Iran J Public Health, Vol. 54, No.10, Oct 2025, pp.2127-2138

Review Article

Technology Adoption in Tourism to Deal with Global Health Crisis: A Narrative Review

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(Received 10 May 2025; accepted 10 Aug 2025)

Abstract

Reviewing the research trends of technology adoption in tourism in reaction to the recent global health crisis provides insights into the evolution of the academic discourse of this topic and the role of technology adoption, especially in terms of attaining sustainability. This narrative review was conducted to explore the patterns of technology adoption in tourism in response to the health crisis. The findings reveal a growing scholarly focus on this topic, as well as geographical, methodological, and theoretical concentrations. Technology adoption was seen as the immediate reaction to the crisis and a tool to ensure sustainability by facilitating resilience and recovery after the pandemic. The review highlights the dual role of technology in emergency response and long-term sectoral resilience. However, ethical and structural challenges remain, necessitating better governance of tech integration in tourism.

Keywords: Global health crisis; Pandemic; Technology adoption; Tourism

Introduction

While technological progress has generated economic and social transformation (1), the link between the two is not straightforward. The relationship is mediated by a series of technology adoptions, with the pace and nature of these processes varying over countries and sectors (2, 3). Therefore, exploring the adoption processes of technologies within specific sectors and under specific circumstances seems meaningful. Technology adoption is often prompted by crises, and they become transformational opportunities, with technology being the central triggering agent of innovation (4-6).

Tourism as a sector has witnessed economic and social advancement associated with technological innovations. Such innovations were specifically triggered by the COVID-19 pandemic, which was the latest worldwide health crisis. The high

DOI: https://doi.org/10.18502/ijph.v54i10.20133

uncertainty experienced during COVID-19 made technologies the major coping mechanisms (7, 8). The focus of research connected to COVID-19 is the expedited technology adoption in tourism, with the urgent needs that came with lockdowns and the restricted tourism mobility. Examples include virtual reality (VR) (9), robots (10, 11), digital technologies (12), and information and communication technologies (ICTs) (13, 14). Understanding technological innovation during this global health crisis provides us with insight into not only the stream of such advancements in human history accelerated by the crisis but also the changes of technology adoption in tourism.

This study aims to understand the phenomenon by analyzing academic papers focused on the technologies adopted due to COVID-19, which allowed an easier spread of technologies and shaped the generalization of the use of some of these technologies. The study not only distinguishes the types of technologies adopted but also provides specific information about the sector of application associated with the technologies.

To achieve the goal, this research provides an analysis through a literature review of articles published between 2020 and 2022. This time frame was strategically chosen to capture the full scope of the pandemic's impact on technology adoption within the tourism industry. The beginning of 2020 marked the onset of the pandemic as a global health crisis, which triggered the urgent need for technological solutions. The end of 2022 was selected as a logical endpoint, representing the transition toward recovery. This period effectively encompasses the phases of immediate reactions, allowing for an explorative understanding of how technological innovations paved the way for the adoption of technology in tourism, and the generalization of concrete technology use became more widespread in the following years.

This study aims to address the following research questions.

RQ1: How was technology adoption to deal with COVID-19 discussed in tourism literature?

RQ2: How is each sector of tourism research discussed regarding technology adoption to deal with COVID-19?

RQ3: Which theories/ antecedents and consequences are utilized in the research on the technology adoption in tourism to cope with COVID-19?

Methods

In this narrative review, the SCOPUS database was searched. The word schemes were implicit to three underpinning concepts, namely, pandemic, tourism, and technology. The concepts were expanded into (pandemic OR COVID-19 OR COVID OR lockdown OR Coronavirus OR SARS-CoV-2 AND tourism OR travel OR trip OR hospitality AND technology) within the time frame of 2020 through 2022. Searching with the selected keywords and filtering initially yielded 835 documents. Applying more selection criteria, 105 studies were considered eligible for the final review.

