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PERCEPTIONS OF CROATIAN AND MONTENEGRIN HOTEL MANAGERS

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Robots have been utilized in the hospitality industry for a considerable period of time. Schraft and Wanner (1993) were the first to publish an article on robot use in hospitality, discussing industrial aircraft cleaning robots. Since then, the integration of robotics in the industry has seen significant advancements which stimulated further investigation and innovation in the field (Ivanov et al., 2018).

With the rising interest for robotics in hospitality industry and its adoption in hotels, it has become necessary to take a closer look at extant studies on this topic and areas ripe for exploration. With a paucity of information pertaining to robot introduction and use in hotels in Croatia and Montenegro, this study aims to investigate views of Montenegrin and Croatian hotel managers' on robot integration in hotel operations and to identify the factors that influence their decision-making.

Abstract

As part of technology's continued march into our work and lives, robot use in hotels is becoming more common as a way to improve efficiency, enhance guests' experience, and reduce costs. This exploratory study strives to determine Croatian and Montenegrin hotel managers' thoughts concerning the introduction, use, and impacts of robots in their hotels. These hotel managers were identified via LinkedIn and thirty-four completed an online survey between April 5th and 18th, 2023. The results are slightly affirmative that robot use will increase hotel profitability; although, not by raising prices, but through operational cost decreases. Operations identified best suited for robot use in terms of increasing customer service include activities that are repetitive and involve limited customer interaction. At the hotel department level, results indicate that robot introduction in Croatian and Montenegrin hotels is least likely to occur in Human Resources and most likely in Room Service. From a strategic standpoint, the results indicate that robots use will not provide hotels with a competitive benefit. Concerning employees, this study concludes that robot introduction will increase their effectiveness and efficiency, resulting in an enhancement (not substitution) effect. Additionally, this study finds that Croatian and Montenegrin hotels will not be introducing robots into their operations in the next three years; although, three and four-star properties will do so before five-star properties. It is

suggested that perceived costs and benefits associated with robot use do not warrant their introduction.

Keywords: Robots, Hotel industry, Service Robots, Artificial Intelligence, Robotics in Hotels

1. Literature Review

1.1. From fiction to fact: The history of robots in hotels

The word 'robot' was initially used in a play called R.U.R (or Rossum's Universal Robots) by Karel Capek in 1920 (NPR, 2011). Robots have been defined as an operated device that can be programmed to move independently in two or more directions within the surrounding environment and execute intended functions as instructed (International Organization for Standardization, 2012, as cited in Ivanov & Webster., 2019). Furthermore, Ivanov et al. (2017) describe robots as physical devices with artificial intelligence (AI) that are able to complete tasks autonomously, without the need of human intervention.

According to International Federation of Robotics (2012), it took many years for the idea of robots to get widely recognized and accepted in mainstream culture. During the 1950s, the entertainment industry, particularly Hollywood and popular culture, had a considerable impact on the dissemination and promotion of the concept of robots, as well as an impact on advancement of robots. Founded in 1956, Unimation invented the first industrial robot in 1959 (International Federation of Robotics, 2012).

Travel and tourism firms have been slow in adopting robotics due to the fact that many of their services demand complex responses to customer needs. The hospitality sector readily adopted self-service terminals and vending machines, while the implementation of robots was hindered by various factors including their high costs, limited technical know-how, as well as the perception that tourism is primarily a human-centered industry (Ivanov et al., 2020). But different from the aforementioned service terminals, service robots exhibit greater flexibility in their ability to respond and adjust to their environment. They can collect input data through sensors, instantly analyze it, create a strategy and quickly implement choices through the use of mechanical devices (Ivanov & Webster, 2019).

Henn na Hotel, located in Nagasaki, Japan, established the first primarily robot staffed hotel in 2015 (Reis et al., 2020). The hotel has made significant investments in various types of robots and advanced technology, including in-room helper robots, luggage robots, receptionist robots, concierge robots, and facial recognition systems (Bhimasta & Kuo, 2019).

2. Robotic Implementation in Hospitality: How Robots are transforming the Hospitality Industry

Unlike AI-based software programs, robots have physical attributes which appear in a range of versions that include: anthropomorphic (human-like); zoomorphic (animal-like); or representational objects (Bowen & Morosan, 2018). The world's first robotic hotel in Japan, the aforementioned Henn na Hotel, has implemented both anthropomorphic and zoomorphic robots at the front desk. Furthermore, each room is staffed with spherical mini–robots resembling the droid from Star Wars, which are used to assist guests with various tasks such as playing music or changing TV channels (Ono, 2018).

Bowen and Morosan (2018) have determined that the one of the main reasons for the surge in service robot adoption across various markets is an insufficient labor supply. In Japan, for example, reasons for this include the expanding senior population, strict immigration policies, declining birth rates, and a projected increase in demand for services; consequently, those in the hospitality industry must rely on new and developing technologies (Schneider & Hong, 2018).

Future-focused or innovative companies in the hospitality industry will not only replace certain positions with robots, but also create new service delivery systems that incorporate robots. One such example involves combining robots and other technologies to eliminate the need for a front desk. This would, however, present a challenge for hotel management to maintain the warm and inviting atmosphere of the hotel (Bowen & Morosan, 2018).

In their research, Shin and Jeong (2020) investigated how guests perceive robot concierge services and their willingness to use them. According to the authors, guests generally hold a positive view of robot concierges, perceiving them as effective and useful. Moreover, guests view them as innovative and forward-looking, contributing to the hotel experience. Shin and Jeong (2020) further determined, however, that guests may have reservations regarding the dependability and accuracy of information provided by robot concierges. Despite this concern, guests are generally willing to use them if they are available.

A study conducted by Cheng Chang et al. (2022) explored the factors that influence customers' willingness to accept service robots in Chinese hotels, finding that customers' willingness to accept service robots was positively influenced by three main factors: perceived usefulness; perceived ease of use; and perceived enjoyment. In addition, the study found that customers' age, gender, and occupation were important factors in their willingness to accept service robots in hotels. Younger customers were more likely to accept service robots than older customers, while male customers were more willing to accept them than female customers. Although the reasons for this gender difference were not explored, it may be related to attitudes towards technology.

