Review

Intelligent technologies and applications in Smart Tourism—A systematic review

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Abstract: Smart tourism has used information technology with the infrastructure environments built for all kinds of tourism services that provide advantages for tourists, service providers, technology companies or the city itself. Due to the popularity of mobile technologies and applications, smart tourism undoubtedly changes consumers' and providers' behavior. The purpose of this study is to provide a systematic literature review of academic research related to information technology, computer science, mobile technologies and applications in smart tourism published between 2017 and 2019. Published articles are gathered from online search engines "Google Scholar", "ScienceDirect" and "EBSCOHOST". According to a keyword-driven search and content analysis, 142 articles have been chosen for examination in this research. Selected publications are collected and analyzed according to the proposed research questions, methodology, topics, technology focus, sub-themes and future trends that are thematically classified into three main categories: consumer perspective, technological perspective and provider perspective. The findings provide to an overall understanding of the most recent research into information technology, computer science, mobile technologies and applications in smart tourism by demonstrating the main results, methods, future trends and other insights of relevant publications. This study provides a systematic review of the most current published academic research from 2017 to 2019 on information technology, computer science, mobile technologies and applications in smart tourism. The results of this study construct an agenda for future research in tourism and hospitality industry by identifying major future trends and developments in smart tourism.

Keywords: technology; smart tourism; consumers, mobile technologies; mobile applications; providers

1. Introduction

Smart tourism has used information technology with the infrastructure environments built for all kinds of tourism services that provide advantages for tourists, service providers, technology companies or the city itself. As the usage of smartphones has grown increasingly around the world, the smart technologies have become a critical component for our daily lives and especially for helping tourists gain information and share it during travelling [1]. Specifically, a huge amount of data is collected that supports all stakeholders in the destination in a real time environment [2]. Therefore, tourists can enhance the travel experience by adopting smart tourism throughout the whole process of their trip. Smart tourism not only

relies on enormous amount of data but also analyzes and transforms into business solutions for new innovations.

According to Goeldner and Ritchie [3] in "Tourism principles, practices, philosophies", tourism may be defined as the processes, activities, and outcomes arising from the relationships and the interactions among tourists, tourism suppliers, host governments, host communities, and surrounding environments that are involved in the attracting and hosting of visitors. Recently for the rapid increase of "smart" technology around the world, tourists use smartphones especially for communication and sharing information when travelling [1,4]. In terms of advanced technology, the revolution of information technology is a composite of the different stages from the 1960s [5]. Starting from the stage of World Wide Web, the stages of digital technology were classified as Web 1.0, Web 2.0 and Web 3.0. In the past 10 years, Web 2.0 has focused on the social media of mobile applications such as Facebook, Twitter and TripAdvisor. The current stage that corresponds to Web 3.0 is projected to be the stage of smart technology where the web provides the necessary conditions for individuals and organizations to use information in ways that facilitate the exchange of content independently of the devices and the networks [6]. The advanced technology stage of industry 4.0 concerns with big data, customer analysis and artificial intelligence where it becomes more important to analyse customer behavior in terms of their selection will be greatly aid in more accurate data to be used in marketing in the future [7]. Combining advanced technologies and tourism, smart tourism is using information technology intelligently with infrastructure environments built for all kinds of tourism services that provide advantages for tourists, service providers, technology companies or the city itself [1,2]. Tourists can enhance their travel experience by adopting smart tourism for the whole process of their trips [8].

A recent study by Kim and Law [1] provided an overview of literature related to smartphones, technology, and applications in tourism and hospitality marketing, while Liang et al. [9] reviewed articles related to mobile application and mobile tourism. The study by Kim and Law [1] reviewed 104 articles published between 2000 and 2013; the study by Liang et al. [9] covered 92 articles published between 2002 and 2015. Recent studies by Dorcic et al. [10] give the overview of literature related to mobile technologies and applications towards smart tourism. They reviewed 126 articles from the perspectives of consumer, technological and providers published between 2012 and 2017.

Although there is a significant contribution in these three studies, it is believed that it is necessary to explore relevant and more recent studies (especially between 2017 and 2019) related to the recent up-to-date trend of mobile technologies, mobile applications, big data, robots and artificial intelligence etc. reflecting the latest emerging development of smart tourism.

