Adoption of Smart Technologies in the Cruise Tourism Services: A Systematic Review and Future Research Agenda

Abstract

Purpose – The main aim of this paper is to systematically analyze existing studies related to the adoption of smart technologies (RAISA) in cruise tourism services, particularly robots, artificial intelligence, service automation, and virtual reality. More specifically, we intend to highlight the current state of research on this topic, present the findings within a conceptual framework, and propose a research agenda.

Design/methodology/approach – The relevant literature was extracted using two major electronic databases, WoS and Scopus. We identified 31 articles from high-quality journals and used a systematic review and the VOSviewer software to analyze them.

Findings – Since 2014, there has been an increase in the number of studies related to smart technologies in cruise tourism services. At first, researchers focused on Royal Caribbean's robotic bartender arm, while other technologies such as digital signage, self-service options, facial recognition, and virtual culinary experiences received less attention. However, the interest in exploring these last smart technologies has grown significantly since 2019. The ASCT framework was proposed identifying five major domains: cruise robotic technology; technology innovation; cruise passengers' engagement behavior; cruise passengers' technology readiness; and privacy perception and knowledge expertise. These domains provide valuable guidance for future research in this field.

Originality – This is the first study to systematically analyze literature on the adoption of new technologies in cruise tourism services, specifically focusing on the major technologies available on cruise ships.

Keywords: Cruise tourism; service robot; service automation, artificial intelligence; virtual reality; systematic literature review

1. Introduction

The evolution of technologies forced the tourism industry to innovate and become more digital (Hao et al., 2020). Consequently, service providers are adopting cutting-edge technologies, called smart technologies here – comprising RAISA (Robots, Artificial intelligence (AI), and Service Automation (SA)), IoT (Internet of Things), Virtual Reality (VR), or augmented reality (AR) – to replace traditional human services (Sharma *et al.*, 2021). Self-check-in/out, mobile app payments, digital voice assistance, and service robots are some of the most widely used technologies in hospitality (Ma *et al.*, 2023).

The cruise industry, one of the fastest-growing sectors in the tourism industry (Ali *et al.*, 2022; Loureiro *et al.*, 2019; Papathanassis, 2020a), was halted for almost 11 months due to Covid-19, resuming its activities only in mid-2021 (CLIA, 2020; Pan *et al.*, 2021). The industry's recovery heavily relied on the adoption of new technologies (CLIA, 2020), such as keychains, virtual assistants, or apps, to enhance the traveler's experience (CLIA, 2019). Although these technologies have been adopted, most studies related to the use of AI, VR, or robots (Hou *et al.*, 2021; Ivanov *et al.*, 2019; Seyitoğlu and Ivanov, 2021) are confined to restaurants, hotels, or airports (Loureiro *et al.*, 2020; Lu *et al.*, 2019) and are scattered across different academic journals.

Most of the research on cruise technology is primarily limited to technical aspects, such as the engine room, air conditioning, or safety (Man *et al.*, 2018; Nolich *et al.*, 2019), with few studies focused on the technological services used to leverage the value proposition for cruise passengers (Tussyadiah *et al.*, 2020). To address this gap, we conducted a systematic review with the purpose of analyzing existing research on the adoption of RAISA in the cruise industry, providing valuable insights into the principal research areas explored. This will enable academics and practitioners to thoroughly understand the current research scope and the most used technologies on cruises. Furthermore, the identified research gaps can guide them in future research endeavors. As such, this study seeks to answer the following research question: *What are the key research domains studied in the realm of RAISA in cruise tourism services?* Consequently, the aims of this study are to (i) identify the main theoretical constructs; (ii) synthesize the findings in an integrating framework; and (iii) identify clusters of research interest in the field of technology and cruise tourism related to unexplored research topics.

The contributions of the study are fourfold. First, the analysis of the extant literature allows scholars to conduct additional research in their respective fields of study. Second, the framework for the adoption of RAISA in the cruise tourism service (ASCT) is the major contribution of this paper, as it helps synthesize findings in an integrative way that opens several avenues for future research directions. Third, responding to the call to further explore smart technologies in cruise tourism (Loureiro *et al.*, 2020; Tussyadiah *et al.*, 2020). Finally, identify gaps and provide a research agenda highlighting five main domains for future studies.

2. RAISA technologies in the cruise tourism service

Cruise companies transform their industry by leveraging advanced technologies on their ships to enhance the passenger experience. Therefore, finding RAISA (Robots, AI, and Service Automation) technologies (Ivanov and Webster, 2019) onboard cruise ships is increasingly common with each new ship. Cruise companies continually develop innovative services using technology designed to enhance human interaction (Macefield, 2020), such as humanoid robots, virtual concierges, or mobile applications. These services are empowered by AI, IoT, and big data to meet the technological expectations of passengers (Bilgihan and Ricci, 2023). Like hotels, cruise ships employ RAISA technologies at different stages of the passenger cycle – pre-arrival, arrival, stay, departure, and assessment (Lukanova and Ilieva, 2019). The following are the most representative:

Artificial intelligence onboard cruise ships. AI technology has become an asset for cruise ships, as it can simulate human intelligence, learn from experiences, and perform human-like tasks (Li et al., 2019). AI onboard ships work alongside other innovative technologies, such as IoT, VR, or AR to enhance productivity, operational efficiency, and decision-making related to the service experience. For example, MSC Cruises has introduced ZOE – the world's first *virtual personal cruise assistant* available in every cabin on their latest ships. ZOE is a voice-enabled AI device that can answer over 800 ship-related questions in seven languages, assist passengers with reservations, provide information about services, and offer suggestions regarding activities while learning about passenger preferences (MSC Cruises, 2021a; Shallo, 2019).

Robotic technology onboard cruise ships. Major cruise lines adopted industrial and service robots, especially in areas like the bar and reception. Mechanical AI-powered industrial robots are commonly used for automated or repetitive tasks (Tussyadiah, 2020). These robots are implemented in cafés or bars as they can produce multiple drinks within a given timeframe. A

prime example onboard cruise ships is the Royal Caribbean's Bionic Bar, which features two robotic arm bartenders that can mix, stir, shake, and serve the drinks from a selection of 50 different ingredients (Royal Caribbean International, 2021; Tussyadiah et al., 2020). However, service robots have different levels of powered AI, ranging from analytical (able to collect and process consumer data and learn from it) to intuitive (capable of understanding the data to provide service recommendations) (Tussyadiah, 2020). Costa Cruise lines leverage this technology with Pepper – the first-ever robot capable of recognizing and responding to human emotions. Pepper welcomes passengers as they board the ship, provides information related to cruise activities, itineraries, ports of calls, and even asks passengers about their cruise experience (SoftBank Robotics, 2016). Similarly, MSC Cruises introduced Rob – the first humanoid robotic bartender at sea available on the MSC Virtuosa cruise ship – who can serve a variety of cocktails to passengers, while interacting with them (MSC Cruises, 2021b).