Each article was coded for its descriptive information, type of technology examined, tourism sector under study, applied methodology, theoretical framework, and main contribution. The authors independently conducted the initial full-text coding, after which their results were cross-checked. Such coded data were synthesized and were analyzed using SPSS Version 28 (IBM Corp., Armonk, NY, USA). This enabled us to generate findings that address the research questions presented above.

Results

Temporal and Geographical Distribution

The publications were organized based on the time, geographical distribution, and methodology adopted. The number of publications increased rapidly, with 9 publications in 2020, 25 publications in 2021, and 71 publications in 2022. Geographically, about half the studies (n=53) were based on data collected in the Asia-Pacific, dominated by China (n=19), Indonesia (n=8), and Ko-

rea (n=5). About a quarter (n=24) were from Europe, with no saliently dominating countries.

Research Method and Research Design

Among the studies, 61 (58.10%) used primary data, 28 (26.67%) used secondary data, and 16 (15.24%) used both types of data. Quantitative methods were prevalent, followed by mixed methods and qualitative methods. A closer examination of the research designs revealed a diverse range of designs utilized in the studies. Surveys emerge as the most prevalent method, constituting 50.48% of the studies. Other specific methodologies, such as experiments, database analysis, and content analysis, made relatively fewer contributions to the broader mix (Table 1).

Table 1: Research method and research design

Method/Design	Frequency	%
Research method		
Quantitative	41	39.04
Mixed	28	26.67
Qualitative	25	23.81
None	11	10.48
Research design		
Survey	53	50.48
Focus group	9	8.58
Case study	7	6.67
Conceptual	6	5.71
Interview and survey	6	5.71
Literature review	4	3.81
Database analysis	4	3.81
Experiment	3	2.86
Literature review, survey	3	2.86
Literature review, case study, interview	3	2.86
Content analysis, documentation	2	1.90
Prototype development	1	0.95
Prototype system development	1	0.95
Thematic analysis	1	0.95
Content analysis	1	0.95
Focus group, literature review	1	0.95
Total	105	100

Trend of the Adopted Technologies

Table 2 illustrates the primary technology highlighted in the studies. As some of them addressed multiple technologies, there were 140 mentions in 105 publications. VR was mentioned most frequently (27.86%), followed by ICT (17.86%), digital and smart technology (14.29%), and robots (12.14%). Trends in AI and in mobile and online services were similar. AR, IT, drones, and kiosks were mentioned relatively rarely. Publications peaked in 2022 for all technologies except for drones. In 2020, robots and AI dominated; in 2022, VR, ICT, digital and smart technology, and mobile and online services prevailed.

Table 2: The frequency of the technologies focused on in the publications

Technology	Year			Total (N)	%
	2020	2021	2022		
Virtual reality (VR)	2	6	31	39	27.86
Information and communication technology (ICT)	1	6	18	25	17.86
Digital and smart technology	1	6	13	20	14.29
Robot	6	4	7	17	12.14
Artificial intelligence (AI)	4	2	8	14	10.00
Mobile and online service	0	3	9	12	8.57
Augmented reality (AR)	1	1	4	6	4.29
Information technology (IT)	0	0	3	3	2.14
Drone technology	0	2	0	2	1.43
Kiosk technology	0	1	1	2	1.43
Total	15	31	94	140	100.00

Technology Adoption by Tourism Sectors

The publications were further classified according to tourism sectors. Seven main sectors were identified: smart tourism, virtual tourism, customer behavior, hotel, travel, foodservice, and tourism education (Table 3). Further, our analysis outlines the utilization of each technology by each sector.

