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ARTICLE

Hotel Employees' Attitude and Acceptance Toward Human-Robot Co-Working Based on the Industry 5.0 Concept

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ABSTRACT

The emergence of AI-powered machines and robotics technology has strongly influenced the service industry, especially the hotel business. The effects of their introduction to the work environment on the human workforce have been a subject of much debate. However, practical studies in this regard are relatively limited. Therefore, this study investigates the employees' attitude and acceptance toward working alongside robots in a sample of employees working in luxury hotels in Yekaterinburg, Russia. This study employed a self-administered questionnaire as the data collection instrument. Two hundred questionnaire forms were distributed. Among them, 167 forms were completed and valid for analysis. Data were analyzed descriptively using IBM SPSS (Version 28). The findings revealed that, although the employees agreed to interact with robots and indicated that robots are helpful, enjoyable, and productive, they also pointed out that robots would control jobs. Besides, the extensive introduction of robots will lead to social issues such as losing contact with humans. The study conclusion has practical implications for hotel managers and can guide further research for academics.

KEYWORDS

Industry 5.0, Hotel 5.0, employee-robot co-working, artificial intelligence agents, employees' attitude and acceptance

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Introduction

Keeping a position at the top is becoming more challenging and complex due to the rapid development of information technology and artificial intelligence-based solutions. Mass customization and sophisticated production are experiencing a significant transformation in the technological world. Industrial revolutions are often regarded as the driving force behind many of the world's most essential innovations, developments, and modernity (Longo et al., 2020; Nahavandi, 2019). There are several perspectives around Industry 5.0. Some studies declare that Industry 4.0 is about smart manufacturing and connecting devices together, while Industry 5.0 is about collaboration between humans and robots in the workplace. As a result, the cooperation of humans and robots will lead to many benefits and boost the unique human touch on functions instead of the similar automation production (Demir & Cicibas, 2017; Skobelev & Borovik, 2017). In addition, Industry 5.0 reshapes human jobs to benefit employees. It maximizes efficiency by using human intelligence, artificial intelligence (AI), and creativity. Industry 5.0 may enrich the workforce by transitioning workers from physical to cognitive jobs, achieving value-added duties in the workplace alongside collaborating robots that are sensitive and aware of human desires (Longo et al., 2020; Özdemir & Hekim 2018). Moreover, Industry 5.0 places a high value on personalized consumer services (Pillai et al., 2021). There is a switch from mass customization to mass personalization, which is particularly important for meeting the needs of individual customers. Thus, Industry 5.0 may decrease work-related injuries and address value-added activities through human brainpower. Humans will concentrate on critical thinking, decision-making, innovation, and creativity, leading to increased personalized services, while robots will perform repetitive, tedious, and labor-intensive work (Alcácer & Cruz-Machado, 2019; Sarfraz et al., 2021; Verevka, 2019).

Implementing new technology such as robotics, artificial intelligence, and service automation (RAISA) results in remarkable changes to how hotels serve their customers. The function of RAISA is vital since technology, service automation, and personalized services are all fundamental components of the hotel industry. RAISA presents a significant opportunity for hotel corporations to increase productivity, enhance operations, and maintain a constant level of quality (Kim et al., 2022; Lukanova & Ilieva, 2019). Service robots designed to operate in the service sectors have emerged in hotels, catering, and entertainment enterprises to assist customers and provide information on different services. Hence, high competition, a labor shortage, the need for greater efficiency and productivity, and increasing customer expectations have contributed to the rising usage of service robots (Ivanov & Webster, 2019a; Manthiou et al., 2021).

Service robots work as robot guides at museums and bag-drop robots at airports (Ivanov et al., 2017). Such service robots that are now being used in hotels perform several functions such as greeting customers, preparing meals, room service, taking orders, check-in and check-out operations, providing information about the destination, cleaning rooms, pools and public areas, as well as cutting grass, carrying baggage, and delivering food and other goods. Robots can work 24/7, much longer than human workers' standard 40-hour workweek. Moreover, robots can serve many clients simultaneously and conduct this activity countless times without tiring or complaining (Zhong et al., 2021).

The pace at which automation enters our lives is primarily determined by the degree of technology and people's acceptance of robots. Since robots have a significant influence on society, it is vital to investigate the interactions between people and robots and their consequences for society as a whole (Demir et al., 2019; Lu et al., 2019). If the majority of the workforce in an organization have a negative attitude to robots, transferring to human–robot co-working arrangements will be difficult, if not impossible. Moreover, there are many positive cases regarding robots supporting human partners, even though not everyone has a positive attitude toward robots. It is vital to identify the workers' attitudes to robots and working with them in the hotel business since the success of robot employment depends on the employees' acceptance. Most of the studies concentrated on guests' perceptions and examined human–robot collaboration from customers' perspectives (Rosete et al., 2020; Tussyadiah, 2020). The studies around employee–robot interaction are relatively limited (Chi et al., 2020; Demir et al., 2019; Xu et al., 2020). Therefore, this study explores the employees' attitude and acceptance toward robot co-working in the hotel business.

Literature Review

From Industry 5.0 to Hospitality 5.0

Industry 5.0 consists of several components, including the human-cyber-physical system (HCPS), Internet of Service (IoS), and Internet of Things (IoT). The first component, HCPS, combines human, artificial intelligence, and the enterprise system under a high-speed Internet framework. In order to access work objects and activities, various sensory devices are widely used, such as light sensors, touch screens, and smart devices (Zhou et al., 2019). In addition, HCPS contributes to a high level of customer service by integrating human intelligence with artificial intelligence. The hotel industry is one of the economic sectors that HCPS has a high impact on—it affects many of its aspects. The second element, IoS, focuses on cross-organizational services provided and used by supply chain members and enabled by cloud computing and big data (Alvarez-Aros & Bernal-Torres, 2021). The IoS's core concept systematically utilizes the Internet to create new value in the service industry. IoS is known as guest service-oriented architecture in the hotel business and links IT with customer service (Pillai et al., 2021). Customer bills, room availability, and restaurant services have always been controlled at the

organizational level. IoS offers companies the flexibility and efficiency to serve consumers better and transfer data via its channels. The systems collect information about customer needs from databases in order to use them to provide services that meet these needs and give a better customer experience. The third element, IoT, is a system of several electronic and digital components linked together to exchange information and data within a single network. IoT is utilized in the hospitality industry to keep track of clients' comfort preferences and room settings, such as lighting, TV channels, temperature, and music, and automatically prepare the room for their next visit (Ghazy & Fedorova, 2021; Rosete et al., 2020).