The journal Tourism Review, volume 74 Issue 1, 2019—" Special Issue: Smart tourism and competitive advantage for stakeholders" by Chulmo Koo, Luiz Mendes-Filho & Dimitrios Buhalis, presents 8 articles about smart tourism, discussing theoretical and practical implications for the tourism industry and academia [10–17]. This special issue is beneficial to the tourism industry in helping us understand the

new trends and developments related to smart tourism. However, the articles mainly present from the tourism and hospitality journal perspective. There is a gap in exploring new trends and developments in smart tourism and a need to integrate from an information technology and application journals perspective as well. Therefore, this study extends the literature review from the study of Dorcic et al. [10] and provides an extensive systematic literature review of articles published not only on tourism and hospitality but also on information technology and computer science. A systematic review is an effective method to identify, assess and analyze published primary studies, and to investigate specific research questions [18]. There are several expected outcomes in conducting a literature review on mobile technologies and applications in the tourism and hospitality arena:

- To provide a good understanding about the topic;
- To analyze methodologies used in past studies;
- To identify research streams and current trends; and
- To identify topics needing further research.

The purpose of this study is to give the latest overall review of published articles and to do a systematic literature review of mobile information, technologies and applications in tourism by collecting, presenting, analyzing and generating insights for the topic from consumers, from a technological standpoint, and from a provider perspective.

From a theoretical viewpoint, the study can provide a better understanding of recent developments and trends in mobile technologies and applications in tourism. The results of this study should be beneficial for industry practitioners looking for an overview of the main findings and trends of recent smart tourism research focusing on mobile technologies and applications in different fields. The findings may help tourists and providers to better deal with the challenges of smart tourism and to gain competitive advantages.

2. Methodology

In order to provide a comprehensive systematic literature review, several selection guidelines are applied. The articles published in information technology, computer science, tourism and hospitality journals are treated in the analysis. The journal articles were gathered from the search engine "Google Scholar", "ScienceDirect" and "EBSCOHOST" [19]. In line with the methodology of other review studies in different research areas [19–21], books, research notes, literature review studies, conference proceedings, theses, business reports and other possible relevant publications were excluded. Those articles published between 2017-2019 regarding mobile technologies and applications in smart tourism are analyzed to make sure that the information presented was current.

The keywords "mobile technology", "mobile applications", "smartphone" and "apps" were combined with "smart tourism", "tourism" and "travel" to search the abstract, title and keywords of the journal articles. At the end of the data collection process, the authors independently reviewed all selected journal articles to increase the reliability and validity.

After the data collection process, the final sample included 142 journal articles. Following previous classification methods applied in summarizing literature related to the adoption of ICT in tourism [10,19–21], the articles were categorized as follows:

- Consumer perspective, containing 53 journal articles;
- Technological perspective, containing 55 journal articles; and
- Provider perspective, containing 34 journal articles.

By analyzing the distribution of article sources, published year, research countries or regions and research methodology, a descriptive statistical analysis was performed. After descriptive statistical analysis, the content of each article was analyzed. Based on the topical review, the key findings and possible directions for future research are presented.

3. Descriptive analysis of the review journal articles

3.1. Distribution of articles sources

In total, 142 papers were published in 61 journals. Out of those 61 journals, there are 24 journals in information technology and computer science and 37 journals in tourism and hospitality. The majority of articles were published in leading journals in information technology, computer science, tourism and hospitality (**Table 1**). Most of these articles were published in Technological Forecasting & Social Change ($n = 11$). For tourism and hospitality journals, most of these articles were published in Transportation Research ($n = 9$), Journal of Hospitality and Tourism Technology ($n = 7$), Information Technology & Tourism ($n = 6$), Sustainability ($n = 6$), International Journal of Contemporary Hospitality Management ($n = 5$) & Tourism Management ($n = 5$). For information technology and computer science journals, most of these articles were published in Technological Forecasting & Social Change ($n = 11$), Future Generation Computer Systems ($n = 5$), International Journal of Information Management ($n = 4$) & Procedia Computer Science ($n = 4$). The topic of mobile technologies and applications is very attractive to leading journals in information technology, computer science, tourism and hospitality. **Table 1** lists 29 journals that have published more than one related article. For the previous literature review from the study of Dorcic et al. [10], it did not indicate or include the information technology and computer science journals. The information technology and computer science journals contain over 40% out of the total journals. It may reflect that smart tourism is also the trend and emerging topic for publishing in information technology and computer journals. Comparing the results with the study of Dorcic et al. [10], it is obvious to understand that the articles published in Transportation Research, Sustainability, International Journal of Contemporary Hospitality Management, Current Issues in Tourism, Journal of Travel Research and Tourism Management are the key trend in recent years from 2017 to 2019.

