Stakeholder perspectives on artificial intelligence and service robots in urban hotels

Abstract

The main purpose of this exploratory research was to determine city hotel guest, manager, and owner perspectives on the impacts in terms of costs and benefits of the introduction of artificial intelligence (AI) service robots. Hotel guests perceived more benefits than costs while management views were more focused on the costs involved. Owners mainly adopted a financial view of hotel robot use. The negative attitudes held by hotel managers toward AI service robots were related to costs of implementation and a concern that these costs could not be returned. The Technology Readiness Index (TRI) was applied to examine guest perceptions.

Keywords: Artificial intelligence (AI); hotel service robots; urban hotels; stakeholders; cost-benefit analysis; Technology Readiness Index (TRI)

Introduction

There is a growing body of literature on robot applications in hospitality; however, most previous studies adopt a singular perspective on the topic. The findings contribute by addressing this gap in the academic literature by providing a multi-perspective and multi-stakeholder perspective on hotel robot use. Also, the research should assist industry with more effective design and implementation of hotel robot technology and services. The goal of this research was to explore the impacts of robots on three direct hotel stakeholders -- guests, managers, and owners. Their perspectives were combined to provide an overall view of the adoption of robots in hotels. The specific research objectives were to:

1. Determine guest, manager, and owner perspectives on the impacts of robot usage in urban hotels.
2. Articulate the specific costs and benefits perceived to accompany hotel robot use.
3. Compare and contrast the perspectives of multiple stakeholders on the application of service robots in urban hotels.
4. Provide recommendations for the effective application of hotel service robots.

Literature review

Artificial intelligence (AI) and robots are important for all services (Prentice, Lopes, & Wang, 2020). The following section includes an introduction to AI and service robots. Combined with AI, service robots are able to conduct different tasks and have various applications in the provision of services.

AI and service robots

The definition of AI originated from computer science in which AI refers to the system working intelligently for its environment and purpose, acting flexibly for changing circumstances and purposes and, most importantly, making proper decisions considering specific limitations (Poole, et al., 1998). AI enables computer systems to automatically learn from past experience and conduct human-like projects to increase the efficiency of daily routines, which is the simulation of human intelligence (Aghaei et al., 2012). In management, Kaplan and Haenlein (2019) proposed that there were three classifications of AI systems: analytical, human-inspired, and humanized artificial intelligence. Analytical AI only has cognitive intelligence while human-inspired AI is composed of both cognitive and emotional intelligence. Humanized AI features all types of capabilities, including cognitive, emotional, and social intelligence, and is capable of being self-conscious and self-aware in interactions with others. The definition of service robot

was proposed by the International Organization for Standardization, suggesting that a robot is able to perform useful tasks for humans or equipment excluding industrial automation applications (ISO 8373). When combined with AI, service robots are able to conduct cognitive-analytical tasks because of underlying computer power, and emotional-social tasks (Wirtz et al., 2018). The application of service robots equipped with AI has increased in customer service for reasons of service innovation (Lu et al., 2019) and labor saving (Ivanov and Webster, 2017). These applications can be divided into two categories: physical and virtual service robots. Virtual service robots include voice-based applications such as Siri, and text-based applications including chatbots.

Experts predict that by 2030, robots will account for about 25% of the hotel industry's labor force (Bowen & Morosan, 2018). Physical service robots widely appear in leading hotel brand properties. Collaborating with IBM, Hilton launched the robot called Connie, which is able to inform guests about nearby places of interest, give dining recommendations, and provide travelers with as much information as they require. InterContinental Hotels bought the robot called Dash to deliver snacks and toiletries with a greater emphasis on enhancing the guest experience. What surprises the hotel guests is that Dash can calculate its own battery usage and return to the charging point if necessary.

Stakeholder perspectives on AI and robots

According to Freeman (1984, p. 46), a stakeholder refers to "any group or individual who can affect or is affected by the achievement of an organization's objectives." Stakeholder theory suggests that all voices should be heard when making a decision no matter the power or interest of different stakeholder groups (Byrd, 2007). The key to quality service is to ensure harmonious interactions between service stakeholders (Ho, Tojib, & Tsarenko, 2020). In this research, guests,

employees, and hotel owners were identified as primary stakeholders who are highly relevant to the adoption of AI service robots. Considering the trade-offs existing among the stakeholders as the result of service innovations and hospitality development (Byrd et al. 2009), it is critical to examine different stakeholder values, perceptions, and interests since their roles are important to planning, management, and decision-making processes (Imran et al. 2014).