Additionally, customers' occupation also played a significant role in their acceptance of service robots, with IT professionals being more willing to accept them than those in other occupations. This indicates that customers' level of familiarity with technology and their professional experiences could impact their attitudes towards service robots. The findings suggest that hotels should consider these factors when implementing service robots to improve customer satisfaction (Cheng Chang et al., 2022).

3. The Robot Dilemma in Hospitality: Exploring the advantages and disadvantages

In order for managers and proprietors to make knowledgeable choices, it is essential that they possess comprehension of the strengths and weaknesses of service robots as opposed to human staff (Ivanov et al., 2020).

According to experts, it is anticipated that robots will make up a quarter of the workforce in hospitality industry by the year 2030. This is due to challenges such as shortages of labor, an increase in international travellers, and a large amount of consumer data (Bowen & Morsan, 2018).

According to Ivanov and Webster (2019), professionals in the tourism industry believed that jobs that involve providing information, maintaining cleanliness, collecting garbage, transporting luggage and processing documents were the most appropriate for robotization . On the other hand, jobs that involve humans being subservient to robots, in both physical and emotional aspects, were deemed inappropriate for automation, including tasks like taking care of children, styling hair, giving massages through a robot or dancing with customers.

The adoption of service robots in the tourism and hospitality industry would have both a replacement and a performance-boosting impact on jobs as suggested by Ivanov and Webster (2019). The substitution effect means that robots can mechanize most of the responsibilities that comprise a job, leading to the removal of the whole job. In contrast, the enhancement effect arises when robots do not supplant workers but rather aid them in enhancing their work output, for example, by being more effective, efficient, and productive. As a result, automating and robotizing hotel tasks could enable employers to offer more meaningful and rewarding jobs to their staff members (Tuomi et al., 2021).

The rise of robot usage in hospitality is attributed to several factors including improved cost-effectiveness, better use of resources, more precise demand estimation, enhanced quality oversight, advanced process control, and the avoidance of human mistakes (Ivanov & Webster, 2019). Some of the advantages of robots include: the ability to work 24/7; their capability to carry out tasks accurately and timely; and the ability to provide consistent service quality (Ivanov et al., 2020). Moreover, according to Starfleet Research (2018, as cited in Nam et al., 2020) and Zhou (2019, as cited in Nam et al., 2020), AI and robots offer various benefits to hotel operations. One benefit is that robots can provide guests with unique and lasting moments. By providing immediate and accurate responses as well as personalized services that anticipate demands, these robots can satisfy customer demands. A second set of benefits that robots provide relates to operations, reducing operating costs by 15% and increases revenues by 10%, as well as improving employee satisfaction by relieving them of repetitive tasks. Robots designed for deliveries and guest assistance are examples of popular technologies that can be implemented with minimal resistance to reduce costs and enhance customer experiences. Aloft Hotel and Crowne Plaza are among the hotels that have adopted butler and delivery robots (Nam et al., 2020).

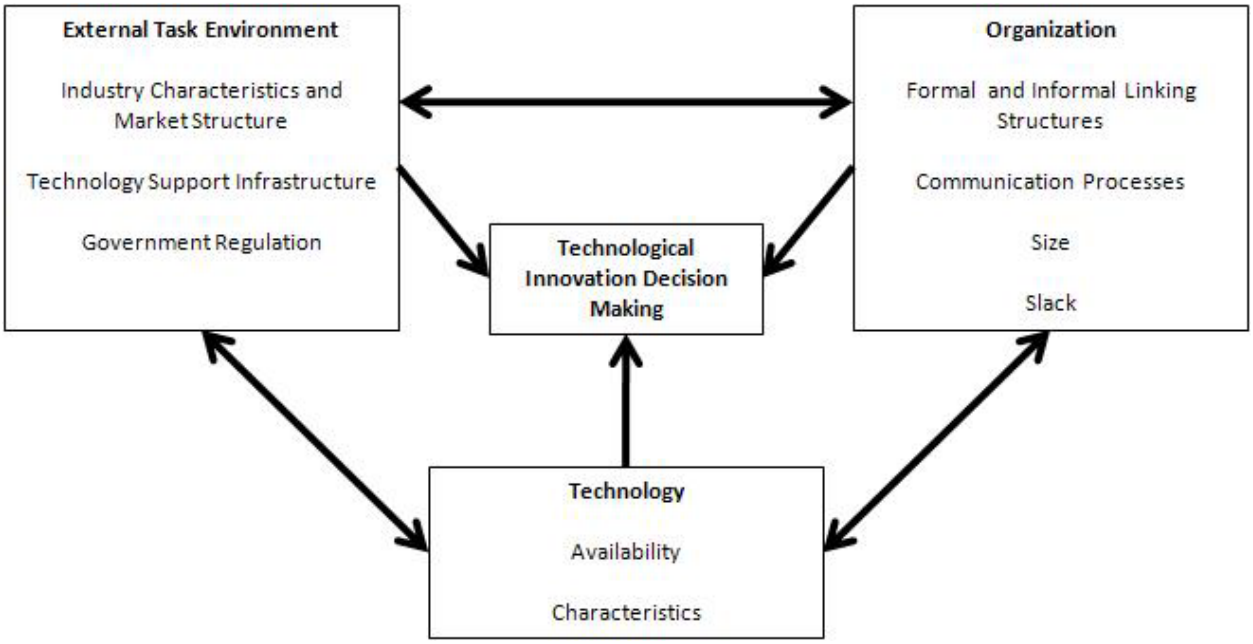
Ivanov et al. (2020) further identified disadvantages of robots which include: their ability to work only in structured situations and their inability to perform tasks for which they were not trained. AI robotic systems can be trained using large amounts of data to recognize patterns and make predictions or recommendations. In this way, AI-powered systems can anticipate customer desires based on past purchase patterns or other behavior. However, these systems are limited by the data they have been trained on and may not be able to handle completely new situations that are outside their training data.