Table 3: The trend of technology adoption in the selected publications based on tourism sectors

Technology adopted	Tourism sector (Number of publications)						
	Smart tourism	Virtual tourism	Customer behavior	Hotel	Travel	Foodservice	Tourism education
VR	9	19	6	0	2	0	3
Information and communication technology (ICT)	10	4	5	0	4	2	0
Digital and smart technology	6	0	2	7	3	2	0
Robot	6	0	2	8	1	1	0
Artificial intelligence (AI)	4	1	2	5	1	0	1
Mobile and online service	2	0	5	2	1	1	0
Augmented reality (AR)	3	3	0	0	0	0	0
Information technology (IT)	0	0	0	2	1	0	0
Drone technology	1	0	0	0	0	1	0
Kiosk technology	1	0	1	0	0	0	0
Total	42	27	23	24	13	7	4

Smart Tourism

In smart tourism, VR involving immersive platforms created value as a destination marketing tool (15), customer interaction, and transactions focused on ICT (16). Digital technologies were adopted in cruise tourism through a smart ecosystem for ship operations (17). Remote communication technologies were adopted globally in the events (18). Further discussed was how the pandemic would stimulate the adoption of AI and robots to mitigate the negative impacts of the crisis by enhancing customer safety (19). Adopting mobile and online services, such as self-service technologies, was proposed (20). Finally, the potential of augmented reality, such as Mobile Augmented Reality in Tourism (MART), was practically tested to recover from the crisis (21).

Virtual Tourism

Virtual tourism research mainly dealt with adopting VR and acknowledged that ICT, AI, and AR enhanced virtual tourism. Some studies highlighted virtual tourism as an entertainment activity where VR brings immersive experiences to people (13, 22, 23). Virtual tourism was illustrated by highlighting the adoption of ICT as well. For instance, in one study, a live-streaming experience was developed for heritage guiding as a sustainable, immersive, interactive, and inclusive tourism product (24). Studies also considered AR and VR together in virtual tourism because of the commonalities in the types of devices used, targeted users, advantages and disadvantages, and the market growth (25).

Customer Behavior

Papers in customer behavior dealt with the customers' perceptions, attitudes, and behaviors towards the adoption of new technology and usage. Antecedents such as usefulness, ease of use, perceived enjoyment and perceived service quality, trustfulness, socio-demographic variables, and context-specific variables, such as anthropomorphism of service robots, were tested to examine the consequences, such as the intention to accept technology as well as future behavior. For example, the changes in customers' attitudes toward robot-staffed hotels were highlighted (10). Another study pointed out the relationship between the functional value of smart accommodation and the customers' perception (26). Chan et al.'s (27) study discussed negative emotions that may hinder the use of kiosk technologies. While it was concluded that the pandemic increased the intention to use smartphones (28), two studies highlighted the behavioral concerns in terms of mobile payment usage (29, 30).

Hotel

Literature shows that hotels proactively adopted technology during the crisis, including digital and smart technology, robots, IT, and mobile and online services. Adopting tech-based transformation strategies by hotels in India led to reestablishing trust by creating a safe space, decreasing fear, and enhancing customer confidence (31). Besides, hotels' digitalization has the potential to generate high-efficiency gains both in public-facing and back-office operations (12). The technological shift provided managerial implications through adopting numerical data that can help to identify where smart systems need to move from data to action (32).

The research on hotels focused on robots (33), and the hotel guests' acceptance of the hotel robots depended on their types and ease of use (11). Hotels have also demonstrated an ability to incorporate IT-based business models (8). Lau (34) reported that digital technology, robots, and AI were integrated into the daily operations to enhance service quality. Combining AI and robots by adopting biosensors, robotic room services, and contactless hosting were introduced as technology-focused solutions for hotel management (35).

Travel

Literature focused on the adoption of VR, ICT, digital and smart technology, robots, AI, mobile and online services, and IT in the travel sector. VR was discussed together with AI, digital and smart technology, such as 5G, and robot automa-

tion technologies (36). ICT was exemplified with phone applications to provide a better travel experience, such as safe environments for pilgrims (37). Among digital technologies, blockchain was found as a new tool to transform traveling by offering innovative solutions. A study designed a framework that facilitates implementing blockchain-enabled solutions across different travel stages (38). A study on mobile and online services segmented tourists according to various motivations for using social media (39).

