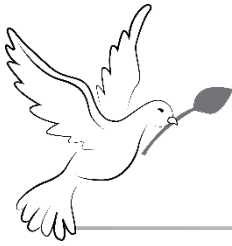


Internet of Things in the Hospitality Industry – A Current State of Art*



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Abstract

Due to the advancement of technology and the shift to integrated devices, the hospitality field has seen the rise in usage of the Internet of Things (IoT). This study reviews and analyzes related articles both in academic journals and non-academic primarily in the hospitality and tourism industries. The chronological sequencing shows the shift from internet/mobile-based technology to the Internet of Things and the progression to artificial intelligence. The purpose of this study is to show the current research on the Internet of Things in the hospitality industry along with emerging trends. This is a synthesis of current thinking and a review of literature. This study also contributes by showing some areas less researched, which provides future research possibilities.

Keywords: artificial intelligence; hospitality; internet of things; smart cities; smart tourism

Introduction

The objective of this research is to highlight the current technologies being used in the hospitality industry and show the emerging trends. Less researched areas will also be identified and suggestions made for future research. Before the rise of the Internet of Things (IoT), the tourism and hospitality industry was affected by other technological progress. In the past, the development in information communication technologies (ICTs) has transformed business practices, strategies, and industry structures (Buhalis & Law, 2008; Porter & Heppelmann, 2014). Through the development of websites, social media, and mobile technologies, the number of travelers around the globe that engages in the use of technologies during the planning process and while traveling has increased dramatically since the year 2000 (Law, Chan, & Wang, 2018).

Along with this, ICTs have also radically affected the efficiency and effectiveness of the operating system in tourism organizations (Buhalis & Law, 2008). For organizations to perform better than their competitors, they need to update themselves with the latest technologies actively. Since the use of the internet and its communication technology has changed the process of developing, managing, and marketing tourism products and destinations (Wang, Park, & Fesenmaier, 2012). It is interesting to see how the hospitality industry can utilize the technologies that arise with the current technology - Internet of Things (IoT).

The internet of things (IoT) is the network of physical objects embedded with electronics, software, sensors, and network connectivity, which turns it into intelligent objects to allows it to collect and exchange data (Madakam, Ramaswamy, & Tripathi, 2015; Meola, 2016). A common term used by consumers to refer to IoT is Smart. The emerging trend is to use these devices that will give rise to an increase in the automated system in almost all industry, including cities and hotels that are turning themselves into smart cities and smart hotels (Guo, Liu, & Chai, 2014).

Technology has always been part of the hotel experience. In 2017, having free Wi-Fi is the norm (Saldanha, 2017; Sterkenberg, 2017a). However, the emerging trends in 2018, is now shifted towards the use of IoT and more technological advancement such as artificial intelligence. IoT is at the core of influencing trends in data analytics, edge computing, and 5G cell processing (Newman, 2017).



Research Methodology

This study reviews and analyzes related articles both in academic journals and non-academic primarily in the hospitality and tourism industries. The analysis through chronological sequencing of papers shows the shift from internet/mobile-based technology to the Internet of Things and the progression to artificial intelligence. The purpose of this study is to show the current research on the Internet of Things in the hospitality industry along with emerging trends. This is a synthesis of current thinking and a review of literature. The scope of the literature review covers trends in academic and non-academic papers since 2008. The content analysis was carried out and charted by publication dates as seen in Table 1. Emerging trends are those arising since 2018 and future suggestions are those technologies that are being considered into usage. The chronological sequencing highlights the technology introduced into the industry at a given time. As can be seen, there is a gap in publication between 2008 and 2014. Around 2008 is at which time the internet started to be widely used in the hospitality industry both for business and consumer side. After that there was a lack of modern technology impact until 2014 when IoT was introduced.

Following previous research, articles related to hospitality and tourism were identified and the selection process was based on keywords searches. These keywords include artificial intelligence, internet of things, smart cities, smart tourism, mobile technology, and mobile applications. These words were searched for in the titles, keywords, or abstracts. The articles both academic and non-academic used must be offered in full-length in English. The short-listed papers were then analyzed chronologically to identify current technologies and trends.

