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Impact of Covid-19 on the Hospitality Industry and Responding to Future Pandemic through Technological Innovation

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Abstract

Covid-19 pandemic has severely affected the human lives and businesses around the world. Globally, the demand for hospitality services is at an all-time low due to borders closing and restricted movement in various countries. This article highlights the impact of Covid-19 on the hospitality industry, mainly hotels and restaurants. It further discusses ICT (Information and Communication Technology) and machine learning-based solutions for the current and future pandemics. The study has used the exploratory research method. It has referred to the existing theoretical and empirical findings in the hospitality establishment with regard to the Covid-19 impact.

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1. Introduction

The Hubei Province in China was the first to report Covid-19 pandemic. Since the first reporting of Covid-19 case, the number of infected people has been rising exponentially. The Covid-19 is highly infectious and due to this nature, governments in different parts of the world have taken drastic measures to control the spread. The lists of

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measures include complete and partial lockdowns, restricted mobility, social distancing, visa suspensions, border closing, and ceasing of airline and airport services.

The hospitality industry is one of the most important industries in the world. Millions of people are directly and indirectly employed by the industry. The hospitality industry consists of hotels/lodges, restaurants/coffee shops, travel, and tour agencies. Covid-19 has done immeasurable loss to the hospitality sector. The social distancing, restricted movements, and shutdowns have forced the industry to layoff millions of employees and potential revenue loss in billions of dollars. Covid-19 continues to wreak havoc on the hotel industry. The hotel occupancy in 2020 was an all-time low. The revenues of hotels, airlines, cruise lines, and car rentals have substantially lowered [1]. The hotel industry needs to frame prevention and active management strategies to minimize the negative impact of Covid-19 on bookings and revisits by guests [2]. This and post Covid-19 recovery of the hotel and restaurants need extraordinary measures, financial, and other kinds of support [3]. As such, several procedures have been suggested for guests in hotels, such as disinfecting the keycards (using peroxide-based chemical or an alcohol solution), computer equipment, doorknobs, elevators, sitting, and waiting spaces. To enforce social distancing, the hotels have marked two-meter distances on floors (reception desks, waiting areas, etc.) using tape or paint. However, one of the effective solutions is the implementation of ICT and machine learning at a large scale. ICT includes software (mobile and web applications) and hardware (sensors, digital display boards). Most hospitality establishments are far away from ICT use. For instance, the restaurants in Ukraine were asked to deliver food through courier services during Covid-19 [4]. The restaurants in Ukraine do not have custom apps and digital platforms. Lew et al. [5] investigated the adoption of mobile wallet payment in the Malaysian hospitality industry. They found low acceptance of mobile wallet payment.

Moreover, the statistical forecasting has failed to deliver with changing demand and uncertainty in the case of epidemic and pandemic, the machine-learning model has proved effective. Al-Shehhi and Karathanasopoulos [6] applied machine learning algorithms in forecasting hotel room prices and compared the outcomes with traditional statistical models. They reported the effectiveness and robustness of machine learning in forecasting hotel room prices. Machine learning is a subset of artificial intelligence. The applications of machine learning include Facebook recognizing photographs and finding the best itinerary in a defined route for Uber pool riders. Machine learning techniques help in designing an intelligent system using current and past data. Machine learning has been employed in medicine and health care services for disease diagnosis, prediction of virus infection, and drug discovery. Machine learning training is important for accurate guests and revenue forecasting in the hospitality industry. Sooner or later machine learning and robotics will provide extensive hygiene and cleanliness, and healthcare services in the hospitality industry. Machine learning, big data, automation, augmented reality, robotics, and other emerging technologies presents tremendous opportunities for hospitality and Tourism 4.0 [7-9]. This study uses exploratory research methods and content analysis. The sources referred to are the world reports, statistical reports, and government regulations on Covid-19 crises and the hospitality industry. The current paper aims to analyze the impact of Covid-19 on the hospitality industry and discuss the ICT and machine learning-enabled solutions. An integrated ICT infrastructure and machine learning solutions in the form of booking app, food delivery app, robots for cleaning, digital signage, online payment, contract tracking app, cleaning checklist app, a software system for revenue management, and online platforms for communication and training will help to deal with future pandemics.

There are five sections. Section 2 corresponds to Covid-19 impact on the hospitality industry. Section 3 proposes how the hospitality industry should respond to Covid-19 using ICT and machine learning. Section 4 presents analysis and discussion. The last section concludes the findings.