Table 1. Distribution of articles sources.

Journal Title	*n*	(%)
Technological Forecasting & Social Change	11	7.7%
Transportation Research	9	6.3%
Journal of Hospitality and Tourism Technology	7	4.9%
Information Technology & Tourism	6	4.2%
Sustainability	6	4.2%
Future Generation Computer Systems	5	3.5%
International Journal of Contemporary Hospitality Management	5	3.5%
Tourism Management	5	3.5%
Current Issues in Tourism	4	2.8%
International Journal of Information Management	4	2.8%
Journal of Travel Research	4	2.8%
Procedia Computer Science	4	2.8%
Computers in Human Behavior	3	2.1%
Industrial Management & Data Systems	3	2.1%
Information & Management	3	2.1%
Journal of Destination Marketing & Management	3	2.1%
Journal of Hospitality Marketing & Management	3	2.1%
Telematics and Informatics	3	2.1%
Annals of Tourism Research	2	1.4%
Applied Computing and Informatics	2	1.4%
Geoforum	2	1.4%
IATSS Research	2	1.4%
International Journal of Hospitality Management	2	1.4%
Journal of Network and Computer Applications	2	1.4%
Science of the Total Environment	2	1.4%
Sustainable Cities and Society	2	1.4%
The Service Industries Journal	2	1.4%
Tourism Review	2	1.4%
Travel Behaviour and Society	2	1.4%
International Journal of Advanced Computer Science and Applications	1	0.7%
Asia Pacific Journal of Tourism Research	1	0.7%
Business Horizons	1	0.7%
Case Studies on Transport Policy	1	0.7%
Cities	1	0.7%
Future Generation Computer Systems	1	0.7%
Landscape and Urban Planning	1	0.7%
Electronic Commerce Research and Applications	1	0.7%
Expert Systems with Applications	1	0.7%
Information Processing and Management	1	0.7%
Information Systems	1	0.7%
International Journal of Engineering & Technology	1	0.7%

Table 1. (*Continued*).

Journal Title	*n*	(%)
International Journal of Medical Informatics	1	0.7%
International Journal of Sustainable Transportation	1	0.7%
International Journal of Tourism Research	1	0.7%
Journal of Business Research	1	0.7%
Journal of Cultural Heritage	1	0.7%
Journal of Hospitality and Tourism Management	1	0.7%
Journal of Outdoor Recreation and Tourism	1	0.7%
Journal of Retailing and Consumer Services	1	0.7%
Journal of Sustainable Tourism	1	0.7%
Journal of Transport Geography	1	0.7%
Journal of Travel & Tourism Marketing	1	0.7%
Journal of Urban Technology	1	0.7%
Journal of Visual Languages and Computing	1	0.7%
Landscape and Urban Planning	1	0.7%
Measurement	1	0.7%
Pervasive and Mobile Computing	1	0.7%
Research in Transportation Business & Management	1	0.7%
Revista Turismo & Desenvolvimento	1	0.7%
Simulation Modeling Practice and Theory	1	0.7%
Tourism Management Perspectives	1	0.7%
Grand Total	**142**	**100.0%**

3.2. Distribution of articles per year

Since 2017, the number of articles related to the topic of mobile technologies and applications has slightly decreased. **Table 2** indicated that among the 142 identified articles, 54 articles were published in 2017, 47 articles in 2018 and 41 articles in 2019. Comparing the study of Dorcic et al. [10], 11 articles were published in 2012 and 24 articles in 2013. In total, 31 articles were published in 2014 and 2015, and 37 articles in 2016. The number of articles published has increased dramatically from 2012 to 2017 and slightly decreased from 2017 to 2019.