Service Automation technologies onboard cruise ships. Several cruise lines adopted various self-service technologies that allow customers to produce service independently without requiring employee assistance (Fernandes and Pedroso, 2017). On cruise ships, SA technologies not only transfer responsibility from crew members to passengers but also help to reduce waiting times, minimize service errors, and improve the overall passenger experience (Ivanov and Webster, 2019). For example, *digital self-service kiosks/tablets* enable cruise passengers to complete tasks independently, improving responsiveness and reducing peak-hour wait time (Yoon and Cha, 2020). Conveniently located near the reception, these user-friendly and contactless devices expedite the embarkation/disembarkation processes, checking onboard accounts, making payments, and booking reservations or excursions (Carnival, 2022). Another SA technology on cruise ships is *digital signage* or *interactive touch screens*. These large screens are mainly found

in the public areas of newer ships and display various activities available throughout the day, advertise onboard promotions or meals, and port arrival and departure times. Passengers use them as a wayfinding map to share/find venue locations with family or friends (Saltzman and Garay, 2020). These screens offer access to the daily program, allow reservations, and some even offer interactive games for children (Macefield, 2020).

Safety on ships is a high priority, and the adoption of SA technologies, such as *smart wearable devices*, has become crucial. These devices work in conjunction with IoT technologies to enable real-time tracking of passengers (Virto and Blasco López, 2019), especially children, and are used by crew officers to quickly locate passengers during emergencies (Kwee-Meier *et al.*, 2016). Princess Cruises' Ocean Medallion is one of the best examples of this technology. Embedded with sensors using Near-Field Communication (NFC) and Bluetooth Low Energy (BLE) wireless technology, this waterproof and hit/sun/cold resistant medallion holds the passenger's unique digital identity (Barsocchi *et al.*, 2019). Available as a bracelet/wristband, pendant chain, lanyard, or clip (Buhalis *et al.*, 2022), it serves as a cabin key and allows passengers to adjust the lighting and temperature in their cabins. Additionally, streamlined embarkation/disembarkation enables contactless payments around the ship, and allows the crew to deliver food/drink almost anywhere onboard the ship (Buhalis *et al.*, 2022; Princess Cruises, n.d.). Royal Caribbean and MSC cruises also offer smart bands with similar functionality. MSC cruises have a wristband called MSC for Me that works as a copy of the cruise card, while MSC for Me Plus has an additional feature – a locator (MSC Cruises, 2022) – allowing the app to locate family and friends.

One of the most common technologies is the *cruise application,* which offers passengers and crew members a significant advantage. Passengers can download the app to their smartphones

at no cost, giving them access to a variety of daily activities, and allowing them to make purchases, order drinks, and book excursions or dinners (Saltzman and Garay, 2020). The Virtual Concierge app from Celebrity Cruises (2022a) can unlock cabin doors, control lights, and adjust room temperature. It also acts as a digital assistant, providing personalized recommendations based on passengers' behavior and directing them around the ship. The app continually learns tracks and assists crew members in responding to passengers' preferences (EY Global, 2022). Cruise lines are also developing apps for safety and security purposes. For example, Royal Caribbean's Muster 2.0 provides safety instructions for the assigned muster station and offers guidance on using life jackets. Similarly, Carnival's Hubb app can verify whether passengers attended the security drill before departure (Cotfas *et al.*, 2023).

Virtual reality onboard cruise ships. Many cruise companies provide 360° VR tours on their websites, enabling passengers to access them independently via laptops or smartphones. Yet, using VR onboard cruise ships requires crew member assistance, as the headsets need to be set up. VR technology provides an immersive 3D simulated environment that allows real-world experience (Loureiro *et al.*, 2020). Cruise lines incorporate VR in shore excursions and culinary dining to encourage passengers to purchase these services (Arlati *et al.*, 2018). For example, Royal Caribbean introduced VR dining that allows passengers to view virtual food and other digital images, which are then replaced by real food – snacks or desserts (Marshall, 2022). The company also provides VR headsets at excursion desks for passengers to preview tours before purchasing (Gaudiosi, 2017). VR is utilized for entertainment and gaming, especially on family-oriented cruises (Saltzman, 2019).

3. Methodology

3.1 Search strategy

The systematic literature followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Moher *et al.*, 2009) and used two main electronic databases – WoS and Scopus – to extract the relevant literature. The same query was applied to the title, abstract, and keywords: (("cruise industry" OR "cruise line" OR "cruise ship" OR "cruise technologies" OR "cruise tourism" OR "smart cruises") AND ("artificial intelligence" OR "app" OR "digital technology" OR "emergency evacuation" OR "environmental" OR "health care" OR "mobile app" OR "robots" OR "safety" OR "service automation" OR "security" OR "service robots" OR "smart technology" OR "smartphones applications" OR "sustainability" OR "technology" OR "virtual reality")).

3.2 Selection criteria

We apply specific search filters to focus on articles of the highest quality directly related to our topic. First, we consider only full-text articles and articles published in academic or scientific journals. Second, those articles had to be ranked in the SCImago Journal and Country Rank (SJR) to ensure they were published in top-quality journals. SJR is a journal quality indicator that uses a Q index that ranks journals into four categories. Therefore, our study only included articles from journals in the first and second quartile, considered top-quality journals (Q1=29 and Q2=2).

Third, only English-language articles were regarded since journals published in this language are the most represented and significantly impact scientific research (Dobrescu *et al.*, 2021). Fourth, we select only journals related to computer science, engineering, environmental, marine, marketing, social sciences, sustainability, technology, tourism, leisure, and hospitality management. Fifth, conference articles, proceedings papers, book chapters, extended abstracts,

and all other non-academic articles were excluded. Finally, all articles published until May 2023 were included.

3.3. Data extraction

Based on the selection criteria, we gathered 1,948 articles from the WoS database and 9,989 from Scopus. After merging both datasets, we removed 541 duplicates, leaving 11,396 articles. From this group, we screened the articles and selected only those from top-quality journals with SJR's Q1 and Q2 scores. Then, non-English language articles, those unrelated to the proposed research field, and non-academic articles were eliminated. Remaining 2,715 articles.

After title screening, 591 irrelevant articles (e.g., chemical engineering, neuroscience, marine biology, policy, and governance) were removed, leaving 2,124 articles for abstract reading. From this group, we select the most relevant articles related to our study field, eliminating 1,945 articles and reducing them to 179 (see Figure 1).

Figure 1 here.