2. Impact of Covid-19 on Hospitality Industry

The hospitality industry is a major source of employment, businesses, and financial activities for countries. It generates significant tax revenue for both local and national governments. Covid-19 has impacted and continued to impact the hospitality industry at financial and operational levels, the impacts are discussed below.

2.1. Covid-19 and travel restrictions

Countries across the world have enforced social distancing and lockdowns. Covid-19 has led to imposition of travel restrictions as a precautionary measures to control the virus spread and consequently business transactions have gone to a dormant state. The hospitality industry is the hardest hit due to border closing, travel advisories, and suspension of Visas. Europe and North America have closed their borders, Vietnam suspended Visa on Arrival schemes, Singapore suspended airport transit, and Japan quarantined cruise ships. The Malaysian government imposed Movement Control Order (MCO), as a result, the number of flight operations was minimized, employees from hotels and resorts were asked for unpaid leave [10]. Table 1 shows the containment measures taken by different countries.

Table 1. Containment measures as on June 12, 2020 [11]

Country	Hospitality	Borders
France	Gradual opening	Closed for non-EU
Germany	Partially open	Closed for some countries
Italy	Partially open	Closed
Spain	Closed	Closed
Netherland	Partially open	Closed for some countries
United Kingdom	Closed	Open
United States	Closed in some states	Closed for Europe, China, Iran
Brazil	Closed in some states	Closed for all nationalities

The restriction on travel has caused disruptions in the airline industry as well. A high percentage of hotel revenues comes from the traveling industries such as airlines. Thus the airline industry has indirectly affected the hotel industry. Figure 1 and 2 show change in the departing flights and airline seat capacity across the globe.

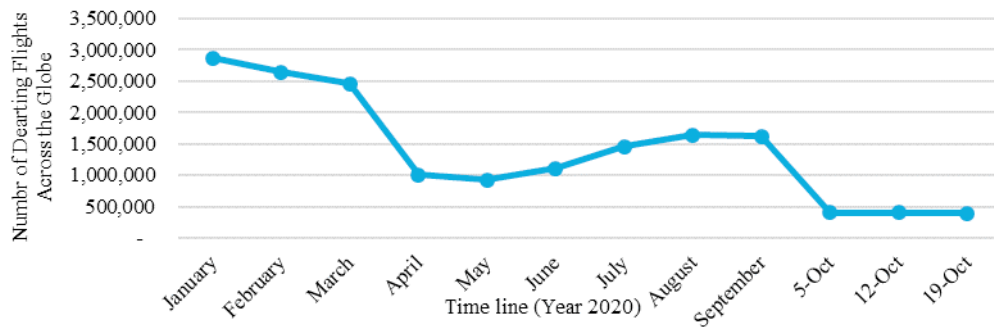


Figure 1. Departing flights across the globe [12]

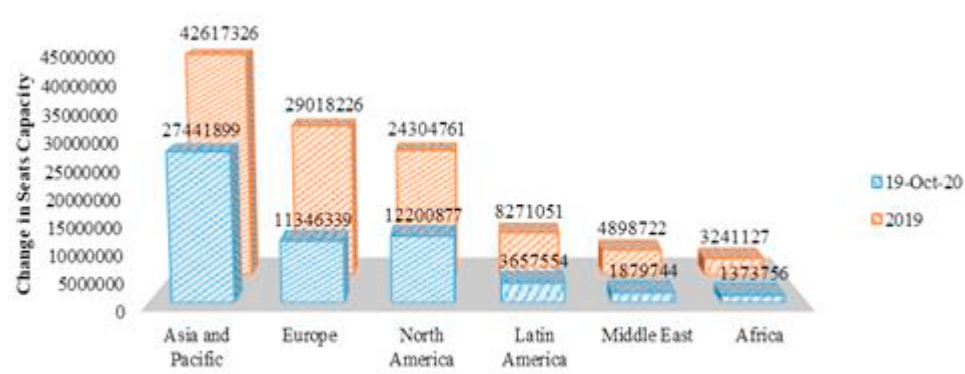


Figure 2. Change in the airline seat capacity across the globe [12]

2.2. Reduced hotel occupancy rate

In 2020, all worldwide business, social, and sporting activities were cancelled. For instance, many events in Europe and North America, including the 2020 Summer Olympic Games and the UEFA EURO 2020, were canceled [13]. As such, the hotel occupancy and operations have reduced significantly. Staple [14] published a report regarding the financial impact of Covid-19 on accommodation and food services. He discovered a more pronounced impact on accommodation and food services. The first time, after the 1993 Great Depression (CBRE), the hotel occupancy was the worst and statistically eight in ten hotel rooms were empty (STR) [15]. Figure 3 shows the occupancy in hotels. The occupancy rate is only 40% compared to the previous years.