Table 2. Year of journals published.

	n	%
2017	54	38.0%
2018	47	33.1%
2019	41	28.9%
Grand Total	**142**	**100.0%**

3.3. Distribution of research countries and regions

Table 3 indicated that Asia is the most researched region, as identified by 60 studies (42.3 per cent of total). It is followed by Europe, identified in 54 studies

(38.0 per cent of total). It is worth noting that studies in the Asian region group are mostly conducted in China including HK & Taiwan (identified in 24 studies) and Korea (identified 11 studies). The studies in European region group are mostly in United Kingdom. North America, with 17 studies mainly in the United States of America, is the third region covered by the analyzed articles. China, Korea, UK and USA together are the mostly covered, making up over 49.3% out of the overall total studies. In comparison the study done by Dorcic et al. [10] concluded that the European region was the most researched region in between 2012 to 2016. However, this trend has shifted to the Asian region which has increased in research output in between 2017 to 2019.

Table 3. Countries/Regions.

	n	*%*
Africa	**3**	**2.1%**
Ghana	1	0.7%
Morocco	1	0.7%
South Africa	1	0.7%
Asia	**60**	**42.3%**
China	14	9.9%
Korea	11	7.7%
India	6	4.2%
Malaysia	6	4.2%
HKSAR, China	5	3.5%
Taiwan, China	5	3.5%
Saudi Arabia	4	2.8%
Japan	3	2.1%
Dubai	2	1.4%
United Arab Emirates	2	1.4%
Indonesia	1	0.7%
Vietnam	1	0.7%
Europe	**54**	**38.0%**
UK	18	12.7%
Spain	9	6.3%
Greece	5	3.5%
Italy	4	2.8%
Netherlands	3	2.1%
Austria	2	1.4%
Finland	2	1.4%
France	2	1.4%
Germany	2	1.4%
Portugal	2	1.4%
Sweden	2	1.4%
Belgium	1	0.7%

Table 3. (*Continued*).

	n	*%*
Norway	1	0.7%
Poland	1	0.7%
America	**21**	**14.8%**
USA	17	12.0%
Canada	3	2.1%
Brail	1	0.7%
Oceania	**4**	**2.8%**
Australia	3	2.1%
Grand Total	**142**	**100.0%**

3.4. Research methodology

The majority of the selected articles were empirical studies. **Table 4** indicates that the methodologies included quantitative (50 percent), and qualitative (50 percent). The most commonly used statistical analyses within the quantitative methods were factor analysis and SEM (16.9 percent), followed by PLS-SEM (12.0 per cent), descriptive statistics (11.3 percent), clustering analysis (3.5 percent). These analyses were mainly used in the category consumer perspective. Content Analysis (34.5 percent), Interviews (7.0 percent), Case Study (4.9 percent) and Focus groups (3.5 percent) were the most applied techniques within the qualitative method. Interviews, Content analysis and Multiple-case study analysis were mostly applied in the category provider perspective, 57% out of qualitative research belonged to the category technological perspective. In comparison with the study of Dorcic et al. [10], it is consistent with the results for the reseach methodology.

Table 4. Research methodology.

	n	%
Qualitative	**71**	**50.00%**
Content analysis	49	34.5%
Interview	10	7.0%
Case study	7	4.9%
Focus group	5	3.5%
Quantitative	**71**	**50.0%**
SEM	24	16.9%
PLS-SEM	17	12.0%
Descriptive method	16	11.3%
Clustering analysis	5	3.5%
Regression	5	3.5%
Experiment	4	2.8%
Grand total	**142**	**100.0%**

3.5. Technology focus

Table 5 indicates that the majority of studies for the technology focus are on Smartphone and Mobile Apps (21.1 percent), A.I.-Augmented Reality (AR) & Virtual Reality (VR) (11.3 percent), Social Media & Social Networking (10.6 percent), Big Data, IoT and Sensor (10.6 percent), Smart facilities and service (9.2 percent) and Location-based service and GPS/Geo information (7.0 percent). The identified technology foci cited above contain approximately 70% of the total studies. Smartphone and mobile apps are the biggest technology focus mainly in the category of consumer perspective. A.I.-Augmented Reality (AR) & Virtual Reality (VR) is the technology focus mainly from a technological perspective. It is worth pointing out that owing to the current stage of industry 4.0, the trend of the applications for A.I., big data, IoT, AR and VR, GPS with location-based services is increasing. Thus, review articles related to the above identified technology focus is also increasing. Mobile as a Service (MaaS), Mobile shopping and QR code payment are also a new technology focus recently. Although the review of articles with robots, blockchain & cloud services as technology focus is still a few numbers it maybe expected to increase in upcoming articles in near future.

