Development of Information and Communication Technology: From e-Tourism to Smart Tourism

Rosanna Leung

Contents

Abstract

This chapter reviews e-tourism development across three areas: suppliers, tourists, and educational needs. Regarding suppliers, the adoption of information and communication technology (ICT) begins with simplifying operational procedures, increasing employee productivity and enhancing information retrieval. Tourism managers rely on ICT and data to carry out management tasks such as promoting products online, making strategic decisions, monitoring customer satisfaction and product customization, and maintaining a sustainable business environment. Application systems within the tourism ecosystem should be interconnected and interoperable to form a smart network. An intelligent

R. Leung (✉)
Department of International Tourism and Hospitality, I-Shou University, Kaohsiung, Taiwan
e-mail: rosannaleung@isu.edu.tw

environment enables smart networks with high-speed data exchange and autonomy services. From the tourist perspective, ICT significantly changes tourists' trip decision-making process and behavior. Destination choice and travel product information are available online without time delays or any geographical or language barriers. Multimedia and 3D virtual images expand the information richness and facilitate co-created travel experiences. Social media allow tourists to share their trip experiences with friends and relatives in real time and express their feedback about travel products on easily accessible review sites. To address employers' and future employees' needs, the university must revise the tourism education curricula with a significant inclusion of the ICT component to ensure students will be equipped with the necessary ICT skills in areas such as data analysis, scenario interpretation, robot management, and artificial intelligence (AI) applications

Introduction

People have travelled for centuries all around the globe for leisure and business. Travellers benefit from experiencing different cultures, interacting with locals, dining, shopping, and being able to escape dull, boring daily routines (Greenblat and Gagnon 1983). Half a century ago tourism suppliers such as airlines and chain hotels introduced affiliated reservation systems on a worldwide basis to enable barrier-free tourism product distributions However, travel product procurement processes strongly depend on intermediaries' expertise in operating these systems. On the one hand, tourism suppliers relied on travel intermediaries to distribute their products while on the other hand, travel intermediaries also needed to maintain good relationships with their suppliers to secure competitive rates for maximizing their profits and increasing their attractiveness for consumers. This tourism ecosystem has worked seamlessly for decades (Buhalis and Leung 2018). Travel agents assisted inexperienced tourists in arranging travel plans and purchasing travel products. Tourists followed the information provided in travel guidebooks and destination management office (DMO) promotional materials to plan and arrange their travel itinerary. Marketing activities of tourism organizations focused on advertisements in traditional media such as travel magazines and travel guidebooks and participating in travel expos hosted by DMOs to expand into new market segments and explore business opportunities. When tourists were away from their home countries, they were wholly disconnected from friends because international communication was not widely available or expensive.

This travel business model and tourist behaviors were followed for decades up to the dawning of the Internet era. However, information and communication technologies (ICT) and the Internet have revolutionized and disrupted the tourism ecosystem and tourist travel behavior. ICT simplifies communication, data storage, and computation; increases employee productivity, customized service, and travel products; and enables self-service capabilities for customers (Buhalis and O'Connor 2005). The rapid development of ICT, ubiquitous use of smartphones and mobile networks, as well as high-speed Internet connections affect business operation and management style. ICT strengthen tourism organizations' competitiveness and improve their strategic performance and are inseparable from business operations, customer services, cost control, and strategic planning (Law et al. 2009).

The Internet empowers both tourism enterprises and tourists. Technology-enabled tourism, commonly referred to as e-tourism, has drastically impacted the ways of doing business within the tourism industry. e-Tourism is broadly described as the practice of analyzing, designing, implementing, and applying ICT and Internet solutions in the tourism, travel, and hospitality industry (Chuang et al. 2017). To support public and private sector operations and management and enable tourists to stay connected with family and friends, e-tourism infrastructure requires integrated software, networked hardware, and diverse information sources. Tourism is a complex product, but ICT further enhance its experiential and complexity level (Racherla et al. 2008) . The affordable cellular network connects and allows tourism suppliers to be seamlessly connected with tourists. Nowadays, electronic word-of-mouth (eWOM) and user-generated content (UGC) replaced traditional marketing channels, changed customer information search behaviors, and impacted purchase decision processes (Bruhn et al. 2012). Travellers share status updates via online social network platforms during their trips (Rouhani et al. 2013)

With the growth of smart city networks and intelligent technologies, hospitality and tourism suppliers start providing humanless and automated services. Furthermore, AI assists forecasting and decision-making and catalyzes the tourism ecosystem toward smart tourism. The following sections will highlight the development of e-tourism from two key stakeholder perspectives: suppliers and tourists. Then, the resulting education and training needs related to IT skills will be identified. The last section of the chapter will forecast future developments in smart tourism.

ICT Development from the Tourism Supplier's Perspective

ICT digitized the entire tourism ecosystem, including transportation, accommodations, dining, intermediaries, public sectors, and non-profit organizations. ICT has also disrupted the traditional ways of doing business. Developments in ICT have had profound effects on the determination of competitive advantages within the tourism industry. ICT has produced outcomes, introduced innovations, and facilitated the shift to a knowledge-based economy (Papanis and Kitrinou 2011). ICT has also been the catalyst for the formation of an integrated tourism ecosystem

through interconnected and interoperable application systems. Most importantly, ICT has provided added value to stakeholders such as cost reductions, value-added marketing, and being able to participate in a virtual community (Mahajan et al. 2015). ICT adoption started as a tool to enhance service quality, increase the efficiency of business operations (Richardson and Marshall 1999), and provide cost savings (Oyewole et al. 2008).

Organizations that implement e-business can be categorized into five types of adopters, including leaders, technology experts, fast adopters, beginners, and late adopters (Vlachos 2013). Leaders and technology experts are always the pioneers in their industry and role models in their discipline. They are willing to take risks and invest in ICT and reengineer traditional operating procedures. Late adopters on the other hand are more conservative regarding changes and reluctant to invest in ICT. Their investments mainly focus on those areas that can generate revenue, but for those intangible areas such as employee efficiency and productivity, brand image, and customer perceptions where the return on investment cannot be easily quantified, late adopters always show hesitation in new ICT adoption (Sigala 2003b). ICT adoption in the tourism industry can be classified on three levels. The first level is digitalization of operations to enhance data processing efficiency and transaction handling accuracy (Leung and Law 2013). The second level involves data-driven management where ICT assists managers with scenario analysis, decision-making, and revenue management. The third level is the adoption of tourism ecosystem applications with dynamic interconnectivity and interoperability via smart networks. In this last stage, ICT allows interoperable applications within the tourism ecosystem without human intervention.

Digitalization of Tourism Operations

ICT adoption marks the beginning of a revolution in tourism operations. Tourism organizations typically start adopting ICT to reengineer operations and procedures more efficiently and effectively and also to more accurately handle transactions (Alcántara-Pilar et al. 2017; Leung and Law 2013). Initial ICT adoption can improve company efficiency and productivity (Sedmiak et al. 2016), enhance communication among operations and departments, increase employee productivity and efficiency (Davidson et al. 2002), and reduce manpower needs (Thorn and Chen 2005). Hotels and airline industries were the pioneers in adopting ICT for key operations (Buhalis 2004; Sheldon 1983). Also, the potential of ICT development, ICT adoption, and ICT acceptance have been researched for decades. Buhalis and Deimezi (2004) found that tourism business sectors lag behind other industries in a rapidly changing high-tech environment. Small- and medium-sized enterprises continue to find it difficult to cope with the ever more complex and rapidly challenging online environment in which they have to operate (Romero and Tejada 2020).

Front Office Operations

ICT was first introduce to tourism and hospitality industries to reduce expensive human labor with technological labor to enhance operational efficiency and improve customer experience. Both customers and businesses can benefit from improved communication, reservations, and guest service systems. The aviation industry adopted tremendous ICT applications for both operation management and customer services. The first tourism-related ICT platform was an airline reservation system which was launched in 1946 by American Airlines, and the first business-to-business (B2B) platform – global distribution systems (GDS) – began operation in 1963 to keep track of flight schedules, availability, and prices (Sheldon 1997) Travel agent staff use the system to search and sell tourism products to customers. However, the system required intensive training to operate the system because the operation platform was command-based without any navigation assistance. Moreover, GDS required a dedicated terminal and communication line and therefore the cost of using GDS was relatively high. The Internet era saw many GDS enhancements. Travel agencies were soon able to use their existing computers and data lines to access the system, and staff no longer needed to use text commands since operations could be handled via mouse clicks. Reservations of all kinds of travel products became the norm including hotels, cruises, car rentals, and theme parks. Other than reservation systems, aviation operations also heavily rely on ICT for seamless operation. Marketing and customer relationship management (CRM) system provides loyalty programs and personalization services to frequent travellers; decision support system manages fleet management and schedule optimization; baggage and cargo handling system reads barcode and radio-frequency identification (RFID) tags to seamless transports of the checked baggage to and from aeroplanes; in-flight entertainment system allows passengers to obtain on-demand video programs on personal television (Benckendorff et al. 2019). Compared to the aviation industry, hotels were relatively conservative and slow to utilize ICT (Ayeh 2006). The first electronic front desk operation system *Reservation* handled the hotel guest reservations and inter-departmental communications for Sheraton Hotel and was launched in 1958 (Sheraton 2019). Later, it was modified as a property management system (PMS) for handling hotel operations. Before the Internet era, operation-oriented applications such as magnetic card key systems, CRM, and guest-operated in-room devices, such as call accounting systems, minibar systems, and in-room entertainment systems, played a key role in hotel service. These systems increase staff productivity and enhance inter-departmental communication efficiency. However, interconnecting different applications that run on different IT platforms required costly custom-made propriety interfaces in which many hotels were not willing or able to invest. As a result, manual operations were required for an extended period, which only increased human error and decreased efficiency.

With the growing popularity of the Internet, an increasing number of tourism start-ups that work as online travel intermediaries or as an online travel agency (OTA) providing travel products and services emerged. Because of the consumers' successful adoption of these new intermediaries, hotels needed to handle an increasing number of online channels related to rate management and product

availability. Various types of online channels and rate management applications were introduced and connected with PMS to reduce workload and assist hotel management (RateTiger 2020). International hotel chains developed their central reservation systems (CRS) to enable cross-country hotel reservations. However, this traditional and propriety system limited the development and collaboration with other online channels. As a result, hotel chains start phasing out of their propriety CRS (IHG 2015) and collaborate with GDS companies, such as Pegasus, Sabre SynXis, and Amadeus iHotelier, on a cloud-based reservation system in order to optimize their channel management via a web-based platform.

Back Office Operations

Computers can reliably process enormous amounts of information faster and cheaper than humans, simultaneously analyzing and comparing the data, making information more easily distributable and accessible to users (Sheldon 1983). Therefore, tourism organizations started adopting ICT for back-of-the-house operations and management such as financial and human resources management (Alonso-Almeida and Llach 2013), procurement (Au et al. 2014), and customer relations and marketing (Fuchs et al. 2010) decades ago. Back office operations typically focus on resources management such as procurement and inventory control, cost control, financial management, and document management. ICT also assists human resources management by handling employee payroll, leave, duty rosters, and various scheduling matters. CRM was first introduced to profile customers in the tourism industry (Álvarez et al. 2007; Taga et al. 2011) and gather customer preferences and activity usage that can be examined and later used to plan and implement direct marketing. These systems support frontline operations by keeping track of a large amount of daily business-related data so that the operation staff can easily retrieve historical information. Furthermore these data can be used as supplementary data for management decision-making. ICT also assist DMOs in managing and promoting tourist's attractions. Destination management system (DMS) shifts from simple information databases to complex, web-based platforms that support and facilitate communication and interactions among stakeholders including tourists, OTAs, suppliers, and government.