Customer perspectives on AI service robots: The Technology Acceptance Model (TAM) (Davis, 1989) refers to customer intention to use a new technology influenced by cognitive evaluation, perceived usefulness, and perceived ease of use. Ivanov, Webster, and Garenko (2018) pointed out that customers of different genders have significant differences in the acceptability of different types of tasks that robots may do in hotels, and women's attitudes toward service robots was slightly more positive. Robot service has the potential to enhance customer willingness to buy (Zhong, Sun, Law, & Zhang, 2020). Tung and Au (2018) evaluated consumer experiences of hotel robots through five dimensions (embodiment, emotion, human-centered perception, safety, and common experience).

Chan and Tung (2019) showed that the robot service has a higher level of sensory and intellectual experience, but a lower level of emotional experience. Lin, Chi, and Gursoy (2019) verified and expanded the application of the Artificial Intelligence Device Use Acceptance (AIDUA) framework in hotel service settings, pointing out that hotel customers' intentions to use artificial intelligence devices are affected by society, hedonism, anthropomorphism, performance, effort expectations, and the emotional impact. Wirtz et al. (2019) proposed the sRAM (service Robot Acceptance Model) which adopted the model of Heerink et al. (2010) who extended TAM by incorporating a set of social-emotional and relational variables. These social-emotional elements were comprised of perceived humanness, perceived social interactivity, and

perceived social presence. Perceived humanness is the indistinguishable appearance of robots from humans. Duffy (2003) suggested that the installation of anthropomorphic characteristics in robots is necessary to encourage meaningful social interaction between humans and robots. Anthropomorphism can be an effective hotel communication strategy (Lee & Oh, 2019). Robots are considered to be human-like and have a positive impact on customer-robot rapport and guests' hospitality experiences (Qiu, Li, Shu, & Bai, 2020; Tussyadiah, Zach, & Wang, 2020). When people comment on humanoid robots, likeability, and personification are important attributes (Yu, 2020). Perceived social interactivity is regarded as the goal of service robots which observe accepted social norms, including appropriate actions and emotions, and develop appropriate social skills. Choi, Choi, Oh, and Kim (2019) divided robot service perceptions into three dimensions (interaction quality, result quality and physical service environment) and Choi, Oh, Choi, and Kim (2020) showed that interactions between hotel guests and robots are one of the main experience components of robot hotels. Customers can trust the robot from human-robot interactions (Park, 2020). Thus, it is reasonable that in-house hotel guest experiences can be enhanced by advanced in-room technologies (Seric and Gil-Saura, 2012) because of increased interaction.

Based on the goal of AI service robots to improve stay experiences through interacting with guests, co-creation is expected to happen during the interaction process. Co-creation includes dialog, access, risk-benefits, and transparency (Prahalad and Ramaswamy, 2004). Dialog tends to be the most important factor to initiate the interaction, involving deep engagement and willingness to act by both parties (Prahalad and Ramaswamy, 2004). The in-room AI service robots facilitate numerous dialogues, especially for guests who have curiosity about innovative technology and robots. Ranjan and Read (2014) proposed that value co-creation, including co-

production and value-in-use, can explain 19% of customer satisfaction. At the same time, hotel guests are likely to recommend the hotels on social media to family and friends if co-creation facilities and services are accessible (Navarro et al., 2014). Payne et al. (2008) outlined the framework of co-creation, which includes cognition, emotion, and behavior. Further, they proposed that the purchase decision should be involved in the behavioral analysis to understand the whole co-creation experience. Ivanov, Gretzel, Berezina, Sigala, and Webster (2019) recommended that service providers must examine the interaction between robots and humans to ensure the enhancement of consumer value co-creation. According to Dong et al. (2008), when customers are involved in the co-creation context, they tend to express high satisfaction levels, and intentions to participate in activities that also feature co-creation processes, such as repurchasing and revisiting.

This research also incorporated the Technology Readiness Index (TRI), developed by Parasuraman (2000), to measure "propensity to embrace and use new technologies." The TRI includes feelings of optimism, innovativeness, discomfort, or insecurity toward the use of technology to determine a person's readiness to use technology. This framework incorporates drivers and inhibitors of technology readiness to assess psychometric properties, positing various consequences, including satisfaction with products or services. With respect to customer adoption of AI service robots, this research aims to demonstrate how guests perceived the costs and benefits generated by robots based on their demographic characteristics and TRI segments.