Table 5. Technology focus.

	n	%
Smartphone and Mobile Apps	30	21.1%
A.I.-Augmented Reality (AR) & Virtual Reality	16	11.3%
Social Media and Social Networking	15	10.6%
Big Data, IoT and Sensor	15	10.6%
Smart Facilities and service	13	9.2%
Location-Based service, GPS and Geo information	10	7.0%
Mobile Technology and System	8	5.6%
Mobile Shopping	6	4.2%
Mobility as a Service (MaaS)	5	3.5%
Mobile & QR code Payment	5	3.5%
Web-based services	3	2.1%
eWOM & Online Review	3	2.1%
Robot	3	2.1%
Cloud services	2	1.4%
Transportation system	2	1.4%
Gaming	2	1.4%
Internet & ICT	1	0.7%
Blockchain	1	0.7%
Image and Mobile Apps	1	0.7%
Intelligence clustering	1	0.7%
Grand Total	**142**	100.0%

3.6. Topical review

It has been mentioned in the previous literature review studies that a growing number of researchers were attracted by the developing and growing significance of mobile technologies and applications in the tourism and hospitality industry. **Table 6** illustrates the distribution of research topics and sub-topics for each category. The classification of the topics and sub-themes has followed from the study of Dorcic et al. [10]. For the sub-theme of "New technology adoption for travelling and consumer preferences" from Consumer perspectives, the majority of the examined studies investigated the role of mobile technologies and applications from a consumer perspective (37.3 percent). Information technology, computer science, hospitality and tourism scholars have paid considerably more attention to technological innovation (38.7 percent) and the impact of mobile technologies and application by tourism providers (23.9 percent). The reason that the number of journal articles of this study from the technological perspective is higher than that of the study of Dorcic et al. [10] is because information technology and computer science journals have been included in this study. The following parts of this paper demonstrate detailed analyses of the review articles (**Table 7**).

Table 6. Perspectives with Sub-themes.

	n	%
Consumer	**53**	**37.3%**
Consumer' attitudes and intentions	18	12.7%
New technology adoption for travelling and consumer preferences	20	14.1%
Tourist experiences and co-creation	15	10.6%
Provider	**34**	**23.9%**
Adoption of mobile technologies	18	12.7%
New technology and knowledge for enhancing tourist experience	16	11.3%
Technological	**55**	**38.7%**
Functional features	38	26.8%
Technical solutions	17	12.0%
Grand Total	**142**	**100.0%**

Table 7. Perspectives with Sub-theme.

	Publications
Consumer	**53**
Consumer' attitudes and intentions	[22–39]
New technology adoption for travelling and consumer preferences	[40–59]
Tourist experiences and co-creation	[60–74]
Provider	**34**
Adoption of mobile technologies	[75–92]
New technology and knowledge for enhancing tourist experience	[93–108]
Technological	**55**
Functional features	[109–146]
Technical solutions	[147–163]

3.7. Consumer perspective

The literature review on consumer perspectives contains 53 articles which could be classified into three sub-topics: consumer attitudes and intentions; new technology adoption for traveling; and consumer preferences and tourist experience and co-creation.

- Consumer attitudes and intentions: This sub-topic includes 18 out of the 53 articles. Research on consumers' attitudes and intentions toward mobile technologies and applications is mostly grounded on theories from information systems and sociology. The theories used in those sub-themes include: balance theory; theory of reasoned action; unified theory of acceptance; and motivation theory. All those articles are adopting quantitative method. Five articles used PLS, SEM and factor analysis and four articles used cluster and segmentation analysis. It may reflect that segmentation and cluster analysis are good methods to measure consumer attitudes and intentions in various clusters and to understand consumer behavior whilst using smartphones and smart devices [25,29,31,33]. It is obvious that using a smartphone during traveling is the trend among youngsters, therefore millennial tourists are one of the important consumer groups to be studied [36]. However, it is interesting to point out that one study obtained a better understanding about travel-related purchase intentions among senior users of mobile social network sites [28]. From the study of Dorcic et al. [10], it is mentioned that consumers tend to adopt smartphone or mobile technologies and applications if they considered them useful, easy to use and compatible or enhancing the experience in the destination. However, this trend shifted to study about the consumer experience in new technology such as the role of augmented reality (A.R.) for experience-influenced environments and to understand the consumer behavior towards using smartphones in transport [29,30]. To understand the future of consumer behavior for the purpose of sustainability in smart tourism and gaining insights from consumers towards smart tourism also the areas are focus on [27,32]. It is evident that more consumers rely on their mobile devices for travel purposes. Undoubtedly a relationship exists between consumers' skill in using the Internet and their use of mobile applications [27] as well as their attitude toward mobile applications and their intentions in using them [28].