Small tourism enterprises have budget limitations when it comes to ICT adoption in which case governments should provide support and encourage investment in ICT to enhance competitiveness (Mwita 2014). Governments typically play a leading role in advocating for the development of e-tourism that can simulate the demand of adoption. Whenever there is a newly launched technology, the government must initiate changes and prepare relevant rules and regulations in order to protect the rights and obligations among the numerous stakeholders (Kalbaska et al. 2017). Document digitization, for example, cannot be successful without government involvement. Government legislators and policy makers recognize digitized contracts with a digital signature as official documents. Moreover, electronic visa services not only stimulate tourist travel desire and revisit intention but can also improve destination image (Çakar et al. 2018). Therefore, the government should consider digitizing visa application processes and automated immigration services which can additionally expedite tourist arrivals and departures.

Data-Driven Management

In the second stage of ICT adoption, tourism managers utilize ICT for decision-making. One of the main characteristics of a tourism product is perishability. No product can be stored indefinitely for sale at a later time. Therefore tourism managers must closely manage their inventory to minimize lost capacities and make price adjustments for their products to either stimulate purchase intention during low seasons or maximize profits during high seasons. In addition, Internet and social media marketing strategies could assist tourism organizations for brand image formation and customer engagement. Prior studies have examined the role of ICT in strategic planning, online marketing strategies (Ruiz-Molina et al. 2014; Yayli and Bayram 2010), the implementation of distribution strategies (Zare and Chukwunonso 2015), profit maximization (Xu and Li 2017), and customer value co-creation (Neuhofer and Buhalis 2014).

Previous research has also proposed knowledge management-driven decision support systems for DMOs to provide up-to-date and precise information for scenario analysis and strategic planning (García-Crespo et al. 2010) . Knowledge-based destinations have the potential to enhance and sustain competitiveness in both urban and rural communities (Racherla et al. 2008). E-services such as web information, an interactive map with virtual tours, virtual games, and journey planners could improve the sustainability of tourism management (Chiabai et al. 2013). Moreover, external data related to political, economic, social, and technological data must be considered and made publicly available for tourism organizations in order to prepare better strategic planning and accurate management decisions (Buhalis and Leung 2018). The following subsections illustrate how ICT and big data influence online marketing strategies, channel management, service personalization, and environmental sustainability.

Online Marketing

Online marketing starts with the development of a website. Small- and medium-sized organizations adopted the use of websites to maintain long-term relationships with their customers (Çetin et al. 2004) as well as to increase productivity (Sigala 2003a). Many marketing activities have moved to online platforms since the first commercial websites were launched in the early 1990s because this advertising medium seemed likely to increase global visibility and precise targeting ability of the most desired audiences (Giannopoulos and Mavragani 2011). In the mid-1990s, web surfers needed web portals because obtaining a website address (URL) on the Internet was not easy, especially for novice users (Klausegger 2005). Web surfers would not be able to locate and retrieve information about a business without knowing the specific URL. Search engines changed information search behavior and nowadays play an important role in online marketing, and websites that allow quick navigation are likely to attract travellers, and distinct designs can even lead to subsequent revisit intentions (Ku and Chen 2015).

Establishing trust is essential for increasing e-booking website usage intention (Jeng 2019); trust greatly helps to reduce any perceived risks of online purchases. OTAs provide one-stop service with a wide range of products as well as product/service reviews that can assist customers with their purchase decisions. Therefore, their role in creating distribution channels is seen as important (Law et al. 2015; Novak and Schwabe 2009). The metasearch engine is another intermediary but does not directly offer any travel products; instead, metasearch engines offer a valuable service by referring or linking customers directly to key sources or businesses (Christodoulidou et al. 2010). Travel suppliers strongly depend on these new networks to help broadcast and globally distribute their products (Buhalis and Kaldis 2008; Novak and Schwabe 2009).

Websites have become quintessential information sources and distribution channels for all facets of the tourism industry. Tourism industry practitioners need to know how to design and maintain an attractive website that stands out from their competitors. More so, tourism websites need to be user-friendly and accessible. First impressions are long-lasting, and acceptance and trustworthiness of a tourism website is essential, or else users will move on to another competitor (Besbes et al. 2016; Sahli and Legohérel 2015). Ert (2014) argued that a simplistic, minimalist website design could generate a surprisingly positive effect on customers. The semantic web can personalize information and improve higher satisfaction with e-tourism applications (Siricharoen 2010). Semantic web rules can also be used in an expert system to detect fraud in tourism e-commerce transactions (Roldán-Garcí et al. 2017). Additionally, the emotions of a user can be predicted by using sentiment analysis based on their communication threats (Neidhardt et al. 2017). A website evaluation is an examination process where the quality of the websites, including features and performance, is accessed (Qi et al. 2020). Various evaluation models have been created to examine the functionality and usability of tourism-hospitality websites, and such models serve to define industry benchmarks against which performance can be evaluated (Ali 2016; Law et al. 2010; Zafiropoulos and Vrana 2006). Mobile applications also need evaluation of their performance and efficacy due to their increasing information accessibility and purchase capability via smartphones (Groth and Haslwanter 2016; Hoadjli et al. 2017).

Online platforms have greatly empowered and enhanced old-fashioned "word-of-mouth." Social media and user review websites contain rich textual information on customers' opinions and attitudes about a whole array of touristic tourism organizations and businesses. e-Tourism marketing strategies can now focus on customer interaction and engagement via social networks and mobile platforms. Nowadays, customers post negative reviews to express their dissatisfaction, vent their emotions, and share information with other prospective customers. Therefore, managers should respond properly and quickly, especially to any negative comments, suggestions, or feedback (Fernandes and Fernandes 2018). Destination promotion has recently faced challenges, especially due to unofficial information sources which capture tourists' attention. Proactively learning and better understanding the users' perceptions on the context of social media could help managers maintain high user engagement and fortify positive brand image (Mich and Baggio

2015). Recommender systems, for example, must include social data in any recommendation algorithm. Facebook has many sophisticated users whose behavioral data can be tracked, collected, and analyzed to understand an organization's online branding ranking (Capatina et al. 2018). Destination managers must manage their business's online reputation by listening closely and responding appropriately to social media comments that can impact their reputation and patronage (Inversini and Cantoni 2011).

Data mining and sentiment analysis on social network platforms allow tourism marketers to measure tourist preferences and then aggregate that information for tourism promotion and management (Sun et al. 2017). Big data stored within Facebook and Tripadvisor are treasure troves for marketing departments. "A picture is worth a thousand words" is a commonly used expression easily understood across virtually all cultures and languages. By analyzing photos' geoposition indicators on image-focused social media, tourist's visit intention of any particular destination can be discovered (Latorre-Martínez et al. 2014). However, analyzing big data is a challenge for frontline tourism operators and managers. Researchers have designed and tested tools that assist managers with data collection, analysis, reviews, and subsequent action planning.

Other than websites, near field communication (NFC) tags on promotion posters draw tourists' attention and provide supplementary information that improves destination service quality, branding, and marketing (Pesonen and Horster 2012). Digitization also helps form destination image (Mannas et al. 2013) because destination branding is easily communicated via social media (de Rosa et al. 2019). Technology can also customize and co-create new experiences by adopting a virtual environment to deliver multisensory simulations via the five senses; it has proven a useful tool for promoting wine tourism (Martins et al. 2017). Virtual reality (VR) generates realistic 3D images, sounds, and sensory simulation that stimulate interest; it is also a good marketing tool for destination promotion (Martins et al. 2017). However, when designing smartphone-based virtual guiding services, trustworthiness is an essential factor because tourists need to be assured that the multimedia representations are authentic (Koukopoulos and Styliaras 2013).

Channel Management

Websites and online platforms affect the relationships between suppliers and travel intermediaries. Two decades ago, many studies forecasted disintermediation as customers would choose to directly purchase from suppliers via online platforms (Garkavenko et al. 2003; Standing and Vasudavan 2000; Tse 2003). Buhalis and Licata (2002) proposed a revised e-tourism intermediary framework to showcase the new era of travel distribution channels. To successfully address this challenge, traditional travel agents have altered their business models by adding value to customers by offering online access channels (Zare and Chukwunonso 2015). As an example, recommender systems (RS) enable travel agencies to provide dynamic case-based recommendations to their potential customers (Büyüközkan and Ergün 2011). Management decision support applications such as revenue management and artificial intelligence (AI)-based decision support systems assist managers in

making appropriate decisions derived from historical and external big data. Revenue management applications for forecasting future trends start with an analysis of customers' historical booking patterns such as booking pace, price, and duration. Later versions of revenue management applications incorporate decision support systems that analyze external data, such as competitor data and tourism arrival statistics, to generate various revenue strategy scenarios from which managers are then better enabled to pick the best model for their organization.

Small and medium travel organizations could form alliances to compete with big OTAs with their powerful interconnectivity and interoperability of application systems. A decade ago, many managers hesitated when they conducted risk assessments of implementing technology-related knowledge alliances (Pansiri and Courvisanos 2010). Most notably, the performance and efficacy of supply chains affect the overall business performance of tourism organizations (Paskaleva et al. 2011).

Service Personalization

ICT are a strategic e-business tool for customizing products, personalizing mobile services, sharing data, and supporting UGC sharing (Stiakakis and Georgiadis 2011). An intelligent mobile tour guide keeps track of user behavior and refines the user model to provide flexible travel information (Cena et al. 2006). Recommender systems (RS) contain databases with travel schedules and a service-oriented architecture that can act as a virtual tourist hub (Smirnov et al. 2017) and recommend tourist activities by ranking the geo-location, spatial coordinates of the events, tourists' location, price of the products, time slots, user profiles/personality, and diversity to provide personalized destination recommendations in real time (Gretzel et al. 2004; Montejo-Ráez et al. 2011).

Personalized RS which includes Google Translate could resolve language issues and help cater to different user interaction needs (Håkansson et al. 2010). Graphical 3D maps, as an example, allow users to access visual assistance to customize the results generated by RS (Noguera et al. 2012). Personalized recommendations can further be enhanced by including Global Positioning System (GPS) and semantic web mining from user-generated content review sites or OTA (Logesh et al. 2018). Geotagged social data identify the popularity of tourist spots, so RS can provide real-time suggestions via mobile applications that enable tourists to decide the best time to visit any specific tourist spot (Komninos et al. 2017). Collaborative filtering, which includes machine learning analysis of customer online reviews, provides a precise recommendation on Tripadvisor (Nilashi et al. 2018). However, trust is one of the main factors whenever evaluating the reliability of RS. Therefore tourism organizations must ensure they build and maintain a trust-enabled database (Pettenati et al. 2008). This can be achieved to a significant degree by collecting a traveller's personal network data from social media such as colleagues, schoolmate profiles, and travel behavior and provide recommendations according to their style and preferences (Frikha et al. 2017; He et al. 2016).

ICT can also enhance tourism product loyalty. If the customers are satisfied with an online platform, their loyalty will increase (Kim et al. 2011). Playfulness

is a main factor that affects satisfaction with online services (Vladimirov 2012). Gamification on destination websites can contribute to a more rewarding interaction for web users and elicit higher levels of satisfaction, increased brand awareness, and loyalty (Xu et al. 2017). Prior studies have proposed multiuser online role-playing games for promoting tourism (Berger et al. 2007), but until now, gamification applications are still not widely adopted by tourism organizations.

Customer feedback is perhaps the most ubiquitous of ICT applications. Such apps help business entities evaluate their service quality, gauge their customer satisfaction levels, and then identify areas in need of improvement. Collecting paper-based feedback from customers in the past was expensive, and response rates were extremely low. Online feedback forms on business websites allow customers to provide feedback anytime and anywhere. With social networks and review sites, customers share their opinions with their friends and the public at large. A negative experience posted on an Internet blog or website could be spread to millions of people overnight, and the supplier has no control whatsoever. Therefore, tourism managers should closely monitor social network platforms and promptly respond to user comments to avoid negative comments spreading quickly and afar (Ekiz et al. 2012).