Results

Currently, to improve customer experience, hotels are using technology to assist in the gathering of important guest data to improve offerings (Sterkenberg, 2017a). Hotel guests can easily do self-check-in and receive their room keys on their mobile devices (Saldanha, 2017). Besides, hotels can save customers' room preferences and preload them for returning guests. This helps increase customization and customer satisfaction (Young, 2015).

IoT has various potentials in the scope of hospitality. One approach is through personal wellness tracking, which then allows the hotel to be a health-supporting hotel and promoting wellness aware city tour. Wellness tracking can be done through wearable technology (Pustišek & Kos, 2014). Another use of IoT is in the smart buildings, whereby sensor monitors the

environment such as the temperature, illumination, and air quality. This is done not only to provide a better experience for customers but also to help reduce operational costs and increase efficiency (Pustišek & Kos, 2014).

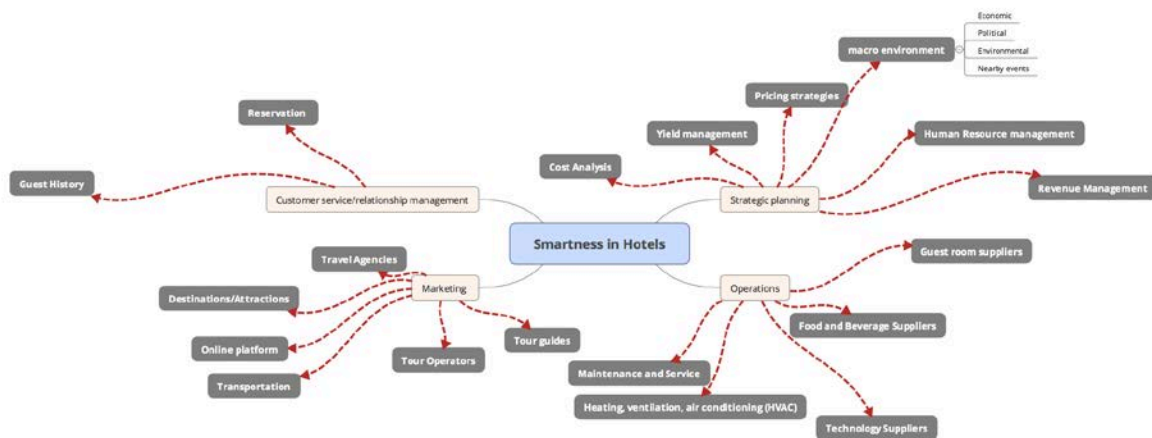
In general, the evidence around IoT in tourism and hospitality shows that its adoption is most rapid in countries looking to develop their tourism industry. For example, there is a trend in embedding IoT in China's scenic spots, and the growth of IoT corresponds with China's economic growth and industrial change (Guo et al. 2014). This indicates that there are values from the use of IoT in hospitality, and valuable research can be carried out. In 2016, 30% of hotels planned to roll out location-based technology (Terry, 2016). Tourism companies have invested heavily in technology in recent years, and it has opened immense opportunities to improve their business operations and boost sales and revenue while being productive at reaching customers (Babu and Subramoniam 2016).

As with IoT in general, some empirical research has been carried out into how IoT can influence customer satisfaction. For example, IoT has been deployed in Taiwan to help hoteliers reduce costs and assist customers, using self-service check-in kiosks to receive an RFID key or checking in via mobile phone to boost satisfaction (Chi-Yu Hsu 2016). Similarly, IoT is also involved in business process management in which it helps increase knowledge flows, innovation, and competitiveness. Also, dealing with challenges and maintain customer satisfaction levels through real-time data (Giudice, 2016).