- New technology adoption for traveling and consumer preferences: This sub-topic includes 20 articles that have explored how consumers use new technology for travel purposes and what their preferences regarding mobile technologies and applications are.

New technology adoption during travel is rising. It is obvious to mention that daily smartphone and new technology adoption are becoming a habit of everyone and thus influence the use of mobile technologies while travelling. Today, tourists are able to use new technology and smartphones during travel for communication, social activity, information acquisition, information search and entertainment. The theories that mainly deployed to use in this category are work family boarder theory and unified theory of acceptance and use of technology (UTAUT) [50,51]. Five studies are using interviews in a qualitative method. Smartphones are the keys in

new technology conducted in this category. For example, exploring the predictors of smartphones used for travel planning and investigated the potential problems of work- related smartphone use on vacation [43,46,50,54]. Mobile shopping is another area that most of studies are conducting recently relating to consumer preferences. For the purposes of retail stores, mobile shopping is also being studied in term of what extent mobile augmented reality (MAR) apps contribute to smart retail settings in creating additional value to customers as well as benefiting retailers. They are also investigating mobile social tourism (MST) shopping, which refers to the use of MST platforms in shopping for tourism products and services [45,52]. For consumer preferences in social networking, it explored the forms of community that existed in physical tourism's domain, contexts not previously analyzed through a community lens, and explored how mobile technology is creating connection [47,57].

- Tourist experiences and co-creation: This sub-topic includes 15 articles that have explored tourists' experiences and how they co-created.

Many studies pointed out that smartphones play a significant role in shaping tourist experience during a vacation. Most scholars examined the positive impact of using mobile technologies and applications, such as travel decision support satisfaction and the moderating effects of self-efficacy on the main relationship [61]; understanding the extent to which smartphone usage influences the family vacation experience [69]; incorporating the concept of passion and any affective outcomes of using mobile phones while travelling [64]; examining the use of experience sampling model (ESM) as it relates to tourist experience research [67]; tourists' value-seeking processes through the tourism services and travel experiences of a destination [68] and creating a model integrating the factors impacting the smart event experience [72]. In terms of new technology, augmented reality (AR) is the trend for studying the tourists' experience through conducting research on relation in technological mediation and then assessing the embodiment of wearable augmented reality technology in a tourism attraction [66]. In terms of the area in social media, three studies examined travel experience satisfaction and explored tourists' experiences and perspectives on the impact or lack of continual engagement with mobile media devices on their tourism experiences [62,65,71]. In addition, the effect of image and personal innovativeness on perceived enjoyment and perceived usefulness were studied in shaping attitudes toward using travel mobile applications [57].

3.8. Provider perspective

The literature review on consumer perspectives contains 34 articles which could be classified into two sub-topics: adoption of mobile technologies and new technology and knowledge for enhancing tourist experience.

- Adoption of mobile technologies: This sub-topic includes 18 out of the 34 articles. One research study conducted to extend and revise the basic technology-based service (TBS) adoption model in luxury hotels in India using smart phone apps and another using the latest technology, robots, explored the current state and the potential adoption of service automation and robots by tourist, travel and hospitality companies [77,92]. It may reflect that there is a

trend for providers such as hotels to adopt the last new technology to enhance their guest service.

- New technology and knowledge for enhancing tourist experience: This sub-topic includes 16 out of the 34 articles. Big data analytics and QR code payment are the new technology for the providers to enhance the tourist experience. For example, one research study drew attention to the huge amount of social big data available from tourists that can nurture the value creation process for a smart tourism destination [100]. While other studies developed a multifaceted framework to analyze critical success factors and determine an optimal solution for mobile technology adoption by using hybrid multiple criteria decision-making methods [107]. Providers such as airports developed an instrument to capture travelers' perceptions of airport technologies and tested a theoretical model that examines the relationship among different types of airport technologies and travelers' confidence, enjoyment, and satisfaction [94]. Such information can be used to enhance the tourists experience for using the airport. In addition, restaurants are also using new technology to enhance the customer experience by testing relationships between experiential quality, perceptual evaluation and perceived ease of use, perceived usefulness, experiential involvement, experiential satisfaction and experiential loyalty as explored in the study by Sudhagar [108].