The previously mentioned Henn na Hotel provides an example of the potential downside associated with using robots. The hotel started with 243 robots in 2015 and four years later it changed its strategy by replacing more than half of the robots with humans (Reis et al., 2020). Guests' complaints related to robots' inability to respond to guests' inquiries combined with the robots propensity to breakdown and the required repair time led to the reduction in robots. Furthermore, an analysis on the hotel guest reviews revealed that some

of the robot related complaints centered on the fact that robots could not answer entire questions. Another complaint was that the in-room assistant robot mistakenly interpreted guests' snoring as commands and subsequently issued a response that disturbs guests' sleep (Bhimasta & Kuo, 2019). Costly software upgrades to the robots also played a role in the decision to decommission robots (Reis et al., 2020). It is evident that robot use has both advantages and disadvantages.

4. Factors affecting Managers' intention to adopt service robots: TOE Framework

The Technology-Organization-Environment Framework (TOE) has been widely employed in facilitating technology adoption within organizations. Tornatzky and Fleischer (1990, as cited in Pizam et al., 2022 and Nam et al., 2020) state that this theory describes the factors that affect technology adoption in organizations.



Source: TOE Framework by Tornatzky and Fleisher (1990)

The three key TOE factors, technology, organization and environment, have proven to aid organizations effectively adopt new technologies. The Technology category includes factors such as: relative advantages, complexity and IT expertise. Relative advantage pertains to the extent to which a new technology innovation is seen as an improvement over the existing one it replaces. Therefore, if an innovation is viewed as strategically and operationally beneficial, and its benefits outweigh the current practices and processes, its adoption will likely be positively influenced. Complexity is seen as the level of difficulty associated with comprehending and implementing a new innovation (Rogers, 1995, as cited in Nam et al., 2020). This factor is considered a significant challenge in the field of AI and robots, where Bowen and Morosan (2018) in their study have identified outmoded and unconsolidated legacy software programs as hindrances. IT expertise refers to the extent of know-how and proficiency that can be leveraged as resources for technology implementation. Financial justification and employee resistance fall under the

Organization category, and the Environment category includes customers, competition and legal issues (Nam et al, 2020).

Within the Organization category, financial justification pertains to the value added by the determination to allocate funds towards technology adoption. The investment decision depends on the projected profitability of the technology and whether the gains from investing outweigh the expenses, as this is crucial to achieve a favorable outcome (Nam et al., 2020).

As part of the Environment category, Customer refers to the fact that customers possess varying levels of knowledge and demands based on factors such as their age / generation, educational and cultural background, and financial situation. As such, hotels must be aware of different types of consumer behaviors and expectations that may be influenced by age and nationality. As an example, millennials, who are considered digital natives, are more receptive to using new technologies than other older generations. From a cultural perspective, Chinese travelers are known for readily accepting new technologies whereas German travelers are the least likely to embrace them (Singer, 2016, as cited in Nam et al., 2020).

The speed of technology adoption can be affected by competition (part of the Environment category) as the introduction of a new technology may impact the degree of rivalry between companies operating in the same market. If a company has achieved a competitive advantage through adopting a new emerging technology, to stay competitive, rival firms may have to consider adopting a comparable technology. In Pizam et al. (2022), competitive pressure was identified as an Environmental factor that had a positive effect on the willingness to implement robotic technologies. The study implies that the likelihood of managers to embrace service robots is greater if there is a competitive pressure to do so (Pizam et al., 2022).

Implementing technology necessitates the company's consideration of legal issues (part of the Environment category) that may affect the implementation process. Government policies, confidentiality and safety are a few obvious applications of legal issues. Hotels must be cautious when utilizing customer information while abiding by ethical standards and data protection regulations, especially globally (Nam et al., 2020).

Pizam et al., (2022) conducted a global study aimed at identifying elements that impact hotel managers' willingness to implement robots, using TOE theory. This study suggests that hotel managers' willingness to adopt service robots was enhanced by factors such as backing from top-level management, relative advantage, and competitive advantage. Moreover, they found out that if managers perceive robotic technologies as challenging to use, they are less inclined to adopt them (Pizam et al., 2022). In contrast, Nam et al. (2020), while researching hotel managers' intention to adopt robotics in Dubai, discovered that hotel managers were more concerned with how AI technology would work with the hotel's current technology than with how complicated it was. The integration of AI with existing technologies was a significant challenge, and if guests do not have up-to-date personal technology, such as mobile phones, they may not be able to utilize the hotel's implemented technology. Additionally, Nam et al. (2020) reported that hotel managers in Dubai were specifically interested in achieving a satisfactory return on investment (ROI) that would validate the usefulness of the technology. It was essential that the ROI was a financial gain,

meaning that if the implementation of a technology resulted in cost savings, revenue growth, or improved customer experience, it was considered acceptable.

5. Method

5.1. Purpose

This research aimed to identify factors that affect hotel managers' perception towards the use of robots in Montenegrin and Croatian hotels and whether they intend to use them.

5.2. Sample

The targeted group of this study's participants were hotel managers in Croatia and Montenegro. Given their positions, they provide an insightful overview of how their hotels perceive issues associated with robot use in these two countries. Participants were identified on LinkedIn and reached via e-mail, receiving a link to this study's Google Forms survey.

Survey participants provided demographic information pertaining to themselves and the hotels where they work. Three questions were directed at survey participants themselves, including: (1) Gender [female, male, Non-binary]; (2) Age [18 - 30; 31 – 40; 41 – 50; 51+]; and (3) years of managerial experience in the hotel industry [<5; 6 – 10; 11 – 15; 16 – 20; 20+]. Five questions described the hotels were survey participants work, including: (1) Hotel category [3 stars; 4 stars; 5 stars]; (2) Hotel size [up to 50 rooms; 51 – 100 rooms; 101 – 150 rooms; 151+ rooms]; (3) Hotel location [urban area; suburban area; rural area; coastal]; (4) Hotel country [Montenegro; Croatia]; and (5) Predominant type of guest [Leisure; Business].

5.3. Procedure

Snowballing was employed, requesting participants to distribute the survey to additional hotel managers across the countries, resulting in thirty-four participants. The survey was conducted from April 5th – 18th, 2023.

5.4. Instrument

The study's instrument is comprised of statements derived from two sources: Pizam et al. (2022) and Ivanov et al. (2020). Some of these statements were modified so as to fit the needs and objectives of this study. This study's statements' response set is a standard five-point Likert scale ranging from "Strongly disagree" (coded as a value of one) to "Strongly agree" (coded as a value of five). A quantitative data-driven approach was selected as it provides a structured and standardized means of data collection and analysis that ensures consistency and reliability in the findings (Bryman, 2016).