Employee perspectives on AI service robots: Although acting as a major source of innovation, AI service robots are potentially a threat to human service jobs. Significant job displacement due to robot use in manufacturing has resulted in a switch from manufacturing to the service industries (Buera and Kaboski, 2012). What then are employee attitudes towards AI

and service robots? Recent studies have shown the relationships between AI and service robots and employees tend to be negative. Chui et al. (2015) proposed that a potentially high turnover rate is associated with taking advantage of AI and robotics in the workplace. They suggested that this trend is inevitable and will happen in not only low-skill, low-wage activities but also in high-wage occupations. When AI is heavily used, the impact on employee performance may be compromised (Prentice, Lopes, & Wang, 2019). Chi, Denton, and Gursoy (2020) pointed out that once the intelligence of service robots reaches a certain level, so that these robots are competent for empathy tasks, service robots may completely replace human employees. AI is increasing employees' concerns about unemployment (Tussyadiah, 2020). Brougham and Haar (2018) found that employees felt undervalued and unappreciated when employers actively explore today's advanced technological options for human labor, such as with AI and robotics. These authors explored the influence of STARA (smart technology, AI, robotics, and algorithms) awareness on specific key job-related results such as organizational commitment and career satisfaction and concluded that there is a significantly negative relationship between STARA awareness and job-related results. However, they also proposed that a positive association existed between employees' STARA awareness and intention to quit. Confirming the findings of Brougham and Haar (2018), Li et al. (2019) argued that AI and robotics awareness was significantly related with employee turnover intention. Noticeably, this association was moderated by perceived organizational support and competitive psychological climate.

Owner perspectives on AI service robots: Financial performance is the most important concern for hotel owners. Owners and investors view smart hotels as fashionable and can increase profits (Leung, 2019). They have high expectations from AI service robots since a reasonable return on investment (ROI) is expected. Hotel owners are also concerned about the

lifespan of robots. As technology is updating rapidly, they believe it is risky to spend a great amount of money for robots which will become obsolete in only a short period (DiPietro and Wang, 2010). A cost and benefit analysis was conducted by Ivanov and Webster (2017) which indicated that these included financial benefits (e.g., labor savings), non-financial benefits (e.g., enhanced company image), financial costs (e.g., acquisition, maintenance, and software update costs); and non-financial costs (e.g., resistance of employees and customers). Robot services can help hotel owners deal with seasonal employment and labor utilization (Kuo, Chen, & Tseng, 2017). Virtual robots can promote environmental protection by conserving resources (Tussyadiah & Miller, 2019). Service robots are expected to increase efficiency and output, and may also bring challenges such as high costs, skill deficiencies, and major changes in hotel organizational structures and cultures (Xu, Stienmetz, & Ashton, 2020). In this research, the return to cost of robot implementation was used to demonstrate the financial benefits and costs generated.

Methodology

The researchers selected 15 hotels from five different cities in China (Shanghai, Nanjing, Suzhou, Xi'an, and Hanzhong). These cities were chosen not only because they are famous tourism destinations in China, but also because they had robot hotels and their managers agreed to participate in the research.

The guest questionnaire gathered perceptions of costs and benefits associated with interactions with hotel robots. Cards containing a QR code for the survey were put along with the robots in guest rooms. The questionnaire was developed as follows: first, respondents were asked for their demographic characteristics including age, gender, education, and income. Next came three questions related to hotel stays, including whether traveling with children, whether it

was the first time to select a robot room, and how many nights the guest was staying at the hotel. The main part of the questionnaire collected guest perceptions of robot benefits and costs. The service robot acceptance model (sRAM) (Wirtz, 2018) was adopted to demonstrate the perceived benefits. sRAM has two dimensions and the questions were developed accordingly. The functional dimension covers perceived ease of use and usefulness. The questions were developed as “Do you feel the robot is responsive?”, “Do you feel the robot offers convenient service?”, and “Does the robot offer customized service?” The social-emotional dimension concerns the perceived social interactivity and social presence and the questions were, “Do you feel the robot offers an interesting experience?” and “Do you feel the robot is good company?” To increase the response rates, the card also included, “If you complete the survey, you will have the opportunity to receive a voucher for purchasing a robot.” Some 97 questionnaires were deemed usable based upon the completeness of the responses and were used for the subsequent analysis.

Managers participated through semi-structured interviews and some financial officers also did when the managers were not sure about the answers. The questions for them included robot acquisition costs, number of robots, average room rates, number of robot rooms, total number of guests, average length of stay during the data collection period, total hotel revenues, and revenues generated from robot rooms.

For robot cost-related questions, the interviews with hotel managers included questions on, “Do you feel the robot protects privacy?” (recognizing that robots contained cameras), and “Do you feel satisfied with the robot room rates?” given that these room prices were likely to be higher than for regular rooms. The key question was, “What are the benefits and costs that robots bring to guests, employees and hotels?” Although hotel owners were not approached, the evaluation of hotel robotic assets was demonstrated via the return to cost of robot

implementation through questionnaires completed by the managers. Hotel financial officers also participated when the hotel managers were not sure about costs, rates, and revenues. All the financial parameters were developed from Sadatsafavi et al. (2016), who conducted deterministic and probabilistic return-on-investment analyses to justify additional costs of single-bed rooms in intensive care units. The researchers also interviewed another 30 hotel employees about their opinions on hotel robots. These staff worked in housekeeping, security, and other service positions.