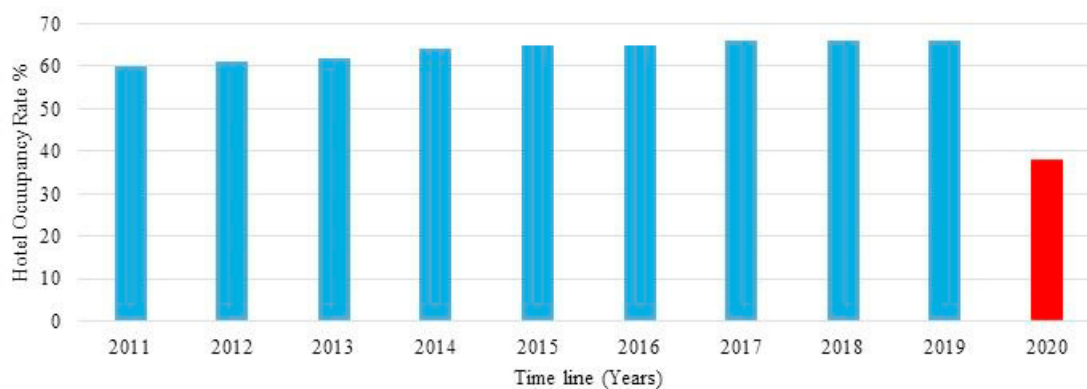


Figure 3. Hotels occupancy rate [15]

2.3. Reduced revenue

The United States (down 122.8 percent), Europe (down 131.9 percent), Asia-Pacific (down 124.1 percent), and the Middle East (down 124.1 percent) are all predicted to see triple-digit YOY percentage decreases in gross operating profit per available room (GOPPAR) (down 115.3 percent). The revenue has dropped to half of what it was (According to STR and Oxford Economics) [15]. The Pacific island, which relies heavily on tourism, hotels and resorts was the worst affected. The Indonesian (Bali Island) reported cancellation of 20,000 hotel bookings by Mid-Feb [16]. Figure 4 shows the US hotel businesses and forecast for 2020 to 2021. Where RevPAR: Revenue per Available Room, ADR: Average Daily Rate. The demand is expected to rise in 2021 as compared to 2020. Table 2 shows countries and the impact of Covid-19 on GDP, TRevPAR, and GOPAR.

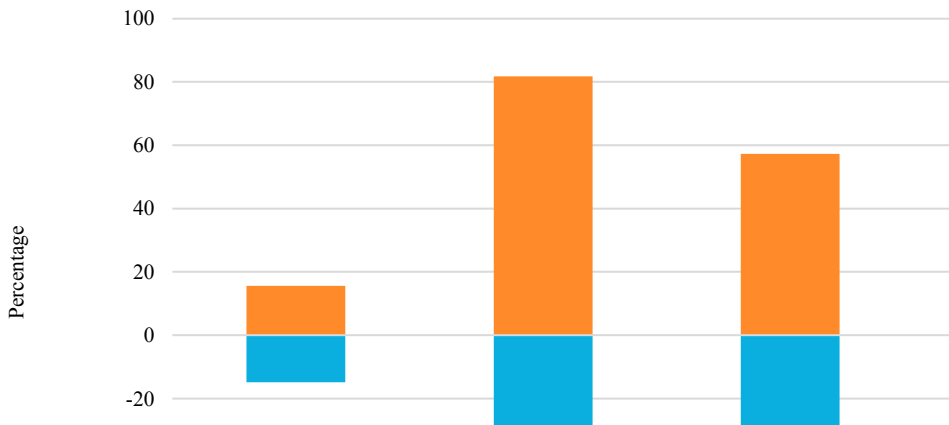


Figure 4. The US hotel businesses and forecast for 2020 to 2021 [17]

