Mobile technologies and applications towards smart tourism – state of the art

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Abstract

Purpose – *The popularity of mobile technologies and applications is constantly growing and undoubtedly changing consumers' and providers' behavior. The purpose of this study is to provide a comprehensive systematic literature review of academic research related to mobile technologies and applications in smart tourism published between 2012 and June 2017.*

Design/methodology/approach – *Published peer-reviewed articles were gathered from the three largest and most popular online databases and search engines – EBSCO host, Science Direct and Google Scholar and ENTER conference proceedings. Based on a keyword-driven search and content analysis, 126 articles were determined to be relevant to this study.*

Findings – *Selected publications were analyzed in accordance with the proposed research questions and thematically classified into three main categories: consumer perspective, technological perspective and provider perspective. The findings contribute to a better overall understanding of recent research into mobile technologies and applications in smart tourism by presenting the main results, methods, trends and other insights of relevant publications.*

Research limitations/implications – *Although the researchers used two databases, one search engine and ENTER conference proceedings to collect articles, there is the possibility that some studies connected to the topic were not included. The study did not include books, other conference proceedings, literature reviews, theses, business reports and other possibly relevant publications.*

Originality/value – *This study provides a systematic review of the most recent published academic research (2012-June 2017; also including "Online First" articles) on mobile technologies and applications in smart tourism. The results of this study provide an agenda for future research in tourism and hospitality industry by identifying major trends and developments in smart tourism.*

Keywords *Technology, Smart tourism, Consumers, Mobile technologies, Mobile applications, Providers*

Paper type *Literature review*

1. Introduction

The new era of ICT has opened a wealth of new tools for the tourism industry. As the tourism industry is one of the well-suited areas where information technology is used extensively from operational and business perspectives, it is not surprising that the idea of smart tourism destinations has developed fairly quickly (Koo *et al.*, 2016). Smart tourism refers to the use of technologies (e.g. internet, mobile communication and augmented reality) to collect enormous amounts of data and to provide real-time support to all stakeholders in the destination (Gretzel *et al.*, 2015; Hunter *et al.*, 2015; Tu and Liu, 2014).

One of the first attempts to define the characteristics of smart tourism was made by Molz (2012). According to Molz (2012), smart tourism is related to:

- connectivity through web-based applications with location capabilities;
- tourists as co-producers of destination content;

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- enhancing experiences through new technologies (augmented reality);
- connecting and interacting with local communities and other tourists in the destination; and
- improving social and environmental sustainability.

In smart tourism, technology is infrastructure that integrates hardware, software and network technologies to provide real-time data which enables more intelligent decision-making for all stakeholders (Gretzel *et al.*, 2015). Mobile technologies, especially the use of smartphones and their application, have a significant influence on smart tourism development. The increasing development of mobile technologies has attracted academic attention, and there is need for a systematic literature analysis of relevant publications.

A recent study by Kim and Law (2015) gave an overview of literature related to smartphones in tourism and hospitality marketing, while Liang *et al.*, (2016) reviewed articles related to m-tourism. The study by Kim and Law (2015) reviewed 104 articles published between 2000 and 2013; the study by Liang *et al.*, (2016) covered 92 articles published between 2002 and 2015. Despite the valuable contribution of these two studies, it is believed that there is a need to explore relevant and most recent studies (especially between 2015 and 2017) related to mobile technologies and applications reflecting the emerging development of smart tourism.

This study presents an extensive systematic literature review of articles published in peer-reviewed tourism and hospitality journals and ENTER conference proceedings covering the past five years. A systematic review is a method to identify, assess and analyze published primary studies to investigate a specific research questions (Staples and Niazi, 2007). There are several reasons for conducting literature review on mobile technologies and applications in tourism and hospitality area:

- to develop good understanding of what is already known about the topic;
- to determine methodologies used in past studies;
- to identify research streams and latest trends; and
- to identify topics that need further research.

The aim of this study is to provide a comprehensive review of published articles on mobile technologies and applications in tourism by analyzing the topic from the consumer, technological and provider perspective and to provide answers to the following research questions:

RQ1. Consumer perspective Which factors influence tourists to use mobile technologies and applications during their trip? How do they use mobile devices and what benefits does it provide for them?

RQ2. Technological perspective What are the recent trends in the development of mobile applications in tourism? How can mobile data be gathered and used to improve the tourists' experience in the destination?

RQ3. Provider perspective What are the benefits for tourist providers of using mobile technologies and applications? What problems do tourist providers face in adopting mobile technologies?

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

2. Methodology

To provide a comprehensive systematic literature review, several selection criteria were applied. First, only full-length peer-reviewed articles published in tourism and hospitality journals and ENTER conference proceedings were included in the analysis. Full-length peer-reviewed journal articles were gathered from the largest and most popular online databases Science Direct and EBSCO host, as well as the search engine Google Scholar (Buhalis and Law, 2008). In line with the methodology of other review studies in different research areas (Law *et al.*, 2014; Buhalis and Law, 2008; Sotiriadis, 2017), books, research notes, literature review studies, conference proceedings, theses, business reports and other possibly relevant publications were excluded. The ENTER conference proceedings are the only proceedings included in the analysis, as they are one of the "largest publications channels on technology applications in travel and tourism" (Law *et al.*, 2010, pp. 298). The analysis of those publications can, thus, reveal the progress and development of eTourism research (Wang *et al.*, 2013). Second, only full-length peer-reviewed articles published between 2012 and June 2017 regarding mobile technologies and applications in smart tourism were analyzed to ensure 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. Selected journal articles were directly exported to the free reference manager Mendeley which helped the authors organize the research. At the end of the data collection process, the authors independently reviewed all 89 selected journal articles to increase the reliability and validity.

