ASERS

Journal of Environmental Management and Tourism

Quarterly
Volume XII
Issue 1(49)
Spring 2021
ISSN 2068 – 7729
Journal DOI
https://doi.org/10.14505/jemt

ASERS Publishing

Spring 2021
Volume XII
Issue 1(49)

ASERS Publishing
http://www.asers.eu/asers-publishing
ISSN 2068 – 7729
Journal DOI: https://doi.org/10.14505/jemt

Table of Contents:

Spring 2021
Volume XII
Issue 1(49)

ASERS Publishing
http://www.asers.eu/asers-publishing
ISSN 2068 – 7729
Journal DOI: https://doi.org/10.14505/jemt

Call for Papers
Summer Issues 2021
Journal of Environmental Management and Tourism

Journal of Environmental Management and Tourism is an interdisciplinary research journal, aimed to publish articles and original research papers that should contribute to the development of both experimental and theoretical nature in the field of Environmental Management and Tourism Sciences.

Journal will publish original research and seeks to cover a wide range of topics regarding environmental management and engineering, environmental management and health, environmental chemistry, environmental protection technologies (water, air, soil), pollution reduction at source and waste minimization, energy and environment, modeling, simulation and optimization for environmental protection; environmental biotechnology, environmental education and sustainable development, environmental strategies and policies, etc. This topic may include the fields indicated above, but are not limited to these.

Authors are encouraged to submit high quality, original works that discuss the latest developments in environmental management research and application with the certain scope to share experiences and research findings and to stimulate more ideas and useful insights regarding current best-practices and future directions in environmental management.

Journal of Environmental Management and Tourism is indexed in SCOPUS, RePEC, CEEOL, ProQuest, EBSCO and Cabell Directory databases.

All the papers will be first considered by the Editors for general relevance, originality and significance. If accepted for review, papers will then be subject to double blind peer review.

Deadline for submission:	28th May 2021
Expected publication date:	June 2021
Website:	https://journals.aserspublishing.eu/jemt
E-mail:	jemt@aserspublishing.eu

To prepare your paper for submission, please see full author guidelines in the following file: JEMT_Full_Paper_Template.docx, then send it via email at jemt@aserspublishing.eu.

DOI: https://doi.org/10.14505/jemt.12.1(49).17

Technologies Supporting Pandemic Restrictions in the Hospitality Industry, Hitherto Experiences and Outlook

Wieslaw URBAN
Faculty of Engineering Management
Bialystok University of Technology, Poland
w.urban@pb.edu.pl

Krzysztof ŁUKASZEWICZ
Faculty of Engineering Management
Bialystok University of Technology, Poland
k.lukaszewicz@pb.edu.pl

Suggested Citation:

Urban, W., Łukaszewicz, K. (2021). Technologies Supporting Pandemic Restrictions in the Hospitality Industry, Hitherto Experiences and Outlook. *Journal of Environmental Management and Tourism*, (Volume XII, Spring), 1(49): 196 - 210. DOI:10.14505/jemt.v12.1(49).17

Article's History:

Received 30th of November 2020; Received in revised form 15th of December 2020; Accepted 18th of January 2021; Published 22nd of February 2021.

Abstract:

The circumstances of the Covid-19 pandemic established new conditions for the hospitality industry, pandemic restrictions precluded full provision of leisure services. The study aims to identify technological concepts that could noticeably support the industry in dealing with pandemic restrictions while allowing guests take advantage of hospitality services. This is a conceptual study based on comprehensive review of the scientific literature and secondary sources, supported by the creative methodology. Twelve technological device concepts are elaborated, then evaluated, how they support pandemic-related restrictions and affect customer experience. Proposed concepts are aiming at the state of the art and beyond. The study mainly contributes with technological conceptualizations conceivably inspiring further developments favorable to the hospitality industry, particularly in pandemic time. The study presents a value co-creation analysis of the device concepts, several conclusions referring to the implementation of technologies in the hospitality industry are drawn up. One of the conclusions is that the current pandemic situation brings an opportunity to move toward the Industry 4.0 transformation. The study concerns a wider problem of technological changes than just pandemic restrictions.