Table 2. Countries and the impact of Covid-19 on GDP, TRevPAR, and GOPAR

Geographic distribution	Asia	North America	Europe	Europe
	China	USA	Spain	Germany
Population	1.393 billion	328.2 million	46.94 million	83.02 million
Number of confirmed cases/death (Jan 12, 2020) ^a	87,591/ 4,634	23,174,243/386,324	2,111,782/ 52,275	1,948,745/ 42,590
Q2 2019 to Q2 2020 change in GDP ^b	+3.2 %	-9.5 %	-18.5 %	-11.70 %
Q2 2019 to Q2 2020 change in TRevPAR ^c	-58.6 %	-91.9 %	-99.0 %	-90.9 %
Q2 2019 to Q2 2020 change in GOPPAR ^d	-81.7 %	-119.0 %	-126.4 %	-126.5 %

^a <https://www.worldometers.info/coronavirus/>; ^{b, c, d} <https://www.hotstats.com/blog/hotel-demand-and-gdp-have-a-strong-correlation-and-thats-a-problem>; Total revenue per available room (TRevPAR)

2.4. Reduction in wages and mass lay off

The hotel occupancy rate has reduced significantly and so is the staffing level as the industry is finding it difficult to pay wages. The number of jobs lost is more than 3.9 million in the hospitality industry (Oxford Economics). More than 70% of hotel employees have been laid off (Oxford Economics and Hotel Effectiveness) [15]. By March 2020, the Malaysian hotel industry reduced employees pay by 4% and asked for unpaid leave [18]. In Fiji, since the outbreak 279 hotels and resorts have closed, and 25,000 workers being laid off [19]. The existing literature has reported few articles on the impact of Covid-19 on the hospitality industry (hotel and restaurant). Table 3 summarizes the literature on the impact of Covid-19 on the hospitality industry (hotel and restaurant).

3. How ICT and Machine Learning can respond to the Present and Future Pandemic

The hospitality industry should develop and promote the use of online platforms. These platforms will ease in doing business. They should have mobile apps and software systems such as food delivery apps, revenue management systems, and hotel booking systems. This will reduce the operational cost and human contact in case of any future pandemic.

Table 3. Existing literature on the impact of Covid-19 on the hospitality industry (hotel and restaurant)

Study	Industry	Country	Focal point
[20]	Hotel	China	Impact of Covid-19's on China's hotel business was investigated.
[21]	Hotel	China	Impact of Covid-19's on hotel booking activity in China was studied.
[22]	Restaurant	China	The researchers discussed Covid-19's impact on the restaurant.
[23]	Hotel/restaurant	China	The researchers reported the impact of Covid-19 in terms of fall in demands and loss in revenues.
[24]	Restaurant	USA	The researchers conducted a survey to learn more about Covid-19 impact on small enterprises.
[25]	Restaurant	USA	The researchers looked into the impact of Covid-19 on private dining preferences.
[26]	Restaurant	India	The researcher looked into the impact on the restaurant business in India.
[27]	Hotel	India	The researcher suggested ICT in the hotel industry in order to handle the Covid-19.
[28]	Hotel/restaurant	Global	The researchers examined the impact of Covid-19 on 45 hospitality firms through a survey.
[13]	Hotel/restaurant	Global	The researchers assessed and compared Covid-19 impact with the past pandemics.
[29]	Hotel	Global	The researchers reviewed the impact of Covid-19 on socio-economic conditions.
[30]	Hotel	Global	The researcher stressed the importance of hotel cleaners' health and safety during Covid-19.
[31]	Hotel	Global	The researchers discussed the hotel industry's restart of activity during and after Covid-19.
[32]	Hotel	Global	The researchers proposed and discussed certain health-related issues and measures in the hotel industry.
[33]	Hotel	Global	The researchers proposed solutions how to restart hotel activities during and after the Covid-19.

3.1. Booking app, food delivery app, and drone-based food delivery

The hotels and restaurants should have mobile applications for booking rooms and premises. Currently, the hospitality industry lags behind high-tech implementation and innovation. In the hospitality industry the most of the bookings, transactions, and administrative tasks are still managed manually [34]. There are few existing software applications for booking such as Hotelchamp, Allora, Expedia, or Booking.com. The hotels and restaurants should have their own food delivery mobile applications. The customers with food delivery mobile applications can order the food sitting at home instead of visiting restaurants and food courts. A few of the food delivery platforms currently operational are Grubhub and UberEats [35]. Another option is the customization of drones and its integration with the food delivery mobile applications. The food can be delivered via drone and customers can even pay to the drone via credit/debit cards.