For the hospitality industry, the concept of Industry 5.0 is incredibly significant. Personalized service, adaptability, creative work conditions, lower costs via completely customized facilities, and accurate information on customer preferences through big data technologies and digital advancements could affect guest satisfaction, experience, loyalty, and quality of service (Shamim et al., 2017). The primary concept of Industry 5.0, including interoperability, virtualization, modularity, decentralization, and real-time functions, can be transferred to the hospitality business, leading to hospitality 5.0 (Pillai et al., 2021).

Artificial Intelligence Agents in the Hotel Business

Presence and embodiment are considered the two dimensions of artificial intelligence agents that can be categorized into three kinds (Li, 2015).

Smart devices

Smartness relates to the interconnection of intelligent components within a single network to receive and process data and add value to the user's system. In addition, smart devices can change their functions automatically according to external conditions (Buhalis & Leung, 2018). There are a variety of smart devices, such as thermostats, lighting, security cameras, and speakers. Customers could easily adjust the settings inside the room, such as selecting a desired temperature and lighting level, using an intelligent hub, tablet device, or other central control points. The heating, lighting, air conditioning, and other facilities can automatically adapt and maintain those settings, offering a delightful guest experience (Tung & Law, 2017).

Chatbots

Another kind of AI is the chatbot, which can simulate human interaction and actively communicate with customers (Chi et al., 2020). In addition, chatbots are virtual, disembodied, technological, and autonomous conversational agents that can understand and communicate via human language through Natural Language Processing (NLP) in voice or text connections (Tussyadiah, 2020). Thus, chatbots have been employed in various service sectors, including tourist recommendations, medical consultations, and hotel reservations (Parmar et al., 2019; Ukpabi et al., 2019). Virtual assistants Siri (Apple), Alexa (Amazon), and Edward (Edwardian Hotels) are forms of AI-driven chatbots. Edward can lead travelers over their whole trip adventure in a standard, ordinary conversation, and it develops and learns from each contact

(Buhalis, & Leung, 2018; Castillo et al., 2020). Edward handled 69% of all visitor inquiries in 2019, succeeding in greater efficiency and reallocating employees from routine activities to more significant inquiries.

Consequently, because of the developed machine learning, clients may be unaware that they are communicating with an AI service device in a virtual condition (Tussyadiah, 2020). On the one hand, chatbots have some benefits versus human service representatives, including the capacity to conduct virtually enormous numbers of orders simultaneously, save massive amounts of data, and are less vulnerable to mistakes, stress, or emotional fluctuation (Chi et al., 2020). Chatbots, on the other hand, have two main weaknesses. Firstly, an ethical concern arises when individuals think they are communicating with a real person when they are actually speaking with software. Secondly, when companies use chatbot-based customer service instead of real staff, clients may feel that they are being devalued by the firm which they are doing business with (Blut et al., 2021).

Cobots (Collaborative Robots)

As a result of the rapid development of AI and innovation, it is now apparent that all devices equipped with computing capability have become more competent and have launched a new technology known as cobots. Cobots, or collaborative robots, are designed for direct human–robot interaction in a shared environment or when robots and people are in close contact (Maddikunta et al., 2022). Cobot applications encourage human engagement with robots, unlike traditional industrial robotic uses that keep robots isolated. Cobots' safety may depend on soft edges, lightweight materials, speed and force limitations, or software and sensors that maintain safe behavior. Cobots are very sensitive to unexpected impacts, allowing them to stop on their own when human employees identify any misplaced items on their route. In most cases, this makes them much more reliable than traditional industrial robots (Bender et al., 2016; Simões et al., 2020). Generally, two major categories of robots are recognized by the International Federation of Robotics (IFR), which are industrial robots performing a wide range of industrial processes and service robots for personal and professional purposes. Service robots are cobots because they are designed to operate alongside humans (Haegele, 2016). In addition, service robots are intended to assist humans with functional tasks by interacting with them physically and socially. Service robots are classified into two categories: personal used by individuals for non-commercial activities, such as domestic servant robots, automated wheelchairs, pet exercise robots, and personal mobility aid robots and professional used by businesses for commercial purposes, such as delivery robots in offices, cleaning robots for public areas, fire-fighting robots, rehabilitation robots, and surgery robots (Ivanov et al., 2017).

Robotic technology and service automation activities have impacted several aspects of hotel operations. Self-service terminals have been launched in hotels to minimize the need for front-desk staff and allow guests to perform check-in and check-out processes without help (Ivanov et al., 2017). Check-in/out procedures have been accessible through smartphones for increasing speed and convenience.

Robots are increasingly being used in the hotels and travel sectors to perform various functions, including delivering food and other items, cleaning purposes, carrying luggage, and providing support and information (Yadav, 2020).

Several hotel companies have recently utilized service robots to offer dependable, convenient, entertaining, and efficient service, creating unique guest experiences. For instance, at the Japanese Henn na Hotel, founded in 2015, robots were hired as staff members and hotel porters carrying the human staff functions (Alexis, 2017). Bilingual robots can greet tourists, assist them, and collect guest complaints, demands, and requests. As the first hotel to employ robots, it was awarded a Guinness World Record for having employed a total of 186 robots (Mende et al., 2019). Similarly, Connie, a robot, worked at the Hilton McLean Tysons Corner. It served guests with helpful information at reception. Aloft Hotel Cupertino hired a servant robot to deliver soap, towels, shampoo, and linens to rooms and bring the dirty bed sheets to the laundry. In addition, The Housekeeping Robot, created by Peanut Robotics in collaboration with RLH Corporation, assists a human housekeeper with additional housekeeping tasks such as collecting linens and cleaning bathrooms (Choi et al., 2020). The housekeeper may use the cleaning robot's mobile application to start the room cleaning procedure from anywhere, allowing it to vacuum one room while they clean another (Wirtz, 2018). The startup Dishcraft company focuses on designing dishwasher robotics for restaurant kitchens. Other robots do not communicate with guests but are used to perform repetitive duties. For example, the Caliburger robot, which prepares hamburgers and sets food on dishes, and the robot arm that works as a bartender at Royal Caribbean (Tussyadiah, 2020).