Environmental Sustainability

ICT has ushered in an era of innovative ways for sustainable tourism development. Energy management systems monitor hotel room occupancy to automatically adjust in-room temperature settings. Carbon calculators are used to determine carbon emissions and the amount of energy consumed by business activities. Computer simulation applications simulate real-world settings for direct observation, manipulation, and analysis of the most effective management strategies. Destination management systems consolidate and distribute tourist information via online channels and hence reduce paper reports and brochure printing. Environment management systems keep track of waste and emission data for cost-benefit assessment and better decision-making. Websites assist cultural tourism promotional campaigns by creating destination awareness through the use of digital images and virtual tours and can thereby protect fragile artifacts and archaeological sites (Valčić and Domšić 2012). GPS, geographic information systems (GIS), and carbon calculators can assist destination managers who are dedicated to sustainable tourism (Ali and Frew 2014). Local cities can adopt location-based services via smartphones for visitors and e-parking services via mobile communication to increase the utilization of urban green spaces (Karagiannis et al. 2014). Cultural heritage concerns can adopt ICT to convey and distribute diverse multimedia information and contribute to their own long-term competitiveness and sustainability (Paskaleva and Azorín 2010). Gamified ICT applications for promoting sustainable tourism can lead to a positive impact on communication and social interaction with tourists and residents who will be better informed, more skilled, and disposed with more positive attitudes toward tourism and sustainability (Negruşa et al. 2015). Heritage sites, museum exhibits, and historical artifacts are fragile; however, it is almost impossible to stop tourist visits since these are primary tourism attractions. AR allows tourists to interact with

virtual exhibits which can increase their enjoyment while also protecting fragile artifacts with displays of accurate digitized 3D objects (Webb et al. 2016).

Overtourism is a hot topic that received intense attention and discussion in the past decade. Reino et al. (2014) proposed a benchmarking framework so that managers could quickly evaluate their current carrying capability against the benchmark and have a better understanding of their own capability. Social media is now an established factor that stimulates travel demand and leads to overtourism (Alonso-Almeida et al. 2019). Therefore using social media to disperse tourists away from the main pressure points is the best way to combat overtourism (Gretzel 2019). DMOs could manage a destination's carrying capacity by careful planning and managing tourism which concurrently respects the well-being of the permanent residents at tourism destinations (Wall 2020). By adopting ICT analytic tools and sensors, tourist movement and travel patterns could be monitored and thereby lessen the tension of overtourism.

Digital Ecosystems

In the current Internet era, it is necessary to have interconnectivity and interoperable application software to handle comprehensive business-to-business integrations (Fodor and Werthner 2004; Perks and Riihela 2004). According to Chuang et al. (2017), important technologies for e-tourism include computers, the Internet, mobile computing, social network, cloud computing, big data,, and IoT. Buhalis and O'Connor (2005) pointed out that ambience and intelligence should be the focal point of technology developments in tourism. This requires an emphasis on sensor technology, embedded systems, ubiquitous communications, media management and handling, natural interaction, contextual awareness,, and emotional computing. A prior study predicted that the future of e-tourism would focus on consumer-centric technologies that would enable business entities to carry out innovative interactions and reengineer their communication strategies (Buhalis and Law 2008). From an organization's perspective, smartness refers to the integration of a network of organizations and smart features that engage in interoperable and interconnected systems to simplify and automate daily activities. Doing so adds value throughout the entire ecosystem for all stakeholders (Buhalis and Amaranggana 2015; Buhalis and Leung 2018).

Definitions of smart tourism have been discussed among scholars. Gretzel et al. (2015b) presented seven main differences between e-tourism and smart tourism: Core technologies of smart tourism are sensors and smartphones. Data is the lifeblood of smart tourism, which means it requires a move from discrete information to big data. Smart tourism also involves shifting from a value chain mindset to an ecosystem perspective that not just serves tourists pre- and post-travel but also includes time and activities during a trip. Rather than transactional information exchanges, smart tourism values stakeholder collaborations and partnerships. And finally, smart tourism is not only about digitization but helps actors within the smart tourism ecosystem bridge digital and physical environments.

Gretzel et al. (2015a, p. 181) defined smart tourism as:

Tourism supported by integrated efforts at a destination to collect and aggregate/harness data derived from physical infrastructure, social connections, government/organizational sources and human bodies/minds in combination with the use of advanced technologies to transform that data into on-site experiences and business value-propositions with a clear focus on efficiency, sustainability and experience enrichment.

Liburd et al. (2017) proposed smart tourism should be considered involving three aspects including (1) embracing the fluid and emergent nature of intelligent, appreciative, and complementary understanding that is more empathic, flexible, humble, and sustainable, (2) co-design of values, and (3) collaborative design with trust.

Intelligent Environment

The move toward a smart tourism ecosystem necessitates a re-engineering of operations and procedures with interconnectivity and interoperable application systems. Governments can play a leading role in moving an entire country through a smart transformation by investing in DMOs, ICT capital, human capital, and values (Vargas-Sánchez 2016). For example, the government of Russia constructed an information highway and associated e-government integrations with numerous digitalization programs (Kolarova et al. 2006). The Taiwan government was the first to provide free Wi-Fi access to both residents and tourists (iTaiwan 2011). Citizens and visitors in public areas within the European Union have been provided free Wi-Fi connectivity primarily by funding made available by municipalities for hardware and maintenance.

The vast mobile network will continue to play a crucial role in the tourism industry and must adjust and constantly adapt as the functions and durability of smartphones are continually enhanced. Smart hospitality networks connect all stakeholders within the overall smart ecosystem and sub-ecosystems and consolidate and aggregate historical and external environment contextual observations to form big data while all data can be maintained anonymously and confidentially (Buhalis and Leung 2018). Unfortunately, many stakeholders in the tourism industry have not yet recognized the importance and benefits of mobile technology (Dorcic et al. 2019). Many smart applications such as AI-enabled business intelligence systems are available, but ICT adoption in the hospitality and tourism industry is still considered rather limited. Most business applications remain mainly text- and image-based while 3D and real-time applications are not widespread.

The involvement of government can be significant. Some local city governments have installed an impressive array of sensors to measure the external environment such as water and air quality which, in turn, can ensure travel quality and attractiveness (Karagiannis et al. 2014). Business organizations make use of these sensors and beacons for their marketing activities. Edge computing allows the information collected by these sensors to be processed to the edge of the network away from data centers so as to reduce data traffic (Taleb et al. 2017). Subsequently, data can be sent to the cloud for comprehensive data analysis by combining it into big data and using AI to scrutinize it.

Even though smart tourism has recently become a hot topic, there remain a series of challenges to overcome before full realization. Smart tourism experiences require extensive technologies and derivative services; therefore, the IT skill level of the tourists especially with handheld devices will impact smart service delivery and tourist satisfaction (Gretzel et al. 2015a). Moreover, some tourism stakeholders do not clearly understand the definition of "smart tourism" and its critical functions such as interconnectivity and interoperability along the supply chain points, applications, and linkages to external big data. For example, accurate revenue forecasting, social media monitoring, and the use of AI and robots are fundamentally beneficial to any manager or leadership team (Leung 2019). Interconnectivity and interoperability of devices installed inside a hotel for use by both employee and hotel guests is occurring with the implementation of high-speed 5G networks and the Internet of Things (IoT). Ambient intelligence brings current information to tourism ecosystems and helps make those environments more sensitive, flexible, and adaptive to the needs of stakeholders (Buhalis 2019). For example, hotel and restaurant lighting and temperature can be dynamically adjusted to provide a comfortable environment for customers and guests. Operations can also be automated via an IoT network. For example, inventory management can be monitored by sensors installed inside a warehouse or refrigerators that will identify the inventory on hand and the expiry date of the items.

Autonomous Services

Self-service options can reduce contact with human staff members for mundane and/or simple assistance. Therefore, implementing a customer relationship management system and providing personalized services could maintain or bolster brand loyalty (Stockdale 2007). Self-service kiosks, for instance, provide a pre-programmed environment for novice users for simple tasks such as ticket selling, check-in/checkout, food ordering, and information retrieval that previously were completed by service staff. Autonomy devices, self-learning algorithms, and IoT are at the forefront of the movement of tourism ecosystems from e-tourism toward smart tourism. However, this ecosystem cannot be truly ubiquitous without the establishment of the necessary technological and regulatory foundations (Gretzel et al. 2015c).

Public sector policy makers should define any technical standards, policies, and regulations for implementing any new tools in the tourism industry. As an illustration, robots have been increasingly replacing humans to carry out repetitive, boring, and stressful tasks at even high speeds and efficiency (Engelberger 2012). The first robot hotel Henn na Hotel was opened in Nagasaki, Japan, in 2015. The hotel management placed emphasis on humanless service. The receptionists, concierge, luggage handling, and in-room ambient controls were all done by robots. However, these robots were not AI-embedded, so they could not interact with hotel guests according to any specific, in-the-moment requests. Because of this inflexibility and lack of intelligence, Henn na Hotel Group decided to lay off half of their in-room robots after 4 years because they found that some robots were not advanced enough to perform many of the tasks they needed to do and quite

unexpectedly created much extra work for the human staff (Forbes 2019). Also, Hilton hotel collaborated with IBM to design the first Watson-enabled robot *Connie* to assist with guest requests, personalize guest experiences, and empower travellers with additional information for trip planning (Hilton 2016).

It is important to extend research on human-robot interactions with the increasing number of users interacting with robots every day (Tung and Law 2017). Service robots in restaurants not only serve customers but can also cook and prepare meals. Operations from low-level operational robots for flipping hamburgers and making cocktails to sophisticated robots with learning ability that can simulate celebrity chef movements to assist with cooking at home are useful as well as popular (Moley Robotics 2015). Autonomous devices can save labor costs and increase service efficiency. Drones can be utilized for remote service delivery in areas where no infrastructure is available, and hotels or event venues can adopt autonomous furniture that can automatically relocate to a desired location for any specific occasion.

Virtual agents (VA) or chatbots (e.g., Google Assistant, Apple's Siri, Amazon's Alexa, and Microsoft's Cortana) are currently the most developed forms of AI that support customer services (Syam and Sharma 2018). Tourists can use their mother language to voice control VAs to accomplish tasks such as tour and restaurant reservations, in-room ambient control, and numerous functions from inside their room even without any language barriers.

ICT Development from the Tourist Perspective

One of the reasons why people travel is to escape from their daily routine; however, because of increasing digitalization of life and work, people are having difficulties due to their inability of letting go of network connections when they travel (Egger et al. 2020). On the positive side, ICT has changed tourist travel patterns and enabled co-creation of experiences. This transformation has revolutionized the travel planning process and ushered in a new era of co-created tourist travel experiences on three levels: technology-assisted experience, technology-enhanced experience, and technology-empowered experience (Neuhofer et al. 2014). At the technology-assisted experience level, ICT acts as a mediator for information retrieval and communication. At the technology-enhanced level, tourists participate and interact with tourism organization's activities via interactive technologies such as social media platforms (e.g., Facebook, Instagram, Twitter, and YouTube). Finally, tourists incorporate high-level technologies at the technology-empowered experience to co-create and optimize their own experiences. These enhanced travel experiences appear in all three stages of the tourist life cycle (pre-trip, in-trip, and post-trip) (Joseph and Anandkumar 2016).