EBSCO host database was searched first. A total of 50 journal articles were identified. After careful reading, four articles were excluded because of the literature review categorization and two were not related to this study. A final sample of 44 articles was generated for analysis. The second database Science Direct produced a sample of 25 journal articles. After a second review, two articles were not in the focus of this study, three were categorized as literature reviews and four were duplicated and excluded. In total, 16 journal articles were reviewed in the second stage. The search engine Google Scholar was searched last. In total, 14 full-paper journal articles in the tourism and hospitality field were selected. Of these 14 articles, 2 were literature reviews, 1 full paper was not accessible and 4 were duplicates and, therefore, excluded. A sample of seven journal articles was generated for analysis.

An analysis of the ENTER conference proceedings from 2012 to 2017 identified a total of 70 articles. After careful reading, six articles were excluded because of the literature review categorization and five articles were not in the focus of this study.

At the end of the data collection process, the final sample included 126 peer-reviewed articles (67 peer-reviewed journal articles and 59 articles originating from ENTER conference proceedings). Following previous classification methods applied in summarizing literature related to the adoption of ICT in tourism (Law *et al.*, 2014; Buhalis and Law, 2008; Sotiriadis, 2017), the articles were categorized as follows:

- consumer perspective, containing 83 journal articles;
- technological perspective, containing 28 journal articles; and
- provider perspective, containing 15 journal articles.

To analyze the distribution of article sources, year of publishing, research regions and research methodology a descriptive statistical analysis was performed. Keyword clustering was done by the VOSviewer program (available for free at: www.vosviewer.com), which was developed for creating, visualizing and exploring bibliometric maps of science (Van Eck

and Waltman, 2010). The co-occurrence keywords analysis was also performed with the VOSviewer. The program analysed the extracted keywords from the titles and abstracts using the binary counting method. 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 reviewed articles

3.1 Distribution of article sources

The majority of articles were published in leading peer-reviewed journals in tourism and hospitality (Table I). In total, 67 papers were published in 18 peer-reviewed journals.

Most articles were published in *Information Technology and Tourism* (*n* = 8), *International Journal of Travel Research* (*n* = 7), *Journal of Hospitality and Tourism Technology* (*n* = 6), *Journal of Travel & Tourism Marketing* (*n* = 6) and *Tourism Management* (*n* = 6). During the period of analysis, the journal *Information Technology and Tourism* published a special issue (Mobile Systems for Tourism, in 2016), while the *Journal of Hospitality and Tourism Technology* had two special issues related to the topic of this study (Technological Advances in Hospitality; and Innovation in hospitality and tourism, in 2015). It seems that the topic of mobile technologies and applications is very attractive to leading journals in tourism and hospitality. Table I lists 14 journals which published more than one related article. Of the 18 journals, 13 mentioned in Table I are classified as Q1 class of journals.

3.2 Distribution of articles per year

Since 2012, the number of articles related to the topic of mobile technologies and applications has increased. Among the 126 identified articles, 11 articles were published in 2012 and 24 articles in 2013. In total, 31 articles were published in 2014 and 2015. The

Table I Distribution of article sources

Journal title	n	*(%)*
Information Technology and Tourism	8	6.3
Journal of Travel Research	7	5.6
Journal of Hospitality and Tourism Technology	6	4.8
Journal of Travel & Tourism Marketing	6	4.8
Tourism Management	6	4.8
Current Issues in Tourism	5	4.0
International Journal of Contemporary Hospitality Management	5	4.0
International Journal of Tourism Research	5	4.0
International Journal of Hospitality Management	4	3.2
Annals of Tourism Research	3	2.4
Asia Pacific Journal of Tourism Research	2	1.6
e-Review of Tourism Research	2	1.6
Journal of Hospitality and Tourism Management	2	1.6
Journal of Hospitality Marketing & Management	2	1.6
Journal of China Tourism Research	1	0.8
Journal of Sustainable Tourism	1	0.8
Tourism & Management Studies	1	0.8
Tourism Management Perspectives	1	0.8
Information and Communication Technologies in Tourism 2012	7	5.6
Information and Communication Technologies in Tourism 2013	7	5.6
Information and Communication Technologies in Tourism 2014	13	10.3
Information and Communication Technologies in Tourism 2015	9	7.1
Information and Communication Technologies in Tourism 2016	11	8.7
Information and Communication Technologies in Tourism 2017	12	9.5
Total (18 journals and 6 ENTER conference proceedings)	126	100.0

highest number of articles was published in 2016 (n = 37). Until June 2017, 23 articles had been published (including "Online First" articles).

3.3 Research regions

Europe was the most researched region, identified in 36 studies (28.6 per cent of total). It was followed by Asia, identified in 32 studies (25.4 per cent of total). It is worth pointing out that studies in the Asian region group were mostly conducted in China (identified in 11 studies) and Korea (identified 11 studies). North America, with 25 studies, is the third region covered by the analyzed articles. In all, 21 studies used an international sample and covered more than one county or region, while 4 studies did not specify the research region.