Subsequently, the full-text articles (179) were downloaded and subjected to an in-depth analysis following the previously defined inclusion criteria. The objective was to identify relevant literature on innovative technologies (robotics, AI, SA, and VR) in cruise tourism services. Hence, as final selection criteria, we exclude articles that: (1) the full text could not be accessed (n=25, 16.6%) and are in publishers that are not Emerald, Elsevier, Taylor & Francis, Wiley, Sage, Springer, or Inderscience; (2) did not measure variables of interest (n=74, 49.0%) to the scope of this study, such as RAISA technology in cruise tourism; and (3) did not coincide with the proposed objective (n=52, 34.4%) of determining theoretical constructs, creating a framework, and identifying unexplored areas of research in technology and cruise tourism.

Finally, manually searched the reference lists of the selected articles and performed a supplementary search on Google Scholar, thus adding 3 additional articles. Based on the last screening and other searches, 31 relevant articles emerged (see Figure 2) for final analysis (see Web Appendix A for the final list of articles).

Figure 2 here

4. Descriptive analysis of the literature

4.1. Scientific journals and publication year

The 31 articles were published in 20 different journals related to computer science, economics, engineering, environmental science, marine studies, safety science, social sciences, tourism, leisure, and hospitality management (see Figure 3). The most stand-out journals are the International Journal of Contemporary Hospitality Management, Sustainability, and Annals of Tourism Research, with three articles each.

Additionally, as of 2019, researchers wrote more articles associated with cruise technologies in service, with the largest number of articles published in 2020 (n = 8) and 2021 (n=7) (Figure 4), and only 16 articles were published in journals related to tourism and hospitality.

Figures 3 and 4 here.

4.2. Bibliometric analysis of keywords

We used VOSviewer software (van Eck and Waltman, 2010) to analyze the main keywords of the final set of 31 articles. The software clustered similar keywords into 11 clusters, each represented by a distinct color on the keyword network visualization map (Figure 5a) – with 136 keywords in total. *Ships, tourism, sustainability, evacuation, safety, covid-19, digitalization, artificial*

intelligence, *technology*, and *Internet of Things*, are among the most used keywords, being the main topic related to the latest technologies implemented onboard cruise ships.

Figure 5b shows the keyword overlay visualization map that is identical to the network visualization map, but the difference is that it shows different colors representing how keyword trends varied throughout time – from articles more focused on *artificial intelligence* used in cruises in 2010 (in dark purple) to articles more related to *covid-19* and *sustainability* in 2020 (in yellow).

Figure 5a/5b here

5. Framework for the adoption of RAISA in the cruise tourism service

We develop a conceptual framework for the adoption of RAISA in the cruise tourism service (ASCT) – grounded on the ADO (Antecedents, Decision, and Outcomes) framework (Paul and Benito, 2018) – to organize and classify the findings of the existing literature. According to Lim et al. (2021), antecedents explain the reasons for engaging in certain behaviors, decisions explain behavioral performance, and outcomes describe the consequences of these behavioral responses. Thus, antecedents are the factors influencing cruise tourism service consumption towards the new technologies onboard cruise ships. The decision refers to the cruise passenger's behavioral intention towards the use of these new technologies, and the outcomes are the results of the cruise passenger's behavioral responses. The ASCT framework (see Figure 6) also considers the main moderator and mediator constructs identified in the literature.

Figure 6 here

5.1 Antecedents (A)

Cruise Health and Safety. Cruise companies prioritize passenger health and safety, mainly due to their growing number (CLIA, 2022) which increases onboard emergencies like disease outbreaks

(Silva, 2021), collisions, fires, explosions, or engine damage (Cotfas *et al.*, 2023; Yue *et al.*, 2022). Cruise companies responded to these accidents by implementing innovative technologies (e.g., smart wearables devices or cruise apps, as they send emergency alerts, report missing passengers, and track the real-time location of crew and passengers) (Kwee-Meier *et al.*, 2016).

The latest pandemic outbreak led cruise lines to use contactless service technologies (e.g., self-service options, service robots, and cruise apps) (Silva, 2021; Yang *et al.*, 2021). This approach not only helps to prevent the spread of the virus but also mitigates other infectious diseases (e.g., norovirus or gastrointestinal illnesses) that can also cancel sailings and limit passengers' services (Holland *et al.*, 2021).

Cruise Sustainability. Several academics underscored the importance of sustainability for cruise lines (Papathanassis, 2020b; Strazza *et al.*, 2015). Cruise companies' accelerated growth causes environmental damage through waste disposal and CO_2 emissions (Penco *et al.*, 2017). Therefore, cruise companies adopted innovative technologies (e.g., Liquified Natural Gas (LNG) or Exhaust Gas Cleaning Systems (EGCS)) to minimize emissions and reduce air pollution (Carnival Corporation, 2023). They also implemented advanced technologies in wastewater treatment to mitigate their environmental impact (Paiano *et al.*, 2020).

RAISA in Cruise Facilities. Cruise companies integrated cutting-edge service RAISA into their ships' facilities, including passenger staterooms and public areas (e.g., arcades, casinos, lobbies, restaurants, spas, shops) (Calza *et al.*, 2020; Sun *et al.*, 2021). These technologies significantly enhanced public venues and rooms, offering passengers features like an AR dining experience, self-service options, virtual assistants, smart staterooms, and even robotic concierges and

bartenders (Saltzman and Garay, 2020). Several studies (Barsocchi *et al.*, 2019; Martínez-Molés *et al.*, 2022), showed the positive impact of these advancements on passenger behavior and satisfaction levels, fostering greater engagement between them and the cruise company.

Passengers' Growth and Experience. Cruise companies implemented RAISA to meet the tech-savvy millennials and Gen Z consumers' technological demands and remain competitive (Verhoef *et al.*, 2021). This led passengers to repeat their trips on those technological ships, thus increasing their experience, which is a crucial factor in their decision to use novel technologies in the future (Roy *et al.*, 2017). Prior experience also influences their technology readiness, as more expertise leads to more readiness (Blut and Wang, 2020).

5.2 Mediator and Moderator Variables

Mediators. First, the main mediating constructs influencing consumer adoption of new technologies (e.g., AI/SA onboard cruise ships (Lu *et al.*, 2019)) are perceived usefulness and ease of use. These constructs refer to consumers' perception of how easy or difficult it is to use the technology (Davis, 1989), especially during shipboard emergencies or disease outbreaks (Cotfas *et al.*, 2023). Second, for customers to trust technologies, they must be functional, useful, and reliable (Tussyadiah *et al.*, 2020). Previous studies showed that trusting belief can influence their behavior, leading them to use or recommend to others, resulting in trusting intentions (Park, 2020).