***Keywords*:** Covid-19; technologies; hospitality industry; service innovation; value co-creation.

JEL Classification: D20; I19; I15; L80; L83; Z32.

Introduction

This is a time of dramatic changes caused by technologies, technologies that are revolutionizing many industries, manufacturing and service ones. The global trend called Industry 4.0 (Schwab 2017, Lu 2017) is still accelerating, each year it proposes new applications of Artificial Intelligence, the Internet of Things, Virtual and/or Augmented Reality, Big Data, Automatization and other technologies for manufacturing and service processes. Hotels and the entire tourism industry are not isolated from these changes.

This study is addressing the issue of preventive measures demanded by the pandemic in the HI through the use of technological solutions. In particular, the study provides a comprehensive review of technological devices, at different states of readiness to use, which could noticeably support service processes in HI in customer contact points under the social distancing restrictions and other precautions in response to Covid-19. The study aims to identify those technological solutions which are not yet practiced in the HI or only to a very limited extent. The study also aims at conceptual developments of technologies pointing out necessary further improvements making them possible for wide usage within the industry. The study assumes the standpoint of the

service value co-creation concept, and so the possible technological devices are discussed in light of value co-creation and value co-destruction. Adopted framework allows to see technological concepts in the wider view of customer experiences as well as to recognize long-term changes in the HI. Several directions and conditions of technological changes in the industry are recognized. The study is conceptual driven by comprehensive literature studies and supported by a creative methodology carried on young professionals involved in the service engineering issues. However, a crucial stream of the study is based on conceptual work by the authors. The study is targeted at the clear desires of hospitality operators.

1. Literature Review

The literature provides many insights regarding the positive prospects and examples of applications of technology in human-intensive services, hospitality included. According to Kabadayi *et al.* (2019) the smart services, meaning those that are intelligent, anticipatory, and with the adaptable use of data and technology, allow customers to experience services at an even higher level than existing "usual" services. Samala *et al.* (2020) arguing that although AI cannot surpass the human contact that is an essential in tourism, it certainly enhances customer experiences. Authors see this technology as an effective complementary dimension to the future of tourism, for example through the simplification of travel arrangements, automatization of some operations and customization (Samala *et al.* 2020).

Robotics offers variety of tools and devices which could noticeably change service operations (Belanche *et al.* 2020, Wirtz *et al.* 2018). Robots appear more often in services recently, a number of authors state that their presence will eventually become indistinguishable from that of a human (Belanche *et al.* 2020). According to Aarthy and Badrinarayanan (2019), there is a high prevalence of the use of function-based software along with automation in the hospitality industry (HI); however, service points with a high level of personal interaction with customers remain challenging. Technologies in HI are important for two reasons: (1) to improve internal process efficiency, as presented by Cobos *et al.* (2016) on the case of the adoption of radio frequency identification (RFID), and (2) to improve customer experience, as Liu and Hung (2020) demonstrate, customers showed a preference for self-service technologies (SST). Intensive research on technological innovations in tourism and hospitality has been strongly recommended by many scholars (Belanche *et al.* 2020, Kabadayi *et al.* 2019; Buhalis *et al.* 2019, Wirtz, *et al.* 2018). The three areas of service experiences that may possibly benefit from disruptive technological innovations are extra-sensory experiences, hyper-personalized experiences, and experiences beyond-automation (Buhalis *et al.* 2019). As Aarthy and Badrinarayanan (2019) argue, while machines cannot independently carry out hotel main processes, a smart combination of human technologies can provide a much-enhanced delivery of service.