3.4 Keywords clustering

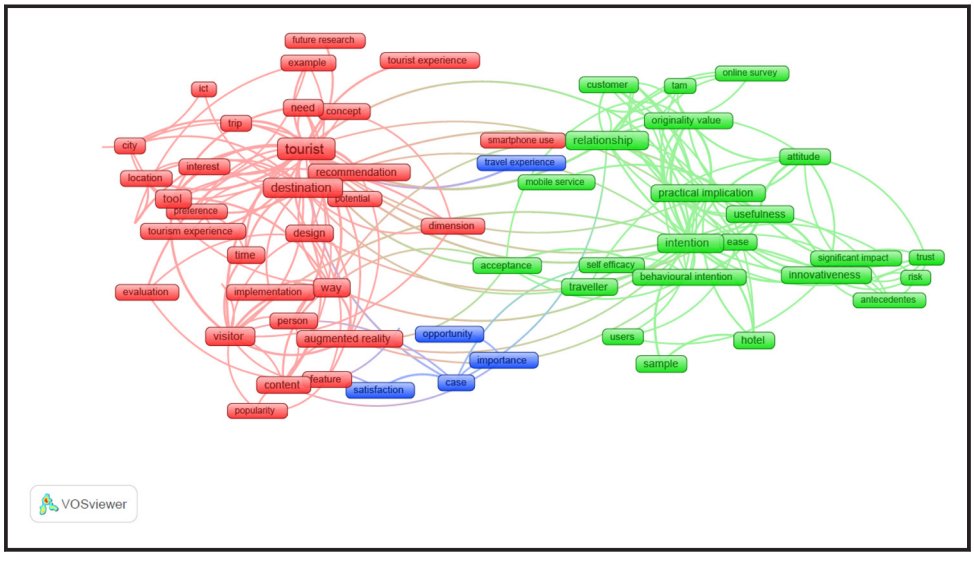
VOS clustering technique identified three clusters of selected keywords (Figure I). To normalize strength of the links between keywords, the LinLog/Modularity method was used. There are 1,221 links and the total link strength is 2,175. The figure shows 200 line connections between keywords. The relatedness between keywords is indicated by the distance of each frame.

The first cluster (depicted in red) has the largest number of keywords (35) and brings together topics related to technological recommendations for improving tourists' destination experience. The second cluster (depicted in green) contains 30 keywords and shows the importance of topics related to consumer intention and attitude toward technology. The third cluster (depicted in blue) represents topics related to traveler experience and satisfaction. Cluster 1 covers articles related to the technological and provider perspective, while Clusters 2 and 3 combine articles from the consumer perspective.

3.5 Research methodology

The majority of the selected articles were empirical studies. The methodologies included quantitative (65.1 per cent), qualitative (23.0 per cent) and mixed methods (4.8 per cent). The most commonly used statistical analyses within the quantitative methods were

Figure 1 The network visualization of the most appeared keywords



PLS-SEM and SEM (33.7 per cent), followed by factor analyses and regression analyses (15.2 per cent), descriptive statistics (15.2 per cent) and *t*-test (6.5 per cent). These analyses were mainly used in the category consumer perspective. Interviews (14.4 per cent) and focus groups (7.6 per cent) were the most applied techniques within the qualitative method. Interviews were mostly applied in the category provider perspective, while seven theoretical papers and one experimental paper belonged to the category technological perspective.

4. Topical review

A growing number of researchers are attracted by the developing and growing importance of mobile technologies and applications in the tourism and hospitality industry. Table II lists the research topics and sub-topics, as well as all related articles to each category. The majority of the examined studies investigated the role of mobile technologies and

Table II Article classification by perspectives and sub-themes

Perspective	*Sub-themes*	*Publication*
Consumer	*Consumers' attitudes and intentions*	Bader *et al.*, (2012), Douglas and Lubbe (2013), Huang *et al.*, (2013), Mo Kwon *et al.*, (2013), Im and Hancer (2014), Morosan (2014), Morosan and DeFranco (2014a), No and Kim (2014), Nunes and Mayer (2014), Boes *et al.*, (2015b), Han *et al.*, (2015), Lu *et al.*, (2015), Jung *et al.*, (2015), Kim *et al.*, (2015b), Lee *et al.*, (2015), O'Regan and Chang (2015), Rivera *et al.* (2015), Antunes and Amaro (2016), Kim *et al.*, (2016), Kim and Preis (2016), Morosan and DeFranco (2016a), Morosan and DeFranco (2016c), Ozturk *et al.*, (2016), Rivera *et al.* (2016), Fong *et al.* (2017), Im and Hancer (2017), Park and Huang (2017), Wozniak *et al.* (2017)
	Smartphone adoption for travelling and consumer preferences	Garcia *et al.* (2012), Paris (2012), Tussyadiah (2012), Scott and Frew (2013), Schroeder *et al.* (2013), Tussyadiah (2013), Wang and Fesenmaier (2013), Morosan and DeFranco (2014b), Tussyadiah (2014), Wang *et al.* (2014), Kim *et al.* (2015a), Lyu and Hwang (2015), Meng *et al.* (2015), Morosan (2015), Morosan and DeFranco (2015), Beier and Aebli (2016), Chen et al. (2016), Erawan (2016), Hui et al. (2016), Inversini et al. (2016), Mang *et al.* (2016), Park and Tussyadiah (2016), Park *et al.* (2016), Tussyadiah (2016), Wang *et al.* (2016a), Douglas *et al.* (2017), Kim *et al.* (2017)
	Tourist experiences and co-creation	Linaza *et al.* (2012), Han *et al.* (2013), Lee *et al.* (2013), Buhalis and Amaranggana (2015), Leue *et al.* (2015), Minazzi and Mauri (2015), tom Dieck and Jung (2015), Jung *et al.* (2016), Lalicic and Dickinger (2016), Lalicic and Weismayer (2016a), Lalicic and Weismayer (2016b), Kirillova and Wang (2016), Morosan and DeFranco (2016b), Quinlan Cutler *et al.* (2016), Tussyadiah and Wang (2016), Wheaton *et al.* (2016), Xu *et al.* (2016), Aluri (2017), Chen *et al.* (2017), Disztinger *et al.* (2017), Garcia *et al.* (2017), Lee *et al.* (2017), Neuburger and Egger (2017), Rincon et al. (2017), Tanti and Buhalis (2017), Tussyadiah *et al.* (2017), Yu *et al.* (2017), Zach and Tussyadiah (2017)
Technological	*Technical solutions*	Höpken *et al.* (2012), Kurata (2012), Yang *et al.* (2012), Brown *et al.* (2013), Garcia et al. (2013), Kasahara *et al.* (2013), Linaza *et al.* (2013), Martín *et al.* (2013), Pitman *et al.* (2013), Kasahara *et al.* (2014), Kasahara *et al.* (2015), Raun *et al.* (2016), Saravanan and Sadhu Ramakrishnan (2016), Baggio and Scaglione (2017), Wörndl *et al.* (2017)
	Functional features	Not and Venturini (2013), Wang and Xiang (2012), Fuentetaja *et al.* (2013), Schieder *et al* (2013), Stienmetz *et al.* (2013), Dickinson *et al.* (2014), Groth and Haslwanter (2015), Gibbs *et al.* (2016), Wang *et al.* (2016b), Fraiss *et al.* (2017)
	Visualisation technology	Yovcheva *et al.* (2012), Mesároš *et al.* (2016), Marchiori *et al.* (2017)
Provider	*New technology and knowledge for enhancing tourist experience*	McCabe *et al.* (2012), Buhalis and Wagner (2013), Ronay and Egger (2013), Neuhofer *et al.* (2014), Boes *et al.* (2015a), Buonincontri and Micera (2016), Cranmer *et al.* (2016), Garcia *et al.* (2016), Tscheu and Buhalis (2016)
	Adoption of mobile technologies	Leung *et al.* (2013), Liu and Law (2013), Adukaite *et al.* (2013), Wang *et al.* (2016c), Lin (2017)
	Mobile applications and the stock market	Qin *et al.* (2017)

