barriers, such as issues of copyright,

privacy, and security, which requires the state to develop clear regulations that encourage innovation and protect user rights.

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