Foodservice

Cheong and Law (40) highlighted the role of ICT in the emergency adoption of an online platform for restaurants to increase the quality of interaction between customers and staff. Studies also mentioned that new digital and smart technologies helped to overcome challenges this sector faced during the health crisis (41). Cha (42) revealed that sensory elements of robot services improve customer attitudes towards the use of robots in restaurants. A similar study explored the role of perceived innovativeness of food delivery facilitated by drones (43).

Tourism Education

Education in tourism was also affected by technology adoption due to the pandemic. Research mostly focused on the applicability of VR and AI. One study revealed that a mobile virtual field trip is a better alternative for obtaining information during actual visits, and it can address the limitations (44). Other studies contributed to the effective implementation of VR technologies in university settings (45) and mentioned the need to add new concepts of technology adoption to curricula, such as AI and big data, in addition to VR (46).

Theories Utilized

A total of 25 theories were used in the papers (Table 4). The Technology Acceptance Model (TAM) was the most frequently adopted theory. The Unified Theory of Acceptance and Use of Technology (UTAUT, 6.66%) and the Theory of Planned Behavior (TPB, 5.71%) followed.

Table 4: The theories of the searched studies (N=105)

Theories	Frequency	%
Technology Acceptance Model (TAM)	19	18.09
Unified Theory of Acceptance and Use of Technology (UTAUT)	7	6.66
Theory of Planned Behavior (TPB)	6	5.71
Technology Readiness and Acceptance Model (TRAM)	3	2.85
Theory of Consumption Values	3	2.85
Health Belief Model	3	2.85
Technology Readiness (TR)	2	1.90
Self-Determination Theory (SDT)	2	1.90
Diffusion of Innovations (DOI)	2	1.90
Social Theory	2	1.90
Cognitive Appraisal Theory and Cognitive–Behavioral Theory	2	1.90
Articles without a specific theory	41	39.04
Other theories*	13	12.38
Total	105	100.00

*Virtual Tourist Experience (VTE), TTF Model under social distancing, Theory of Total Immersion, Risk Theory, Theory of Reasoned Action, Staged Authenticity Theory, Protective Action Decision Model (PADM), Tech-based Transformation Strategies, Hedonic Motivation System Adoption Model (HMSAM), Motivation Theory, Mood Management Theory, Innovation Resistance Theory (IRT), Media Richness Theory

Overall, the perception and attitude towards new technologies, perceived values, and motivations appeared to be the antecedents of technology adoption and satisfaction. Consequences included behavioral intention as well as actual technology adoption. Studies that adopted TAM focused on perceived ease of use and perceived usefulness of the technology as the antecedents (47, 48). Studies that adopted the UTAUT considered performance expectancy, effort expectancy, social influence, and facilitating conditions as antecedents and behavioral intention as consequences (49). Some studies adopted the Theory of Planned Behavior, which focused on attitude and behavioral intentions (43). Studies that used the theory of consumption values focused on how functional value and emotional value adopted new technologies in delivering experience (26). Studies that adopted Self-Determination Theory were interested in the intention of technology adoption, such as mobile payment usage, and supported that motivation and satisfaction contributed to such behavioral intentions (29). Lee (50) adopted the Media Richness Theory in the context of VR tourism and reported that the media richness of tourism content significantly increased perceived usefulness and perceived enjoyment. Another study that used innovation resistance theory identified usage barriers and image barriers, privacy concerns, and visibility and security concerns as crucial factors for the mobile payment service (30).