The rapid evolution and use of digital technology, particularly robots, is a priority for the Russian government. In 2017, the Russian government launched the "Digital Economy of the Russian Federation" program, which includes various robotics-related projects. For instance, the Russian Ministry of Trade and Industries is assisting the Russian Association of Robotics (RAR) in developing a plan for the growth of the Russian robotics industry. Besides, the government aims to introduce the legal aspects of robotics to stimulate this industry's progress by reducing legal issues. Meanwhile, Russia has about 100 service robot organizations. In 2018, the top ten companies had 30% workforce growth and doubled annual revenue (Khalimon et al., 2018; Konuikhovskaia, 2019).

During the pandemic, the robotics firm Promobot, located in the Ural town of Perm, invented various important robots, such as a remote temperature measurement robot, which can test temperature and other essential indications in less than 5 seconds. The company also created the Scorpion remote-controlled sanitizing robot, which can navigate obstacles, including stairs and corners, by integrating GPS/GLONASS and ultrasonic sensors. The robot has a spray device, and a container holds a disinfecting liquid (Five handy robots, 2020). Russia is also starting to use drones and robotic technologies in the hospitality industry. At the Cosmos Group hotel chain in the Emerald Forest, located near Moscow, Yandex began testing drones and rovers. The hotel occupies an enclosed area of 220 hectares and is a good platform for testing modern technologies. Drones take guests

around the territory, and rovers deliver food to the room (Maslenko, 2021). Kravt Invest, an IT and high-tech company, launched the first robotic hotel on the territory of the scientific town of Innopolis near Kazan. Hotel devices can use AI to identify the guest's feelings through images, sounds, or videos, assess his tiredness, and make assumptions about his mood. Based on this, the system adjusts the temperature and light in the room and offers tea or coffee and snacks. In addition, it is planned to transfer cleaning, delivery of luggage, and cooking to robotic solutions (Malakhova, 2020). In 2019, the Promobot Russian robot, Mikhalych, became an employee of the Park Hotel in Dobrograd. Its responsibilities include greeting guests, assisting with check-in and check-out procedures, and issuing room key cards. In addition to providing guests with information, the robot can arrange transportation for them. Mikhalych serves as an extra marketing tool, and it reminds guests of any events hosted in the restaurants and invites them to reserve a table. Mikhalych makes the registration process easier and faster while significantly decreasing the hotel staff's workload. Promobot operates not just in Russia but also across 36 countries worldwide. It works as a promoter, administrator, guide, and concierge (Kak rabotaet pervyi v Rossii, 2020).

Although automation and robotics are becoming increasingly widespread in the hospitality industry, the employment of service robots to perform human tasks may be resisted by society. Studies indicate that the reasons for this are the loss of human contact, in addition to fears of an increase in the unemployment rate in society and the dominance of machines in the labor market (Hou et al., 2021; Meidute-Kavaliauskiene et al., 2021).

Service robots that replace human employees might add a psychological issue to the standard concept of service. For example, human interaction with a robot may be avoided if it causes anxiety. In the context of the hotel business that depends primarily on personal contact, replacing human employees with robots would change the style of the experience by adding human–robot interactions and affecting the user's attitudes and behaviors. Besides, technological anxiety is regarded as a significant psychological factor influencing the adoption of new technologies (Huang et al., 2021; Li et al., 2019).

Even though there are many positive cases regarding robots supporting human partners, not everyone has a positive attitude toward robots. Robots are less likely to be used if people have negative views about them. Attitude is recognized as an individual's acquired judgment of a positive or negative emotion regarding service robots, which influences the individual's intentions and behavior. Attitudes develop due to complex psychological processes and act as motives to behavioral responses. They are crucial considerations in determining if robots are adopted (Cha, 2020; Pozharliev et al., 2021; Tussyadiah et al., 2020).

As a result of his study, Yu (2020) found that potential consumers' attitudes regarding human-like robots are likely to be unfavorable. Conversely, Tung and Au (2018) explored consumer evaluations provided on the websites TripAdvisor, Yelp, Agoda, and Booking.com in order to evaluate user experiences of robotic hotels. The findings highlighted the impact of automated service on customer experience, and

customers were proactively seeking chances to communicate and interact with robots to create a relationship with them. Similarly, Ivanov and Webster (2019b) performed another study to investigate users' perceived effectiveness and feelings about using robots in tourism. The findings indicated that housekeeping, handling inquires, reservations, and payment services are the best-suited duties and operations for robot employment. Using a mixed-methodology approach, Ivanov et al. (2020) examined the opinions of Bulgarian hotel managers on the strengths and weaknesses of service robots, as well as the effects of service robots on the different departments of the hotel. The study indicated that repetitive, tedious, and risky duties would be better suited for robots. In contrast, managers prefer to use humans for jobs requiring emotional intelligence and social skills (Ivanov et al., 2020).

As previously mentioned, most of the studies concentrated on guests' perceptions and examined human–robot collaboration from customers' perspectives. The studies around employee–robot interaction are relatively limited (Chi et al., 2020; Ivkov et al., 2020; Li et al., 2019). Thus, employing AI robots as service agents requires essential consideration of not only cost, technology, or quality of service but also of the attitudes and acceptance by human employees.

Attitudes and Demographics

Previous research has demonstrated that socio-demographic and individual variables such as gender, age, and level of education have a significant role in service robot acceptability. In a study examining gender differences, Nomura et al. (2006) revealed that men and women had different levels of negative opinions about robots. The results showed that female participants reported fewer negative opinions regarding robots than male participants. However, de Graaf and Ben Alouch (2013) discovered the opposite behavior, concluding that females experience more nervousness than males while engaging in conversation with robots. Furthermore, de Graaf and Ben Alouch (2013) found that females' negative opinions increased after interacting with a robot, while males' opinions remained the same. According to Loffredo and Tavakkoli (2016), men and youth respondents were more interested in the concept of robots than women and older participants. Besides, Hudson et al. (2017) analyzed Eurobarometer statistics on around 1000 individuals in each European country to examine public views toward robots utilized in elderly care. According to the results, age, gender, and educational level are significant independent factors connected with people's views on using robots to care for the elderly. The study reveals that males, younger, and higher-educated people are more supportive of including robots to assist the elderly. Therefore, the following hypotheses have been developed:

Hypothesis 1 (H1): There is a significant difference between employees' men and women regarding their attitudes toward robots.