Third, we suggested three additional mediating variables to improve the proposed framework. One is the attitude towards use, frequently employed in early studies to explain consumer behaviors (Fishbein and Ajzen, 1975; Zimbardo *et al.*, 1977). Passengers' attitude towards a given behavior (e.g., the use of new technology onboard) are influenced by their positive

or negative perceptions. Those with a positive attitude are likelier to use it out of curiosity, trend, or convenience. Perceived value and perceived benefits are also proposed as mediating variables since they significantly influence consumers' intention to use technologies (de Kervenoael *et al.*, 2020). Consumers evaluate the usefulness of a product based on the perceived benefits and sacrifices made to obtain it (Kim *et al.*, 2007). Therefore, passengers' willingness to use new technologies on cruise ships is subject to their evaluation of the benefits and sacrifices involved. The benefits offered by these technologies create a positive intention to adopt them, which leads to satisfaction (Dubey and Sahu, 2021).

Moderators. Age, gender, and propensity to stay onboard as moderated strengthen the relationship between onboard cruise environments and behavioral intention. Women are more sensitive to the onboard environment and are more likely to recommend and repeat the cruise experiences (Calza *et al.*, 2020).

Another moderator is technology readiness (suggested variable). Previous studies (van Doorn *et al.*, 2017; Wang *et al.*, 2017) demonstrated that this construct strengthens the relationship between technological antecedents and consumer behavioral response. For example, technology readiness moderates the relationship between technological robots and social cognition. Accordingly, consumers who are more receptive to new technologies are more likely to adopt them (van Doorn *et al.*, 2017).

5.3 Decision (D). Two types of intentions were the most discussed: adoption intention, which is a decision that makes full use of or rejects a technology (Rogers, 2003), and behavioral intention to use, which drives consumers to embrace new technologies (Davis, 1989). For instance, cruise

companies have adopted wearable devices and AS to ensure passenger safety during emergencies. These devices allow passengers to be tracked anywhere on the ship (Virto and Blasco López, 2019), which can also help them locate their friends/family (Kwee-Meier *et al.*, 2016) and thus escape danger faster.

From a sustainability standpoint, cruise lines embraced sustainable and eco-friendly practices to reduce air and marine pollution (Carnival Corporation, 2023). They adopted digitized services, including cruise apps and digital signage, to replace printed information (Strazza *et al.*, 2015), promoting sustainable passenger practices. Similarly, larger ships have introduced robotic concierges or bartenders, virtual assistants, and self-service technologies (Calza *et al.*, 2020) strategically placed in public areas and passenger staterooms. Thus, passengers use these technologies in a fully digitized environment to obtain faster and more efficient service experiences (de Kervenoael *et al.*, 2020; Park, 2020), eliminating the need to wait in line for crew assistance.

5.4 Outcomes (O)

Behavioral Response. This construct was the outcome most used by academics, expressed through the intention to recommend, repeat, return, purchase, or visit. Our analysis revealed that these behavioral outcomes (Martínez-Molés *et al.*, 2022; Yung *et al.*, 2021) are interconnected, with one leading to the other. For example, the intention to visit a cruise through virtual tours can lead to the intention to purchase a cruise vacation or recommend it to others (Simoni *et al.*, 2022; Yang *et al.*, 2021; Yung *et al.*, 2021). Thus, passengers continue to utilize virtual tours even after the lifting restriction of the latest outbreak, recognizing they expedite services and enhance safety (Seyitoğlu and Ivanov, 2021).

Overall Experience Enhancement. The new smart services on cruise ships aim to enhance the customer experience (Calza *et al.*, 2020), leading to satisfaction, sustainable cruising, and faster service, which are also outcomes. Adopting technological services – such as virtual concierges that remember passenger preferences (Buhalis *et al.*, 2022; Simoni *et al.*, 2022), cruise apps, or digital signage – reduces paper waste and allows passengers to check their daily activities online. This not only enhances passengers' satisfaction but also contributes to faster and more environmentally responsible service (Strazza *et al.*, 2015), making cruising more sustainable.

6. Major domains and future research agenda

Based on the findings, the study proposes a list of research questions that fall into five domains (Table 1): (i) Cruise robotic technology; (ii) Technology innovation; (iii) Cruise passengers' engagement behavior; (iv) Cruise passengers' technology readiness; and (v) Privacy perception and knowledge expertise.

6.1 Cruise robotic technology

The use of robotic technology on cruise ships is a topic constantly discussed in various articles. While some studies suggest that customers feel intimidated by robots (van Doorn *et al.*, 2017; Tussyadiah *et al.*, 2020), particularly mechanical ones, other studies (Park, 2020; Yoganathan *et al.*, 2021) affirm that humanoid robots are more accepted by consumers. As more service robots are implemented on cruise ships, it opens up an opportunity for further research into how these humanoid service robots impact passengers' experience (Yang *et al.*, 2021) and ship workers.

6.2 Technology innovation

Although some cruise companies have implemented innovative technologies (e.g., facial recognition, contactless technology, or AR), there is a scarcity of studies conducted on cruise tourism and technologies other than the robot bartender from Royal Caribbean cruises (e.g., Buhalis et al., 2022; Sun et al., 2021; Tussyadiah et al., 2020). Celebrity Cruises' AR dining experience, called Le Petit Chef (Celebrity Cruises, 2022b), is an example of innovation that requires further exploration in future studies. This culinary experience projects a little chef cooking cruise passengers' food orders in 3D animation while the actual dish is prepared in the kitchen (Carmosino *et al.*, 2021).

6.3 Cruise passengers' engagement behavior

Another important factor that needs further development is the cruise passengers' engagement behavior, which is not fully explored in the literature. According to van Doorn et al. (2010), customers' behavior towards a firm goes beyond purchase, including other types of behaviors (e.g., word-of-mouth, blogging, and online reviews). Thus, more studies should address this topic, as most cruise passengers rely on reading other passengers' experiences on cruise blogs to learn about their chosen company (Gonzales Santiago and Correira, 2019). Sun et al. (2021) further emphasize this idea by highlighting that these word-of-mouth tools become a key source of information for cruisers, influencing their travel choices.

6.4 Cruise passengers' technology readiness

The ASCT framework highlights the importance of technology readiness (moderating variable) in determining consumers' technological proficiency and preferences (Wang *et al.*, 2017; Yoganathan

et al., 2021), which significantly impacts their satisfaction levels and overall experience (Wang *et al.*, 2017). As such, due to the rapid disruption of technology, companies must adopt innovative technologies into their services, while consumers must stay up-to-date with these advancements to fully enjoy them when traveling. Thus, future research could explore how cruise passengers' technological readiness affects their overall experience-

6.5. Privacy perception and knowledge expertise

The systematic review offers the main mediating and moderating variables used in the analyzed articles. In the future should be considered additional moderators. For example, several articles mentioned the adoption of cruise ship apps that passengers must download to improve their service experience (Celebrity Cruises, 2022a; CLIA, 2020). Therefore, it is suggested to investigate further the privacy perception of cruise passengers towards these new technological services (e.g., apps, that require passengers' private information to provide personalized services) (Saltzman and Garay, 2020).