The survey consists of eighteen statements and the aforementioned eight sample demographic questions related to the respondents and the hotels where they work. Four of the statements were applied to specific hotel departments, providing a greater level of granularity. The survey consists of six sections, including robot use complexity, robots impact on customer service, competitive advantage associated with robot use, readiness for implementation of robots, intention to introduce robots, and demographic

characteristics of respondents and their hotels. Note that there is also an open-ended question at the end of the survey, allowing respondents to provide any comment.

A 'not sure' option was included in some of the statements' response sets in order to provide respondents with an alternative response option for situations where they may not have a strong or informed view. This option was added to prevent respondents from using the 'neutral' (coded as a value of three) option, which could potentially skew and muddy results.

6. Results and Discussion

This preliminary study attempts to provide insight into a number of issues associated with the introduction of robots into various aspects of hotel operations in Croatia and Montenegro. So as to provide a higher level of granularity, department level analysis as well as hotel as a whole occurred.

Collected demographic characteristics related to respondents included age, gender, and years of managerial experience in the hotel industry. Information related to the hotels at which respondents are employed included category of hotel (three to five-star), primary guest segment (leisure or business) of hotel, hotel location (Montenegro or Croatia), hotel community setting (rural, suburban, urban, and coastal) and number of rooms at the hotel (Table 1).

Table 1: Demographic information of sample

Demographic Variable	Category	Count	Percentage
Hotel Category	5-star hotels	19	55.9%
	4-star hotels	13	38.2%
	3-star hotels	2	5.9%
Primary Segment	Leisure	31	91.2%
	Business	3	8.8%
Mgmt. Experience in Hotel Industry	Up to 5 years	10	29.4%
	6 to 10 years	9	26.5%
	11 to 15 years	7	20.6%
	16 to 20 years	3	8.8%
	More than 20 years	5	14.7%
Hotel Location	Croatia	18	52.9%
	Montenegro	16	47.1%
Hotel Community Setting	Rural	6	17.6%
	Suburban	4	11.8%

	Urban	19	55.9%
	Coastal	5	14.7%
Hotel Size	Up to 50 rooms	10	29.4%
	51 to 100 rooms	5	14.7%
	101 to 150 rooms	5	14.7%
	More than 150 rooms	14	8.8%
Gender	Male	15	44.1%
	Female	16	47.1%
	Non-binary	3	8.8%
Age	18 – 30	7	20.6%
	31 – 40	12	35.3%
	41 – 50	13	38.2%
	51 and older	2	5.9%

Source: authors' research

Mean and standard deviation values to statements concerning commonly researched aspects related to the impact of robot usage in hotel operations at the hotel-wide level (as opposed to department-specific level) are found in Table 2. Note that some respondents checked the "Not sure" response, meaning that each statement did not have a numeric response from all 34 survey participants. The least number of numeric responses was 31 out of the 34 completed q surveys.

Table 2: Mean and std dev values for robot usage impact on hotel operations

	n	Mean	Std Dev
Q2: Using robots could increase profitability at the hotel where I work.	33	3.1515	1.1489
Q3: Robots will reduce operating costs at the hotel where I work.	33	3.2121	0.9604
Q4: Using robots will allow the hotel where I work to charge higher prices.	31	2.5484	1.1207
Q5: If robots are used in the hotel where I work, some employees will lose their jobs.	33	3.3636	1.1677
Q6: Robots would help employees in the hotel where I work to enhance the work output by being more effective.	33	3.3939	0.9334

Q7: Robots would help employees in the hotel where I work to enhance the work output by being more efficient.	32	3.4688	1.0468

N = minimum of 31 respondents and maximum of 34

Correlation analysis revealed a large degree of correlation among the above six statements (Q2-7). Pearson correlation coefficients and associated levels of significance are found in Table 3.

Table 3: Correlation matrix for various impacts of robot usage on hotel operations

	Q2 Profit	Q3 Red Ops	Q4 Prices	Q5 Lose Jobs	Q6 Effective	Q7 Efficient
Q2 Profit	1					
Q3 Red Ops	0.677979***	1				
Q4 Prices	0.602164***	0.567594***	1			
Q5 Lose Jobs	0.504715***	0.086692	0.360789**	1		
Q6 Effective	0.32064*	0.63527***	0.63604***	0.206672	1	
Q7 Efficient	0.259895	0.626845***	0.426322**	0.118989	0.677988***	1

**: p<0.10; **: p<0.05; ***: p<0.01*

Not surprisingly, Q2 Profit correlates highly with Q3 Red Ops, Q4 Price, and Q5 Lose Jobs – profitability increases as operating costs are reduced, prices are raised, and jobs are reduced. Interestingly, however, despite the fact that respondents somewhat agree that robot introduction will result in some employees losing their jobs (Q5 u = 3.3636), Q5 Lose Jobs does not significantly correlate with Q3 Red Ops (use of robots will decrease operating costs). Respondents were slightly affirmative that robot usage will reduce operating costs (Q3 Red Ops u = 3.2121), but respondents do not associate this reduction in operating costs with employees losing jobs (Q5 Lose Jobs). Furthermore, while respondents indicated that robot usage will somewhat increase employee effectiveness and efficiency (Q6 Effective u = 3.3939 and Q7 Efficient u = 3.4688 respectively), Q5 Lose Jobs did not significantly correlate with Q6 Effective and Q7 Efficient, suggesting that respondents felt that any increased job effectiveness and efficiency will not result in job losses.

One possible explanation for these job loss-related results is that respondents recognize that jobs in the sense of tasks done by employees (and not headcount – the number of employees) will be reduced (e.g., the number of front desk personnel will be reduced), but that employees will be trained and used in different roles.