With ICT, tourists can gather and analyze travel information to plan for the trip, adopt ICT to enhance the travel experience, and share their travel memories online. Figure 1 illustrates the ICT applications for tourists in the three travel stages.
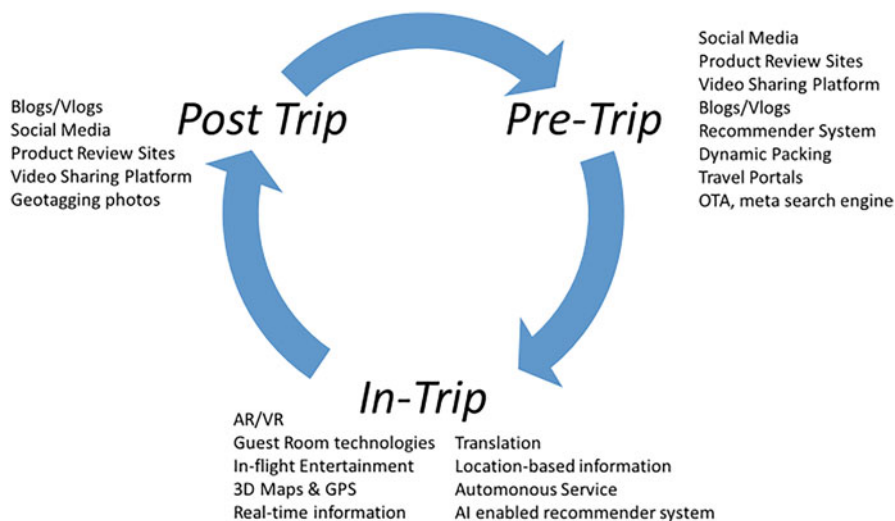
Social Media
Product Review Sites
Video Sharing Platform
Blogs/Vlogs
Recommender System
Dynamic Packing
Travel Portals
OTA, meta search engine

Blogs/Vlogs
Social Media
Product Review Sites
Video Sharing Platform
Geotagging photos

Post Trip   *Pre-Trip*

In-Trip

AR/VR
Guest Room technologies   Translation
In-flight Entertainment   Location-based information
3D Maps & GPS   Automonous Service
Real-time information   AI enabled recommender system

Fig. 1 ICT applications for tourists in the three stages of travel

Technology Changes Pre-trip Behavior

Traditionally, travel inspiration came from DMO promotional materials, tourist guidebooks, tourism promotional videos, recommendations from travel agencies, and friends and relatives' word-of-mouth regarding their past experiences. Tourists went to a travel agency seeking travel information and products, and they usually would end up using the tourist agency's services. Just a few decades ago, there were extremely few channels for the ordinary customer to buy airline tickets or book hotel rooms directly from suppliers. In those times, communication costs (e.g., IDD calls) were very expensive, and language differences posed major barriers whenever communicating with overseas companies. Besides, operating a GDS required special training, and printing of airline tickets also needed specific licensing from the airline company. As a result, travel agencies were the main channels for tourists to buy travel products.

In the current Internet era, tourist travel behaviors have changed dramatically. At the pre-trip stage, tourist travel intention behavior can be gathered from computer clicks and keywords typed related to any banner and/or online advertisements. Information search behavior can be found from the product searched via e-distribution intermediaries. Visits to travel review sites can help better understand and evaluate processes. Online transactions inside shopping carts can indicate tourist buying behaviors, and membership profiles record customer preferences and help form target marketing (Louvieris and Driver 2004).

With the popularity of smartphones and the rapid development of broadband cellular network technology, mobile applications have gradually replaced desktop applications. Tourists no longer depend on outdated paper-based travel materials for

travel ideas (Umlauft et al. 2002). Especially for younger generations, their travel desire is influenced by blogs, vlogs, and social networks (Bajpai and Lee 2015). Business travellers' ICT needs include reliable website reservation systems and in-room Internet access; these have become the most critical ICT application for hotel choice (Yeh et al. 2005). Multimedia, 3D images, and web-based GIS applications such as Google Maps have greatly expanded the ways travel information is being accessed. Practical information, such as transportation, accommodation, and location-specific information, have become primary information sources for travel destination choice and planning (Chang and Caneday 2011). In addition, tourists can obtain VR materials prepared by tourism organizations which is an innovative way to be inspired when engaging in travel planning. Furthermore, users can immerse themselves in a computer-generated environment such as Second Life, where interactions with the virtual environment and co-created travel experiences can occur with avatars (Guttentag 2010).

Traditional travel planning mainly depended on tour guidebooks and information brochures from DMOs. The information provided from these two channels was very generic. Consequently, the more experienced tourists were oftentimes not satisfied. Tourists could only explore their destination upon arrival at the destination, so no advanced planning could be carried out. ICT, however, assists tourists when planning their trips. The earliest intelligent travel planning began with collecting travel-related information by WebBots and providing solutions to resolve specific user problems (Camacho et al. 2001). However, since the results were obtained from existing databases, personalization was essentially impossible and unavailable. For instance, chat-based RS recommender systems allow users to make decisions among sets of alternatives (Nguyen and Ricci 2018).

Destination information is an important piece of information for any travel planner. The e-tourism tools examine the spatial and temporal data collected from social media channels and then can forecast the most likely tourist travel behavior and assist tourists with their vacation planning (Pichler et al. 2014). RS assist with automatically arranging travel affairs (Camacho et al. 2006), so it must be able to provide various itinerary recommendations based on the tourist's specific preferences, demographic characteristics, and places visited on former trips. In this manner, personalized travel information can be offered that best matches the user's taste (Sebastia et al. 2009). Advanced RS include using social network data and travel patterns which provide customized recommendations (Chiang and Huang 2015; Frikha et al. 2017; He et al. 2016). Later on, RS included machine-learning algorithms to analyze customer online reviews and assist tourist travel decision-making (Nilashi et al. 2018).

Travel products are high-involvement products because customers cannot try them beforehand. Therefore, travellers need extra information to support their purchase decisions. Review comments posted on social media and UGC sites play a highly valued role for travel product choices (Papathanassis and Knolle 2011). Facebook is one of the key information sources for travel planning, a practical and efficient place for sharing judgments and complaints, as well as enhancing tourist knowledge management, coordination, and even claim reduction (Pantano

and Pietro 2013); however, users understandably trust information that comes from close friends (Stiakakis and Vlachopoulou 2017). Since social media and UGC comments play a crucial role in travel planning, it is important to ensure the online review data are reliable data sources (Xiang et al. 2018).

Tourists seek comments/reviews from the virtual community before purchasing travel products. Sources such as Tripadvisor should formulate their strategies for significant adoption and implementation of consumer-generated media which will attract tourist attention (Burgess et al. 2015). Even though tourists can purchase products directly from a supplier's website, many of them use metasearch engines to compare prices. Metasearch engines have become a new form of travel intermediaries (Hikkerova 2010). All in all, understanding e-tourists' digital behavior is essential and significant for enhancing the success of online channels.

ICT Co-create In-trip Experiences

The durability of mobile devices, battery life, and high speed, along with low data communication costs and a cellular network, have greatly catalyzed the development of tourist in-trip applications. Context-aware mobile multimedia guides that integrate emerging technologies and new communication standards provide both appealing and ubiquitous solutions to tourists (Raposo et al. 2012). Geographical location, as an example, is one of the most critical pieces of information for tourists during their trip. Tourists can easily explore the city with mobile applications such as route planning and real-time map services (e.g., Google Map). Web-based self-guided applications integrated with online maps and GPS allow users to edit their travel plans, browse an itinerary via mobile devices, and share their itinerary with friends (Lin et al. 2014). With geotagged social data, social context crowdsourcing mobile application identifies the popularity of tourist spots and showcases a heatmap of a social "buzz" that can help tourists decide the best place to go and the best time (Komninos et al. 2017). RS can provide in-trip recommendations to enhance travel satisfaction by combining the GPS location of the tourists with review site data (Logesh et al. 2018).

Multimedia displays, especially 3D images from augmented reality (AR) and VR, present new experiences to tourists in museums (Jung et al. 2016). ICT cocreates a tourist's real-time experiences in various ways, for instance, location-based promotional messages via smartphone; receiving external environment conditions such as weather and road traffic conditions via sensors and beacons installed around the city; retrieving instant attraction details by scanning QR codes; and locating empty parking space locations via geofencing network (Karagiannis et al. 2014). Mobile technology spurs virtual experiences. AR applications support tourists via smartphone applications who like roaming around in unfamiliar environments (Yovcheva et al. 2012). During a trip, a tourist's experiences can be enhanced by virtual tours with an interactive map, virtual games, and journey planners (Chiabai et al. 2013). AR provides supplemental information such as development or construction/repairs in progress, the original look of onsite architecture, and

even personalized site details via mobile devices that are interesting to the tourists (Tscheu and Buhalis 2016). On the one hand, tourists can explore and interact with an accurate digitized 3D exhibit and increase the enjoyment of learning and, on the other hand, protect the real, fragile artifacts (Webb et al. 2016).

One of the major barriers to travelling is having to negotiate a foreign language. AI-enabled language recognition systems assist tourists in this regard. Cross-lingual information retrieval systems that can automatically translate an English phrase into Chinese characters were developed over a decade ago (Li and Law 2007). Shortly thereafter Mexican entrepreneurs implemented a mobile application that incorporated Spanish translations, Google Map API, and a GPRS cellular network to display heritage site information (Zacarias et al. 2015). More recently, translation devices provide instant multiple language translation services for tourists that greatly facilitate interaction with locals worldwide. Any successful e-tourism system nowadays must also be able to handle a wide range of online payment options with efficient and user-friendly interfaces (Mohamed and Moradi 2011). Besides traditional payment methods like credit cards, stored-value pre-paid cards, and electronic wallets, cryptocurrency has demonstrated the potential to become an indispensable future currency for tourists since it can avoid currency exchange and rate fluctuation.

ICT-Empowered Real-Time and Post-trip Sharing

Travelling is not only for creating short-lived personal experiences but also provides long-term memories. Images are a quintessential type of souvenir that provide authentic reminders of a particular place and/or experience (Gordon 1986). Traditionally in past generations, tourists would send a postcard to friends for sharing their happiness and travel experiences. The web platform Web 1.0 was mainly for information retrieval and business activities, so users were not able to share their experiences. However, Web 2.0 enables social networking such that tourists can easily contribute online by writing blogs (e.g., TravelBlog) and microblogs (e.g., Twitter) and through social network sites (e.g., Facebook) and multimedia-sharing sites (e.g., YouTube, Instagram) to share their travel diary with friends and family. Furthermore, tourists can also register reviews of their experiences with the public via user-generated content (UGC) review sites (e.g., Tripadvisor) or OTA websites. Photographs or short videos sent from mobile phones are now the new de facto postcard for sharing among friends. Sharing, of course, includes not only knowledge-related aspects such as the product quality, prices, and weather conditions but may include the tourist's personal emotions, imaginations, and fantasies about their trips.

Tourists are widely different and have different motivations for contributing to social networks. One simple reason is the enjoyment of showing their experience to the particular virtual community to which they belong. Through their contribution they might feel a sense of belonging, solidarity, and identification as a unique member of their community. Moreover, they can support other members and

help everyone feel needed and appreciated. Electronic word-of-mouth (eWOM) comprises active persons who provide their personal evaluations and opinions about products and businesses in virtual communities found across the web. Travelling, for instance, is a unique visual experience and vacation photos are important components of one's travels. Travel photos contain information relating to the interests and activities of tourists during their trips. "The art of much tourist photography is to place one's 'loved ones' within an 'attraction' in such a way that both are represented aesthetically" (Urry and Larsen 2011, p. 179). Therefore, and not surprisingly, people believe that personal information on review sites is more trustworthy than the marketing materials provided by tourism organizations (Yoo and Gretzel 2008).

The Internet has become an ideal channel for customers to voice their dissatisfaction to a service provider; it is fast and direct; minimizes any barriers of time, place, or prescribed process for registering a complaint; and eliminates any face-to-face embarrassment (Ekiz et al. 2012). Therefore, the response rates of posting negative online reviews are relatively higher than the paper-based versions. Customers log their comments not only to express their dissatisfaction but sometimes hope their feedback will help an organization to quickly and appropriately improve. As a result, tourists expect managers to respond to their reviews or else they will most likely feel even more disappointed. "Attention is retention," as the adage goes.