Hypothesis 2 (H2): There is a significant difference between employees' age groups regarding their attitudes toward robots.

Hypothesis 3 (H3): There is a significant difference between employees' educational levels regarding their attitudes toward robots.

Methodology

Sample and Data Collection

A self-administered questionnaire was distributed between employees of the luxury hotels in Yekaterinburg, Russia, to investigate their perspectives regarding the topic of the study. The study sample consists of 20 hotels determined by the convenience sampling approach. A convenience sample is a collection of people chosen based on their accessibility. The minimal sample size required should be 7 to 10 times the number of scale items analyzed (Floyd & Widaman, 1995; Tantawy et al., 2016). Accordingly, there were 200 questionnaire forms distributed between employees of these hotels. Among them, 167 forms were valid for analysis, representing 83.5%. The questionnaire distribution took two months (August and September 2021). Besides, the study concentrated on Five- and Four-star hotels because innovation and modern technologies are implemented first in luxury hotels. The researchers explained the concept of robots to the employees, and then they were able to answer the questionnaire. The questionnaire was translated into Russian because some staff members do not speak English.

Measures and Pretest

The instrument used in the current study was divided into three groups of questions; the first group contained items regarding the changes that occurred in the workplace. In the second group, there were questions to examine the study variables—Psychological Attitude (PA), Social Attitude (SA). The third group addressed demographic categories, including gender, age, and educational level. The questionnaire was adopted from previous research (Bröhl et al., 2016; Nomura et al., 2004; Weiss et al., 2008), which has been validated. The participants were questioned to indicate their level of agreement with the statements according to the Likert scale with five points ranging from “1 = strongly disagree” to “5 = strongly agree”. The questionnaire was pretested using data obtained from ten employees through the convenience sampling technique. Participants were specifically asked to identify any misunderstandings in the questionnaire’s phrasing. The feedback received from these participants was used to further improve the tool. The adjusted instrument contained 22 elements.

Data Analysis

The data analysis was processed as follows. First, Cronbach’s alpha coefficients were applied to test the internal reliability of these varied Likert-type scales and questions. Second, a descriptive data analysis was conducted to explore the attitude and acceptance of hotel employees toward human-robot co-working. In addition, the Mann–Whitney U test was used to check the differences in employees’ gender regarding their attitude toward robots. The Kruskal–Wallis $\chi 2$-test was used to check the differences in employees’ age groups and educational levels regarding their attitude toward robots. The results obtained from the valid questionnaire forms were statistically analyzed whenever needed using IBM SPSS (Version 28).

Results

Table 1 represents the demographic variables of the respondents. Table 2 shows the employees' responses to the changes in their workplaces due to robotics. As displayed in Table 2, a notable percentage of the answers indicated reducing the number of employees (69.4%), followed by transferring part of jobs to distance work (28.1%) and using temporary workers provided by other companies (23.3%). In contrast, the lowest percentage indicated the complete dismissal of workers (10.8%), and no changes (8.3%). Employees added that among the changes in the workplace are the continuous adjustments of work tasks and responsibilities.

Table 1
Participants' Demographic Characteristics

Demographic data		Freq.	%
Gender	Male	65	38.9
	Female	102	61.1
Age	25 years or younger	81	48.5
	From 26 up to 35	53	31.7
	From 36 up to 50	24	14.4
	Over 50	9	5.4
Education	Secondary School Education	28	16.8
	University or Higher Institute Degree	135	80.8
	Postgraduate Degrees (Masters or PhD)	4	2.4
	Other	–	–

Note. Source: Developed by Authors.

Table 2
Responses to the Question: What Changes Have Occurred in Your Organization Due to the Introduction of Collaborative Robots?

Answer alternatives	Freq.	%
The introduction of collaborative robots involved the dismissal of employees	18	10.8
Partial reduction of the number of employees	116	69.4
Transferring some of the employees to distance work	47	28.1
The use of temporary or seasonal workers provided by other companies	39	23.3
Hiring new employees only on a short-term basis (from 1 to 6 months)	24	14.4
There were no changes	14	8.3
Other	28	16.7

Note. Source: Developed by Authors.

Table 3 illustrates the results of the descriptive analysis of the psychological and social variables. First, Cronbach's alpha coefficients were applied to test the internal reliability of the varied Likert-type scales and questions. The Cronbach's alpha coefficient results all passed the acceptable recommended value of 0.7. The findings show that the scores of psychological variables ranged from 2.00 to 3.92 on a five-point scale. The items with the highest average were "I think that in the future, society will be dominated by robots" and "If robots had feelings, I would be able to make friends with them"; while the lowest average item was "I feel nervous operating a robot in front of other people." In addition, scores of social variables ranged from 2.87 to 3.98 on a five-point scale. The items with the highest average were "I fear that I may lose my work due to the robot" and "I fear that I lose contact with my colleagues because of the robot." While the lowest-mean item was "I have no objection if the robot stores my personal information."

Table 3

Analysis Results

Scale Item	Mean	Standard Deviation	Cronbach's Alpha
Psychological attitude			**0.752**
I feel uneasy if robots really have emotions	2.23	0.588	
Something terrible might happen if robots developed into living beings	3.33	0.575	
I feel relaxed dealing with robots.	3.77	0.744	
If robots had feelings, I would be able to make friends with them	3.88	0.631	
I would feel comforted being with robots that have emotions	3.66	0.578	
I feel nervous operating a robot in front of other people	2.00	0.329	
I feel nervous just standing in front of a robot	2.08	0.538	
I think that if I depend on robots too much, something terrible might happen	3.75	0.644	
I feel paranoid talking with a robot	2.09	0.605	
I think that in the future, society will be dominated by robots	3.92	0.634	
Social attitude			**0.781**
In general, my organization supports the use of robots	3.83	0.736	
People in my hotel who use robots have more prestige than those who do not	3.86	0.491	
The use of the robot is appropriate to my various job-related tasks	3.92	0.396	
The robot's output is of excellent quality	3.90	0.428	
I find using a robot enjoyable	3.81	0.431	
I fear that I will lose contact with my colleagues because of the robot	3.93	0.655	
I have no objection to sharing a workstation with a robot	3.80	0.428	
I have no objection if the robot stores my personal information	2.87	0.447	
I fear that I may lose my work due to the robot	3.98	0.394	
I feel safe while using the robot	3.03	0.354	
I can operate the robot if someone teaches me how to use it first	3.76	0.379	
Operating the robot enhances my job performance	3.89	0.431	

Note. Source: Developed by Authors.