However, these technologies become so intrusive that the knowledge acquired from the passenger's information on the apps enables robots to recommend drinks or virtual concierges to suggest activities based on cruise passenger's preferences and location on the ship, turning into service experts (MSC Cruises, 2021a; Shallo, 2019). Thus, more studies should investigate privacy perception and knowledge expertise as a moderating between trust and willingness to share private information, such that if cruise passengers' privacy perception when disclosing their information on cruise apps is trustworthy, the willingness to share their information will increase, but if the cruise passenger feels that the technology onboard is already too knowledgeable about them, the willingness to share their information will decrease.

Table 1 here.

7. Conclusion and implications

7.1 Conclusion

This paper presents a detailed literature review on the use of RAISA in cruise tourism services. By analyzing 31 articles from two main electronic databases (WoS and Scopus), the study reveals the main keywords used across journals, identifies research gaps, and delves into five major domains in the ASCT framework.

7.2 Theoretical Implications

This paper presents four significant contributions. First, it enhances the existing knowledge of tourism studies by delving into the adoption of technology innovation in cruise tourism services. The systematic findings demonstrate that the contextualization of technologies in cruise tourism studies initially focused on Royal Caribbean's robotic bartender arm (Buhalis *et al.*, 2022; Sun *et al.*, 2021; Tussyadiah *et al.*, 2020), whereas other types of technologies (e.g., digital signage, self-service technologies, facial recognition (CLIA, 2020), or virtual culinary dining (Arlati *et al.*, 2018) did not received the same level of attention from academics. Although there has been an increase in conceptual studies in recent years, empirical evidence is still needed to fully understand this evolving topic. With the technological disruption of cruise services, staying up to date with the latest trends has become even more challenging. Therefore, this literature review takes a unique approach by narrowing its research scope to cruise technologies services, providing a foundation for future empirical studies.

Second, the ASCT framework is the main contribution of this paper. This framework is instrumental in identifying research gaps and avenues for future research. A potential area of future study is the use of RAISA technologies (Ivanov and Webster, 2019), widely used in cruise tourism

services throughout different stages of the passenger cycle (Lukanova and Ilieva, 2019). Passengers recognize that they can receive faster service with a more personalized experience without waiting for crew assistance, thus making their vacation more enjoyable (Calza *et al.*, 2020). However, despite their prevalence, no studies have yet explored the use of RAISA in the cruise industry. Therefore, this framework is a starting point for further investigation into this area.

Third, this systematic review responds to the call to further explore RAISA in cruise tourism (Loureiro et al., 2020; Tussyadiah et al., 2020), as existing studies on this subject are limited. Finally, we have identified five major domains and propose a future research agenda, which allowed us to answer our research question. We formulated a series of research questions that require further examination. Therefore, researchers can delve into the suggested questions to extend the proposed conceptual framework and make valuable contributions to this field.

7.3 Practical Implications

The study identified four implications for cruise managers and marketers. First, the results reveal that RAISA is increasingly being used on ships. However, not all passengers feel comfortable using them, so cruise managers should provide these new services (e.g., self-service technologies or service robots) along with human assistance to guide passengers, as it has been proven to enhance customer trust and experience (van Doorn *et al.*, 2017).

Second, cruise marketers should benefit from this literature, as they can develop new strategies based on these findings. This study highlights how cruise companies leverage RAISA to remain competitive and position themselves as industry leaders (Yung *et al.*, 2021). Therefore, practitioners must target those tech-savvy markets that demonstrate a keen interest in this novel experience, such as millennials (CLIA, 2022), who prefer modern cruise ships incorporated with

RAISA that align with their preferences. The analysis also indicates that tourists rely heavily on online information, making it imperative to adopt a digital marketing strategy, particularly on social media platforms.

Third, VR is a powerful marketing tool for the tourism industry. Virtual tours can influence the intention to purchase and visit (Martínez-Molés *et al.*, 2022; Simoni *et al.*, 2022), as most tourists who use them tend to buy cruise vacations. This is because virtual tours allow them to try before buying, which helps in their decision-making process. As such, practitioners should consider incorporating virtual tours into their strategies to promote cruise vacations and attract potential cruisers. Finally, cruise managers should regard the above-mentioned managerial implications, as cruise ships are considered floating hotels with similar activities and features as a hotel on land (Kester, 2002).

7.4 Limitations and Future Research

First, only top-quality journals were included in this review, so publications found in technology journals did not meet the established requirements and were not included. Second, only articles in the English language were considered. Third, the systematic review is limited to RAISA in cruise tourism services and does not include other technologies such as AR or Information and Communications Technology (ICT). Therefore, future studies should consider examining these other technologies, particularly social networking, which falls under the umbrella of ICTs and is a key source of information for most travelers. Consequently, it is imperative to examine whether these platforms influence passengers' behavior when organizing or purchasing their cruise trips.

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Figure 1. Systematic review process