When examining the relationship between Q5 Lose Jobs and intention to incorporate robots in specific departments (Table 4), interesting results arise. It is seen that Q5 Lose Jobs is not significantly correlated with the intention to introduce robots in the Human Resources and Sales & Marketing departments, suggesting that robot use is not seen to cause job or position losses in these departments. Conversely, Q5 Lose Jobs does correlate significantly (*p<0.05*) with intention to use robots to perform the concierge function, suggesting that jobs or positions will be lost in concierge departments as robots are introduced there. Finally, Q5 Lose Jobs correlates at *p<0.10* for intent to use robots in House Cleaning, Front Desk, and Room Service, again suggesting that tasks in these departments will be overtaken by robots.

Table 4: Correlation matrix for robot usage impact on hotel operations and intention to use robots in 3 years by dept.

	Intention House-keeping	Intention Front Desk	Intention HR	Intention Room Service	Intention Concierge	Intention S&M
Q2 Profit	0.318622*	0.424004**	0.190193	0.363068***	0.559651***	0.23242
Q3 Red Ops	0.404271**	0.502507***	0.34633**	0.271607	0.455386***	0.310921*
Q4 Prices	0.496883***	0.485106***	0.497507***	0.295551	0.611546***	0.192864
Q5 Lose Jobs	0.346277*	0.339912*	0.119894	0.332676*	0.427586**	0.158551
Q6 Effective	0.711403***	0.609998***	0.508708***	0.414265**	0.597764***	0.416528**
Q7 Efficient	0.682213***	0.532354***	0.444287**	0.405179**	0.40719**	0.426659**

**: p<0.10; **: p<0.05; ***: p<0.01*

One of the overarching findings of this study is that hotels in Montenegro and Croatia will not be introducing robots into operations in the near future (as defined as three years in this study). At the hotel level (as opposed to individual departments), a majority of respondents indicated that they expect to use robots in five years (8 out of 34; 23.5%) or more than five years (13 out of 14; 38.2%). Likewise, only seven of thirty-four respondents (20.6%) felt that robots would be introduced in their hotels in the next three years. Reflecting this lack of enthusiasm for robots, respondents slightly disagree that their hotels are willing to invest the required amounts for robots (u = 2.900; SD = 1.0289) and somewhat agree that robots will require significant changes to hotel facilities (u = 3.4688; SD = 1.0468). Finally, survey respondents disagree with the statements that not using robots will cause their hotels to lose customers to the competition (u = 2.088; SD = 1.1110) and that that it is

a strategic necessity to have robots in order to compete (*u* = 2.6471; SD = 1.1776). See Table 5.

Table 5: Indicators that robots will not be introduced within the near term (three years)

	Mean	Std Dev	Resp. = "1"	Resp. = "2"	Resp. = "3"	Resp. = "4"	Resp. = "5"
Intend to use robots in "(1" = >5 years; "2" = 5 years; "3" = 4 years; "4" = <= 3 years)	2.206	1.175	7	6	8	13	Not appl.
The hotel is willing to invest the needed amounts to meet the cost of adoption & implementation of robots (1 = strongly disagree; 5 = strongly agree). Four "not sure" responses.	2.900	1.029	4	5	11	10	0
The introduction of robots in our hotel will require that we make significant changes to our facilities. (1 = strongly disagree; 5 = strongly agree). Two "not sure" responses.	3.468	1.047	2	3	9	14	4
It is a strategic necessity to introduce robot applications in the hotel where I work in order to compete in the existing market (1 = strongly disagree; 5 = strongly agree). Two "not sure" responses	2.647	1.178	7	8	11	6	2
We will lose customers to competitors if we do not adopt robot applications (1 = strongly disagree; 5 = strongly agree). One "not sure" response.	2.088	1.111	14	7	10	2	1

When considering intention to use robots in specific hotel departments, only one, Housekeeping, had a score above three (*u* = 3.0938; SD = 1.1739) in response to the statement that the respondent's hotel intends to incorporate robots within three years. Additionally, not one of the six departments had a mean response larger than three to the statement that a respondent's hotel was ready to adopt, implement, and utilize robots (Table 6).

Table 6: mean and std dev values by dept. for robots make operations easier, prepared to use robots, and intend to use robots within three years (1 = Highly disagree; 5 = High Agree)

		House-keeping	Front Desk	HR	Room Service	Con-cierge	S&M
Robots will make the operational process easier in (dept):	Mean	3.3235	2.8235	2.3529	3.4118	2.9118	3.0294
	Std Dev	1.1489	1.1407	1.1250	1.1042	1.2879	1.2906
The hotel where I work is highly prepared to adopt, implement and utilize robots in (dept)	Mean	2.7879	2.7576	2.3030	2.9394	2.8182	2.7576
	Std Dev	1.1112	1.1189	1.0749	1.1440	1.4242	1.1465
I would use robots within a time-frame of 3 years in the following operations (dept):	Mean	3.0938	2.5938	2.2813	3.0000	2.8485	2.8750
	Std Dev	1.1739	1.2407	0.9583	1.2181	1.3257	1.2636

N = minimum of 32 respondents and maximum of 34

Despite these results that suggest that robots will not be used in Montenegrin and Croatian hotels soon, two results suggest that they most likely will be at some point. As noted above, Table 4 shows that hotel managers feel that robot usage will increase employee effectiveness and efficiency (Q6 Effective $u = 3.3939$ and Q7 Efficient $u = 3.4688$ respectively) to some extent. And Q6 Effective and Q7 Efficient correlate significantly at $p<0.05$ for the intention to introduce robots in all departments. This suggests that hotel managers recognize that robots can make employees more effective and efficient, and that, subsequently, robots will be introduced at some point.

A correlation analysis of Table 6's three statements showed them to be strongly correlated. Further analysis revealed that the Cronbach's Alpha value for the above mentioned statements (robots will make operations easier; prepared to use robots; and intend to use robots within three years) was 0.76 or higher for all departments (Table 7), suggesting an acceptable level of reliability for the survey questions loading on a latent concept; namely, that hotels are ready and interested in adopting robots.