There is also some specific research on the role of IoT in the hospitality and tourism industry. For example, Selig (2016) "highlights the application of IoT in the hospitality industry including in alerting staff regarding maintenance issues and patterns in energy use, incorporating IoT-enabled devices in guestrooms and establishing the communication between guests and staff." Similarly, Mott (2016) notes that that value of IoT is currently higher for companies in the hospitality environment than for end-users. Figure 1 shows the interconnectivity of different areas in hospitality that uses IoT.



Figure 1: Interconnectivity of technology in hospitality establishments. Courtesy of (Buhalis & Leung, 2018; DiPietro & Wang, 2010; Law, Leung, Lo, Leung, & Hoc Nang Fong, 2015; Smith, Leimkuhler, & Darrow, 1992; Zhang, Song, & Huang, 2009)



As for the future of IoT in the hospitality industry, hotel guests and industry competitions are now driving hotels to invest in technology (Sterkenberg, 2017b). The hospitality industry will start using technologies that are used in smart homes (Rauch 2017). Not only will sensor-activated thermostats and digital room keys be used, but hotel rooms will also become voice-activated (Rauch, 2017; Sterkenberg, 2017b). An example of this is the Wynn Las Vegas hotel that put Amazon Echo in all 4700 hotel rooms to allow guests to control things such as lighting and temperature (Chipkin, 2017). The mobile keycard will also see increased use in the industry due to its financial and security benefits (Saldanha, 2017; Terry, 2016).

Hotels are now crossing into other categories as well; for example, Hyatt has purchased a wellness brand (Chipkin, 2017). This may lead to the use of more comprehensive wellness tracking technology in hotels. Furthermore, hotels are encouraging immersive experiences with investment in the development of activities company and mobile applications, which leads to it being in smart tourism.

Table 1: Hospitality and Modern Technology

2008

Internet-based: search engines, planning process (Buhalis & Law)

2014

IoT: smart cities, scenic spots (Guo et al.)

IoT: personal wellness tracking (Pustisek & Kos)

IoT: smart building - sensor controlled temperature, lighting, air quality (Pustisek & Kos)

2015

IoT: smart locks, customized preferences (Young)

AI: marketing strategy, financial management, manpower (Claveria et al.)

2016

30% of hotels = location-based technology (Terry)

IoT: real-time use of data to increase satisfaction (Giudice)

IoT: maintenance issues, energy pattern (Selig)

2017

IoT: check-in and mobile key (Saldanha)

IoT: hospitality sector adopts Smart Homes technology (Rauch)

IoT: voice activation (Rauch; Sterkenberg; Chipkin)

Hotels crossing into wellness sector (Chipkin)

AI: personalized experience (Chipkin)

2018

AI: revenue maximization and optimization of performance (Buhalis & Leung)

AI: customer services, strategic planning, forecasting (Buhalis & Leung)

AI: robot concierge, language, suspicious behavior (Buhalis & Leung)

Future

Conclusion and Discussion

The research to date has focused on the development of smart cities and how this can influence the tourism industry. For instance, Wayne (2016) discussed the "implementation of digital technologies in all city functions including human activity to create a smart city," and the ability of this to develop a city which is more attractive to visitors and tourists. However,

this analysis is focused on the role of government in influencing the tourism industry and not how businesses involved in the tourism and hospitality industry can improve customer satisfaction by engaging in the use of IoT.

Arguments around the IoT in tourism have indicated that the economic implications and governmental support of smart tourism and how IoT can change opinions needs to be researched further. Therefore, indicating that this is another area in which significant gaps are present (Xiang, Tussyadiah, & Buhalis, 2015). Finally, Mobile Payments Today (2017) notes that companies are losing more than \$30 billion per annum from customer dissatisfaction, but while IoT can reduce that loss, there is a lack of research into how the digital and physical experiences can be managed in a way which truly addresses the issue.