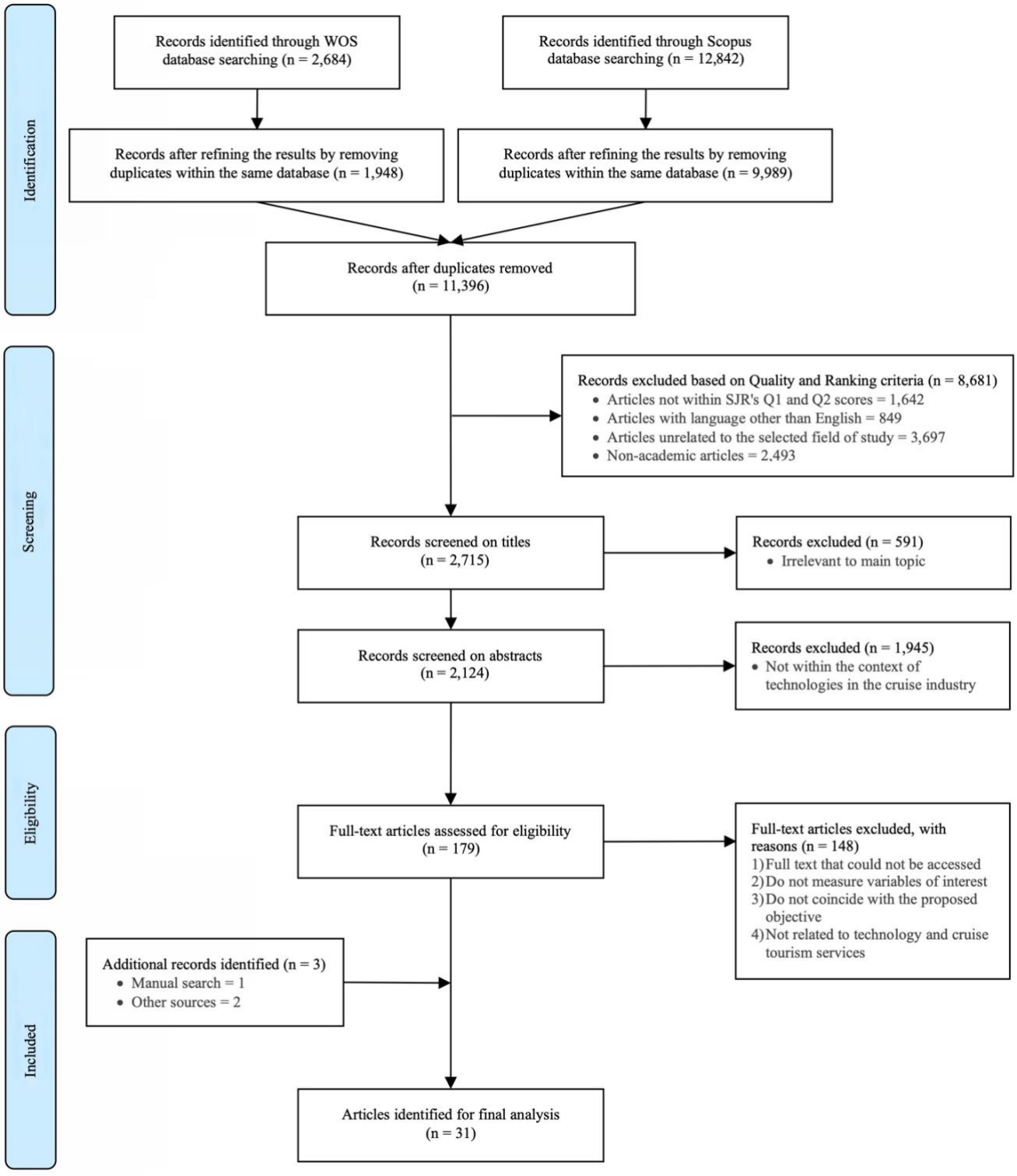

Figure 2. Selection flow diagram

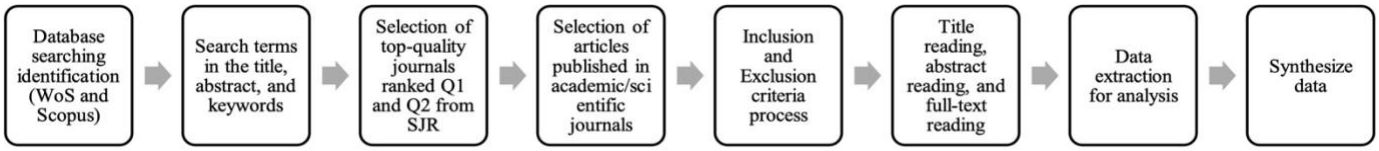

Figure 3. Distribution of articles by publication source

Figure 4. Distribution of articles by year of publication

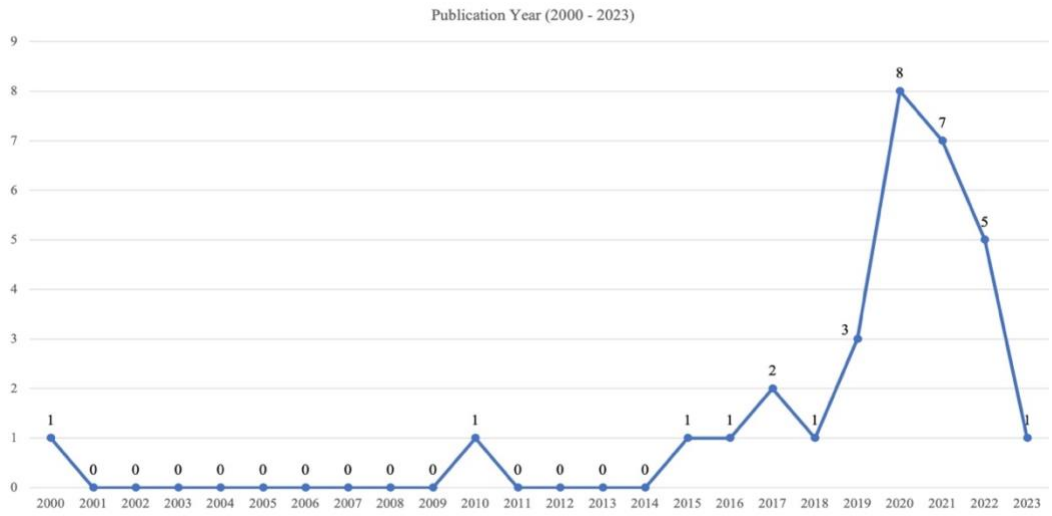

Figure 5. (a) Keyword network visualization map based on occurrences (b) Keyword overlay visualization based on publication per year sources