applications from the consumer perspective (65.2 per cent). Hospitality and tourism scholars have paid considerably less attention to technological innovation (22.2 per cent) and the impact of mobile technologies and application by tourism providers (11.9 per cent). The following parts of the paper provide detailed analyses of the reviewed articles.

4.1 Consumer perspective

The literature review on consumer perspectives contains 83 articles which could be grouped into three sub-topics: *consumer attitudes and intentions*, s*martphone adoption for traveling and consumer preferences* and *tourist experience and co-creation*.

4.1.1 Consumer attitudes and intentions. This sub-topic includes 28 out of the 83 articles. Research on consumers' attitudes and intentions toward mobile technologies and applications is mostly grounded on theories from information systems. All articles in this sub-topic applied one or even two theories or models in developing their research framework. The Technology Acceptance Model (TAM) is used in 14 (50 per cent) out of 28 articles. Three articles (10.7 per cent) applied the Unified Theory of Acceptance and Use of Technology (UTAUT) model and one (3.6 per cent) the extension of the previously mentioned theory – UTAUT2. Two articles (7.1 per cent) used the Innovation Diffusion Theory (IDT). Other theories found in the articles are: the DeLone and McLean model, Contingency and Task Technology Fit theory, Theory of Planned Behavior (TPB), Theory of Reasoned Action (TRA), etc.

Consumers tend to adopt mobile technologies and applications if they consider them useful, easy to use and compatible (Lu *et al.*, 2015) in tasks such as searching travel information (No and Kim, 2014), purchasing travel-related services (Morosan, 2014; Morosan and DeFranco, 2014a.), making hotel reservations (Ozturk *et al.*, 2016; Fong *et al.*, 2017; Park and Huang, 2017) or enhancing the experience in the destination (Jung *et al.*, 2015; Lee *et al.*, 2015). By using mobile technologies and applications, customers want to save time, be more efficient and effective (Bader *et al.*, 2012).

Many hotels and travel companies have mobile applications through which they offer service assistance, additional information and the possibility to make or change the reservation. Finding a way to encourage customers to download mobile applications remains a significant problem in the hospitality industry. Mo Kwon *et al.* (2013) showed that that promotion information was not the only reason to download mobile applications. Content information plays an important role in consumer likelihood to use mobile applications (Rivera *et al.*, 2016). A study by Im and Hancer (2014) revealed that the primary reasons for downloading mobile applications in the hospitality industry are obtaining information about the company and making a transaction via smartphone.

There is evidence that more and more consumers rely on their mobile devices for travel purposes. There is no doubt that a relationship exists between consumers' skill in using the internet and their use of mobile applications (Douglas and Lubbe, 2013) as well as their attitude toward mobile applications and their intentions to use them (Rivera *et al.*, 2015). The motivation to use mobile applications for booking is not only limited to utilitarian values (e.g. perceived usefulness and ease of use) but also hedonic values (perceived enjoyment, pleasure). Kim *et al.* (2015b) revealed that enjoyment is a psychological motive for tourism shoppers to buy or book products and services through mobile sites and that value is the most important determinant of satisfaction in mobile tourism shopping. Therefore, to increase mobile hotel bookings, mobile booking systems need to be easy to access and navigate (Ozturk *et al.*, 2016), allow consumers to control the process during the transaction and provide them with a secure shopping environment (Park and Huang, 2017).

In addition to identifying the antecedents and benefits of consumers' use of mobile technology and its application, several articles examine the reasons why tourists reluctantly use mobile technologies and applications. Mobile applications gather a lot of personal

consumer information to provide personalized information. Thus, consumers unconsciously weigh the benefits and risks of using mobile technologies. Morosan and DeFranco (2016a) found that app-related privacy concerns negatively influence consumers' intentions to use hotel apps. Similarly, the research by Wozniak *et al.* (2017) recently confirmed that mobile users' information privacy concerns negatively affect behavior on the mobile customer journey. Trust has become the key factor in reducing customers' risk perception in the mobile environment (Huang *et al.*, 2013) and the degree to which using a technology will provide benefits has become an important factor affecting their intentions to use the mobile application (Antunes and Amaro, 2016).