ICT Catalyze IT Skills Training and E-Learning

Over the last few decades, the development of ICT introduced new technologies such as the Internet, social media, NFC, VR and AR, ubiquitous computing, AI, IoT, and cloud computing. Their applications like reputation management, revenue management system, decision support system, service robot, and autonomous devices not only revolutionized tourism ecosystem operations and management and customer travel behavior (Boes et al. 2015). To cope with the rapidly changing and developing tourism industry environment, colleges and university have to ensure the graduates' IT skills needed by the industry are covered in the curriculum (Bilgihan et al. 2014). Elliot and Joppe (2009) identified several IT-related competencies, including electronic information sharing, IT knowledge and e-business, e-marketing skills, computer skills, and general use of IT. ICT knowledge and skills have become a core set of competencies for students. Employers expect graduates will be well equipped with ICT skills after they graduate. At the most fundamental level, the tourism curriculum design should include computer skills on how to use office tools such as word processing (Microsoft Word) and presentation tools (PowerPoint) (Sigala 2002). With the rapid expansion of ICT throughout almost every aspect of the tourism industry, the need for updating the tourism curriculum is critical. For example, big data analysis, online marketing, database management, GDS/GIS operations, and word processing are indispensable. However, inside tourism program curriculum design, ICT-related educational components have been relatively weak. Future management decision-making strongly depends on

extrapolating meaningful results generated from big data and problem-solving applications. Future tourism employees must be able to understand the concept of data mining, analysis, and interpretation for decision-making. There currently exists a gap between the students' expectations/needs and actual curriculum design (Femenia-Serra 2018).

ICT and the Internet form the learning media platform in tourism (Cantoni et al. 2009). Industry practitioners and undergraduate students hold positive perceptions toward e-learning courses (Eraqi et al. 2011; Kalbaska et al. 2013). Integrating technology into instructional practices also helps develop student capabilities for wisely using and managing technological trends within their working environment (Sigala, 2007).

Generation Z was born with the Internet, and smartphones are a commonplace critical tool used daily. Shifting lectures and tutorials onto a mobile platform is an essential next step forward (Fermoso et al. 2015). Goh and Sigala (2020) proposed that tourism education must teach the necessary ICT usage skills by integrating ICT into course curriculum content, and instructors must adopt ICT and innovative teaching methods for interacting with students. Innovative teaching materials have been shown to increase students' learning motivation and outcomes.

A study on using Wiki and blogs as teaching aids indicated that students show positive attitudes but these are not overwhelmingly favorable (Lillo-Bañuls et al. 2016). Online learning platform such as Massive Open Online Courses (MOOCs) uses a counselling learning approach so that by combining social media, interaction among instructors and learners could increase and help build a sense of an interpersonal relationship. This relationship continues even after a course is completed (Marchiori and Cantoni 2018). Organizing and taking a large group of students to a hotel for a field trip may be a challenging task for most instructors. However, visiting via a web (virtual field trip) could motivate students toward problem-solving and generate more anticipation with a 360-degree view (Patiar et al. 2017) which indicates that VR could serve as a valuable instructional platform.

Expected Future Developments

Even though ICT has become an essential tourism tool, tourism organization managers and technology experts have overlooked its potency in a few key areas. For instance, accessible tourism offers substantial economic potential, but web-based information has not always been easy to access by disabled persons (Pühretmair 2004). Tourists who are challenged with different forms of impairments as well as elderly populations who require different levels of assistance when making decisions about travel and destinations are just two segments that can be assisted with ICT. In turn, this could increase travel business competitiveness via specially focused destination marketing activities (Buhalis and Michopoulou 2011). Elderly consumers are inaccurately considered and widely ignored as users of e-tourism (Szopiñski and Staniewski 2016). Tourism organizations should avoid inequalities in access, use, and engagement with ICT between tourism markets and destinations (Minghetti and Buhalis 2010).

The Internet of Things (IoT) and 5G network are fuelling the rapid evolution and growth of e-tourism toward smart tourism and are further disrupting the current ecosystem, business models, and practices. Sensors and beacons installed around a city and within organizations can monitor the external and internal environment and reflect real-time data accessible by application systems for big data analysis. Open data applications suit continuous business operations and data sharing among all tourism business entities (Yu 2016). However, open databases might not be easily implemented without government involvement.

Blockchain technology is still in its infancy in practice (Yuan and Wang 2016), but it can assist in smart tourism developments in various ways. It creates new opportunities for the sharing economy, altering conventional e-commerce operations through effective and efficient reallocation of resources (Pazaitis et al. 2017). The emergence of sharing economy services such as Uber and Airbnb changes how people plan their trips. Nevertheless, the essence of the sharing economy cannot be optimized without mutual trust between service providers and users. Blockchain can serve as an intermediary for business contracts between travel suppliers and customers since contract information is impossible to be altered after being established and can deal with the trust problem effectively (Rashideh 2020). It can stream data from various sources and platforms to maximize capacity without overbooking (Irannezhad and Mahadevan 2020). Furthermore, the decentralization of blockchain, that is, distributed ledgers, can further alleviate the problem of trust engendered by peer-to-peer business models or hotels in their relationship with online travel intermediaries (Flecha-Barrio et al. 2020).

Smart tourism network interconnected the tourism ecosystem. The whole network is supported by IoT, sensors and beacons, network infrastructure, and the cloud. Each organization's internal databases are inter-exchangeable among the supply chains. External databases from public and private sectors and environmental data collected from sensors are consolidated on the cloud. AI-enabled applications support both organizational management and customer service. Decision support systems consolidate external data with operations and management data for strategic decisions. Robots and autonomous devices react automatically according to the customer's context. Intelligent building adjusts architecture's ambience: on one hand it can provide comfortable ambient to the customers and, on the other hand, can protect the environment and save energy cost. The smart tourism network and the applications also support the tourist's three travel stages. The smart applications not only allow tourists to enhance their travel experience but also improve the interaction with the tourism practitioners. Figure 2 illustrates a proposed future smart network for the tourism ecosystem.

Smart networks not only focus on technology adoption and implementation but also on architectural design. The layout and structure of an intelligent building with a responsive and adaptive design can be changed according to the user's requirements (Urquhart et al. 2019) which allows tourism managers more flexibility on venue management. Buildings covered with smart materials can be adjusted according to outside stimuli such as weather conditions to reduce energy consumption and environmental impact (Alobeidi and Alsarraf 2018). The future hotel
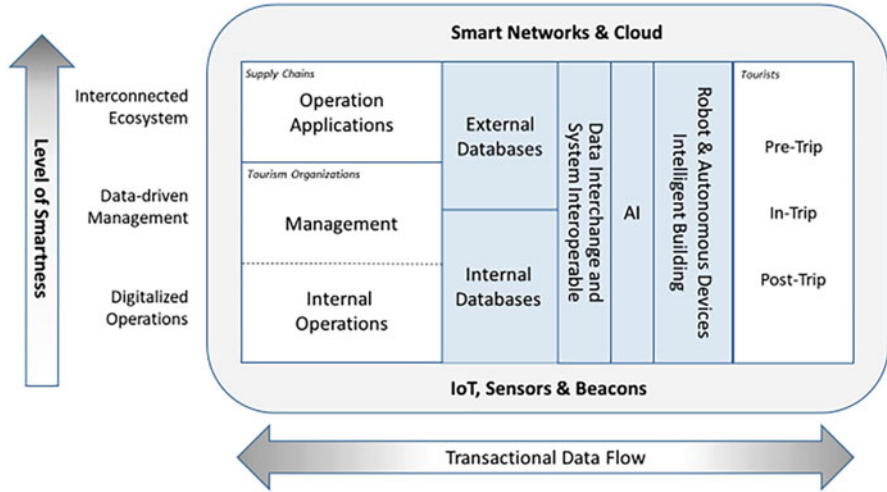
Fig. 2 Proposed comprehensive smart tourism network

should be operated by an intelligent building with adaptive architecture. Inclusion of smart technology into basic building design and architectural planning can (1) dynamically adjust the internal ambience including lighting, temperature, and humidity according to the external environment and (2) adjust the living dimensions of a hotel room and functional areas according to guest size and layout needs (Leung 2020). Planners will also analyze real-time data on consolidated hotel occupancy, restaurant, and event bookings and can then accordingly convert guest rooms for an event venue or vice versa according to demand.

Cross-References

References

Alcántara-Pilar JM, del Barrio-García S, Crespo-Almendros E, Porcu L (2017) Toward an understanding of online information processing in e-tourism: does national culture matter? J Travel Tour Mark 34(8):1128–1142. Scopus. https://doi.org/10.1080/10548408.2017.1326363

Ali F (2016) Hotel website quality, perceived flow, customer satisfaction and purchase intention. J Hosp Tour Technol 7(2):213–228. Scopus. https://doi.org/10.1108/JHTT-02-2016-0010

Ali A, Frew AJ (2014) Technology innovation and applications in sustainable destination development. Inf Technol Tour 14(4):265–290. https://doi.org/10.1007/s40558-014-0015-7

Alobeidi MM, Alsarraf AA (2018) The impact of the use of smart materials on the facades of contemporary buildings. Int J Eng Technol 7(4.19):744–750

Alonso-Almeida M-M, Llach J (2013) Adoption and use of technology in small business environments. Serv Ind J 33(15–16):1456–1472. https://doi.org/10.1080/02642069.2011.634904

Alonso-Almeida M-M, Borrajo-Millán F, Yi L (2019) Are social media data pushing overtourism? The case of Barcelona and Chinese tourists. Sustainability 11(12):3356. https://doi.org/10.3390/su11123356

Álvarez LS, Martín AM D, Casielles RV (2007) Relationship marketing and information and communication technologies: analysis of retail travel agencies. J Travel Res 45(4):453–463. https://doi.org/10.1177/0047287507299593

Au N, Ho GKC, Law R (2014) Towards an understanding of e-procurement adoption: a case study of six hotels in Hong Kong. Tour Recreat Res 39(1):19–38. https://doi.org/10.1080/02508281.2014.11081324

Ayeh JK (2006) Determinants of Internet usage in Ghanaian hotels: the case of the greater accra region (GAR). J Hosp Leis Mark 15(3):87–109

Bajpai A, Lee C-W (2015) Consumer behavior in e-tourism services: a case of Taiwan. Tour Hosp Manag 21(1):1–17

Benckendorff PJ, Xiang Z, Sheldon PJ (2019) Tourism information technology, 3rd edn. CABI, Wallingford

Berger H, Dittenbach M, Merkl D, Bogdanovych A, Simoff S, Sierra C (2007) Opening new dimensions for e-tourism. Virtual Reality 11(2–3):75–87. Scopus. https://doi.org/10.1007/s10055-006-0057-z

Besbes A, Legohérel P, Kucukusta D, Law R (2016) A cross-cultural validation of the tourism web acceptance model (T-WAM) in different cultural contexts. J Int Consum Mark 28(3):211–226. Scopus. https://doi.org/10.1080/08961530.2016.1152524

Bilgihan A, Berezina K, Cobanoglu C, Okumus F (2014) The information technology (IT) skills of hospitality school graduates as perceived by hospitality professionals. J Teach Travel Tour 14(4):321–342. https://doi.org/10.1080/15313220.2014.955303

Boes K, Buhalis D, Inversini A (2015) Conceptualising smart tourism destination dimensions. In: Tussyadiah I, Inversini A (eds) Information and communication technologies in tourism 2015. Springer International Publishing, pp 391–403. https://doi.org/10.1007/978-3-319-14343-9_29

Bruhn M, Schoenmueller V, Schäfer DB (2012) Are social media replacing traditional media in terms of brand equity creation? Manag Res Rev MRN Patrington 35(9):770–790. https://doi.org/10.1108/01409171211255948

Buhalis D (2004) eAirlines: strategic and tactical use of ICTs in the airline industry. Inf Manag 41(7):805–825. https://doi.org/10.1016/j.im.2003.08.015

Buhalis D (2019) Technology in tourism-from information communication technologies to e-tourism and smart tourism towards ambient intelligence tourism: a perspective article. Tour Rev 75(1):267–272. https://doi.org/10.1108/TR-06-2019-0258

Buhalis D, Amaranggana A (2015) Smart tourism destinations enhancing tourism experience through personalisation of services. In: Tussyadiah I, Inversini A (eds) Information and communication technologies in tourism 2015. Springer International Publishing, Cham, pp 377–389

Buhalis D, Deimezi O (2004) E-tourism developments in Greece: information communication technologies adoption for the strategic management of the Greek tourism industry. Tour Hosp Res 5(2):103–130. https://doi.org/10.1057/palgrave.thr.6040011