Table 7: Cronbach's Alpha values by depart for robots make operations easier, prepared to use robots, and intend to use robots within three years

Department	Cronbach's Alpha for robots make operations easier, prepared to use robots, and intend to use robots within three years	Composite Index value of three statements

Housekeeping	0.7638	3.0684
Front Desk	0.9298	2.7250
HR	0.8993	2.3124
Room Service	0.7982	3.1171
Concierge	0.9142	2.8595
S&M	0.8737	2.8873

Further analysis into the department vs. department comparison related to the three robot adoption related statements (intent to use robots within three years; hotel preparedness to adopt, implement, and utilize robots; and robots make operations easier) yielded significant findings. When creating a composite index (using a simple arithmetic mean) from these three statements, it is seen that HR is the department least likely to incorporate robots in the near term (Table 7). This is not surprising as HR had the lowest level of agreement or mean value for intention to use robots (u = 2.2183), preparedness for using robots (u = 2.3030), and making operations easier (u = 2.3529) (Table 6). Moreover, HR's mean value was statistically significantly less than all other departments' means except the Front Desk for intention to implement robots as well as for Housekeeping, Front Desk, and Room Service for prepared to adopt robots (Tables 8 and 9). Note that no other significant differences occurred between non-HR departments for these two statements (intention to use robots and prepared to adopt robots). Regarding the third statement, that robots make operations easier, HR's mean value was statistically significantly less than all other departments (Table 10). These results suggest that HR is the department least likely to see an introduction of robots.

Table 8: t-test statistics for intend to use robots in 3 years among hotel departments

	House Keeping	Front Desk	HR	Room Service	Concierge	S&M
Housekeeping	1					
Front Desk	1.655967	1				
HR	3.033034***	1.127623	1			
Room Service	0.313487	-1.32171	-2.62329**	1		
Concierge	0.790261	-0.80011	-1.98137*	0.48002	1	
S&M	0.717454	-0.89841	-2.11787**	0.402869	-0.08255	1

**: p<0.10; **: p<0.05; ***: p<0.01*

Table 9: t-test statistics for prepared to adopt and implement robots among hotel departments

	House Keeping	Front Desk	HR	Room Service	Concierge	S&M
Housekeeping	1					
Front Desk	0.110389	1				
HR	1.801566*	1.682978*	1			
Room Service	-0.54575	-0.65271	-2.32885**	1		
Concierge	-0.09636	-0.19223	-1.65854	0.381169	1	
S&M	0.109028	0	-1.66155	0.644891	0.190422	1

**: p<0.10; **: p<0.05; ***: p<0.01*

Table 10: t-test statistics for robot use makes operations easier among hotel departments

	House Keeping	Front Desk	HR	Room Service	Concierge	S&M
Housekeeping	1					
Front Desk	1.801996*	1				
HR	3.522059***	1.712698*	1			
Room Service	-0.3231	-2.16047**	-3.91663***	1		
Concierge	1.392008	-0.29905	-1.90549*	1.718588*	1	
S&M	0.993102	-0.69694	-2.30384**	1.31259	-0.37624	1

**: p<0.10; **: p<0.05; ***: p<0.01*

One final statement addressed robots' ability to improve customer service, (Customer service can be improved in the hotel where I work by using robots in: [department or specific operation / task]). Respondents were asked to state their level of agreement with the statement ("Strongly disagree" to "Strongly agree") as applied to seven different departments or tasks: back-of-house, customer interaction tasks, documents and payments tasks, prepare and serve drinks, information provision, taking orders, and

entertainment. Respondents mostly disagreed that robots could improve customer service in three areas (customer interaction tasks, prepare and serve drinks, and entertainment) and mostly agreed that robots could improve customer service in three situations (documents and payment tasks, information provision, and taking orders). The seventh item, back-of-house, was viewed slightly positively. T-tests confirmed that respondents had significantly different views pertaining to which scenarios robots could improve customer service. See Table 11 for means, standard deviations, and t-test results.

This survey largely confirmed other studies' findings that robots are well suited for simple, repetitive tasks that are performed in controlled environments where unknown and/or unforeseen situations typically do not occur. As such, respondents supported the notion that robots could improve customer service in tasks such as document processing, providing information, and receiving orders. These tasks are relatively straight-forward, not requiring in-depth analysis or attention. Conversely, survey respondents did not agree that robots can improve customer service in areas that require relatively involved interactions such as customization, problem solving, or non-defined interactions.

Table 11: mean, SD, and t-test results for robots' ability to improve customer service in departments or operations / tasks

dept./task	mean	SD	t-value vs. Back of house	t-value vs. Cust inter-action task	t-value vs. Docs & pay-ment tasks	t-value vs. prep & serve drinks	t-value vs. info provision	t-value vs. Taking orders
Back of house	3.182	1.185						
Cust inter-action tasks	2.697	1.186	1.662					
Docs & pay-ment tasks	3.364	1.194	0.621	2.276**				
Preparing & serve drinks	2.606	1.144	2.008**	0.317	2.632*			
Information provision	3.406	1.188	0.763	2.409**	0.144	2.765***		
Taking orders	3.485	1.149	1.055	2.741**	0.420	3.114***	0.271	
Entertainment	2.636	1.270	1.804*	0.200	2.396**	0.102	2.525**	2.846***

** p<0.10; ** p<0.05; *** p<0.01*

Further analyses were performed using t-tests to determine if sub-samples (based on collected demographic characteristics) had different opinions. Observed sub-samples were based on gender (female vs. male), age (40 and under vs. 41 and older), years of experience (10 years or less vs. 11 or more years), category of hotel (three and four stars vs. five stars), hotel size (150 rooms and less vs. 151 or more rooms), and hotel location (Croatia or Montenegro). These sub-samples were created so as to optimize (given the total sample size) sub-sample sizes (see Table 12)

Table 12: counts for demographic characteristic based sub-samples

Demographic	Category	Count
Gender*	Male	15
	Female	16
Age	younger: <= 40	19
	older: >= 41	15
Years of experience	less experience: <= 10	19
	more experience: >= 11	15
Hotel category	3 and 4 stars	15
	5 stars	19
Hotel size	smaller: <= 150 rooms	20
	larger: >= 151 rooms	14
Hotel location	Montenegro	16
	Croatia	18

* three respondents identified as “non-binary”

Limited differences were observed in the six demographic sub-samples, ranging from zero for gender to ten in hotel category. When reviewing the twenty significant differences in the sub-samples (Table 13), however, it should be noted that in seven cases the sub-samples are not in disagreement regarding their opinions, but, rather, in the amount in which they disagree or agree. Sub-samples had seven significant differences where both sub-samples had mean values less than three (on a 1-5 Likert scale), indicating that they both disagreed with the statement. In one statement, the sub-samples had mean values above three, indicating that they both agreed with the statement. Again, in these seven cases the sub-samples came down on the same side of the statement; it was simply their level of disagreement or agreement that was significantly different.