Technology Adoption and Sustainability

Technology adoption was highlighted as a tool to enhance the sustainability of post-pandemic tourism. Such advances are called 'sustainable innovation', which provides a solution to cope with the health crisis (5). For example, Niewiadomski (51) discussed how the pandemic offers opportunities for tourism firms to follow in line with sustainability principles. The environmentally friendly aspects of VR were pointed out (52). ICT was proposed for rural areas to cope with the pandemic and facilitate revitalization (53). AI can help societies respond quickly to crises, it also has the power to predict and prevent disruptions while supporting the business sectors (54). Among the various tourism sectors, literature on hotels tends to view the contribution of technologies to sustainability as most remarkable. Several benefits were recognized in hotel management (32, 34, 35) and hotel digitalization (12, 31). Some scholars stated that technology can deal with a labor shortage in the long term (55). Studies such as Papagiannidis and Davlembayeva (26) focused on emotional values and showed the benefits of customers' sense of contributing to sustainability at the hotels that adopt smart technologies.

Discussion

Shift Toward Technology Adoption

The health crisis has accelerated the adoption of technology (55), and technology has played a pivotal role in managing the challenges faced during the health crisis, leading to a favorable shift in industry acceptance of technology. The results of this review reveal a growing interest in the context of technology adoption to manage the health consequences of the pandemic and to attain tourism sustainability. Technologies adopted during the pandemic did not disappear after the health crisis concluded – the pandemic circumstances only accelerated the period of adaptation and a qualitative jump in the usage of these technologies. This evolving landscape of technology adoption will likely continue to shape the future of tourism.

The results provide insights into the temporal and geographical distribution of the examined publications. The yearly distribution of publications highlights the emerging response of the tourism industry and research. The geographical distribution of research published in English shows the publication concentration limited to a few countries and particularly a lack of research from each European country, though a considerable proportion of studies did not focus on specific countries of data collection. This indicates the interest of scholars in addressing the health crisis at the global level. Therefore, the global health crisis caused a shift in attitude towards

technology adoption for customers in different sectors of tourism.

The results also support the potential of adopting a wide spectrum of technologies in tourism, including robots, AI, VR, ICT, digital and smart technology, and mobile and online services. These findings suggest a maturation of the industry's response, focusing on enhancing customer experiences, operational efficiency, and adaptability through a broader spectrum of technologies. Further, the investigation on research trends by tourism sectors revealed a diverse landscape of technology adoption.

Technology was believed to be able to address uncertainties during the crisis (14), specifically in tourism marketing (15), rural tourism (53), and cruise tourism (17), among others. The unique features of virtual tourism were revealed to provide an innovative opportunity during the lockdown and social restrictions during the global health crisis. Our review captured studies that highlighted the benefits of VR as an efficient tourism marketing tool during and after the crisis (13, 22, 23). The technologies adopted spanned from underlying technologies to various applications and service robots (56). In the case of robots, several studies (11, 12, 47) detailed how the usage of robots ascended as they provided the opportunity for fewer social interactions while delivering the needed services to customers, ranging from hotel attention (11, 12) to food delivery (44). Technological transformation is likely to be highly beneficial in managing the health issues in a service-based business (56). Hotel and foodservice sectors especially benefited from new systems and facilities provided by technology adoption, implying that technology adoption can help to react and recover from the health crisis.

In general, VR was the most studied technology across tourism sectors, whereas there was a strong prevalence of information and communication technologies in the case of smart tourism, and robots when the research versed about hotels. The rapid transformation product of the pandemic has not only introduced or made common the use of new technologies, but also reshaped the way tourism and hospitality promote, operate, and offer their services to clients; these changes are likely to endure beyond the pandemic.

Theories Adopted and Implications for Sustainability

The study of adopted theories led to the finding that antecedents such as usefulness, ease of use, perceived enjoyment, perceived service quality, trustfulness, socio-demographic variables, and more sector-specific variables, such as anthropomorphism of service robots, were tested to examine the consequences including the actual acceptance intention to use technology and future customer behavior, which highlight the importance of exploring behavioral intentions. It was generally clear that COVID-19 altered customers' attitudes and behavioral intentions toward technology (15).