To evaluate the difference between employees' men and women regarding their attitude toward robots, the Mann–Whitney U test was utilized. Table 4 shows no statistically significant difference between men and women regarding psychological attitude (p-value = 0.547) and social attitude (p-value = 0.942). Hence, H1 is not supported. In addition, the Kruskal–Wallis test was used to evaluate the differences among the employees' age groups. Table 5 reveals a statistically significant difference between employees' age groups regarding psychological attitude (p-value = 0.045) and social attitude (p-value = 0.027). Hence, H2 is supported. The results showed that employees aged 25 or under had the least negative attitude toward robots (M = 54.20) regarding their psychological attitude considering that the psychological scale is negative. Besides, the results showed that employees over 50 had the least positive attitude toward robots (M = 40.11) regarding their social attitude (Table 5). Furthermore, the Kruskal–Wallis test was used to evaluate the differences among the employees' educational levels regarding their attitudes toward robots. Table 6 shows no statistically significant difference between employees' educational levels regarding psychological attitude (p-value = 0.666) and social attitude (p-value = 0.529). Hence, H3 is not supported.

Table 4

The Difference Analysis Between Men and Women

No.	Construct	Gender	*N*	Mean Rank	Mann–Whitney U	*Z*	Asymp. Sig. (2-tailed)
1.	Psychological	Male	65	81.22	3134.000	–.602	.547
		Female	102	85.77			
2.	Social	Male	65	83.68	3294.000	–.072	.942
		Female	102	84.21			

* Significant ($p \leq .05$)

Note. Source: Developed by Authors.

Table 5

The Difference Analysis Between Employees' Age Groups

No.	Construct	Employees Age	*N*	Mean Rank	Chi–Square	*DF*	Asymp. Sig.
1.	Psychological	25 years or under	81	54.20	4.092	3	.045*
		From 26 up to 35 years	53	80.16			
		From 36 up to 50 years	24	94.19			
		Over 50 years	9	98.67			
2.	Social	25 years or under	81	90.21	9.219	3	.027*
		From 26 up to 35 years	53	85.05			
		From 36 up to 50 years	24	83.21			
		Over 50 years	9	40.11			

* Significant ($p \leq .05$)

Note. Source: Developed by Authors.

Table 6
The Difference Analysis Between Employees' Educational Levels

No.	Construct	Level of Education	*N*	Mean Rank	Chi–Square	*DF*	Asymp. Sig.
1.	Psychological	Secondary School	28	78.73	8.763	2	.666
		University Degree	135	84.32			
		Postgraduate Degrees (Masters or PhD)	4	70.13			
2.	Social	Secondary School	28	81.00	5.207	2	.529
		University Degree	135	89.12			
		Postgraduate Degrees (Masters or PhD)	4	79.25			

* Significant ($p \leq .05$)

Note. Source: Developed by Authors.

Discussion and Conclusions

This study aimed to explore hotel employees' psychological and social attitudes toward working side by side with robots. Service robots have joined our lives as a result of technological advancement and industrial revolutions. Among their applications are augmented reality and intelligent devices working with AI, which significantly affect economic and social life. Consequently, companies are working to keep pace with the external environment's development to obtain a competitive advantage and provide a unique service that receives customer satisfaction. In addition, the hotel business is one of the industries affected by technological developments. The success and effectiveness of implementing new technology in companies depend on employee acceptance and involvement. The adoption of service robots in business, especially in service sectors, is still in its preliminary stages and is considered a significant innovation in literature. Therefore, studies into this topic need to be conducted from different perspectives.

The study results showed a partial reduction in the number of hotel workers due to the introduction of collaborative robots. This finding agreed with Manyika et al., (2017), who indicated that one of the most significant points in the literature is the prediction that robots will replace people or decrease the number of jobs and employees. According to the study results, employees feel threatened and worry about the future of their work and about losing jobs due to automation and digitalization process. Many studies estimated that by 2030, between 400 and 800 million of today's occupations would be automated (Bowen & Morosan, 2018). Robotic technology and service automation have impacted several aspects of hotel operations. Self-service terminals have been launched in hotels to minimize the need for front-desk staff and allow guests to perform check-in and check-out processes without help (Ivanov et al., 2017). Check-in/out procedures have been accessible through smartphones for increasing speed and convenience. Robots are increasingly being used in hotel and travel sectors

to perform various functions, including delivering food and other items, cleaning purposes, carrying luggage, and providing support and information (Yadav, 2020).

The demographic analysis revealed no statistically significant difference between employees' men and women regarding their attitude toward robots. This result differs from previous studies that indicated gender differences toward robots. According to de Graaf and Ben Alouch (2013), female respondents are more anxious regarding robots than male respondents. A possible explanation for this finding is that the COVID-19 pandemic has changed people's attitudes toward technology and innovation (Barrutia & Echebarria, 2021; Zhong et al., 2022). In addition, the finding represented a statistically significant difference between the employees' age groups. The results showed that employees aged 25 or under had a less negative attitude toward robots, whereas employees over 50 had a less positive attitude toward robots than other age groups. This finding agreed with Loffredo and Tavakkoli (2016), who indicated that young people are more interested in the concept of robots than older people. Moreover, the study showed no statistically significant difference between employees' educational levels. This result is consistent with the previous research (Ivanov et al., 2018), which showed that respondents' level of education had no impact on their attitudes toward robots.

This research contributed to the current literature by providing supportive results from the Russian staff perspectives. On the one hand, employees agreed to interact with robots and indicated that they are helpful, enjoyable, and productive; robot employment would save time by taking over routine tasks and workload. On the other hand, employees fear that robots will control jobs, and the extensive introduction of robots will lead to social issues such as losing contact with humans.

We recommend that hotel managers create new roles for employees, which require new skills and competencies in order to make human labor more valuable than that of robots and keep pace with the continuous development in the work environment. On the other hand, courses on technology advancements and artificial intelligence must be included in the curriculum across all education levels, where future leaders and workers are trained and developed. These courses will prepare students to join the new work environment and effectively deal with future challenges. Moreover, since service robots are helpful for the hotel business, hotel managers must provide incentives to older employees to motivate them to engage with robots.