3.2. Hotels and restaurants revenue management, discounts, cancellation, and booking policies

A software system for the hotels and restaurants revenue management collects and computes large amounts of complex and distributed data on sales and purchase. In the hotels, the revenue management system uses complex and variant data to determine the best possible room rate in real-time. For example, "Price Match," is a revenue management system that makes real-time price recommendations. The system tracks corporate tax holiday, travel, and hospitality sectors' defer statutory dues (advance tax, custom duties, excise duties, bank charges, etc.). Machine learning helps in pandemic discovery and travel restrictions monitoring. Machine learning will help in analyzing the guests' data and would suggest discounts besides rendering customized services. The customized packages and services will optimize the expenses to guests. The cancellation and booking policy can be made flexible with the help of machine learning. The machine learning techniques will use the past and present data and financial status to suggest the cancellation with fee and without a fee.

3.3. Contact tracing app, sensors for maintaining physical distance, contactless payments, and digital signage

Contact tracing apps and sensors in the hospitality premises will help in maintaining the physical distances. It will further calculate the maximum number of allowable guests present in the communal areas. The rapid contract tracing, requires details regarding the number of guests sitting together, tables and their separation, number of

accommodated guests, and number of persons per square meters. The installed sensors will automatically maintain a database on the cloud of all visitors (patrons, suppliers, maintenance workers, etc.) to the venue. The world has shifted to online payments and micropayments. The hospitality industry should use contactless payment services. The payments via online and mobile apps reduces the infection and prevents virus spread. Signage and display boards are helpful in communication to key health and safety points of hygiene and physical distancing. The protocols of cleaning and disinfection including hand hygiene infographics, and use of face masks for guests and workers can be displayed on digital boards. Internet of Things enabled guests' ID scanning services will be very helpful. The use of key cards/keys should be replaced with contactless door keys (mobile app enabled). In hotels, facial recognition check-in and check-out eliminates the need for guests to wait at the front desk. They can check-in and check-out with ease thanks to facial recognition. [36]. With the help of Alibaba's Fliggy travel service platform, Marriott International Hotel Group has successfully established a facial recognition system [37].

3.4. Chabot, sensors, and online platforms for communication, training, and work from home

The online platforms and sensors will update the incoming guests and already present guests with new policies, guidelines, and regulations. Before their arrival, they are informed about specific measures and the guidance by local public health authorities. The website, social media, email, press releases, posters are the best to get in touch with customers, caterers, and sponsors for delivering key messages, press release, possible infections, precautions methods in hotels and restaurants. The public health authorities and hospitality service providers can monitor the progress, communicate, and share the information. The pandemic guidelines and regulations from the Organization (WHO), European Centre for Disease Control and Prevention (ECDC) can be integrated into the online platforms for accessibility and easy reference. The Chat bot responds to text and voice messages 24x7 hours. The Voice bot can help the customers in putting light on and off, door closing, etc., inside the booked room. The health and safety of guests and employees is the key priority. An integrated system consisting of field clinics, hospitals, and the public health authorities with a direct line of communications help to identify Covid-19 symptoms and take necessary actions [38]. The staff needs to be trained, for measures and actions to be taken in case a guest shows virus symptoms, or they have symptoms. Staff can be trained online for virus signs and symptoms, materials' handling, disinfecting carts, and frequently touched areas. A hotel should establish contingency working plans for infectious disease control such as rotational shifts and work from home.

3.5. Robots for serving the guests and cleaning services

Robots can be used in providing necessary services to guests in the hospitality industry. A robot can serve as a substitute for humans in certain cases of controlling virus infections. A robot called, Social Distancing Robot Ambassadors is a three-foot robot for delivering pillows and groceries. For example few of them are named used at renowned hotels, Winnie (Embassy Suites by Hilton Los Angeles International Airport North), Wally (Residence Inn by Marriott Los Angeles LAX/Century Blvd), and Hannah (H Hotel Los Angeles, Curio Collection by Hilton, Homewood Suites by Hilton Los Angeles International Airport). The purpose of Virus assassination robots is to maintain hygiene, kill the virus, and germs. UVD robots from Blue Ocean Robotics use ultraviolet light to autonomously kill bacteria and viruses [39]. The work areas, staff rooms, canteens, and equipment are cleaned frequently between uses and it should be recorded as well. A cleaning record and checklist app helps to avoid in-person meetings. The app can have a checklist for approved chemicals, cleaning timing, cleaning place, and shift details.