When reviewing the thirteen cases where sub-samples disagreed with the statement / indicator (one sub-sample having a mean value less than three on a 5-point Likert scale and the other greater than three), six of these involved hotel categorization (3 and 4-stars vs. 5 stars) and the preparedness and intent to use robots.

When examining specific sub-samples, it is seen that hotel size revealed one significantly different indicator, with smaller hotels feeling that robots are too complex to use, reflecting, perhaps, smaller hotel managers relative perceived lack of resources at their hotels. Hotel location had two significant differences, with Montenegrin hotel managers agreeing more than Croatian hotel managers that robots will make operations easier in the concierge and HR departments. In the experience demographic, three significant differences were observed. Less experienced hotel managers disagreed significantly less than their counterparts that it is strategically necessary to use robots so as to compete in the marketplace and that HR is prepared to adopt, implement, and use robots. Additionally, less experienced managers were somewhat in agreement that Sales & Marketing is prepared to adopt, implement, and use robots while more experienced managers disagree. See Table 13.

The age demographic had mixed results as younger managers significantly disagreed less with the statement that HR is prepared to adopt, implement, and use robots. Conversely, younger managers agreed significantly less with the statement that significant facility changes are needed to facilitate robot use. Younger and older managers disagreed on two statements: younger managers agreed that learning to operate robots would be difficult while older managers did not and younger managers did not feel that their hotels were prepared to adopt, implement, and use robots in Room Service while older managers did. One interpretation of these two disagreements in that younger managers, being more technically savvy in general, have more complete and/or advanced knowledge related to robots and are, thus, more negative in terms of learning to use and implement them.

Table 13: Sub-sample significant differences

Demographic	Statement / Indicator	Means & p-value
Hotel size	Robot applications are too complex to implement.	Smaller = 3.500; Larger = 2.786
		p-value = 0.0502*
Hotel location	Robots will make the operational process easier in HR.	Montenegro = 2.813; Croatia = 1.944
		p-value = 0.0332**
	Robots will make the operational process easier in Concierge.	Montenegro = 3.438; Croatia = 2.444
		p-value = 0.0233**

Years of experience	It is a strategic necessity to introduce robot applications in the hotel where I work in order to compete in the existing marketplace.	Less exp. = 2.947; more exp. = 2.267
		p-value = .0883*
	The hotel where I work is highly prepared to adopt, implement and utilize robots in HR	Less exp. = 2.579; more exp. = 1.929
		p-value = 0.0657*
	The hotel where I work is highly prepared to adopt, implement and utilize robots in S&M	Less exp. = 3.053; more exp. = 2.357
		p-value = 0.0730*
Age	Learning how to operate robot applications would be difficult.	Younger = 3.333; Older = 2.538
		p-value = 0.0164**
	The hotel where I work is highly prepared to adopt, implement and utilize robots in HR	Younger = 2.684; Older = 1.786
		p-value = 0.0096***
	The hotel where I work is highly prepared to adopt, implement and utilize robots in Room Service	Younger = 2.632; Older = 3.357
		p-value = 0.08127*
	The introduction of robots in our hotel will require that we make significant changes to our facilities.	Younger = 3.175; Older = 3.800
		p-value = 0.0858*
		p-value = 0.0536*
Hotel category	I would use robots within a time-frame of 3 years in Housekeeping.	3 & 4-stars: 3.571; 5-stars = 2.722
		p-value: 0.0397**
	I would use robots within a time-frame of 3 years in Room Service.	3 & 4-stars: 3.426; 5-stars = 2.667
		p-value: 0.0746*
	I would use robots within a time-frame of 3 years in Concierge.	3 & 4-stars: 3.500; 5-stars = 2.368
		p-value: 0.0152**
	I intend to use robots in (“1” = >5 years; “2” = 5 years; “3” = 4 years; “4” = <= 3 years).	3 & 4-stars: 2.800; 5-stars = 1.737
		p-value: 0.0093***

	Robots will make the operational process easier in HR.	3 & 4-stars: 2.800; 5-stars = 2.200
		p-value: 0.0634*
	Customer service can be improved in the hotel where I work by using robots in Entertainment.	3 & 4-stars: 3.1429; 5-stars = 2.263
		p-value: 0.0566*
	The hotel where I work is highly prepared to adopt, implement and utilize robots in Concierge.	3 & 4-stars: 3.400; 5-stars = 2.333
		p-value: 0.0316**
	The hotel where I work is highly prepared to adopt, implement and utilize robots in S&M.	3 & 4-stars: 3.200; 5-stars = 2.389
		p-value: 0.0488**
	The hotel where I work is highly prepared to adopt, implement and utilize robots in Front Desk.	3 & 4-stars: 3.267; 5-stars = 2.333
		p-value: 0.0162**
	The hotel where I work is highly prepared to adopt, implement and utilize robots in HR.	3 & 4-stars: 2.667; 5-stars = 2.000
		p-value = 0.0926*

**: p<0.10; **: p<0.05; ***: p<0.01*

When comparing 3 and 4-star hotels vs. 5-star hotels, one finds that they both disagree to two statements, but the 3 and 4-star managers disagree less: that robots will make operations in HR easier and that hotels are prepared to adopt, implement, and use robots in HR. Of the eight statements where disagreement existed between 3 and 4-star and 5-star hotels, four of these dealt with intention to use robots: 3 and 4-star hotels intend to use robots in Housekeeping, Room Service, and Concierge in three years and 3 and 4-star hotels are more likely to use robots sooner (in a three to four year time frame) than 5-star hotel managers. As a possible explanation for 3 and 4-star hotel's relative eagerness to adopt robots, it might be the case that 5-star hotel managers see services delivered with a personal touch providing them a degree of service and differentiation, and, thus, they do not need to implement change (for example, robots) any time soon. Three more statements pertaining to preparedness to adopt, implement, and use robots in Concierge, S&M, and Front Desk saw 3 and 4-star hotels somewhat agreeing while 5 star hotels did not. The last disagreement involved 3 and 4-star hotels partially agreeing that customer service as related to Entertainment could be improved via the use of robots while 5-star hotels did not (Table 13).