Results

Hotel profile

The information on the 15 hotels is shown in Table 1. The hotels were located in five cities, with most hotels in Xi'an and the rest in Hanzhong, Nanjing, Shanghai, and Suzhou. All hotels were chain-owned and hotel ratings ranged from 2- to 4-stars except for the H Hotel (Xixiang Branch), which had not participated in the evaluation of hotel ratings. In terms of the number of hotel rooms, H Crystal Hotel (Nanjing Mochou Lake) had the least rooms at 69, while the Suisse Place Hotel had the most at 169. For robot rooms, one had the most at 83, while four hotels each only had two robot rooms.

Respondent profile

Given that the number of hotels with robots is still limited, there is not a large number of guests who have interacted with them. While the 97 completed questionnaires renders this research exploratory in nature, the data provide a useful platform for future research on the topic. Among the 97 respondents, males represented 51.1% (Table 2). The largest age group was from 18 to 25 years at 38.1%. People with bachelor's, associate's, and high-school diplomas accounted for 28.9%, 26.8%, and 21.6% respectively. Slightly less than half of the respondents earned less than

or equal to 60,000 Yuan annually and sales, business management, and full-time students constituted 15.5%, 13.4%, and 10.3% respectively. A majority of respondents stayed at the hotel for one night; 93.8% stayed with no children; and it was the first-time for 82.5% to stay in a robot room.

Customer perceptions

Table 3 shows the responses of guests to the 10 items in the TRI. A cluster analysis was conducted to segment guests based on their TRI and the following four groups emerged:

- Cluster 1: High innovativeness and optimism + High discomfort and insecurity = PARANOIDS
- Cluster 2: High innovativeness and optimism + Low discomfort and insecurity = INNOVATORS
- Cluster 3: Low innovativeness and optimism + High discomfort and insecurity = LAGGARDS
- Cluster 4: Low innovativeness and optimism + Low discomfort and insecurity = SKEPTICS

The largest group was the Paranoids, who were highly innovative and optimistic. However, they were also concerned about the drawbacks of technology and scored high on the discomfort and insecurity dimensions. The second cluster was the Innovators, whose scores for the positive aspects of technology were higher than average. The third cluster, Laggards, had above average scores for technological drawbacks. The last group, Skeptics, rated all the items at 1.

Table 4 shows the mean scores for the benefit perceptions of guests from actually using hotel robots. The higher scores indicated more favorable perceptions of benefits. The reliability of the

11 scale variables was assessed and the Cronbach's alpha was 0.97, exceeding the 0.7 cutoff level suggested by Nunally (1978) and indicating reliability. After conducting ANOVA tests, there were no significant differences between demographic characteristics and perceptions. Likewise, there were no significant differences between variables related to the stay and perceptions. Except for protecting privacy, being responsive, and staying again if price rising 10%, all other variables had mean ratings greater than 4.5, suggesting that guests were generally satisfied with the overall hotel robot experience.

Differences in perceived benefits were examined based on clusters derived from TRI and are also shown in Table 4. The Paranoids perceived all benefits more favorably than the three other groups, indicating this group of guests tended to discern more benefits from robot room than others.

Manager perspectives

The researchers attempted to interview all 15 hotel managers; however, only 10 accepted the invitations. Five declined interviews because they could not meet the researchers unless company headquarters permitted them to do so. The answers from the 10 managers are in Table 5. In contrast to their guests, they tended to perceive more costs than benefits in both financial and non-financial aspects. The managers believed the robots brought benefits and costs to guests. However, only one manager felt that the robots generated benefits for employees, increased well-being, stating that, "The robot makes our hotel employees really happy! We often talk with the robot and expect more funny words that the robot can say." However, three managers complained they had to spend extra time to explain how to use robots if guests were interested, put robots back into their assigned rooms during housekeeping, and connect with IT staff to fix or upgrade robots. Another three managers held negative views on the adoption of robots since

hotel staff did not get extra pay as a result of extended working hours and there was resistance to learn how to use robots because their handbooks were hard to understand. Overall, managers believed that the robots created financial and non-financial costs and benefits, including the implementation costs, influence on Daily Occupancy Rate (DOR), both positive and negative, and hotel reputation.