Buhalis D, Kaldis K (2008) eEnabled internet distribution for small and medium sized hotels: the case of Athens. Tour Recreat Res 33(1):67–81. Scopus. https://doi.org/10.1080/02508281.2008.11081291

Buhalis D, Law R (2008) Progress in information technology and tourism management: 20 years on and 10 years after the Internet-The state of e-tourism research. Tour Manag 29(4):609–623. Scopus. https://doi.org/10.1016/j.tourman.2008.01.005

Buhalis D, Leung R (2018) Smart hospitality – interconnectivity and interoperability towards an ecosystem. Int J Hosp Manag 71:41–50. https://doi.org/10.1016/j.ijhm.2017.11.011

Buhalis D, Licata MC (2002) The future e-tourism intermediaries. Tour Manag 23(3):207–220. Scopus. https://doi.org/10.1016/S0261-5177(01)00085-1

Buhalis D, Michopoulou E (2011) Information-enabled tourism destination marketing: addressing the accessibility market. Current Issues Tour 14(2):145–168. https://doi.org/10.1080/13683501003653361

Buhalis D, O'Connor P (2005) Information communication technology revolutionizing tourism. Tour Recreat Res 30(3):7–16. https://doi.org/10.1080/02508281.2005.11081482

Burgess S, Sellitto C, Cox C, Buultjens J (2015) Strategies for adopting consumer-generated media in small-sized to medium-sized tourism enterprises. Int J Tour Res 17(5):432–441. https://doi.org/10.1002/jtr.2008

Büyüközkan G, Ergün B (2011) Intelligent system applications in electronic tourism. Expert Syst Appl 38(6):6586–6598. Scopus. https://doi.org/10.1016/j.eswa.2010.11.080

Camacho D, Borrajo D, Molina JM (2001) Intelligent travel planning: a multiAgent planning system to solve web problems in the e-tourism domain. Auton Agents Multi-Agent Syst 4(4):387–392. Scopus. https://doi.org/10.1023/A:1012767210241

Camacho D, Aler R, Borrajo D, Molina JM (2006) Multi-agent plan based information gathering. Appl Intell 25(1):59–71. Scopus. https://doi.org/10.1007/s10489-006-8866-z

Cantoni L, Kalbaska N, Inversini A (2009) E-Learning in tourism and hospitality: a map. J Hosp Leis Sport Tour Educ (Oxford Brookes University) 8(2):148–156. https://doi.org/10.3794/johlste.82.263

Capatina A, Micu A, Micu AE, Bouzaabia R, Bouzaabia O (2018) Country-based comparison of accommodation brands in social media: an fsQCA approach. J Bus Res 89:235–242. Scopus. https://doi.org/10.1016/j.jbusres.2017.11.017

Çakar K, Kalbaska N, Inanir A, ªahin Ören T (2018) eVisa's impacts on travel and tourism: the case of Turkey. J Hosp Tour Technol 9(1):13–31. Scopus. https://doi.org/10.1108/JHTT-02-2017-0019

Cena F, Console L, Gena C, Goy A, Levi G, Modeo S, Torre I (2006) Integrating heterogeneous adaptation techniques to build a flexible and usable mobile tourist guide. AI Communications 19(4):369–384

Çetin B, Akpinar A, Ozsayin D (2004) The use of information and communication technologies as a critical success factor for marketing in Turkish agri-food companies. Food Rev Int 20(3):221–228. https://doi.org/10.1081/FRI-200029420

Chang G, Caneday L (2011) Web-based GIS in tourism information search: perceptions, tasks, and trip attributes. Tour Manag 32(6):1435–1437. Scopus. https://doi.org/10.1016/j.tourman.2011.01.006

Chiabai A, Paskaleva K, Lombardi P (2013) e-Participation model for sustainable cultural tourism management: a bottom-up approach. Int J Tour Res 15(1):35–51. https://doi.org/10.1002/jtr.871

Chiang H-S, Huang T-C (2015) User-adapted travel planning system for personalized schedule recommendation. Inf Fusion 21(1):3–17. Scopus. https://doi.org/10.1016/j.inffus.2013.05.011

Christodoulidou N, Connolly DJ, Brewer P (2010) An examination of the transactional relationship between online travel agencies, travel meta sites, and suppliers. Int J Contemp Hosp Manag Bradford 22(7):1048–1062. https://doi.org/10.1108/09596111011066671

Chuang TC, Liu JS, Lu LYY, Tseng F-M, Lee Y, Chang C-T (2017) The main paths of e-tourism: trends of managing tourism through Internet. Asia Pac J Tour Res 22(2):213–231. https://doi.org/10.1080/10941665.2016.1220963

Davidson R, Alford P, Seaton T (2002) The use of information and communications technology by the European meetings, incentives, conferences, and exhibitions (MICE) sectors. J Conv Exhib Manag 4(2):17. https://doi.org/10.1300/J143v04n02_03

de Rosa AS, Bocci E, Dryjanska L (2019) Social representations of the European capitals and destination e-branding via multi-channel web communication. J Destin Mark Manag 11:150–165. Scopus. https://doi.org/10.1016/j.jdmm.2017.05.004

Dorcic J, Komsic J, Markovic S (2019) Mobile technologies and applications towards smart tourism – state of the art. Tour Rev. https://doi.org/10.1108/TR-07-2017-0121

Egger I, Lei SI, Wassler P (2020) Digital free tourism – an exploratory study of tourist motivations. Tour Manag 79:104098. https://doi.org/10.1016/j.tourman.2020.104098

Ekiz E, Khoo-Lattimore C, Memarzadeh F (2012) Air the anger: investigating online complaints on luxury hotels. J Hosp Tour Technol 3(2):96–106. https://doi.org/10.1108/17579881211248817

Elliot S, Joppe M (2009) A case study and analysis of e-tourism curriculum development. J Teach Travel Tour 9(3/4):230–247. https://doi.org/10.1080/15313220903379299

Engelberger JF (2012) Robotics in practice: management and applications of industrial robots. Springer Science & Business Media, Boston

Eraqi MI, Abou-Alam W, Belal M, Fahmi T (2011) Attitudes of undergraduate students toward e-learning in tourism: the case of Egypt. J Teach Travel Tour 11(4):325–348. https://doi.org/10.1080/15313220.2011.624397

Ert E (2014) Nontrivial behavioral implications of trivial design choices in travel websites. Adv Cult Tour Hosp Res 8:53–59. Scopus. https://doi.org/10.1108/S1871-317320140000008002

Femenia-Serra F (2018) Smart tourism destinations and higher tourism education in Spain. Are we ready for this new management approach? In: Stangl B, Pesonen J (eds) Information and communication technologies in tourism 2018. Springer International Publishing, pp 437–449. https://doi.org/10.1007/978-3-319-72923-7_33

Fermoso AM, Mateos M, Beato ME, Berjón R (2015) Open linked data and mobile devices as e-tourism tools. A practical approach to collaborative e-learning. Comput Hum Behav 51:618–626. Scopus. https://doi.org/10.1016/j.chb.2015.02.032

Fernandes T, Fernandes F (2018) Sharing dissatisfaction online: analyzing the nature and predictors of hotel guests negative reviews. J Hosp Mark Manag 27(2):127–150. Scopus. https://doi.org/10.1080/19368623.2017.1337540

Flecha-Barrio MD, Palomo J, Figueroa-Domecq C, Segovia-Perez M (2020) Blockchain implementation in hotel management. In: Neidhardt J, Wörndl W (eds) Information and communication technologies in tourism 2020. Springer International Publishing, pp 255–266. https://doi.org/10.1007/978-3-030-36737-4_21

Fodor O, Werthner H (2004) Harmonise: a step toward an interoperable e-tourism marketplace. Int J Electron Commerce 9(2):11–39. Scopus

Forbes (2019) World's first robot hotel fires half of its robots. Forbes. https://www.forbes.com/sites/samshead/2019/01/16/worlds-first-robot-hotel-fires-half-of-its-robots/

Frikha M, Mhiri MBA, Gargouri F (2017) Social Trust based semantic tourism recommender system: a case of medical tourism in Tunisia. Eur J Tour Res 17:59–82

Fuchs M, Höpken W, Föger A, Kunz M (2010) E-business readiness, intensity, and impact: an Austrian destination management organization study. J Travel Res 49(2):165–178. https://doi.org/10.1177/0047287509336469

García-Crespo A, Colomo-Palacios R, Gómez-Berbís JM, Chamizo J, Rivera I (2010) Intelligent decision-support systems for e-tourism: using SPETA II as a knowledge management platform for DMOs and e-tourism service providers. Int J Decis Support Syst Technol 2(1):36–48. https://doi.org/10.4018/jdsst.2010101603

Garkavenko V, Bremner H, Milne S (2003) Travel agents in the "information age": New Zealand's experiences of disintermediation. In: Information and communication technologies in tourism 2003: proceedings of the international conference in Helsinki, 2003, pp 467–476

Giannopoulos AA, Mavragani EP (2011) Traveling through the web: a first step toward a comparative analysis of European national tourism websites. J Hosp Mark Manag 20(7):718–739. https://doi.org/10.1080/19368623.2011.577706

Goh E, Sigala M (2020) Integrating information & communication technologies (ICT) into classroom instruction: teaching tips for hospitality educators from a diffusion of innovation approach. J Teach Travel Tour 20(2):156–165. https://doi.org/10.1080/15313220.2020.1740636

Gordon B (1986) The Souvenir: messenger of the extraordinary – ProQuest. J Popular Cult 20(3):135–146

Greenblat CS, Gagnon JH (1983) Temporary strangers: travel and tourism from a sociological perspective. Sociol Perspect 26(1):89–110. https://doi.org/10.2307/1389161

Gretzel U (2019) The role of social media in creating and addressing overtourism. In: Overtourism. De Gruyter Oldenbourg, pp 62–75. https://doi.org/10.1515/9783110607369-005

Gretzel U, Mitsche N, Hwang Y-H, Fesenmaier DR (2004) Tell me who you are and I will tell you where to go: use of travel personalities in destination recommendation systems. Inf Technol Tour 7(1):3–12

Gretzel U, Reino S, Kopera S, Koo C (2015a) Smart tourism challenges. J Tour 16(1):41–47

Gretzel U, Sigala M, Xiang Z, Koo C (2015b) Smart tourism: foundations and developments. Electron Mark 25(3):179–188. https://doi.org/10.1007/s12525-015-0196-8

Gretzel U, Werthner H, Koo C, Lamsfus C (2015c) Conceptual foundations for understanding smart tourism ecosystems. Comput Hum Behav 50:558–563. https://doi.org/10.1016/j.chb.2015.03.043

Groth A, Haslwanter D (2016) Efficiency, effectiveness, and satisfaction of responsive mobile tourism websites: a mobile usability study. Inf Technol Tour 16(2):201–228. https://doi.org/10.1007/s40558-015-0041-0

Guttentag DA (2010) Virtual reality: applications and implications for tourism. Tour Manag 31(5):637–651. https://doi.org/10.1016/j.tourman.2009.07.003

Håkansson A, Hartung R, Jung JJ (2010) Using multi-agent system for business applications in multilingual ontologies. Smart Innov Syst Technol 5:157–166. Scopus. https://doi.org/10.1007/978-3-642-14594-0_16

He J, Liu H, Xiong H (2016) SocoTraveler: travel-package recommendations leveraging social influence of different relationship types. Inf Manag 53(8):934–950. Scopus. https://doi.org/10.1016/j.im.2016.04.003

Hikkerova L (2010) E-tourism: players and customer behavior. Probl Perspect Manag 8(4):45–51. Scopus

Hilton (2016) Hilton And IBM Pilot "Connie," The World's First Watson-Enabled Hotel Concierge. Hilton Press Center. https://newsroom.hilton.com/corporate/news/hilton-and-ibm-pilot-connie-the-worlds-first-watsonenabled-hotel-concierge

Hoadjli A, Kazar O, Rezeg K (2017) A layered design approach for mobile tourism, pp 110–115. Scopus. https://doi.org/10.1109/ICITECH.2017.8079986