Tourists today are more connected, technologically sophisticated and interested in interaction with mobile technologies. The study by Nunes and Mayer (2014) confirmed that tourists have a positive attitude towards using mobile games in enhancing their experience if the application is useful, enjoyable and compatible with the locations. The development of mobile technologies has increased the popularity of augmented reality (AR) applications. One of the first attempts to measure customer satisfaction and intention to recommend was made by Jung *et al.* (2015). Their study showed that theme parks are the ideal market for AR applications and that content, personalized service and system quality are significant factors that affect user satisfaction and intention to recommend AR applications.

One of the emerging topics is the consumers' intention to use near-field communication (NFC) in tourism. NFC technology is experiencing rapid growth within the tourism industry (Boes *et al.*, 2015b). Three articles in this sub-topic focused on NFC technology and investigated consumer acceptance of NFC smart posters (Boes *et al.*, 2015b), factors influencing visitors' NFC actual usage in the exhibition sector (Han *et al.*, 2015) and iPhone users' intention to use NFC mobile payments (NFC-MP) in hotels (Morosan and DeFranco, 2016c).

Until recently, researchers have mainly focused on the younger generation, but because of rapidly aging population, studies related to seniors' usage of mobile devices have become very important (Kim *et al.*, 2016). Usefulness and enjoyment are shown to have significant effects on seniors' use of mobile devices for tourism purposes and prior knowledge of information technology has a significant impact on seniors' desire and behavioral intention to use mobile devices for tourism-related purposes (Kim and Preis, 2016).

4.1.2 Smartphone adoption for traveling and consumer preferences. This sub-topic includes 27 articles that have explored how consumers use smartphones for travel purposes and what their preferences regarding mobile technologies and applications are.

Smartphone use during travel is rising. There is no consensus regarding "spill-over effects" from the daily usage of mobile technologies to travel-related activities. Wang and Fesenmaier (2013) claimed that daily smartphone use becomes a habit and, therefore, influences the use of mobile technologies while travelling. However, research by Meng *et al.* (2015) found that regular smartphone use does not directly influence its use for travel purposes. A study by Wang *et al.* (2014) provided a holistic understanding of smartphone use in travel. They identified five factors driving the use of smartphones in travel: extrinsic and intrinsic motivations, situational facilitators, use of smartphones on previous trips, cognitive beliefs and use of smartphones in everyday life. Mang *et al.* (2016) found that the most important factors affecting tourists' use of smartphones are how often they normally utilize their smartphone at home and the availability of WiFi in the destination. Today, tourists are able to use smartphones during travel for communication, social activity, information acquisition, information search and entertainment (Wang *et al.*, 2016a). Changes in tourist behavior are evident and manifested in less prior planning and constant connection with private and business networks. Research by Schroeder *et al.* (2013) demonstrated that, while travelling and in the event of a crisis, tourists had a high likelihood of using social media on their smartphones to look for information and solve problems.

Exploring customer preferences is especially important in developing hotel mobile applications. According to Tussyadiah (2014), smartphones and mobile applications should provide social support and act as travel companions. Therefore, it is desirable to attach humanlike characteristics to the designing of mobile technologies and applications for tourism and travel contexts (Tussyadiah, 2013). Consumers prefer to obtain more relevant, timely and location-based information (Chen *et al.*, 2016), to make accommodation bookings, to check-in via mobile app and to manage loyalty programmes (Douglas *et al.*, 2017) through hotel mobile applications.

As previously mentioned, the issue of privacy and risk regarding smartphone adoption for traveling is becoming a big concern for smart tourism (Gretzel *et al.*, 2015). Morosan and DeFranco (2015) pointed out that trust in the app and the overall value of information disclosure has a significant impact on personal information disclosure via mobile app. Park *et al.* (2016) aimed to assess the perceived risk of mobile travel booking. They identified seven kinds of risk associated with mobile travel booking: time risk, financial risk, performance risk, security risk, psychological risk, physical risk and device risk. In another study, Park and Tussyadiah (2016) showed that the perceived collection of personal information via smartphone contributes positively, while consumer innovativeness, trust and visibility contribute negatively to perceived risk. Erawan's (2016) study found that tourists' intention to give permission via mobile technology is driven by advertising value via attitude and subjective norms.

4.1.3 Tourist experience and co-creation. In tourism literature, the usage of mobile technologies and applications has been examined in many ways. In this study, we identified 28 articles that explored the impact of mobile technologies on overall tourist experience and co-creation.

Many studies pointed out that smartphones play a significant role in shaping tourist experience during a vacation (Lalicic and Weismayer, 2016a; Tussyadiah and Wang, 2016). Most scholars examined the positive impact of using mobile technologies and applications, such as: inspiration and excitement (Lalicic and Weismayer, 2016a), usefulness of smartphone recommendations (Tussyadiah and Wang, 2016) and being more informed and confident while traveling (Yu *et al.*, 2017).

Few studies investigated negative impacts of smartphones on the tourist experience. Nowadays, tourists rarely experience disconnection from their smartphones. Several studies explored using the smartphone for work purposes during a vacation (Kirillova and Wang, 2016; Chen *et al.*, 2017). The study by Chen *et al.* (2017) showed that if a person is not disconnected from their smartphone during vacation, their recovery is reduced. Opposite findings could be found in the research by Kirillova and Wang (2016), where they suggest that quality-work social presence acts as positive moderator between the tourism destination's restorative qualities and vacation recovery.