Owner perspectives

Table 6 indicates the costs and benefits from hotel owners' perspectives. Managers and financial officers provided the data and were a proxy for the owners. These data were from the first day when robots were introduced to rooms and ended on the day when questionnaires were completed. With the exception of one hotel that had a personal relationship with a robot company and purchased the robot at a relatively low price at 1,500 RMB, all other hotels purchased robots from New Human (http://www.newhumantech.com/) at 2,000 RMB. The second column, the cost of implementation, included the purchase of robots and the implementation of the robot system. Except for one property which placed robots in luxury rooms and spent 10,000 RMB, all the other hotels spent 5,000 RMB for robot implementation. The number of robot rooms ranged from 83 to two robot rooms. The average robot room rate varied from 200 to 700.67 RMB, depending on the types of room and the hotel itself. Daily Occupancy Rates (DOR) were compared between robot and other hotel rooms. Most managers claimed that the DOR of robot rooms was almost the same as for ordinary rooms, except for one who said that the DOR of robot rooms was only the half of the other rooms because more than 40% of the hotel guests were international tourists but robots could only recognize Chinese words. Based on the data, the revenues for robot and ordinary rooms were calculated and the months needed to recoup implementation costs were determined.

The revenues from robot rooms was calculated as the rate for the robot room * number of robot rooms * DOR *365 and the revenues from ordinary rooms was calculated as the average room rate * the same number of robot rooms * DOR of the hotel * 365. The return of the cost (in months) was the cost of implementation of robots per room * number of robot rooms divided by (revenues from robot rooms - revenues from ordinary rooms). Only the return of cost at one hotel had a negative value because the DOR of robot rooms was only half of the figure for ordinary rooms, which corresponded to the negative attitude of the manager of this hotel. The shortest time for costs to be returned was only one month and the second fastest was 1.9 months. The longest time required was 23.5 months. There were five hotels where the return on cost was not attained because the robot rooms in these hotels had the same rates as other rooms. These hotels insisted on maintaining the same rates for all rooms. In conclusion, nine hotels returned the costs of robot implementation in less than two years.

Conclusions and implications

As a manifestation of service innovation, the rise of AI service robots has occurred in the hospitality industry. Hospitality organizations are attempting to understand what and how AI service robots can increase competitiveness via enhanced productivity and value. Some hotels have invested in robots and enjoyed competitive advantages, while others are struggling to obtain similar performance resulting from robot use. This research aimed to explore how hotel stakeholders, including guests, managers and staff, and owners perceived robot implementation with respect to costs and benefits. Guests perceived functional and social-emotional benefits and owners had more of a focus on financial benefits. Managers and staff were more concerned with costs because robots increased labor time and due to the complexity in learning how to use

robots. Figure 1 visualizes the main findings. Overall, the benefits and costs perceived by the three stakeholder groups were very diverse.

Theoretical implications

This research used stakeholders as the context to explore the perceptions of guests, managers, and owners towards AI service robots. Confirming the views of Byrd (2007), the relationships among stakeholders is complex and dynamic as their roles are site-specific and vary in type and extent with time. The negative attitudes held by hotel managers and other staff members toward AI service robots is related to costs of implementation in specific hotels and a concern that these costs cannot be returned. The complaints about extended working hours are connected with the needs of guests who want to play and interact with robots. It is important to compare the views and opinions of guests, managers and staff, and owners, and the similarities and differences in expectations and experiences with AI service robots, especially where the interests of stakeholders are in conflict.

TRI was applied to segment guests and examine varying perceptions. In contrast to Victorino et al. (2009) who found the Innovators to be the largest group, this research discovered that most Chinese customers were Paranoids, highly concerned with the drivers and inhibitors of technology. However, these Paranoids perceived benefits significantly higher than all other groups, indicating that customers who are highly concerned by the limitations and potential advantages of technology are more likely to be attracted by robot room because of functional and social-emotional benefits.

With respect to employees, this research confirmed the findings of Ivanov and Webster (2017) that the adoption of AI Service robots can lead to resistance as working hours are extended with no extra compensation. Several hotels offered no training or service manuals,

which put employees outside their comfort zones. Interestingly, however, no managers mentioned that they felt robots would replace human labor. One manager even emphasized that the essence of hospitality is service, and robots could never offer good service as human do. Another manager claimed robots increased employees' well-being as they enjoyed chatting with the humorous and cute machines. These findings were inconsistent with negative relationships between robot awareness and employees' organizational commitment, and career satisfaction (Chui et al., 2015, Brougham and Haar (2018). There are two reasons to explain these findings. First, the interviewers were mangers instead of low-skill and low-wage employees. Thus, these interviewees felt less resistance to the adoption of robot. Secondly, social-emotional benefits perceived by guests can also be observed by employees which may moderate the negative association between the robot awareness and employees' organizational commitment, and career satisfaction.