IHG (2015) IHG and amadeus to revolutionise the technological foundations of the global hospitality industry. @ihgdevelopment. https://www.ihgplc.com:443/en/news-and-media/news-releases/2015/ihg-and-amadeus-to-revolutionise-the-technological-foundations-of-the-global-hospitality-industry

Inversini A, Cantoni L (2011) Towards online content classification in understanding tourism destinations' information competition and reputation. Int J Internet Mark Advert 6(3):282–299. Scopus. https://doi.org/10.1504/IJIMA.2011.038240

Irannezhad E, Mahadevan R (2020) Is blockchain tourism's new hope? J Hosp Tour Technol 12(1):85–96. https://doi.org/10.1108/JHTT-02-2019-0039

iTaiwan (2011) ITaiwan Wi-Fi. Government indoor public area free WiFi access. https://itaiwan.gov.tw/en/

Jeng C-R (2019) The role of trust in explaining tourists' behavioral intention to use e-booking services in Taiwan. J China Tour Res. Scopus. https://doi.org/10.1080/19388160.2018.1561584

Joseph AI, Anandkumar SV (2016) Demographic influences on social media use across tourist lifecycle phases. JOHAR New Delhi 11(2):49–73

Jung T, tom Dieck MC, Lee H, Chung N (2016) Effects of virtual reality and augmented reality on visitor experiences in museum. In: Inversini A, Schegg R (eds) Information and communication technologies in tourism 2016. Springer International Publishing, pp 621–635. https://doi.org/10.1007/978-3-319-28231-2_45

Kalbaska N, Lee HA, Cantoni L, Law R (2013) UK travel agents' evaluation of e-learning courses offered by destinations: an exploratory study. J Hosp Leis Sport Tour Educ 12(1):7–14. Scopus. https://doi.org/10.1016/j.jhlste.2012.09.001

Kalbaska N, Janowski T, Estevez E, Cantoni L (2017) When digital government matters for tourism: a stakeholder analysis. Inf Technol Tour 17(3):315–333. Scopus. https://doi.org/10.1007/s40558-017-0087-2

Karagiannis S, Anthopoulos L, Aspridis G, Sdrolias L, Polykarpidis A (2014) Green urban space utilization for mild ICT-based touristic activities: the case of Pafsilipo Park in Greece. JETA: J Environ Tour Anal 2(1):83–96

Kim M-J, Chung N, Lee C-K (2011) The effect of perceived trust on electronic commerce: shopping online for tourism products and services in South Korea. Tour Manag 32(2):256–265. https://doi.org/10.1016/j.tourman.2010.01.011

Klausegger C (2005) Evaluating Internet portals – an empirical study of acceptance measurement based on the Austrian national tourist office's service portal. J Qual Assur Hosp Tour 6(3/4):163–183

Kolarova D, Samaganova A, Samson I, Ternaux P (2006) Spatial aspects of ICT development in Russia. Serv Ind J 26(8):873–888. https://doi.org/10.1080/02642060601011673

Komninos A, Besharat J, Ferreira D, Garofalakis J, Kostakos V (2017) Where's everybody? Comparing the use of heatmaps to uncover cities' tacit social context in smartphones and pervasive displays. Inf Technol Tour 17(4):399–427. https://doi.org/10.1007/s40558-017-0092-5

Koukopoulos D, Styliaras G (2013) Design of trustworthy smartphone-based multimedia services in cultural environments. Electron Commer Res 13(2):129–150. Scopus. https://doi.org/10.1007/s10660-013-9112-5

Ku ECS, Chen C-D (2015) Cultivating travellers' revisit intention to e-tourism service: the moderating effect of website interactivity. Behav Inf Technol 34(5):465–478. Scopus. https://doi.org/10.1080/0144929X.2014.978376

Latorre-Martínez MP, Iñíguez-Berrozpe T, Plumed-Lasarte M (2014) Image-focused social media for a market analysis of tourism consumption. Int J Technol Manag 64(1):17–30. Scopus. https://doi.org/10.1504/IJTM.2014.059234

Law R, Leung R, Buhalis D (2009) Information technology applications in hospitality and tourism: a review of publications from 2005 to 2007. J Travel Tour Mark 26(5–6):599–623. https://doi.org/10.1080/10548400903163160

Law R, Qi S, Buhalis D (2010) Progress in tourism management: a review of website evaluation in tourism research. Tour Manag 31(3):297–313. https://doi.org/10.1016/j.tourman.2009.11.007

Law R, Leung R, Lo A, Leung D, Fong LHN (2015) Distribution channel in hospitality and tourism. Int J Contemp Hosp Manag. https://doi.org/10.1108/IJCHM-11-2013-0498

Leung R (2019) Smart hospitality: Taiwan hotel stakeholder perspectives. Tour Rev. https://doi.org/10.1108/TR-09-2017-0149

Leung R (2020) Hospitality technology progress towards intelligent buildings: a perspective article. Tour Rev (ahead-of-print). https://doi.org/10.1108/TR-05-2019-0173

Leung R, Law R (2013) Evaluation of hotel information technologies and EDI adoption: the perspective of hotel IT managers in Hong Kong. Cornell Hosp Q 54(1):25–37. https://doi.org/10.1177/1938965512454594

Li KW, Law R (2007) A novel English/Chinese information retrieval approach in hotel website searching. Tour Manag 28(3):777–787. Scopus. https://doi.org/10.1016/j.tourman.2006.05.017

Liburd JJ, Nielsen TK, Heape C (2017) Co-designing smart tourism. Eur J Tour Res 17:28–42

Lillo-Bañuls A, Perles-Ribes JF, Fuentes R (2016) Wiki and blog as teaching tools in tourism higher education. J Teach Travel Tour 16(2):81–100. https://doi.org/10.1080/15313220.2015.1118367

Lin J-W, Chang C-H, Hsieh C-Y, Cheng Y-T, Huang X-T (2014) IEBSR: an integrated e-tourism service for self-guided travel. J Comput (Taiwan) 24(4):12–21. Scopus

Logesh R, Subramaniyaswamy V, Vijayakumar V (2018) A personalised travel recommender system utilising social network profile and accurate GPS data. Electron Gov 14(1):90–113. https://doi.org/10.1504/EG.2018.089538

Louvieris P, Driver J (2004) Avoiding buyer behaviour Myopia in hotel eCommerce. J Hosp Leis Mark 11(1):65–84. https://doi.org/10.1300/J150v11n01_05

Mahajan KB, Patil AS, Gupta RH, Pawar BV (2015) A new ICT based business model for tourism industry for the Maharashtra and Goa States of India. Int J Hosp Tour Syst 8(1):64–69

Mannas PS, Kour P, Bhagat A (2013) Linking E-tourism and cultural digitalization: a sustainable marketing approach towards silk route image. J Tour 14(2):23–33

Marchiori E, Cantoni L (2018) Applying the counseling-learning approach to a tourism-related massive open online course. J Teach Travel Tour 18(1):58–74. Scopus. https://doi.org/10.1080/15313220.2018.1404697

Martins J, Gonçalves R, Branco F, Barbosa L, Melo M, Bessa M (2017) A multisensory virtual experience model for thematic tourism: a Port wine tourism application proposal. J Destin Mark Manag 6(2):103–109. Scopus. https://doi.org/10.1016/j.jdmm.2017.02.002

Mich L, Baggio R (2015) Evaluating Facebook pages for small hotels: a systematic approach. Inf Technol Tour 15(3):209–231. https://doi.org/10.1007/s40558-015-0031-2

Minghetti V, Buhalis D (2010) Digital divide in tourism. J Travel Res 49(3):267–281. https://doi.org/10.1177/0047287509346843

Mohamed I, Moradi L (2011) A model of e-tourism satisfaction factors for foreign tourists. Aust J Basic Appl Sci 5(12):877–883. Scopus

Moley Robotics (2015) Moley – the world's first robotic kitchen. https://www.moley.com/

Montejo-Ráez A, Perea-Ortega JM, García-Cumbreras MA, Martínez-Santiago F (2011) Otiûm: a web based planner for tourism and leisure. Expert Syst Appl 38(8):10085–10093. Scopus. https://doi.org/10.1016/j.eswa.2011.02.005

Mwita M (2014) Opportunities and challenges in ICT adoption in Tanzania's tourism industry: case study of tour operators. E-Rev Tour Res 11(1/2):18–25

Negruşa AL, Toader V, Soficã A, Tutunea MF, Rus RV (2015) Exploring gamification techniques and applications for sustainable tourism. Sustainability 7(8):11160–11189. https://doi.org/10.3390/su70811160

Neidhardt J, Rümmele N, Werthner H (2017) Predicting happiness: user interactions and sentiment analysis in an online travel forum. Inf Technol Tour 17(1):101–119. https://doi.org/10.1007/s40558-017-0079-2

Neuhofer B, Buhalis D (2014) Experience, co-creation and technology – issues, challenges and trends for technology enhanced tourism experiences. In: McCabe S (ed) The Routledge handbook of tourism marketing. Routledge, New York

Neuhofer B, Buhalis D, Ladkin A (2014) A typology of technology-enhanced tourism experiences. Int J Tour Res 16(4):340–350. https://doi.org/10.1002/jtr.1958

Nguyen TN, Ricci F (2018) A chat-based group recommender system for tourism. Inf Technol Tour 18(1):5–28. https://doi.org/10.1007/s40558-017-0099-y

Nilashi M, Ibrahim O, Yadegaridehkordi E, Samad S, Akbari E, Alizadeh A (2018) Travelers decision making using online review in social network sites: a case on TripAdvisor. J Comput Sci 28:168–179. Scopus. https://doi.org/10.1016/j.jocs.2018.09.006

Noguera JM, Barranco MJ, Segura RJ, Martínez L (2012) A mobile 3D-GIS hybrid recommender system for tourism. Inf Sci 215:37–52. Scopus. https://doi.org/10.1016/j.ins.2012.05.010

Novak J, Schwabe G (2009) Designing for reintermediation in the brick-and-mortar world: towards the travel agency of the future. Electron Mark 19(1):15–29. Scopus. https://doi.org/10.1007/s12525-009-0003-5

Oyewole P, Sankaran M, Choudhury P (2008) Information communication technology and the marketing of airline services in Malaysia: a survey of market participants in the airline industry. Serv Mark Q 29(4):85–103. https://doi.org/10.1080/15332960802218802

Pansiri J, Courvisanos J (2010) Attitude to risk in technology-based strategic alliances for tourism. Int J Hosp Tour Adm 11(3):275–302. https://doi.org/10.1080/15256480.2010.498283

Pantano E, Pietro LD (2013) From e-tourism to f-tourism: emerging issues from negative tourists' online reviews. J Hosp Tour Technol 4(3):211–227. Scopus. https://doi.org/10.1108/JHTT-02-2013-0005

Papanis E, Kitrinou E (2011) The role of alternative types of tourism and ICT-strategy for the tourism industry of lesvos. Tourismos 6(2):313–331

Papathanassis A, Knolle F (2011) Exploring the adoption and processing of online holiday reviews: a grounded theory approach. Tour Manag 32(2):215–224. Scopus. https://doi.org/10.1016/j.tourman.2009.12.005

Paskaleva K, Azorín JA (2010) Developing integrated e-tourism services for cultural heritage destinations. Int J Serv Technol Manag 13(3–4):247–262. Scopus

Paskaleva K, Cooper I, Azorín JA (2011) Soft factors in integrating innovation in advanced e-services. Int J Serv Technol Manag 15(3–4):161–177. Scopus. https://doi.org/10.1504/IJSTM.2011.040374

Patiar A, Kensbock S, Ma E, Cox R (2017) Information and communication technology–enabled innovation: application of the virtual field trip in hospitality education. J Hosp Tour Educ 29(3):129–140. https://doi.org/10.1080/10963758.2017.1336096

Pazaitis A, De Filippi P, Kostakis V (2017) Blockchain and value systems in the sharing economy: The illustrative case of Backfeed. Technological Forecasting and Social Change, 125, 105–115. https://doi.org/10.1016/j.techfore.2017.05.025