The Covid-19 pandemic has dramatically changed the circumstances under which HI, hotels and other accompanying services must operate. According to the data provided systematically by the World Health Organization, the treatment of Covid-19 remains fundamental [July, 2020], and globally the number of infections continues to rise (Coronavirus 2020). The virus that causes Covid-19 is "transmitted between people through respiratory droplets, by direct contact with an infected person or indirect one" (Operational 2020, 1). WHO has developed some protective measures addressed directly to the accommodation industry, which include technical and organizational guidelines. "Social distancing measures, together with frequent hand hygiene and respiratory etiquette, are the main measures to prevent transmission of Covid-19" (Operational 2020, 3). WHO also indicates seeking early detection of guests and staff who are possibly infected, giving special consideration to the application of cleaning and disinfection measures in common areas, with particular attention to interactions that are specific to the industry: guest-guest, guest-staff, and staff-staff in all situations, but particularly whilst serving food and beverages, cleaning, organizing activities, etc. (Operational 2020).

Service value co-creation is a central point of service science, it provides an advantageous framework for describing and analyzing customer – service provider interactions, along with customer – the service staff relations. Value co-creation/service product co-production is perceived as various aspects of customer participation in various service activities (Auh 2007, Etgar 2008); its great peculiarity is that the customer is involved in the offering herself or himself (Ramaswamy 2009). Value co-creation relies upon two partnering sides meeting together (Grönroos and Voima 2013, Vargo and Akaka 2009). Value co-creation eventually contains intense and dialoguing customer-company and human-human interactions (Grönroos and Voima 2013, Grissemann and Stokburger-Sauer 2012, Payne *et al.* 2008), the service provider's employees listen and react promptly to customer needs (Grissemann and Stokburger-Sauer 2012). Scholars also underline the spontaneity of customer participation and behaviours, at the same time creativeness and open engagement by the provider's staff (Bolton and Saxena-Iyer 2009, Grönroos and Voima 2013).

Etgar (2008) also links service value co-creation to customization. The service co-production gives the recipient the possibility to customize his or her world (Co-creation 2009) as an active participant in the service process. It has been emphasized that in customization, the receiver is provided with resources prepared in advance and defined a priori by the service provider (Chathoth *et al.* 2013). The point is that these resources can be used in different ways during the service process. Etgar (2008) notes that customization assumes limited options that are offered to customers. However, joint creation occurs when customers carry out individual sequences of the service process themselves. In this case, the service process is transferred from the service provider to the customer (Bolton and Saxena-Iyer 2009). As Oertzen *et al.* (2018) perceive it, the co-creation of services denotes collaborative activities in the customer-provider interface associated with the service. In services, co-creation manifests itself in different forms depending on the phases of the service process, it includes co-ideation, co-valuation, co-design, co-testing, co-launching, co-production and co-consumption; all types of co-* are influenced by a contextual, multiactor network (Oertzen *et al.* 2018, 657).

For this study, the hospitality service processes have particular significance along with a variety of types of contact points where pathogen transmission might occur. All the interactions between guests and the hotel during their stay are determined by the office operations. According to Özdemir *et al.* (2019) the stages of guest stay are as follows: pre-arrival, arrival and accommodation, stay and departure. Krstic *et al.* (2015) identify four key operating processes in the hotel industry: (1) the process of hotel housekeeping, (2) the process of supplying necessary inputs, (3) the process of guest arrivals and departures and (4) the process of producing and serving food and beverages. Others additionally see (5) the process of serving meals and beverages and (6) the process of reception and accommodation of guests (Özdemir *et al.* 2019). Some different approaches to this issue mention the following as hotel service delivery processes: room reservation, check-in, the in room stay, room service orders, serving breakfast, information seeking, complaints, wake up, check-out, follow up (Yung and Chan 2002, Kattara and El-Said 2014, Danaher and Mattsson 1994). According to research conducted prior to the Covid-19 pandemic, in all these processes the safety and security are significant determinants of customer satisfaction, however these are particularly important factors in three-star establishments (Nunkoo *et al.* 2019).