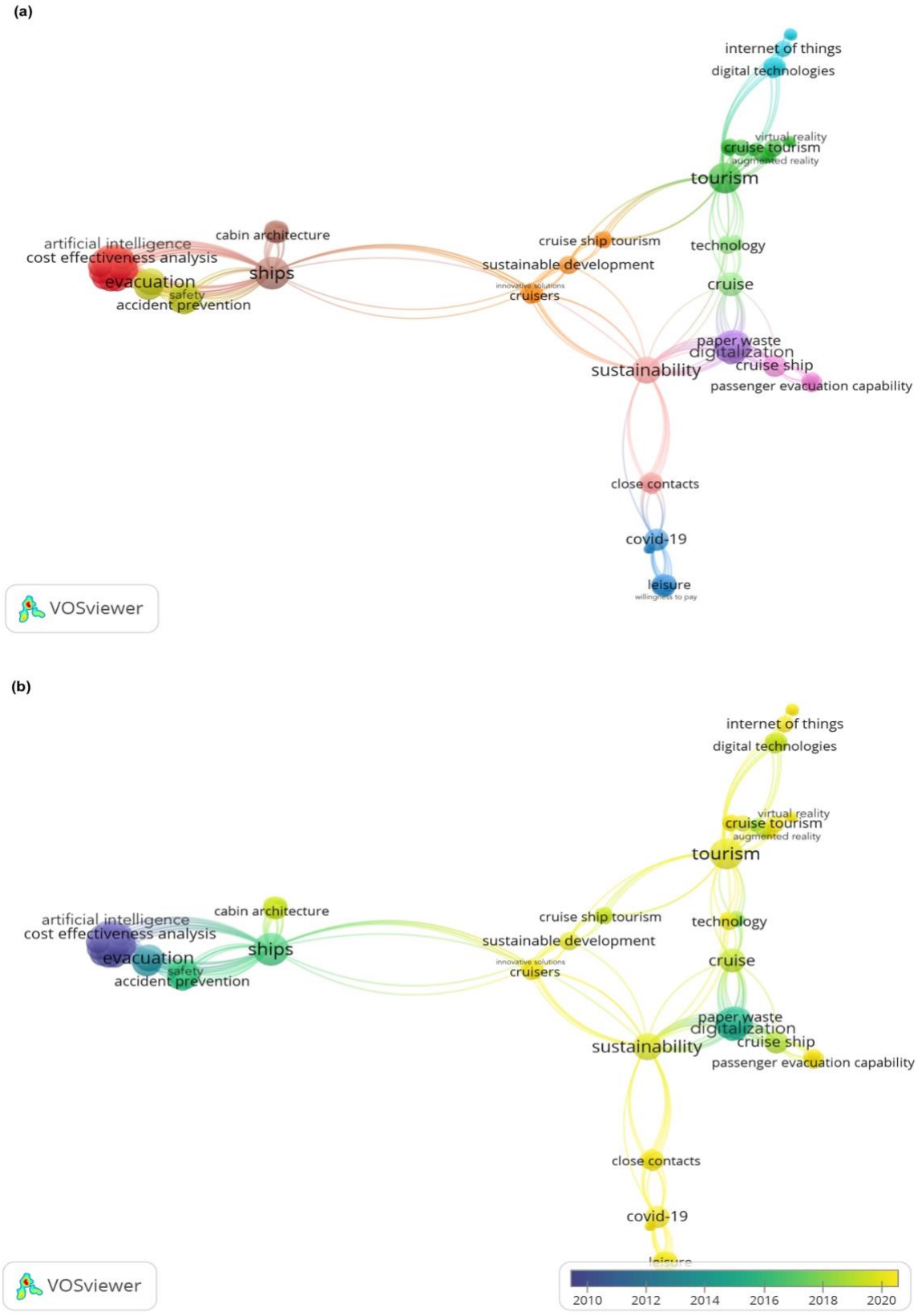

Figure 6. Framework for the adoption of RAISA in the cruise tourism service (ASCT).