3.9. Technological perspective

The literature review on technological perspectives contains 55 journal articles. It should be highlighted that approximately 40 percent of all selected journal articles are related to the technological perspective. Technological perspectives could be classified into two sub-topics: Technical solutions and Functional features.

- Technical solutions: This sub-topic includes 17 out of the 55 articles. Four research studies conducted to explore augmented reality (AR) & virtual reality solutions for smart tourism. These studies propose an AR acceptance model in the context of urban heritage tourism and explore these cultural differences and the effect on AR acceptance in cultural heritage tourism sites, aiming to focus on the aesthetic and hedonic characteristics of AR applications [153,155,157,161]. There is an emerging trend with a few studies are that focusing on location-based service, GPS & mobile applications. Two studies developed a personalized location-based mobile tourism application (PLMTA) for travel planning [147,160]. The new technology of big data, IoT and sensor are also possible the solutions and a few studies review existing travel behavior studies by applying mobile phone data and presenting the future solutions [151,154,162]. Quick response (QR) code payment technology is also the new technology for smart tourism. One study explored QR code payment technology for use in tourism, to provide empirical evidence that mobile technologies can be used to enhance tourist satisfaction [158]. In terms of technical solutions, it estimated that location-based service, GPS, AR, big data, IoT, sensors and QR code payment are the trend for conducting research in recent years.

- Functional features: This sub-topic includes 38 out of the 55 articles. Because most tourists today use smartphones and other mobile technologies for information gathering, it is necessary in mobile destination management organization (DMO), to attract travelers to that destination from the functional features. Gaming is one of the functional features that can attract tourists to particular destinations. The findings of Aluri [120] show that the aspects of the Pokémon GO game influenced travelers to use the app and to pinpoint aspects of the mobile augmented reality (MAR) game to some destinations. The study of Yoo et al. [117] explored some factors affecting the adoption of gamified smart tourism applications. The study of Xu et al. [123] examined gaming in general terms and the application of it in specific tourism fields. It identified game design elements that can contribute to a meaningful gamification for attracting tourists to destinations. The study by Korpilo et al. [124] used GPS features to explore the spatial distribution and density of recreational movement in multiple-use urban forests. Mobile shopping is another functional features used in enhancing tourist experience. A study by Shang and Wu [127] investigated and examined factors contributing to consumers' mobile shopping continuance intention (CI) of food and non-food items via smartphones and other mobile terminals. In addition, the study by Chopdar et al. [137] showed the use of m-shopping apps in a cross-cultural context and suggested that privacy and security moderate intention are used differently across cultures.

4. Discussion and conclusions

As the usage of smartphones has grown increasingly around the world, smart technologies have become a critical component for our daily lives and especially for helping tourists to gain information and to share with on another during travelling [1]. This study systematically reviews 142 articles related to mobile technologies and applications published in information technology, computer science, tourism and hospitality journals between 2017 and 2019. It extends the study of Dorcic et al. [10] for including the journals from 2017 to 2019 and fulfilling the gap of providing the journals also in information technology and computer science.

Findings and discussions of this study are generating insights for industry practitioners and academic researchers, seeking the latest trends in smart tourism, and providing an overview of the main findings in recent research focusing on mobile technologies and applications. Specifically, the trend of the mobile applications for MaaS, AI, big data and IoT is increasing during the current stage of industry 4.0. The managerial implications for AI, big data and IoT applications are the capabilities and integration with open source technologies that allows tourism organizations to take advantage of the technology to automate processes, without the heavy lifting of training AI models. The managerial implications for MaaS application are to decrease car dependency, to enhance effectiveness of transportation, to provide public accessibility and reduce the level of congestion. In order to achieve the goals of MaaS application, the perspective central government is taking makes up a critical part. Moreover, the limited value in MaaS, existing public

transport contracts and poor ICT-conditions are constraints to implement to achieve that.