This study has some limitations that might serve as a guide for further research. Firstly, since the field data were collected from a particular geographic region of one country, future research should incorporate data from other countries with various economic and social backgrounds to increase the generalizability of the results. Secondly, this study collected empirical data using a questionnaire method. Future research might consider other methodological methods such as interviews or observation of daily human–robot interaction in order to go in-depth and identify different themes around the topic. Finally, artificial intelligence research is still in the primary stage, especially in the service sector. Hence, future research is urgently required to expand the understanding of the influence of AI on various social groups and how other users perceive AI technology.

References

Alcácer, V., & Cruz-Machado, V. (2019). Scanning the industry 4.0: A literature review on technologies for manufacturing systems. *Engineering Science and Technology, an International Journal*, *22*(3), 899–919. https://doi.org/10.1016/j.jestch.2019.01.006

Alexis, P. (2017). R-tourism: Introducing the potential impact of robotics and service automation in tourism. *Ovidius University Annals: Economic Sciences Series*, *17*(1), 211–216.

Alvarez-Aros, E. L., & Bernal-Torres, C. A. (2021). Technological competitiveness and emerging technologies in industry 4.0 and industry 5.0. *Annals of the Brazilian Academy of Sciences*, *93*(1), Article e20191290. https://doi.org/10.1590/0001-3765202120191290

Barrutia, J. M., & Echebarria, C. (2021). Effect of the COVID-19 pandemic on public managers' attitudes toward digital transformation. *Technology in Society*, *67*, Article 101776. https://doi.org/10.1016/j.techsoc.2021.101776

Bender, M., Braun, M., Rally, P., & Scholtz, O. (2016). *Lightweight robots in manual assembly—best to start simply!* (W. Bauer, Ed.). Fraunhofer Institute for Industrial Engineering and Organization IAO.

Blut, M., Wang, C., Wünderlich, N. V., & Brock, C. (2021). Understanding anthropomorphism in service provision: A meta-analysis of physical robots, chatbots, and other AI. *Journal of the Academy of Marketing Science*, *49*(4), 632–658. https://doi.org/10.1007/s11747-020-00762-y

Bowen, J., & Morosan, C. (2018). Beware hospitality industry: The robots are coming. *Worldwide Hospitality and Tourism Themes*, *10*(6), 726–733. https://doi.org/10.1108/WHATT-07-2018-0045

Bröhl, C., Nelles, J., Brandl, C., Mertens, A., & Schlick, C. M. (2016). TAM reloaded: A technology acceptance model for human–robot cooperation in production systems. In C. Stephanidis (Ed.), *HCI International 2016—Posters' Extended Abstracts: Proceedings of 18th International Conference, Toronto, Canada, July 17–22, 2016,* (pp. 97–103). Springer. https://doi.org/10.1007/978-3-319-40548-3_16

Buhalis, D., & Leung, R. (2018). Smart hospitality—Interconnectivity and interoperability towards an ecosystem. *International Journal of Hospitality Management*, *71*, 41–50. https://doi.org/10.1016/j.ijhm.2017.11.011

Castillo, D., Canhoto, A. I., & Said, E. (2020). The dark side of AI-powered service interactions: Exploring the process of co-destruction from the customer perspective. *The Service Industries Journal*, *41*(13–14), 900–925. https://doi.org/10.1080/02642069.2020.1787993

Cha, S. S. (2020). Customers' intention to use robot-serviced restaurants in Korea: relationship of coolness and MCI factors. *International Journal of*

Contemporary Hospitality Management, *32*(9), 2947–2968. https://doi.org/10.1108/IJCHM-01-2020-0046

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*, *29*(7), 757–786. https://doi.org/10.1080/19368623.2020.1721394

Choi, Y., Choi, M., Oh, M., & Kim, S. (2020). Service robots in hotels: Understanding the service quality perceptions of human–robot interaction. *Journal of Hospitality Marketing & Management*, *29*(6), 613–635. https://doi.org/10.1080/19368623.2020.1703871

de Graaf, M. M., & Ben Allouch, S. (2013). The relation between people's attitude and anxiety towards robots in human-robot interaction. In *Proceedings of IEEE International Workshop on Robot and Human Communication (ROMAN), August 26–29, 2013* (pp. 632–637). https://doi.org/10.1109/ROMAN.2013.6628419

Demir, K. A., & Cicibas, H. (2017). Industry 5.0 and a critique of industry 4.0. In *Proceedings of the 4th International Management Information Systems Conference, Istanbul, Turkey, October 17–20, 2017*. İstanbul University.

Demir, K. A., Döven, G., & Sezen, B. (2019). Industry 5.0 and human-robot co-working. *Procedia Computer Science*, *158*, 688–695. https://doi.org/10.1016/j.procs.2019.09.104

Five handy robots made in Russia. (2020, December 22). *Russia Beyond.* https://www.rbth.com/science-and-tech/333182-robots-made-in-russia

Floyd, F. J., & Widaman, K. F. (1995). Factor analysis in the development and refinement of clinical assessment instruments. *Psychological Assessment*, *7*(3), 286–299. https://doi.org/10.1037/1040-3590.7.3.286

Ghazy, K., & Fedorova, A. (2021). Industry 4.0 and human resource management in the hotel business. *Human Progress*, *7*(2). https://doi.org/10.34709/IM.172.1

Haegele, M. (2016). *World robotics 2016*. IFR Statistical Department, VDMA.