In terms of the owner perspectives, nine hotels recovered the costs of robot implementation within two years, indicating a relatively quick recouping of the investment. Although five hotels did not increase robot room rates, management insisted on maintaining robot in the rooms, indicating that the benefits outweigh the costs.

Managerial implications

This research potentially contributes to the design and adoption of AI service robots in hotels by revealing the diverging viewpoints of three primary stakeholders. From the guest perspective, the functionality of robots needs to be increased to avoid privacy issues and sudden noises. To more effectively engage employees, appropriate training and extra compensation should be considered. For owners, robot implementation can elevate room rates but not decrease Daily Occupancy Rates. Thus, AI Service robots can be regarded as a revenue growth opportunity.

Limitations and future research directions

There are a number of limitations to this work, providing directions for future research. Because the researchers reached out to hotel stakeholders who actually used robots, only a limited number of guests completed the survey when they were staying in robot rooms. As an exploratory study, the 97 completed questionnaires may still be acceptable considering that a sample size larger than 30 can meet the general rule of Central Limit Theorem. However, in future research, sample sizes should be increased and diversified, leading to greater power in detecting differences. Additionally, this investigation did not completely segment guests, employees, and hotel types. Although TRI was used for clustering, there are many other ways that hotel guests could be divided including by frequency of hotel use. Hotel employees could be separated according to the departments in which they are working, such as food and beverage, housekeeping, and front office. Also, this research was conducted in a single country, restricting its generalizability and calling for future research from different economic and social circumstances to further validate the results.

References

Aghaei, S., Nematbakhsh, M. A., & Farsani, H. K. (2012). Evolution of the world wide web: From WEB 1.0 TO WEB 4.0. *International Journal of Web & Semantic Technology*, *3*(1), 1-10.

Bowen, J., & Morosan, C. (2018). Beware hospitality industry: The robots are coming. *Worldwide Hospitality and Tourism Themes*, *10*(6), 726-733.

Brougham, D., & Haar, J. (2018). Smart technology, artificial intelligence, robotics, and Algorithms (STARA): Employees' perceptions of our future workplace. *Journal of Management & Organization*, *24*(2), 1-19.

Buera, F. J., & Kaboski, J. P. (2012). The rise of the service economy. *American Economic Review, 102*(6), 2540-69.

Byrd, E. T. (2007). Stakeholders in sustainable tourism development and their roles: applying stakeholder theory to sustainable tourism development. *Tourism Review, 62*(2), 6-13.

Byrd, E. T., Bosley, H. E., & Dronberger, M. G. (2009). Comparisons of stakeholder perceptions of tourism impacts in rural eastern North Carolina. *Tourism Management, 30*(5), 693-703.

Chan, A. P. H., & Tung, V. W. S. (2019). Examining the effects of robotic service on brand experience: The moderating role of hotel segment. *Journal of Travel & Tourism Marketing, 36*(4), 458-468.

Chi, O. H., Denton, G., & Gursoy, D. (2020). Artificially intelligent device use in service delivery: a systematic review, synthesis, and research agenda. *Journal of Hospitality Marketing & Management*, DOI: 10.1080/19368623.2020.1721394.

Chin, K. Y., Hong, Z. W., & Chen, Y. L. (2014). Impact of using an educational robot-based learning system on students' motivation in elementary education. *IEEE Transactions on learning technologies, 7*(4), 333-345.

Choi, Y., Choi, M., Oh, M., & Kim, S. (2019). Service robots in hotels: Understanding the service quality perceptions of human-robot interaction. *Journal of Hospitality Marketing & Management*, DOI: 10.1080/19368623.2020.1703871.

Choi, Y., Oh, M., Choi, M., & Kim, S. (2020). Exploring the influence of culture on tourist experiences with robots in service delivery environment. *Current Issues in Tourism*, DOI: 10.1080/13683500.2020.1735318.

Chui, M., Manyika, J., & Miremadi, M. (2015). Four fundamentals of workplace automation. *McKinsey Quarterly, 29*(3), 1-9.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319-340.

Davis, F. D. (2015). On the relationship between HCI and technology acceptance research. Human-Computer Interaction and Management Information Systems: Applications, D. Galletta, ed, 395-401.

DiPietro, R. B., & Wang, Y. (2010). Key issues for ICT applications: impacts and implications for hospitality operations. *Worldwide Hospitality and Tourism Themes*, *2*(1), 49-67.

Dong, B., Evans, K. R., & Zou, S. (2008). The effects of customer participation in co-created service recovery. *Journal of the Academy of Marketing Science, 36*(1), 123-137.

Duffy, B. R., Dragone, M., & O'Hare, G. M. (2005). Social robot architecture: A framework for explicit social interaction. In Android Science: Towards Social Mechanisms, CogSci 2005 Workshop, Stresa, Italy (pp. 3-4).