New mobile technologies such as smartphones, AR applications, virtual reality (VR) technology and games offer benefits in co-creating the tourist experience. Co-creation occurs when tourists are actively involved and collaborate with service providers to create their own experience. It was found that consumer habits regarding mobile technologies influence the extent of the consumer co-creation process with service providers (Morosan and DeFranco, 2016b). The main requirements of AR applications are multi-language functionality, ease of use and capability to personalize the application (Han *et al.*, 2013). There is limited research on consumer acceptance and usage of AR in the tourism context (Linaza *et al.*, 2012; tom Dieck and Jung, 2015). In the analyzed articles, the researchers examined AR applications in urban tourism (Linaza *et al.*, 2012), art galleries (Leue *et al.*, 2015), urban heritage (tom Dieck and Jung, 2015) and museums (Jung *et al.*, 2016; Neuburger and Egger, 2017). Guerra *et al.* (2015, pp. 50) made a distinction between AR and VR by offering the following explanation "the first digital information is added to images and real-life contexts, while the second offers the user a new world in which he is immersed

allowing, for example, to fly over a city without taking his feet off the ground". These technologies allow a realistic pre-experience of the potential destination and a new way of promoting services to tourists (Disztinger *et al.*, 2017). Recently, Tussyadiah *et al.* (2017) examined how the VR experience may influence travel decision making by investigating spatial presence in VR environments and its impact on attitudes toward tourism destinations.

Gamification in tourism is a new challenging area that has not yet been researched sufficiently. In their exploratory study, Xu *et al.* (2016) investigated what drives tourists to play games in tourism. They asserted that tourists start playing games because of curiosity and the possibility of gathering practical information about the destination. Shortly after the launch of the Pokémon GO app, two studies examined the user experience (Aluri, 2017) and behavioral impact of playing the game on mobility and consumption (Zach and Tussyadiah, 2017). There are a lot of opportunities for gamification in tourism such as increasing the visit duration of Point of Interests (POIs) and balancing the distribution of tourists in the destination (Garcia *et al.*, 2017). Mobile augmented reality applications will continue to draw the attention of academicians and practitioners.

4.2 Technological perspective

The studies analyzed in relation to the technological perspective emphasize recent trends in developing mobile applications in tourism and solutions for improving tourist experiences in the destination. It should be highlighted that only 22.2 per cent of all selected journal articles are related to the technological perspective. The articles are divided into three sub-topics: *technical solutions*, *functional features* and *visualization technology*.

4.2.1 Technical solutions. Innovations in mobile technologies provide both tourists and providers the possibility to solve problems that occur in the destination. One the biggest problems of popular destinations or protected areas is crowding and destination managers are struggling to solve the crowd-mitigation problem. Brown *et al.* (2013) proposed a novel method of routing visitors to less crowded areas with push incentives and information on mobile devices. On the other hand, Kurata (2012) focuses on preventing tourists from being overwhelmed by a flood of tourist information. Authors rely on travel recommender systems that help tourists discover and select the POIs, which visualize the sightseeing potential of each place in a tourist area that best fits their preferences and saves them from undue decision-making effort (Kurata, 2012; Garcia *et al.*, 2013; Wörndl *et al.*, 2017).

Analyzing visitor flow using mobile data and space-time tracking data is important for understanding travel networks that go beyond the specific spatial dimension to include informational or virtual dimensions such as travelers' experiences (Raun *et al.*, 2016; Baggio and Scaglione, 2017). According to Raun *et al.* (2016), using space-time tracking data always raises questions concerning data protection and the privacy of the subjects being tracked. To address privacy-related issues, Saravanan and Sadhu Ramakrishnan (2016) focused on methodologies to ensure better privacy based on an intermediary location hider between location-based service app and service provider that creates a cloaked region when sending the query in both static and dynamic contexts.

Kasahara *et al.* (2013, 2014) recognized that mobile technologies could offer solutions even for disaster situations (like earthquakes) by constructing a tourism information system to provide evacuation information and share safety confirmations with relevant people and family.

Mobile tour guides are needed for bikers and cyclists to plan their route and make time estimates. Pitman *et al.* (2013) discussed a number of approaches to time estimation, introducing a nearest neighbor model which is applicable in scenarios where limited learning data are available. GPS-equipped smartphones have the possibility to generate extensive volumes of detailed movement data of tourists. Kasahara *et al.* (2015) proposed a

new GPS semantic annotation method using environmental constraints without machine learning called Segment Expansion with Environmental Constraints (SEEC). This method assumed a tourist behavior model in which tourists move on foot and using public transportation in tourist destinations that include numerous locations of interest. Yang *et al.* (2012) provided a solution for identifying dry beaches in areas that are under the influence of daily tides. The study proposed a web-based geographic information system application for mobile devices that could help tourists (better understand when and where dry beaches will be available for their recreational purposes) and managers (to efficiently manage and monitor beach access).

Quick Response (QR) codes are popular and useful technical solutions in tourism. They have recently been used in the hotel industry to digitalize traditional loyalty cards (Höpken *et al.*, 2012), in pervasive augmented reality games to experience the tourism destination (Linaza *et al.*, 2013) and in web platform design for people without programming skills (Martín *et al.*, 2013).

4.2.2 Functional features. As most tourists today use smartphones and other mobile technologies for information gathering, it is necessary that mobile destination management organization (DMO) websites are well designed and optimized. The findings of Stienmetz *et al.* (2013) suggest that only content and ease of use contribute significantly to the overall usability of DMO mobile websites and that travelers highly value mobile DMO websites that are well-structured and organized, offer convenient services and have an easy-to-understand appearance.