Hou, Y., Zhang, K., & Li, G. (2021). Service robots or human staff: How social crowding shapes tourist preferences. *Tourism Management*, *83*, Article 104242. https://doi.org/10.1016/j.tourman.2020.104242

Huang, H.-L., Cheng, L.-K., Sun, P.-C., & Chou, S.-J. (2021). The effects of perceived identity threat and realistic threat on the negative attitudes and usage intentions toward hotel service robots: The moderating effect of the robot's anthropomorphism. *International Journal of Social Robotics*, *13*(7), 1599–1611. https://doi.org/10.1007/s12369-021-00752-2

Hudson, J., Orviska, M., & Hunady, J. (2017). People's attitudes to robots in caring for the elderly. *International Journal of Social Robotics*, *9*(2), 199–210. https://doi.org/10.1007/s12369-016-0384-5

Ivanov, S., Seyitoğlu, F., & Markova, M., (2020). Hotel managers' perceptions towards the use of robots: A mixed-methods approach. *Information Technology & Tourism*, *22*(4), 505–535. https://doi.org/10.1007/s40558-020-00187-x

Ivanov, S., & Webster, C. (Eds.). (2019a). *Robots, artificial intelligence and service automation in travel, tourism and hospitality*. Emerald. https://doi.org/10.1108/978-1-78756-687-320191001

Ivanov, S., & Webster, C. (2019b). Perceived appropriateness and intention to use service robots in tourism. In J. Pesonen & J. Neidhardt (Eds.), *Information and communication technologies in tourism 2019* (pp. 237–248). Springer. https://doi.org/10.1007/978-3-030-05940-8_19

Ivanov, S., Webster, C., & Berezina, K. (2017). Adoption of robots and service automation by tourism and hospitality companies. *Revista Turismo & Desenvolvimento*, 27–28, 1501–1517.

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. https://doi.org/10.1016/j.techsoc.2018.06.004

Ivkov, M., Blešić, I., Dudić, B., Pajtinková Bartáková, G., & Dudić, Z. (2020). Are future professionals willing to implement service robots? Attitudes of hospitality and tourism students towards service robotization. *Electronics, 9*(9), Article 1442. https://doi.org/10.3390/electronics9091442

Kak rabotaet pervyi v Rossii robot-administrator otelia [How does Russia's first robot-administrator of the hotel work]. (2020, January 29). Promobot. https://promo-bot.ru/review/first-hotel-robot/

Khalimon, E., Guseva, M., Kogotkova, I., & Brikoshina, I. (2018). Digitalization of the Russian economy: First results. In V. Mantulenko (Ed.), *Proceedings of the International Scientific Conference "Global Challenges and Prospects of the Modern Economic Development" (GCPMED 2018), December 06–08, 2018, Samara State University of Economics, Samara, Russia* (pp. 199–213). Future Academy. https://doi.org/10.15405/epsbs.2019.03.21

Kim, T., Jo, H., Yhee, Y., & Koo, C., (2022). Robots, artificial intelligence, and service automation (RAISA) in hospitality: Sentiment analysis of YouTube streaming data. *Electronic Markets*, *32*(1), 259–275. https://doi.org/10.1007/s12525-021-00514-y

Konuikhovskaia, A. (2019, August 27). *Five trends in Russian robotics*. International Federation of Robotics. https://ifr.org/post/five-trends-in-russian-robotics

Li, J. (2015). The benefit of being physically present: A survey of experimental works comparing copresent robots, telepresent robots and virtual agents. *International Journal of Human–Computer Studies*, *77*, 23–37. https://doi.org/10.1016/j.ijhcs.2015.01.001

Li, J. J., Bonn, M. A., & Ye, B. H. (2019). Hotel employee's 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. https://doi.org/10.1016/j.tourman.2019.02.006

Loffredo, D., & Tavakkoli, A. (2016). What are European Union public attitudes towards robots. *Systemics, Cybernetics and Informatics*, *14*(1), 11–19.

Longo, F., Padovano, A., & Umbrello, S. (2020). Value-oriented and ethical technology engineering in industry 5.0: A human-centric perspective for the design of the factory of the future. *Applied Sciences*, *10*(12), Article 4182. https://doi.org/10.3390/APP10124182

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

Lukanova, G., & Ilieva, G. (2019). Robots, artificial intelligence and service automation in hotels. In S. Ivanov & C. Webster (Eds.), *Robots, artificial intelligence, and service automation in travel, tourism, and hospitality* (pp. 157–183). Emerald. https://doi.org/10.1108/978-1-78756-687-320191009

Maddikunta, P. K. R., Pham, Q.-V., Prabadevi, B., Deepa, N., Dev, K., Gadekallu, T. R., Ruby, R., & Liyanage, M. (2022). Industry 5.0: A survey on enabling technologies and potential applications. *Journal of Industrial Information Integration*, *26*, Article 100257. https://doi.org/10.1016/j.jii.2021.100257

Malakhova, P. (2020, July 29). Roboty na resepshn: Kak stroiat pervuiu robotizirovannuiu gostinitsu v Rossii [Robots at the reception: How they build the first robotic hotel in Russia]. *Hi-tech.mail.ru*. https://hi-tech.mail.ru/review/robots-hotel/#a05

Manthiou, A., Klaus, P., Kuppelwieser, V. G., & Reeves, W. (2021). Man vs machine: Examining the three themes of service robotics in tourism and hospitality. *Electronic Markets*, *31*(3), 511–527. https://doi.org/10.1007/s12525-020-00434-3

Manyika, J., Chui, M., Miremadi, M., Bughin, J., George, K., Willmott, P., & Dewhurst, M. (2017). A future that works: Automation, employment, and productivity. *McKinsey Global Institute*.

Maslenko, D. (2021, July 23). Roboty-sotrudniki v oteliakh i parkakh: Gde testiruiut avtonomnye tekhnologii [Employee robots in hotels and parks: Where autonomous technologies are being tested]. *RBK Trendy*. https://trends.rbc.ru/trends/industry/60fab3bf9a7947c47ad7dc56

Meidute-Kavaliauskiene, I., Çiğdem, S., Yildiz, B., & Davidavicius, S. (2021). The effect of perceptions on service robot usage intention: A survey study in the service sector. *Sustainability*, *13*(17), Article 9655. https://doi.org/10.3390/su13179655

Mende, M., Scott, M. L., van Doorn, J., Grewal, D., & Shanks, I. (2019). Service robots rising: How humanoid robots influence service experiences and elicit

compensatory consumer responses. *Journal of Marketing Research*, *56*(4), 535–556. https://doi.org/10.1177/0022243718822827

Nahavandi, S. (2019). Industry 5.0—A human-centric solution. *Sustainability*, *11*(16), Article 4371. https://doi.org/10.3390/su11164371

Nomura, T., Kanda, T., & Suzuki, T. (2006). Experimental investigation into influence of negative attitudes toward robots on human–robot interaction. *AI & Society*, *20*(2), 138–150. https://doi.org/10.1007/s00146-005-0012-7