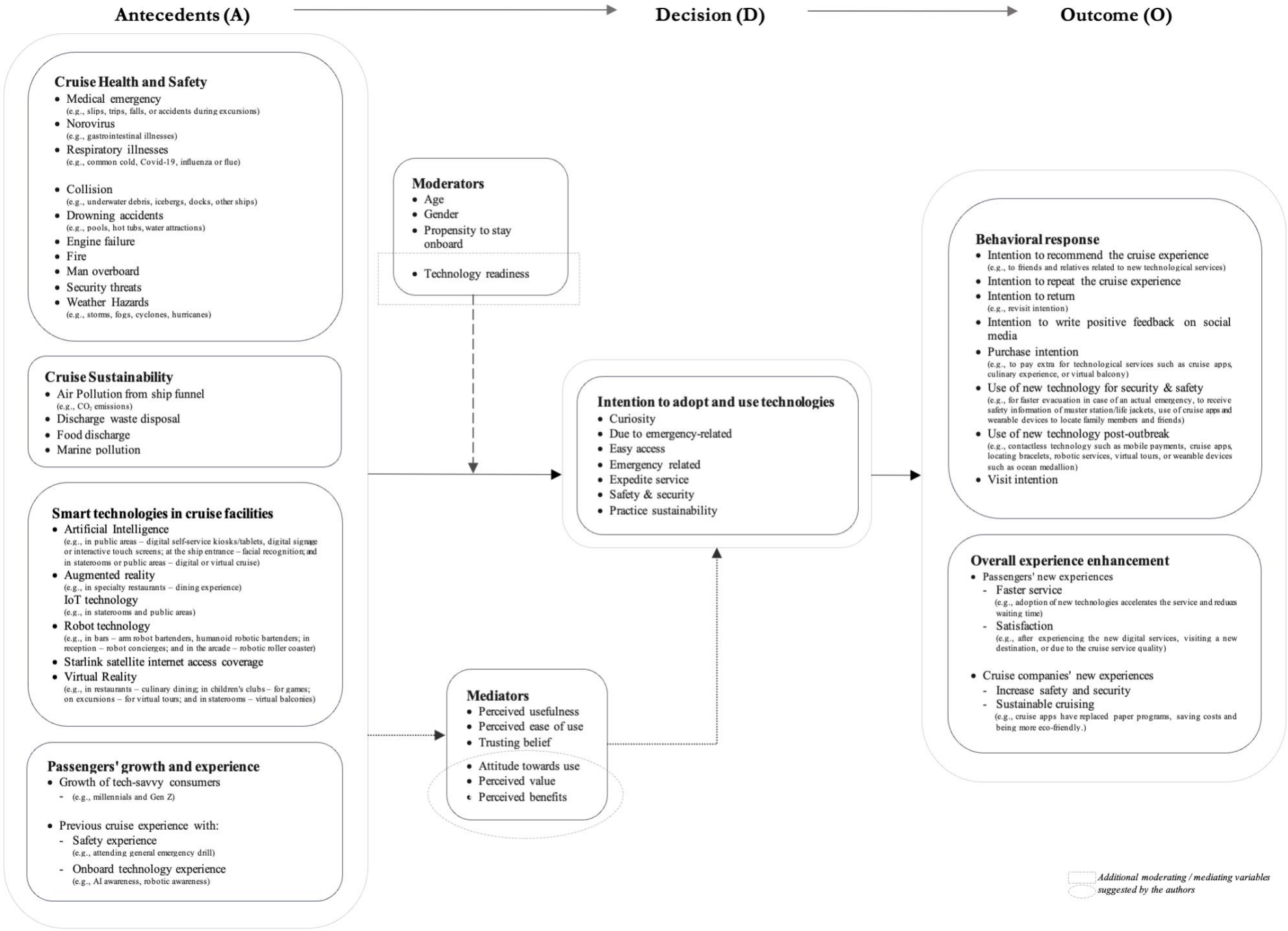

Table 1: Research questions and future topics on cruise tourism service

Domain area	Future topics	Future research questions
Cruise robotic technology	Acceptance of cruise service robots	RQ1: What strategies can be implemented by cruise companies and their managers to mitigate the adverse effects of service robots? RQ2: To what extent can service robots impact the overall experience of cruise travelers?
	Attitudes towards humanoid service robots	RQ3: Do cruise ship workers perceive humanoid service robots to be helpful? Do they reduce their workload or increase it? RQ4: Can the replacement of human labor with a robot influence the passengers' and cruise ship workers' attitudes towards humanoid service robots?
Technology innovation	Cruise technologies	RQ5: Is there a correlation between age and usage related to the latest technological advancements implemented at cruise ships or port terminals among passengers? RQ6: What is the level of acceptance of cruise ship passengers towards the new technological innovations that have replaced crew members, such as servers? RQ7: Which key features are mandatory for these technologies to be considered innovative by the passengers?
Cruise passengers' engagement behavior	Online passenger behavior	RQ8: What are the determinants of cruise passengers' propensity to share their positive or negative experiences on social media or cruise blogs? RQ9: To what extent does e-WOM influence the purchase intention of cruise passengers?
Cruise passengers' technology readiness	Passenger's readiness behavior	RQ10: Is the technology readiness of the cruise passenger a determining factor in their overall travel experience? RQ11: What is the impact of new technologies onboard on frequent cruise passengers? Does their technological readiness level affect their experience with this new type of service? RQ12: How does technological disruption affect the behavior of cruise passengers?
Privacy perception and knowledge expertise	Trust in sharing private information	RQ13: What are the factors that drive cruise passengers to disclose personal information on the cruise app? RQ14: To what extent are cruise companies willing to collect and exchange data to customize passenger services? RQ15: Are service robots becoming knowledge experts in the field of tourism services?

Web Appendix A. List of 31 selected articles included in the systematic literature review

Nº	*Author(s), Year*	*Tittle*	*Journal*	*Citation WOS*	*Citation Scopus*
1	(Dowling and Vasudavan, 2000)	Cruising in the New Millennium	*Tourism Recreation Research*	0	17
2	(Vanem and Ellis, 2010)	Evaluating the cost-effectiveness of a monitoring system for improved evacuation from passenger ships	*Safety Science*	18	20
3	(Strazza *et al.*, 2015)	Investigation of green practices for paper use reduction onboard a cruise ship—a life cycle approach	*International Journal of Life Cycle Assessment*	16	17
4	(Kwee-Meier *et al.*, 2016)	Development and validation of a technology acceptance model for safety-enhancing, wearable locating systems	*Behaviour & Information Technology*	29	36
5	(Papathanassis, 2017)	Cruise tourism management: state of the art	*Tourism Review*	45	49
6	(Pizam, 2017)	The internet of things (IoT): The next challenge to the hospitality industry	*International Journal of Hospitality Management*	12	13
7	(Ferrante *et al.*, 2018)	A general framework for collecting and analysing the tracking data of cruise passengers at the destination	*Current Issues in Tourism*	31	35
8	(Nolich *et al.*, 2019)	Cabin as a Home: A Novel Comfort Optimization Framework for IoT Equipped Smart Environments and Applications on Cruise Ships	*Sensors*	18	25
9	(Barsocchi *et al.*, 2019)	E-cabin: A software architecture for passenger comfort and cruise ship management	*Sensors*	2	5
10	(Wondirad, 2019)	Retracing the past, comprehending the present and contemplating the future of cruise tourism through a meta-analysis of journal publications	*Marine Policy*	16	17
11	(Yoon and Cha, 2020)	A Qualitative Review of Cruise Service Quality: Case Studies from Asia	*Sustainability*	3	5
12	(Papathanassis, 2020b)	Current issues in cruise tourism: deconstructing the 6th International Cruise Conference	*Current Issues in Tourism*	3	3
13	(Tussyadiah *et al.*, 2020)	Do travelers trust intelligent service robots?	*Annals of Tourism Research*	66	79
14	(Shoval *et al.*, 2020)	Impact of incentives on tourist activity in space-time	*Annals of Tourism Research*	18	22
15	(Falcidieno *et al.*, 2020)	Interactive actions between project and communication: new ideas for passenger orientation on board	*International Journal on Interactive Design and Manufacturing*	1	1

Nº	*Author(s), Year*	*Tittle*	*Journal*	*Citation WOS*	*Citation Scopus*
16	(Musio-Sale and Zignego, 2020)	New visions for future cruise ship vessels	*International Journal on Interactive Design and Manufacturing*	0	1
17	(Calza *et al.*, 2020)	Testing moderating effects on the relationships among on-board cruise environment, satisfaction, perceived value and behavioral intentions	*International Journal of Contemporary Hospitality Management*	16	19
18	(Papathanassis, 2020a)	The growth and development of the cruise sector: a perspective article	*Tourism Review,*	19	21
19	(Yang *et al.*, 2021)	A review of early COVID-19 research in tourism: Launching the Annals of Tourism Research's Curated Collection on coronavirus and tourism1	*Annals of Tourism Research*	36	44
20	(Silva, 2021)	An overview of the impact of COVID-19 on the cruise industry with considerations for Florida	*Transportation Research Interdisciplinary Perspectives*	0	12
21	(Sun *et al.*, 2021)	Evaluating and Categorizing Cruise Lines by ship attributes: A Comparison Between Cruisers and Experts	*Tourism Management*	3	3
22	(Chang *et al.*, 2021)	Exploring Cruise Tourists' Preferences and Satisfaction: The Case of Taiwan	*Water Switzerland*	0	1
23	(Mercan *et al.*, 2021)	Improving the service industry with hyper-connectivity: IoT in hospitality	*International Journal of Contemporary Hospitality Management*	15	18
24	(Kaźmierczak *et al.*, 2021)	Using AR Technology in Tourism Based on the Example of Maritime Educational Trips—A Conceptual Model	*Sustainability*	3	5
25	(Yung *et al.*, 2021)	VR the world: Experimenting with emotion and presence for tourism marketing	*Journal of Hospitality and Tourism Management*	23	32
26	(Simoni *et al.*, 2022)	Boosting the pre-purchase experience through virtual reality. Insights from the cruise industry	*Journal of Hospitality and Tourism Technology*	1	1
27	(Yue *et al.*, 2022)	Influence factors on the passenger evacuation capacity of cruise ships: Modeling and simulation of full-scale evacuation incorporating information dissemination	*Process Safety and Environmental Protection*	2	2
28	(Martínez-Molés *et al.*, 2022)	Gathering pre-purchase information for a cruise vacation with virtual reality: The effects of media technology and gender	*International Journal of Contemporary Hospitality Management*	2	2
29	(Buhalis *et al.*, 2022)	Smart cruising: smart technology applications and their diffusion in cruise tourism	*Journal of Hospitality and Tourism Technology*	2	3
30	(Lin and Son, 2022)	Sustainable Ship Management Post COVID-19 with In-Ship Positioning Services	*Sustainability*	1	0
31	(Cotfas *et al.*, 2023)	An agent-based model for cruise ship evacuation considering the presence of smart technologies on board	*Expert Systems With Applications*	0	0