Tourism providers must carefully consider functional features when developing mobile applications. Dickinson *et al.* (2014) gave an overview of current app functions and proposed a conceptual diagram that illustrates how context awareness (information exchange, sharing capabilities, internet of things and tagging), connections to data repositories and data mining projects influence new user travel competencies and travel organizations. The study by Wang *et al.* (2016b) showed that online travel agency (OTA) apps and hotel proprietary apps differ in terms of the design and functional features implemented in the apps. This is not surprising, as OTA apps are mostly used for hotel search and customers reviews, while hotel apps are mostly used for loyalty programs (Wang *et al.*, 2016b). Mobile applications provide travelers with reliable and unlimited access to information. Schieder *et al.* (2013) analyzed mobile applications of World Heritage Sites and concluded that the applications seemed to address tourists, while the minority of the mobile applications contained innovative (educational and scientific) content which could serve as useful tools for teachers, university lecturers and other users.

Personalized customer experiences are recent trends that are offered by hotel applications (Gibbs *et al.*, 2016). Customers look for "smartphone-enabled" services which are only available on mobile platforms such as real-time route recording and the "shake" function to randomly select restaurants. These services provide new experiences to customers and enable them to make decisions or consume destinations in innovative ways (Wang and Xiang, 2012).

The main task of the Responsive Web Design (RWD) is to develop websites dynamically and adjust their layout and content to the screen size of a user's device. Significant differences in perceived usability and user experiences between desktop computers and smartphones, in general, were found (Groth and Haslwanter, 2015), whereby it is necessary to create variable website designs for variable devices (Fraiss *et al.*, 2017).

4.2.3 Visualization technology. Only three articles are categorized in this sub-topic. Two studies are related to AR applications. Yovcheva *et al.* (2012) presented an overview of current smartphone AR applications for tourism. Although the analyzed AR applications offered effective support for tourists in unfamiliar situations, they identified several improvements of AR applications that should be considered in the future when developing

applications, such as: context-aware push information, m-commerce, feedback and routing. The use of AR and gamification techniques in tourism, by Mesároš *et al*. (2016) explores the NosfeRAtu application. During the game, the users discovered and learnt about the marvelous places and history of the castle as they completed the different quests. AR applications offer the possibility of visualizing and telling stories about the places and the history at the specific location. They can employ gamification techniques to be more attractive and interactive for the users. One of the first studies that propose the use of biophysical data for investigating media effects of a tourism-related VR experience was done by Marchiori *et al*. (2017) and discussed the use of such techniques for studying media effects in VR settings. The findings show that specific media characteristics of the VR experience, such as proposing an unusual horizon perspective to the VR viewer, hold the potential to lead to the formation of strong memories.

4.3 Provider perspective

The analysis of provider perspectives consisted of 15 articles retrieved from the database search and is divided in three sub-topics: *new technology and knowledge for enhancing tourist experience*, *adoption of mobile technologies and mobile applications and the stock market*.

4.3.1 New technology and knowledge for enhancing tourist experience. Tourism providers in destinations need to collaborate to enhance consumer experience and gain a competitive advantage. It is important that destinations carefully implement technologies and applications to enhance their competitiveness (Buhalis and Wagner, 2013). However, integration of ICT within a destination is not sufficient to become a Smart Tourism Destination (Boes *et al*., 2015a). Human capital, leadership, social capital and innovation are the four pillars of smart tourism destination (Boes *et al*., 2015a). McCabe *et al*. (2012) suggested a scenario-based design (SBD) that proved to be a useful approach to engage diverse tourism stakeholders in collaboration and overcoming technological knowledge barriers and generating new ideas for transforming the tourists' experience of the city. A similar technique was applied by Ronay and Egger (2013) to investigate the NFC Smart City concept and how plausible future scenarios for implementing such a concept in tourism destinations might look.

Neuhofer *et al*. (2014) investigated best practice companies to generate a holistic understanding of technology-enhanced tourism experiences. On the basis of the five cases analyzed, a nine-field experience typology matrix based on the increasing intensity of co-creation and technology implementation was developed. Furthermore, they created an experience hierarchy with four levels of experience: conventional experience, technology-assisted experience, technology-enhanced experience and technology-empowered experience. This hierarchy provides a useful instrument for companies to understand their current position and develop strategies for future technology development.

As new mobile technologies such as AR applications are important tools for gaining a competitive advantage in the tourism and hospitality sector, it is necessary for stakeholders to know what requirements they need and what benefits the implementation brings. Tscheu and Buhalis (2016) provided a holistic overview of the whole value creation process in the field of AR at cultural heritage sites. Cranmer *et al*. (2016) pointed out that, for successful implementation, organizational support for AR is necessary and that there is a fundamental need to educate internal stakeholders about exactly what AR implementation entails as well as the expected outcomes.

Despite the fact that gamification has a significant number of potential benefits to DMOs, the level of adoption of gamification among DMOs is very limited because of the lack of available tools to generate a gamified mobile tourism experience (Garcia *et al*., 2016). Buonincontri and Micera's (2016) study of two European STD best practices provided

interesting insights for destination managers and policy-makers on how they should use innovative technologies in STDs to improve the experience co-creation. The findings of this study show that the smart approach adopted by the two destinations had a positive influence of on the tourism experience co-creation. The authors concluded that, by using smart technologies, both destinations are able to improve direct interaction, encourage active participation and support the sharing of the experience with a wide network of subjects.

4.3.2 Adoption of mobile technologies. Five articles have shown that different factors impact the adoption of smartphone applications by service providers.

According to Lin (2017), the most important and common critical success factors (CSFs) for adopting mobile technologies are top management support and consumer needs. In the hotel industry, star rating and brand affiliation are associated with the visibility of hotels on smartphones (Leung *et al.*, 2013), while compatibility, firm size, technology competence and critical mass are significantly positively related to mobile hotel reservation system (MHRS) adoption (Wang *et al.*, 2016c). Adukaite *et al.* (2013) found out that the main drivers for publishing an application are increasing loyalty and promoting special offers, as well as enhancing interaction with guests and providing information about the destination. The study by Liu and Law (2013) provides interesting findings about smartphone applications adoption by different types of airlines. Their findings demonstrate, for both international and regional airlines, that if the airline offers a large number of flight destinations and is member of one or more strategic alliance, it is more likely to offer a smartphone application.