Nomura, T., Kanda, T., Suzuki, T., & Kato, K. (2004). Psychology in human–robot communication: An attempt through investigation of negative attitudes and anxiety toward robots. In *RO-MAN 2004: Proceedings of the 13th IEEE International Workshop on Robot and Human Interactive Communication, September 20–22, 2004, Kurashiki, Japan* (pp. 35–40). https://doi.org/10.1109/ROMAN.2004.1374726

Özdemir, V., & Hekim, N. (2018). Birth of industry 5.0: Making sense of big data with artificial intelligence, "The Internet of Things" and next-generation technology policy. *Omics: A Journal of Integrative Biology*, *22*(1), 65–76. https://doi.org/10.1089/omi.2017.0194

Parmar, S., Meshram, M., Parmar, P., Patel, M., & Desai, P. (2019). Smart hotel using intelligent chatbot: A review. *International Journal of Scientific Research in Computer Science, Engineering and Information Technology*, *5*(2), 823–829. https://doi.org/10.32628/CSEIT11952246

Pillai, S. G., Haldorai, K., Seo, W. S., & Kim, W. G. (2021). COVID-19 and hospitality 5.0: Redefining hospitality operations. *International Journal of Hospitality Management*, *94*, Article 102869. https://doi.org/10.1016/j.ijhm.2021.102869

Pozharliev, R., De Angelis, M., Rossi, D., Romani, S., Verbeke, W., & Cherubino, P. (2021). Attachment styles moderate customer responses to frontline service robots: Evidence from affective, attitudinal, and behavioral measures. *Psychology & Marketing*, *38*(5), 881–895. https://doi.org/10.1002/mar.21475

Rosete, A., Soares, B., Salvadorinho, J., Reis, J., & Amorim, M. (2020). Service robots in the hospitality industry: An exploratory literature review. In H. Nóvoa, M. Drăgoicea & N. Kühl (Eds.), *Proceedings of the 10th International Conference, IESS 2020, Porto, Portugal, February 5–7, 2020* (pp. 174–186). Springer. https://doi.org/10.1007/978-3-030-38724-2_13

Sarfraz, Z., Sarfraz, A., Iftikar, H. M., & Akhund, R. (2021). Is COVID-19 pushing us to the Fifth Industrial Revolution (Society 5.0)? *Pakistan Journal of Medical Sciences*, *37*(2), 591–594. https://doi.org/10.12669/pjms.37.2.3387

Shamim, S., Cang, S., Yu, H., & Li, Y. (2017). Examining the feasibilities of Industry 4.0 for the hospitality sector with the lens of management practice. *Energies*, *10*(4), Article 499. https://doi.org/10.3390/en10040499

Simões, A. C., Soares, A. L., & Barros, A. C. (2020). Factors influencing the intention of managers to adopt collaborative robots (cobots) in manufacturing

organizations. *Journal of Engineering and Technology Management*, *57*, Article 101574. https://doi.org/10.1016/j.jengtecman.2020.101574

Skobelev, P. O., & Borovik, S. Y. (2017). On the way from Industry 4.0 to Industry 5.0: From digital manufacturing to digital society. *International Scientific Journal Industry 4.0*, *2*(6), 307–311.

Tantawy, A., Abbas, T. M., & Ibrahim, M. Y. (2016). Measuring the relationship between job stress and service quality in quick-service restaurants. *Egyptian Journal of Tourism Studies*, *15*(2), 1–23.

Tung, V. W. S., & Au, N. (2018). Exploring customer experiences with robotics in hospitality. *International Journal of Contemporary Hospitality Management*, *30*(7), 2680–2697. https://doi.org/10.1108/IJCHM-06-2017-0322

Tung, V. W. S., & 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. https://doi.org/10.1108/IJCHM-09-2016-0520

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*, Article 102883. https://doi.org/10.1016/j.annals.2020.102883

Tussyadiah, I. P., Zach, F. J., & Wang, J. (2020). Do travelers trust intelligent service robots? *Annals of Tourism Research*, *81*, Article 102886. https://doi.org/10.1016/j.annals.2020.102886

Ukpabi, D. C., Aslam, B., & Karjaluoto, H. (2019). Chatbot adoption in tourism services: A conceptual exploration. In S. Ivanov & C. Webster (Eds.), *Robots, artificial intelligence, and service automation in travel, tourism, and hospitality* (pp. 105–121). Emerald. https://doi.org/10.1108/978-1-78756-687-320191006

Verevka, T. V. (2019). Development of industry 4.0 in the hotel and restaurant business. *IBIMA Business Review*, Article 324071. https://doi.org/10.5171/2019.324071

Weiss, A., Bernhaupt, R., Tscheligi, M., Wollherr, D., Kuhnlenz, K., & Buss, M. (2008). A methodological variation for acceptance evaluation of human-robot interaction in public places. In *RO-MAN 2008: Proceedings of the 17th IEEE International Symposium on Robot and Human Interactive Communication*, *August 01–03, 2008, Munich, Germany* (pp. 713–718). https://doi.org/10.1109/ROMAN.2008.4600751

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), 907–931. https://doi.org/10.1108/JOSM-04-2018-0119

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, *32*(6), 2217–2237. https://doi.org/10.1108/IJCHM-05-2019-0505

Yadav, J. S. (2020, November). AI in the hotel industry: Adoption and application of artificial intelligence in the hotel industry. *Hospitality & Travel Connaisseur Magazine*, 30–32.

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. https://doi.org/10.1080/19368623.2019.1592733

Zhong, L., Coca-Stefaniak, J. A., Morrison, A. M., Yang, L., & Deng, B. (2022). Technology acceptance before and after COVID-19: No-touch service from hotel robots. *Tourism Review, 77*(4), 1062–1080. https://doi.org/10.1108/TR-06-2021-0276

Zhong, L., Zhang, X., Rong, J., Chan, H. K., Xiao, J., & Kong, H. (2021). Construction and empirical research on acceptance model of service robots applied in hotel industry. *Industrial Management & Data Systems*, *121*(6), 1325–1352. https://doi.org/10.1108/IMDS-11-2019-0603

Zhou, J., Zhou, Y., Wang, B., & Zang, J. (2019). Human–cyber–physical systems (HCPSs) in the context of new-generation intelligent manufacturing. *Engineering*, *5*(4), 624–636. https://doi.org/10.1016/j.eng.2019.07.015