Perks H, Riihela N (2004) An exploration of inter-functional integration in the new service development process. Serv Ind J 24(6):37–63. https://doi.org/10.1080/0264206042000299176

Pesonen J, Horster E (2012) Near field communication technology in tourism. Tour Manag Perspect 4:11–18. Scopus. https://doi.org/10.1016/j.tmp.2012.04.001

Pettenati MC, Bussotti P, Parlanti D, Giuli D (2008) Trust-enabling decision support system for e-tourism intermediation. Int J Netw Virtual Organ 5(3–4):275–299. Scopus. https://doi.org/10.1504/IJNVO.2008.018824

Pichler M, Rutzinger M, Neiss H (2014) insightTourism – towards understanding online behavior of tourists. E-Rev Tour Res 11(3/4):50–53

Pühretmair F (2004) It's time to make e-tourism accessible. Lect Notes Comput Sci (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics) 3118:272–279. Scopus

Qi S, Ip C, Leung R, Law R (2020) A new framework on website evaluation. In: 2010 international conference on E-business and E-government, pp 78–81. https://doi.org/10.1109/ICEE.2010.27

Racherla P, Hu C, Hyun MY (2008) Exploring the role of innovative technologies in building a knowledge-based destination. Current Issues Tour 11(5):407–428. https://doi.org/10.1080/13683500802316022

Raposo R, Beça P, Figueiredo C, Santos H (2012) Mesh-t: an on-going project on ubiquitous and context-aware technologies in tourism. E-Rev Tour Res 10(2):72–75

Rashideh W (2020) Blockchain technology framework: current and future perspectives for the tourism industry. Tour Manage 80:104125. https://doi.org/10.1016/j.tourman.2020.104125

RateTiger (2020) #1 Hotel Distribution System, Channel Manager & Connectivity Solutions |Hotel Channel Manager |eRevMax. https://www.erevmax.com/travel-solutions/hotel-channel-manager.html

Reino S, Frew AJ, Mitsche N (2014) A benchmarking framework for e-tourism capability of destinations' industries. J Hosp Tour Technol 5(2):126–142. Scopus. https://doi.org/10.1108/JHTT-05-2013-0015

Richardson R, Marshall JN (1999) Teleservices, call centres and urban and regional development. Serv Ind J 19(1):96–116. https://doi.org/10.1080/02642069900000006

Roldán-García MDM, García-Nieto J, Aldana-Montes JF (2017) Enhancing semantic consistency in anti-fraud rule-based expert systems. Expert Syst Appl 90:332–343. Scopus. https://doi.org/10.1016/j.eswa.2017.08.036

Romero I, Tejada P (2020) Tourism intermediaries and innovation in the hotel industry. Curr Issues Tour 23(5):641–653. https://doi.org/10.1080/13683500.2019.1572717

Rouhani S, Ravasan AZ, Hamidi H, Vosough S (2013) Identification and classification of affecting factors on E-tourism in Iran. Middle East J Sci Res 16(10):1361–1368. Scopus. https://doi.org/10.5829/idosi.mejsr.2013.16.10.1330

Ruiz-Molina M-E, Gil-Saura I, Berenguer-Contrí G (2014) Information and communication technology as a differentiation tool in restaurants. J Foodserv Bus Res 17(5):410–428. https://doi.org/10.1080/15378020.2014.967639

Sahli AB, Legohérel P (2015) The tourism Web acceptance model: a study of intention to book tourism products online. J Vacat Mark 22(2):179–194. Scopus. https://doi.org/10.1177/1356766715607589

Sebastia L, Garcia I, Onaindia E, Guzman C (2009) E-Tourism: a tourist recommendation and planning application. Int J Artif Intel Tools 18(5):717–738. https://doi.org/10.1142/S0218213009000378

Sedmiak G, Planinc T, Kociper T, Planinc S (2016) Managers' perceptions of the role of ICT in rural tourism firms efficiency: the case of Slovenia. Tourism (13327461) 64(3):339–345

Sheldon PJ (1983) The impact of technology on the hotel industry. Tour Manag 4(4):269–278. https://doi.org/10.1016/0261-5177(83)90005-5

Sheldon PJ (1997) Tourism information technology, 1st edn. CABI, Wallingford

Sheraton (2019) About us – our history. Sheraton Hotels & Resorts. https://sheraton.marriott.com/about-us/

Sigala M (2002) The evolution of Internet pedagogy: benefits for tourism and hospitality education. J Hosp Leis Sport Tour 1(2):29–45. https://doi.org/10.3794/johlste.12.4

Sigala M (2003a) Integrating and exploiting information and communication technologies (ICT) in restaurant operations: implications for restaurant productivity. J Foodserv Bus Res 6(3):55–76. https://doi.org/10.1300/J369v06n03_05

Sigala M (2003b) The information and communication technologies productivity impact on the UK hotel sector. Int J Oper Prod Manag 23:1224–1245. https://doi.org/10.1108/01443570310496643

Siricharoen WV (2010) Enhancing semantic web and ontologies for E-tourism. Int J Intel Inf Database Syst 4(4):355–372. Scopus. https://doi.org/10.1504/IJIIDS.2010.035581

Smirnov A, Shilov N, Kashevnik A, Ponomarev A (2017) Cyber-physical infomobility for tourism application. Int J Inf Technol Manag 16(1):31–52. Scopus. https://doi.org/10.1504/IJITM.2017.080949

Standing C, Vasudavan T (2000) The impact of Internet on travel industry in Australia. Tour Recreat Res 25(3):45–54. https://doi.org/10.1080/02508281.2000.11014924

Stiakakis E, Georgiadis CK (2011) Drivers of a tourism e-business strategy: the impact of information and communication technologies. Oper Res 11(2):149–169. Scopus. https://doi.org/10.1007/s12351-009-0046-6

Stiakakis E, Vlachopoulou M (2017) The impact of social media on travelers 2.0. Tourismos 12(3):48–74. Scopus

Stockdale R (2007) Managing customer relationships in the self-service environment of e-tourism. J Vacat Mark 13(3):205–219. Scopus. https://doi.org/10.1177/1356766707077688

Sun Y, Ma H, Chan EHW (2017) A model to measure tourist preference toward scenic spots based on social media data: a case of Dapeng in China. Sustainability (Switzerland) 10(1). Scopus. https://doi.org/10.3390/su10010043

Syam N, Sharma A (2018) Waiting for a sales renaissance in the fourth industrial revolution: machine learning and artificial intelligence in sales research and practice. Ind Mark Manag 69:135–146. https://doi.org/10.1016/j.indmarman.2017.12.019

Szopiñski T, Staniewski MW (2016) Socio-economic factors determining the way e-tourism is used in European Union member states. Internet Res 26(1):2–21. Scopus. https://doi.org/10.1108/IntR-03-2014-0065

Taga H, Gaspari A, Vukaj H (2011) Implementation of customer relationship management in Albania travel industry: its overall impact on performance. J Mark Manag 2(1):51–60

Taleb T, Dutta S, Ksentini A, Iqbal M, Flinck H (2017) Mobile edge computing potential in making cities smarter. IEEE Commun Mag 55(3):38–43. https://doi.org/10.1109/MCOM.2017.1600249CM

Thorn K, Chen H-C (2005) E-business in the New Zealand tourism industry: an examination of implementation and usage. Current Issues Tour 8(1):39–61. https://doi.org/10.1080/13683500508668204

Tscheu F, Buhalis D (2016) Augmented reality at cultural heritage sites. In: Inversini A, Schegg R (eds) Information and communication technologies in tourism 2016. Springer International Publishing, pp 607–619. https://doi.org/10.1007/978-3-319-28231-2_44

Tse AC (2003) Disintermediation of travel agents in the hotel industry. Int J Hosp Manag 22(4):453–460. https://doi.org/10.1016/S0278-4319(03)00049-5

Tung VWS, Law R (2017) The potential for tourism and hospitality experience research in human-robot interactions. Int J Contemp Hosp Manag Bradford 29(10):2498–2513. https://doi.org/10.1108/IJCHM-09-2016-0520

Umlauft M, Pospischil G, Niklfeld G, Michlmayr E (2002) LoL@, A mobile tourist guide for UMTS. Inf Technol Tour 5(3):151–164

Urquhart L, Schnädelbach H, Jäger N (2019) Adaptive architecture: regulating human building interaction. Int Rev Law Comput Technol 33(1):3–33. https://doi.org/10.1080/13600869.2019.1562605

Urry J, Larsen J (2011) The Tourist Gaze 3.0, 3rd edn. Sage Publishing. https://uk.sagepub.com/en-gb/eur/the-tourist-gaze-30/book234297

Valčić M, Domšić L (2012) Information technology for management and promotion of sustainable cultural tourism. Informatica (Slovenia) 36(2):131–136. Scopus

Vargas-Sánchez A (2016) Exploring the concept of smart tourist destination. Enlightening Tour 6(2):178–196

Vlachos IP (2013) Investigating E-business practices in tourism: a comparative analysis of three countries. Tourismos 8(1):179–197

Vladimirov Z (2012) Customer satisfaction with the Bulgarian tour operators and tour agencies' websites. Tour Manag Perspect 4:176–184. Scopus. https://doi.org/10.1016/j.tmp.2012.07.003

Wall G (2020) From carrying capacity to overtourism: a perspective article. Tour Rev 75(1):212–215. https://doi.org/10.1108/TR-08-2019-0356

Webb T, Wagstaff CRD, Rayner M, Thelwell R (2016) Leading elite association football referees: challenges in the cross-cultural organization of a geographically dispersed group. Manag Sport Leis 21(3):105–123. https://doi.org/10.1080/23750472.2016.1209978

Xiang Z, Du Q, Ma Y, Fan W (2018) Assessing reliability of social media data: lessons from mining TripAdvisor hotel reviews. Inf Technol Tour 18(1):43–59. https://doi.org/10.1007/s40558-017-0098-z

Xu X, Li Y (2017) Maximising hotel profits with pricing and room allocation strategies. Int J Serv Oper Manag 28(1):46–63. Scopus. https://doi.org/10.1504/IJSOM.2017.085904

Xu F, Buhalis D, Weber J (2017) Serious games and the gamification of tourism. Tour Manag 60:244–256. https://doi.org/10.1016/j.tourman.2016.11.020

Yayli A, Bayram M (2010) Web-based destination marketing: do official city culture and tourism websites' in Turkey consider international guidelines? Tourism (13327461) 58(1):51–60

Yeh RJ, Leong JK, Blecher L, Lai HHS (2005) Analysis of hoteliers' e-commerce and information technology applications: business travelers' perceptions and needs. Int J Hosp Tour Adm 6(2):29–62. https://doi.org/10.1300/J149v06n02_02

Yoo KH, Gretzel U (2008) What motivates consumers to write online travel reviews? Inf Technol Tour 10(4):283–295

Yovcheva Z, Buhalis D, Gatzidis C (2012) Overview of smartphone augmented reality applications for tourism. E-Rev Tour Res 10(2):63–66

Yu C-C (2016) A value-centric business model framework for managing open data applications. J Organ Comput Electron Commerce 26(1–2):80–115. Scopus. https://doi.org/10.1080/10919392.2015.1125175

Yuan Y, Wang FY (2016) Towards blockchain-based intelligent transportation systems. IEEE 19th International Conference on Intelligent Transportation Systems (ITSC), 2663–2668. https://doi.org/10.1109/ITSC.2016.7795984

Zacarias F, Cuapa R, De Ita G, Torres D (2015) Smart tourism in 1-click. Proc Comput Sci 56:447–452. https://doi.org/10.1016/j.procs.2015.07.234

Zafiropoulos C, Vrana V (2006) A framework for the evaluation of hotel websites: the case of Greece. Inf Technol Tour 8(3–4):239–254

Zare S, Chukwunonso F (2015) How travel agencies can differentiate themselves to compete with online travel agencies in the Malaysian context. E-Rev Tour Res 12(5/6):226–240