Technology adoption was accelerated because of the wide array of needs that had to be covered during the health crisis, which produced a shift in attitudes. As technologies ease the needs that ought to be covered, tourism professionals and tourists were less reluctant to adopt new technologies, which remained in use once the pandemic concluded. Accordingly, this study highlights the contribution of technology adoption from the lens of sustainability. Noticeably, opportunities for industries, both short-term and long-term, have been considered. Short-term consequences were highlighted as a reaction to the immediate crisis, such as adopting robots as well as digital and smart technologies to deal with labor shortages. The long-term effects assume the role of technology in strengthening the competitiveness of tourism in the context of addressing health issues in this sector.

The notion of sustainability is captured in these findings, with the exploration of the contribution to sustainability thanks to the diversity of tourism technologies, as well as the perceptions of different tourism sectors of the contribution of technology to sustainability. Some of these pieces of research include the environmental friendliness of VR, sustainable management enhanced with IT, and the predictive capability enabled by AI.

Noticeably, the level and way technology can affect sustainability differed by tourism sectors.

The Efficiency of Technology Adoption

The results also reveal that there are some debates on the efficiency of technology adoption. Even though several benefits of technology adoption in tourism were mentioned, heterogeneity existed, and the willingness to use the new technologies was influenced by several determinants (8). While most studies highlighted the positive contributions of technologies in coping with the crises, even citing operational efficiency especially for the hotel sector (12), some pointed out the side effects of the abrupt adoption without ethical considerations. Since the pandemic implied a shock that forced hospitality businesses to quickly adapt, the adoption of technology was especially abrupt. On the one hand, technologies were quickly accepted as they were deemed as necessary, whereas on the other hand, there was a regulation gap that left the tourism industry unsure about these technologies.

For example, VR is a novel domain and has yet to be theorized in tourism research (57). There are still limits to using Virtual tourism, in terms of popularity, ease of use, tourists' technical discomfort, and perceptions of usefulness (47). Nevertheless, technological transformations can be offered as strategies to manage health issues in the tourism industry. Scholars pointed out the need for a new business model, public support, and professional interaction in terms of technology transformation in tourism (48, 58). Thus, the findings show that it is also crucial to design new rules and regulations, as well as supporting organizations for such a transformation in tourism. As these technologies prevail in tourism, it is necessary to design adequate regulations that can not only set a legal framework but also ensure users' safety. Social interactive gadgets within tourism require an organization to make a commitment to futuristic technologies, along with building value by enriching service quality expectations among fearful tourists (58). The absence of clear guidelines and new interdisciplinary competencies in relation to the use of digital technology might lead to unintended consequences for both employees and customers. As the fast-paced environment forced by the crisis subsides, there are opportunities to rectify and adapt technologies, study their functioning, and establish regulations for a fair and ethical use of these technologies in the future, while respecting their usage and adoption.

Conclusion

This study adopted the narrative review approach to investigate technology adoption in tourism during the global health crisis and the repercussions of such adoption. The findings not only expand the understanding of the trends of new technology adoption but also imply the multifaceted patterns of different types of technologies. The technology adoption in tourism was enabled by changes in behavioral intention towards technology. The constructive role of technology adoption in sustainability appeared to be undeniable.

Our research was limited to a short time to discover the trends during the recent health crisis. Comparing the trends before and after the crisis for a longer period would be beneficial. Besides, comparing how the trends differ in other industries and businesses will enhance the literature of technological transformation at the time of a crisis. Future research can also focus on other review protocols to create a deeper knowledge of the topic.

While this study highlights the potential of technology adoption as a tool to address health issues in the tourism industry, it also points out that a system should be established to ensure healthy and ethical adoption and application of technologies. The implications go beyond health crises and point to the need to establish frameworks and regulate new technologies that tourism professionals and users adopt. The pandemic has not only caused disruptions but also forced a quick shift in technological trends, with the shift's im-

pact prevailing after the pandemic is over and changing the technological landscape.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

Acknowledgements

This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korean Government [Ministry of Science and ICT (MSIT)] under Grant RS-2022-NR070854. The research was also supported by the KU Research Professor Program of Konkuk University.

Conflict of interest

The authors declare no conflict of interest.

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