Data security and privacy are also the key issues when implementing smart tourism. Data is very fragile and some mobile applications need to be installed in the smartphone for the purpose of data protection. To solve data privacy issues, mobile applications may provide a function where tourists can choose whether or not their data can be disclosed to others. Thus, the tourists opt out of providing the data information to providers. The acceptance of data privacy depends on the tourists from various age groups. For example, it may not be concerned about data privacy for those young tourists known as millennials, as they have grown up with the Internet and can't imagine a world without it. Moreover, the great challenge of deployment of technology in smart tourism is the criteria to select mobile applications that can generate a high return on investment. In addition, lack of expertise in knowledge of mobile technology and a lack of local government support are also challenges. Local government participation and support for the deployment are critical for the success of smart tourism. For example, it is important to let tourists enhance their experience using smart technology starting from their arrival of the airport of that destination. Furthermore, the collaboration of tourists' data from various parties is also very critical to gain a full understanding of completed tourist behavior. However, it is very challenging to achieve because each stakeholder i.e. the companies involved, will protect their own data. In order to achieve an ideal smart tourism environment and gain the digital behavior information for each tourist, the collaboration of various parties cannot be neglected.

In addition, this study indicates that the majority of the collected and analyzed articles focused on the technological and consumer perspectives. In terms of the consumer perspective, these studies examined consumers' attitudes and intentions towards mobile technologies and applications, smartphone adoption for traveling and consumer preferences, as well as tourist experience and co-creation. For a technological perspective, these studies examined technical solutions and functional features. Contrary to previous studies [10], the literature review showed that more articles focus on the technological and consumer perspective than they do on the provider perspective.

This study can be concluded for future research and the topics identified based on the three perspectives of consumer, technology and provider. For future research into the consumer perspective, it would be advised to conduct a broader, cross-cultural study in various countries while maintaining control of the moderating effect of the cultural dimensions more directly linked to the use of mobile commerce and compare the studies using different national subcultures. For example, firstly a comparative study can be conducted with a sample that consists of both foreign and domestic tourists to see if the multi-mediation model holds in a cross-national context. In addition, future studies may consider investigating a deeper level of consumer characteristics, such as self-image; novelty-seeking; personality; and need for personal status. Thus it can generate further interesting insights into personal differences. Secondly, proposed models in different countries and service contexts can be conducted by a comparative analysis and could examine: the variance in customers' intentions from one context to another; customers' experience with the

usage of technologies; customers' personality traits; technology self-efficacy; and study their effects on customers' intentions to adopt and use technologies. Also, further research could also explore additional factors likely to influence the intention to use smart devices for smart tourism while traveling.

For future research into the provider perspective, future studies may examine the availability and perception of technologies used at different types of airports to enhance the tourist experience. In addition, in order for providers to understand their customers purchasing intentions, they may build on the current study's estimation of behavioral intention for mobile purchasing. Future research should investigate the actual purchasing behavior, aiming to aid decision-making and create marketing strategies with more personalized offerings, transparency and trust in dialogue with customers and stakeholders from the new business models.

For future research into technological perspective, augmented reality (AR) solutions are suggested to focus on user experience and traveler intentions in using mobile augmented reality (MAR) apps in the tourism industry, whilst also reviewing the behavioral intentions when using similar MAR apps as travel guides among other age groups. In addition, future research can use the identified themes and sub-themes: to develop measurement items; to test their validity within mobile AR acceptance research; to explore gender differences as part of a study on AR cultural differences; and to understand the acceptance of AR among different countries and cultures. For the gaming, future research can be conducted into the design process of gamification in the tourism context based on the nature of tourist experiences. For online shopping solutions, future research can target a more general population with respondents from a diverse group of age, income, education, and occupation to fully understand mobile shopping apps use behavior whilst also considering the case of supply data. More specifically, the consideration of market size (e.g., number of downloads from the App stores) would mean retailers could provide further insights into consumer adoption and diffusion of technological innovations. For location based-service and GPS services, further research could link GPS tracking data with questionnaires to gain better knowledge of the socio-cultural background of visitors and environmental features that may influence their spatial behavior inside the urban forest. For Mobility as a service (MaaS), further research could extend MaaS approach for developing the concepts of "Sustainable mobility and tourism" by understanding the tourist flow in different regions.

The major limitation of this study is that only three search engines (Google Scholar, ScienceDirect and EBSCOHOST) were used to collect articles. Therefore, there is a chance that some studies connected to the topic were not contained. The study did not include other database, theses, books, literature reviews, business reports and other relevant conference proceedings. Future research should also consider collecting and analyzing publications from the above sources to gain further insights and recommendations into consideration.

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