2. Methodology

The study is mainly conceptual in its nature; however, it employs three research methods. At the beginning of the research process there were (1) creative workshops with young professionals (students) studying Service Engineering. They were asked to figure out as many possible technological ideas as they could that can be potentially employable to typical processes in HI and which would support restrictions typical to Covid-19. Twenty-one participants took part in online creative workshops in small groups (Markopoulos *et al.* 2016), 107 ideas were collected and categorized according to principles of content analysis (Neuendorf 2016). Evaluation and selection of these ideas yielded ten that were considered as having high potential for use in the HI; however, only a few of these are included in the concepts presented in the following chapter. Detailed systematizations are not presented because, in general, the ideas were not considered to be groundbreaking. However, two important conclusions were drawn from the creative workshops stage: (i) the idea of implementing technology to relieve the difficulty of pandemic restrictions in HI is very promising and that (ii) this study needs to be maximally focused on the technologies themselves and their very creative developments towards HI applications, proposals were in fact very often superficial.

Therefore, the two next methods were employed: (2) in-depth technological literature study along with many kinds of secondary sources related to technologies and (3) the conceptual design. As a number of authors (Christophe *et al.* 2014, Sanders and Stappers 2013, French 1999) state, the conceptual design methodology is widely exploited in many fields, starting with the engineering, product development, and manufacturing systems, and running through new technical and social creations. Conceptual design is modeling by using precise and neutral concepts that come from needs or ideas (Christophe *et al.* 2014). According to Thompson (1999), a designed concept describes the principles and features of a system on which the design is focused. In this study, authors proceeded from a wide review of existing and technically possible technological devices and proposed a set of future technologies which could be widely implemented in the HI to solve, at least to a fair extent, the problem of Covid-19 restrictions.

3. Technology Concepts Applicable to the Hospitality Industry

A summary of solutions with very high potential according to the type of device and technology used, is presented in Table 1. The following human contact points typical for HI is taken into consideration: travelling/trips (T), reception desk (R), dining (D), Spa & Beauty (S), exercise/sport (E), conference rooms and corridors (C).

Indication of the potential effects of technological devices on the service processes compared to services provided traditionally is presented. Directions for the future development of the devices are summarized in the last column. Proposed devices, first column, are supplemented with lists of generic Industry 4.0 technology groups according to following notations: AI - Artificial Intelligence, VR/AR - virtual/extended reality, CL - cloud computing and Big Data, TW - ICT networks, SW - sensor networks, AT - automation, RB - robots.

Table 1. The technologies supporting pandemic safety in the hospitality industry

Devices (I4.0 Technologies)	Contact Points	Influence on HI Processes	Necessary Developments of Devices
Secure kiosks, **KioS** (AT AI SW TW)	T R D S E	▪ Replace humans in orders, billing, check-in, check-out, selling tickets ▪ Information delivery and guidance, *e.g.* weather, availability and accessibility of places and utilities, etc. ▪ Extended accessibility	▪ Ensure they are kept protected microbiologically ▪ Make them intuitable
Voice response kiosks, **VoiK** (AT CL AI SW TW CL)	T R D S E	▪ Replace humans in orders, billing, check-in, check-out, selling tickets ▪ Contact with potentially contaminated surfaces not required ▪ Extended accessibility	▪ Holographic kiosks ▪ Further development of conversation scripts by AI ▪ Further voice recognition development
Delivery robots, **DelR** (AT RB CL AI TW SW)	D S R C	▪ Replacement of staff work, *e.g.* shopping, delivery of towels, cosmetics ▪ Dining delivered to rooms and/or outlying tables	▪ Self-disinfection of the robot after each contact with humans ▪ Ways of smoothly moving through space in buildings ▪ Development of systems for responding to unusual circumstances using low-quality data
Accompanying robots, **AccR** (AT RB CL AI TW SW)	T R D S E	▪ Replacement of several staff roles, *e.g.* guide, concierge ▪ Guest care extended in time and space	▪ Robot anthropomorphism ▪ Further development of relationship maintenance by AI ▪ Further development of the empty component of machines ▪ Self-disinfection after human contact
Tourist drones, **TouD** (RB AT VR/AR CL AI TW SW)	T E	▪ New role for tour guides ▪ Allow visits to places that are difficult to access and dangerous, *e.g.* canyons or underwater locations	▪ Further development of flight control systems ▪ Changes in the legal system, depending on the country, *e.g.* concerning permits for drone flights
Decontamination robots, **DecR** (RB AI TW SW)	S E C	▪ Elimination of human involvement in disinfection and cleaning of floor surfaces ▪ Limitation of employee contact with hazardous disinfectants ▪ Increase in the flexibility of the time slots for cleaning work	▪ Development of a system for disinfection that safe for people and equipment ▪ Development of effective and efficient disinfection methods ▪ Increase in the transparency of the operation of equipment
Visual markers for place and device safety, **VisM** (AT TW SW)	T R D S E C	▪ Improvement of the identification notification of potentially infected equipment ▪ Rapid identification of the most heavily burdened devices ▪ Enable the customer to monitor the threat level and support the decision-making process, *e.g.* whether to use a particular piece of equipment in the gym	▪ Development of solutions allowing disinfection of any device after each use ▪ Holographic markers presenting comprehensive information