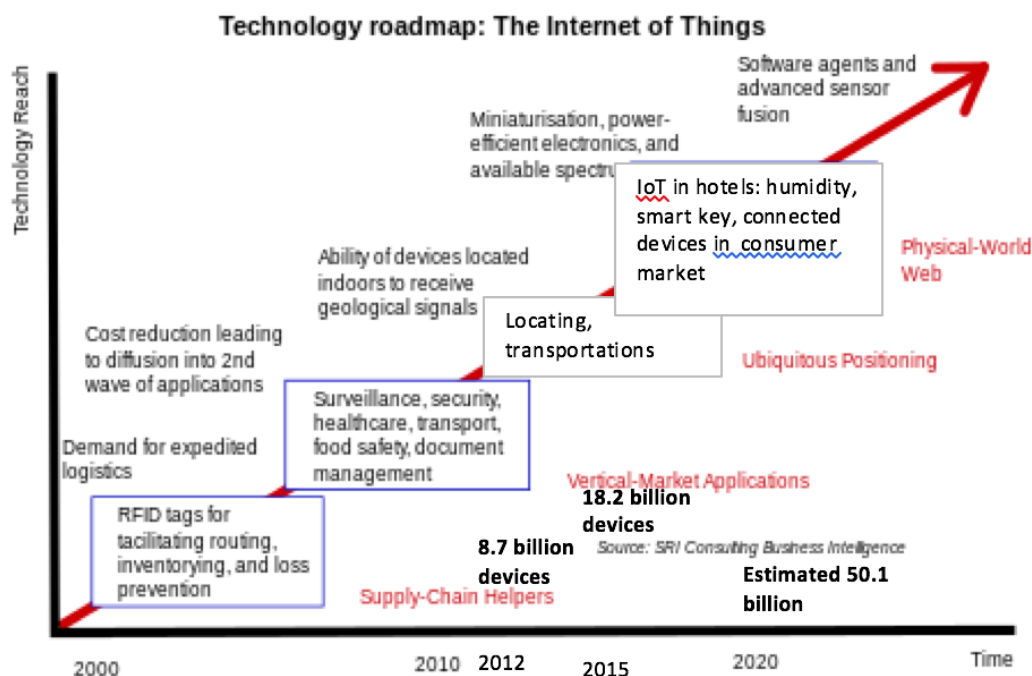


Diagram 1: Combined roadmap of the rise of the Internet of Things and number of connected devices (John Donovan, n.d.; Statista, n.d.)

From this research, it is found that there is a gradual progression from the rise of ICTs and the use of the internet in 2000 to the IoT in 2014. The hospitality industry has adopted several usages of IoT, including the development of smart hotels/buildings in smart cities. This then helps to promote smart tourism and destination. Hotels also engage in implementing sensors and voice activation technology to help increase customer satisfaction and personalized experiences. The use of IoT impacts the hospitality industry positively and this is the current state of the art. However, for the sector to be able to capitalize on the benefit of the technology,

the hotels had to start deploying artificial intelligence. Since 2017, there is an exponential increase in the use of artificial intelligence and the trends continued to show this in 2018.

Implications and Recommendations

This review is limited in its scope since it shows that IoT can influence business models and strategies in hospitality, but not how it will assist in increasing customer satisfaction (Giudice, 2016). The limitations of the current research around IoT in tourism and hospitality are reflected in the extent to which recent panel discussions and analysis have focused on the role of IoT in the industry. Recent conferences have considered how the tourism and travel industry can enhance its use of the concept and drive higher levels of satisfaction and outcomes (Parsons 2015).

Artificial intelligence (AI) will become an integral part of increase personalization and satisfaction. It will also help hotels tap into unrecognized revenue opportunities (Chipkin, 2017; Saldanha 2017). The hospitality industry has large amounts of data that are underused. As stated by Harteveltd (Terry 2016), "If guests do not find what they want from you and you are not leveraging your data in the right way to serve them, they will move onto a competitor." Mobile technology and IoT is exponentially increasing data inputs. AI can assist with revenue maximization and optimization of performance through the improvement of customer service, strategic planning, financial management, and forecasting (Buhalis & Leung, 2018; Claveria, Monte, & Torra, 2015).



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