4.3.3 Mobile applications and the stock market. Aside from the two previously mentioned sub-topics, another important topic from the providers' perspective has been identified in the literature. This sub-topic contains only one article that focused on mobile app introduction and shareholder returns (Qin *et al.*, 2017). The results showed that introducing mobile apps could increase shareholder returns by 1.32 per cent in hotel and air companies. The stock market is efficient in evaluating the value of mobile app introduction in hotel and airline companies. This is the first study that quantified the value of mobile apps by stock market returns instead of consumer market measures. Therefore, this area of study needs to be explored further to gain insights how mobile channels create value for all stakeholders.

5. Discussion and conclusions

This study systematically reviews 126 articles related to mobile technologies and applications published in peer-reviewed tourism and hospitality journals and ENTER conference proceedings between 2012 and June 2017. The literature review indicates that the majority of the collected and analyzed articles focused on 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. Contrary to previous studies (Liang *et al.*, 2016), the literature review revealed that more articles focus on the consumer perspective than they do on the technological and provider perspective. Findings and discussions of this study are valuable to industry practitioners and academic researchers looking for an overview of the main findings of recent research focusing on mobile technologies and applications.

This study aimed to answer research questions related to the consumer, technological and provider perspective. According to Wang *et al.* (2014) and Mang *et al.* (2016), several factors affect tourists to use mobile technologies and applications during their trip (i.e. extrinsic and intrinsic motivations, situational facilitators, use of smartphone on previous trips, cognitive beliefs and use of smartphone in everyday life, as well as WiFi access). Consumers benefit from customized, fast and trusted service, increased communication, connectivity and streamlined transactions. These benefits influence the consumers' trip

planning process and increase their satisfaction, while meeting their expectations and needs.

Recent trends in the development of mobile applications in tourism refer to visualized technology such as augmented reality and gamification techniques which provide a new dimension of virtual reality and increase the attractiveness of certain places. GPS, location-based tracking and applications are useful for providers to gain information and they make travelers' lives easier. Personalized guest experiences are valuable outputs of the advanced technology evolution and will require tourism providers and application developers to increase investments in the idea of co-created experiences. These application features can help providers differentiate their applications from their competitors. In conclusion, users and mobile technological innovations will continue to shape and reshape each other through a process of innovation.

Stakeholders in tourism have not yet recognized the importance of mobile technology application development, availability and benefits, and therefore, valuable opportunities are missing (McCabe *et al.*, 2012). Smart destinations need to offer wearable devices and applications to provide tourists with an enhanced experience on-site (Neuhofer *et al.*, 2014). The implementation of mobile applications is associated with positive returns (Qin *et al.*, 2017) and competitive advantage (Wang and Xiang, 2012). Tourism service providers benefit from attracting target consumers by engaging them with customized services, transferring and analyzing data in real time, while gathering valuable tourist information about experiences and emotions at the destination (Shoval and Ahas, 2016).

Based on the limitations of the analyzed studies several directions for future research could be proposed. Although most scholars examined how consumers adopt and use mobile technologies, there is still need for more critical analysis of consumer experiences with various mobile technologies and applications. The authors agree with Gretzel *et al.* (2015) that privacy issues in the context of smart tourism are a major area of research. As contradictory findings regarding the use of smartphones and recovery have been identified, future research should further examine consumers' technology-dependence and their desire to escape technology while on vacation. Future studies should examine how mobile technologies and applications mediate travel experiences and what consequences do they bring to consumer behavior (e.g. happiness, loyalty and satisfaction). Moreover, most of the studies focused on identifying consumer benefits of using mobile technologies while studies aiming to find out why consumers do not use them are limited. The majority of studies examined privacy and risk concerns of consumers. Therefore, researchers need to further investigate other possible antecedents of reluctant mobile technology use.

Studies related to technological perspectives mostly used descriptive statistics and provided descriptions of innovations with regard to new mobile technologies and applications. In the future, studies should provide more empirical data by using experimental analysis and real consumption data. Finally, it is evident that most of the studies used primary data, while secondary data sources are neglected. Smartphones connected to the web and equipped with location-based services such as GPS enable providers to capture valuable information about tourists in real time. Therefore, more research on big data usage from the technological and provider perspective is needed. Furthermore, regarding the provider perspective, the existing literature is not sufficient to provide direction on how to successfully implement mobile technologies into businesses. Future studies could investigate the organizational and financial performance of various tourism and hospitality industry businesses that have implemented mobile technologies.

The authors believe that the findings of the study contribute to practitioners in both academia and industry. Academically, the authors provided an overview of the current state of knowledge in tourism and hospitality journals regarding the role of mobile technologies and applications in smart tourism. Based on the results of the study, it can be concluded

that most studies were focused on the consumer perspective, while studies regarding the technology and provider perspective are neglected in tourism and hospitality literature. This highlights the need for publishing interdisciplinary research in the tourism and hospitality area. Industry practitioners can use this systematic literature review for gaining an insight into new trends of mobile technologies and applications in smart tourism.

The major limitations of this study lie in the fact that only two databases, one search engine and ENTER conference proceedings were used to collect articles. Therefore, there is the possibility that some studies connected to the topic were not included. The study did not include books, literature reviews, theses, business reports and other relevant conference proceedings. Future research should consider analyzing publications from all the above mentioned sources to gain further insights into the subject.

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