4. Discussion

Covid-19 has wreaked havoc on people's life all around the world, prompting political, economic, and socio-behavioral changes. The hospitality industry has been rocked by the Covid-19 on an unprecedented magnitude. The cancellations of festivals, sports events, and entertainments have negatively affected the employees, caterers, and sponsors. Covid-19 has disrupted the supply chain in the hospitality industry. This has created an economic crisis, reduced demand, and the hospitality industry is looking for alternatives for survival. ICT and machine learning have

become leading tools in solving human problems in recent years. Historically, in general, viruses spread through contact, therefore developing contactless systems using the Internet of Things will be helpful, and they will generate a huge volume of data. Applying machine learning techniques to the collected and stored data will help in prediction and control. The machine learning techniques are under trial in the hospitality industry. For example, in operational analytics, customer experience, booking, occupancy, revenue management, demand forecasting, pricing, performance evaluation, brand monitoring, and competitive analysis [40]. The service robots render hotel housekeeping, room service, and concierge services [41]. The robots are used in delivering food and controlling facilities inside the hotel. Reis et al. [42] conducted a case study on using service robots at Henn-na Hotel, Japan. They found that often the services through robots outperformed than the one by a human; however, more research is needed. Last few years the hospitality industry has put efforts into mobile apps, Internet of Things, and software systems to streamline logistics and employees. After all, the majority of hotels and restaurants are still relying on the traditional methods. ICT along with advanced technologies can be effective in challenging times of the pandemic. Figure 5 shows technologies for handling the current and future crisis.



Figure 5. Technologies for handling the current and future crisis

It is hoped that the current situation would be contained by 2022; however, it is important to prepare for the spread of similar viruses in the future, through digitization and automation. Table 4 summarizes the lists of services along with ICT and Machine learning implementations.

5. Conclusion

The influence of Covid-19 on the hotel industry was investigated in the study, as well as how to deal with the problem in the present and future. Falling occupancy rates, reduced pay, mass layoffs, revenue loss, and shutdown are some of the significant effects of Covid-19 on the hospitality industry that have been identified. The industry should take certain relief measures and implement strategies to overcome the current challenges and ensure the health of guests and workers. Automation of various hospitality services, including operation, human resources, and finance is the need of hour. Sanctioning financial resources to ICT and machine learning for product innovation, pricing innovation, distribution innovation, and promoting innovation will have a long lasting effect. These innovations are in the form of a booking app, food delivery app, robots for cleaning, digital signage, payment gateways, contract tracking app, cleaning checklist app, a software system for revenue management, and online platforms for communication and training. The governments should provide financial and fiscal support to the hospitality sector to overcome this crisis. While a number of analysts estimate that the hotel industry will recover in some form, the exact timing will not be known until the virus has been confined globally and people have been vaccinated. The study has covered only two segments of the hospitality industry namely, hotels and restaurants. In the future, other areas such as tourism and the travel industry will be investigated.

Table 4. Summary of services and possible ICT/Machine learning implementations

Hotel Services	Restaurant Services	ICT and Machine Learning	Benefits
Booking rooms	Eating table	Booking app/online platform	Prevent unnecessary contact
Food delivery	Food delivery	Food delivery app/online platform	Partial/complete lockdown
-	Food delivery	Drone/Unmanned Aerial Vehicle	Partial/complete lockdown
Revenue management	Revenue management	Mobile app/online platform	Prevent unnecessary contact
Guest check-in/check-out	Check-in/check-out	Face recognition/mobile app enabled keys	Prevent unnecessary contact
Discounts and cancellation	Discounts/cancellation	Artificial Intelligence/Machine learning	Resource management
Physical distances	Physical distances	Mobile app/installed sensors in the premises	Health policy implementations
Communication	Communication	Chatbot/online platform	Prevent unnecessary contact
Instructions display	Instructions display	Internet of Things devices	Prevent unnecessary contact
Contact less payments	Contact less payments	Mobile app/online platform	Prevent unnecessary contact
Work from home	Work from home	Online platform	Prevent unnecessary contact
Training	Training	Online platform	Prevent unnecessary contact
Cleaning and disinfection	Cleaning/disinfection	Robots	Prevent unnecessary contact
Room services	Food services	Robots	Prevent unnecessary contact

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