Freeman, R. E. (1984). Strategic management: A stakeholder theory. *Journal of Management* Studies, *39*(1), 1-21.

Heerink, M., Kröse, B., Evers, V., & Wielinga, B. (2010). Assessing acceptance of assistive social agent technology by older adults: The Almere model. *International Journal of Social Robotics*, *2*(4), 361-375.

Ho, T. H., Tojib, D., & Tsarenko, Y. (2020). Human staff vs. service robot vs. fellow customer: Does it matter who helps your customer following a service failure incident? *International Journal of Hospitality Management, 87*, DOI: 10.1016/j.ijhm.2020.102501

Imran, M. A., Baten, M. A., Nahar, B. S., & Morshed, N. (2014). Carbon dioxide emission from brickfields around Bangladesh. *International Journal of Agricultural Research, Innovation and Technology*, *4*(2), 70-75.

Ishak, I. B., Fisher, J., & Larochelle, P. (2016, August). Robot arm platform for additive manufacturing using multi-plane toolpaths. In ASME 2016 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference (pp. V05AT07A063-V05AT07A063). American Society of Mechanical Engineers.

Ivanov, S., Gretzel, U., Berezina, K., Sigala, M., & Webster, C. (2019). Progress on robotics in hospitality and tourism: A review of the literature. *Journal of Hospitality and Tourism Technology*, *10*(4), 489-521.

Ivanov, S., Webster, C., & Garenko, A. (2018). Young Russian adults' attitudes towards the potential use of robots in hotels. *Technology in Society*, *55*, 24-32.

Ivanov, S., Webster, C., & Seyyedi, P. (2018). Consumers' attitudes towards the introduction of robots in accommodation establishments. *Turizam: Međunarodni znanstveno-stručni časopis, 66*(3), 302-317.

Ivanov, S. H., & Webster, C. (2017). Adoption of robots, artificial intelligence and service automation by travel, tourism and hospitality companies–a cost-benefit analysis. Artificial Intelligence and Service Automation by Travel, Tourism and Hospitality Companies–A Cost-Benefit Analysis.

Kaplan, A., & Haenlein, M. (2019). Siri, Siri, in my hand: Who's the fairest in the land? On the interpretations, illustrations, and implications of artificial intelligence. *Business Horizons*, *62*(1), 15-25.

Kelly, P., Lawlor, J., & Mulvey, M. (2017). Customer Roles in Self-Service Technology Encounters in a Tourism Context. *Journal of Travel & Tourism Marketing, 34*(2), 222-238. doi:10.1080/10548408.2016.1156612

King, A. (2017). Technology: The future of agriculture. *Nature, 544*(7651). doi:10.1038/544s21a

Kuo, C.-M., Chen, L.-C., & Tseng, C.-Y. (2017). Investigating an innovative service with hospitality robots. *International Journal of Contemporary Hospitality Management, 29*(5), 1305-1321.

Lee, S. A., & Oh, H. (2019). Anthropomorphism and its implications for advertising hotel brands. *Journal of Business Research*, DOI: 10.1016/j.jbusres.2019.09.053.

Leung, R. (2019). Smart hospitality: Taiwan hotel stakeholder perspectives. *Tourism Review, 74*(1), 50-62.

Li, J., Bonn, M. A., & Ye, B. H. (2019). Hotel employees artificial intelligence and robotics awareness and its impact on turnover intention: The moderating roles of perceived organizational support and competitive psychological climate. *Tourism Management,73*, 172-181. doi:10.1016/j.tourman.2019.02.006

Lin, H., Chi, O. H., & Gursoy, D. (2019). Antecedents of customers' acceptance of artificially intelligent robotic device use in hospitality services. *Journal of Hospitality Marketing & Management*, DOI: 10.1080/19368623.2020.1685053.

Lu, L., Cai, R., & Gursoy, D. (2019). Developing and validating a service robot integration willingness scale. *International Journal of Hospitality Management, 80*, 36-51. doi:10.1016/j.ijhm.2019.01.005

Navarro, S., Andreu, L., & Cervera, A. (2014). Value co-creation among hotels and disabled customers: An exploratory study. *Journal of Business Research, 67*, 813-818.

Oliveira, P., & Hippel, E. V. (2011). Users as service innovators: The case of banking services. *Research Policy, 40*(6), 806-818. doi:10.1016/j.respol.2011.03.009

Parasuraman, A. (2000). Technology Readiness Index (TRI): A multiple-item scale to measure readiness to embrace new technologies. *Journal of Service Research, 2*(4): 307-320.

Park, S. (2020). Multifaceted trust in tourism service robots. *Annals of Tourism Research, 81*, DOI: 10.1016/j.annals.2020.102888.