7. Conclusion

Given the movement toward utilizing robots in hotels and the paucity of research concerning this in Montenegro and Croatia, this exploratory research sought to provide initial insights.

8. Limitations and recommendations

While conducting this research, challenges were encountered. One of the main issues was obtaining survey participants. Given time limitations and the time of year this research was conducted (when hotels managers were busy preparing for the season), it was difficult to locate survey participants. There were 34 respondents in total and this relatively small sample size may limit the generalizability of the findings.

This research was limited to only managers' perspective, but employees' and guests' perceptions towards robots are also important and interconnected. In terms of future research it is recommended to research the factors that influence guests' and employees' intention to use robots. It is also recommended for future research to explore the tangible and intangible costs associated with the implementation of robots in hotel industry as many hotel managers may not be aware of this.

9. Concluding thoughts

Overall, despite the excitement regarding robot implementation in various locations around the world, hotel managers in Croatia and Montenegro are not very enthusiastic about the idea. While these managers are somewhat affirmative pertaining to the potential increased profitability, reduction in operating costs, and increases in employee job effectiveness and efficiencies associated with robot implementation, it appears that this has not translated into a desire to introduce robots into their hotels.

Survey participants' tepid response to robot use could be an economic decision in that costs exceed benefits. Respondents do not feel that robot use provides their properties with competitive benefits as they will not lose customers if they forgo robot use. Conversely, respondents do see robot use as potentially driving additional costs in terms of significant facility adaptations for robot use and employee training. With limited benefits and additional costs, it is not surprising that respondents do not feel that their hotels are willing to invest in robots.

One additional interpretation of the results that suggests that robot implementation is not a priority for survey participants is that respondents did not have strong opinions to the survey's statements. Note, for example, that the statement that the introduction of robots will require human employees to learn new skills was the only one (out of a total of thirty-eight disagree/agree non-demographic type statements) with a mean value greater than 3.5 (u = 3.9706). Likewise, only four statements (out of a total of thirty-eight disagree/agree non-demographic type statements) had a mean value less than 2.5, the lowest (We will lose customers to our competitors if we do not adopt robot application) being 2.0882.

Even though respondents did not see robot use providing competitive benefits, they did agree with other research that robots can provide operational benefits when used to

perform repetitive tasks, making them more appropriate for Room Service tasks that are relatively repetitive and routine as compared Front Desk activities that require more customer interaction. Additionally, this study supports other research (Ivanov & Webster, 2019) in that robot introduction is envisioned to produce an enhancement effect as opposed to a substation effect. One respondent remarked, "Our hotel would implement robots in the future not to replace humans but as an innovative option to enhance guest experience".

A notable finding is that three and four-star hotels are significantly more likely to introduce robots than five-star hotels. These five-star managers seem to prefer a more traditional approach to hospitality. As one five-star hotel respondent stated in the open-ended question, "They (robots) will kill tourism... the key of the success is in human touch".

10. References

Bhimasta, R. & Kuo, P. (2019). *What Causes the Adoption Failure of Service Robots? A Case of Henn-na Hotel in Japan*. Association for Computing Machinery.

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

Bryman, A. (2016). *Social Research Methods* (5th ed.). Oxford University Press.

Cheng, C., Bingjia, S., Young, L., & Young, Z. (2022). *Factors influencing consumers' willingness to accept service robots: Based on online reviews of Chinese hotels.* Frontiers.

International Federation of Robotics (2012), "*History of industrial robots*", available at:https://web.archive.org/web/20121224213437/http://www.ifr.org/uploads/media/History_of_Industrial_Robots_online_brochure_by_IFR_2012.pdf

Ivanov, S., Gretzel, U., Berezina, K., & Sigala, M. (2018). *Progress on Robotics in Hospitality and Tourism: a Review of The Literature*. Emerald.

Ivanov, S., Seyitoglu, F., & Markova, M. (2020). *Hotel managers' perception towardsthe use of robots: a mixed method approach*. Springer.

Ivanov, S., Webster, C., & Berezina, K. (2017) *Adoption of robots and service automation by tourism and hospitality companies*. Researchgate.

Ivanov, S., & Webster, C. (2019*). Robots, Artificial Intelligence, and Service Automation in Travel, Tourism and Hospitality*. Emerald Publishing.

Nam, K., Dutt, C., Chathot, P., Daghfous, A., & Khan, M. (2020) *The Adoption of Artificial Intelligence and Robotics in the Hotel Industry: prospects and challenges*. Springer.

NPR (2011), *"Science diction: the origin of the word Robot",* available at: www.npr.org/2011/04/22/135634400/science-diction-the-origin-of-the-word-robot

Ono, R. (2018). *Robotel: Japan hotel staffed by robot dinosaurs*. Phys.org.

Pizam, A., Ozturk, A., Cejudo, A., Buhalis, D., Fuchs, G., Hara, T., Meira, J., Revilla, M., Sethi, D., Shen, Y., State, O., Hacikara, A., & Chaulagain, S. (2022). *Factors Affecting Hotel Managers' Intentions to Adopt Robotic Technologies: A global study*. Elsevier.

Reis, J., Melao, N., Salvadorinho, J., Soares, B., & Rosete, A. (2020). Service robots in the hospitality industry: The case of Henn-na hotel, Japan. Elsevier.

Schneider, T., & Hong, G. H. (2018). *Japan: Land of the Rising Robot*. International Monetary Fund.

Schraft, R.D. & Wanner, M.C. (1993), The Aircraft Cleaning Robot "SKYWASH", *Industrial Robot, Vol. 20*(6), 21-24. https://doi.org/10.1108/eb004592

Shin,H & Jeong,M. (2020). *Guests' perceptions of robot concierge and their adoption intentions.* Emerald.

Tuomi, A., Tussyadiah, I. P., & Stienmetz, J. (2021). Applications and implications of service robots in hospitality, *Cornell Hospitality Quarterly, 62*(2), 232-247. https://doi.org/10.1177/1938965520923961