Payne, A., Storbacka, K., & Frow, P. (2008). Managing the co-creation of value. *Journal of the Academy of Marketing Science*, *36*, 83-96.

Poole, D.; Mackworth, A.; Goebel, R. (1998). Computational intelligence: A logical approach. New York: Oxford University Press. ISBN 978-0-19-510270-3.

Prahalad, C. K., & Ramaswamy, V. (2004). Co-creation experiences: The next practice in value creation. *Journal of Interactive Marketing*, *18*(3), 5-14.

Prentice, C., Lopes, S., & Wang, X. (2019). Emotional intelligence or artificial intelligence–an employee perspective. *Journal of Hospitality Marketing & Management, 29*(4), 377–403. DOI:10.1080/19368623.2019.1647124.

Prentice, C., Lopes, S., & Wang, X. (2020). The impact of artificial intelligence and employee service quality on customer satisfaction and loyalty. *Journal of Hospitality Marketing & Management*, DOI:10.1080/19368623.2020.1722304.

Qiu, H., Li, M., Shu, B., & Bai, B. (2020). Enhancing hospitality experience with service robots: The mediating role of rapport building. *Journal of Hospitality Marketing & Management*, *29*(3), 247-268.

Ranjan, K. R., & Read, S. (2016). Value co-creation: concept and measurement. *Journal of the Academy of Marketing Science*, *44*(3), 290-315.

Sadatsafavi, H., Niknejad, B., Zadeh, R., & Sadatsafavi, M. (2016). Do cost savings from reductions in nosocomial infections justify additional costs of single-bed rooms in intensive care units? A simulation case study. *Journal of Critical Care, 31*(1), 194-200.

Šerić, M., & Gil-Saura, I. (2012). ICT, IMC, and brand equity in high-quality hotels of Dalmatia: An analysis from guest perceptions. *Journal of Hospitality Marketing & Management, 21*(8), 821-851.

Shin, H., & Perdue, R. R. (2019). Self-service technology research: A bibliometric co-citation visualization analysis. *International Journal of Hospitality Management, 80*, 101-112. doi:10.1016/j.ijhm.2019.01.012

Tung, V. W., & Law, R. (2017). The potential for tourism and hospitality experience research in human-robot interactions. *International Journal of Contemporary Hospitality Management, 29*(10), 2498-2513. doi:10.1108/ijchm-09-2016-0520

Tung, V. W. S., & Au, N. (2018). Exploring customer experiences with robotics in hospitality. *International Journal of Contemporary Hospitality Management, 30*(7), 2680-2697.

Tussyadiah, I. (2020). A review of research into automation in tourism: Launching the Annals of Tourism Research Curated Collection on Artificial Intelligence and Robotics in Tourism. *Annals of Tourism Research, 81*, DOI: 10.1016/j.annals.2020.102886.

Tussyadiah, I., & Miller, G. (2019). Nudged by a robot: Responses to agency and feedback. *Annals of Tourism Research, 78*, DOI: 10.1016/j.annals.2019.102752.

Tussyadiah, I. P., Zach, F. J., & Wang, J. (2020). Do travelers trust intelligent service robots? *Annals of Tourism Research, 81*, DOI: 10.1016/j.annals.2020.102886114.

Victorino, L., Karniouchina, E., & Verma, R. (2009). Exploring the use of the abbreviated technology readiness index for hotel customer segmentation. *Cornell Hospitality Quarterly, 50*(3), 342-359.

Wei, W., Torres, E., & Hua, N. (2016). Improving consumer commitment through the integration of self-service technologies: A transcendent consumer experience perspective. *International Journal of Hospitality Manag*ement, *59*, 105-115. doi:10.1016/j.ijhm.2016.09.004

Wirtz, J., Patterson, P. G., Kunz, W. H., Gruber, T., Lu, V. N., Paluch, S., & Martins, A. (2018). Brave new world: service robots in the frontline. *Journal of Service Management*, *29*(5), 907-9

Xu, S., Stienmetz, J., & Ashton, M. (2020). How will service robots redefine leadership in hotel management? A Delphi approach. *International Journal of Contemporary Hospitality Management*, DOI 10.1108/IJCHM-05-2019-0505.

Yu, C.-E. (2020). Humanlike robots as employees in the hotel industry: Thematic content analysis of online reviews. *Journal of Hospitality Marketing & Management, 29*(1), 22-38.

Zhong, L., Sun, S., Law, R., & Zhang, X. (2020). Impact of robot hotel service on consumers' purchase intention: a control experiment. *Asia Pacific Journal of Tourism Research*, DOI: 10.1080/10941665.2020.1726421.