Devices (I4.0 Technologies)	Contact Points	Influence on HI Processes	Necessary Developments of Devices
Visual information on staff daily health check, **VisH** (AT CL TW SW)	R D S E C	▪ Implementation of a dedicated system of imaging cameras and temperature sensors ▪ Improved identification and rapid notification of cases of infection	▪ Aiming at detection of other symptoms of infection ▪ Adaptation of visualization technologies for hotel convenience
Warning and guide system on RTLS, **WarL**, (AT VR/AR TW SW CL)	T R D S E C	▪ Implementation of an additional app and/or sensor following people's location ▪ Facilitate planning of room capacity and guest traffic ▪ Facilitate decision-making, *e.g.* about the relocation of guests ▪ Facilitate identification of threats, *e.g.* on excursions	▪ Development of an easily implemented automated system to manage the movement of people and robots on the hotel premises ▪ Data security and privacy protection
Convenient and safe disinfection cabins, **DesC** (AT)	R S E	▪ An additional step for a process allowing guests to disinfect their belongings ▪ Important usability for guests	▪ Safer for people and not harming belongings disinfectants
Cash and paper document disinfectors, **CasD** (AT)	T R	▪ Improvement of the provision of services involving cash transactions and document creation	▪ Development of rapid and safe disinfection methods
E-billing, **EbIG** (AT CL TW)	R	▪ Speeding up the billing process through paperless transactions	▪ Technological standard commonly accepted ▪ Changes in the legal system

Source: own study

Many hotel chains use KioS and VoiK to improve the check-in process, including Accor Hotels, Choice Hotels International, Hilton Worldwide, InterContinental Hotels Group and Marriott International. Some examples of commonly used Self Service Technology (SST) include KioS, pay-at-the-pump gas terminals, movie ticket kiosks and automatic hotel checkout machines (Heng 2018). The kiosks in its current state are a half-way solution, they ensure a good social distance, however still leave the risk of spreading pathogens by touching surfaces. The challenge is to have anti-microbial POS screens and/or keep screens microbiologically clean (Malbec 2020).

KioS can be adapted to individual needs both visually and technically (*e.g.* built-in loyalty card modules, payment terminals, voice recognition systems). KioS's main tasks include check-in and check-out without contacting the reception, which significantly increases the level of epidemiological security. KioS can automatically issue cards or print codes for electronic locks. Another advantage of KioS is the ability to change the application language, which greatly simplifies the use of the technology by guests from different countries. It is quite convenient in the case of requests for amenities, additional services, room changes, special promotions for frequent guests and other hotel services. The data entered to KioS can be sent directly to CL-based management systems (Stamenov 2018).

The use of KioS and VoiK self-service kiosks may be a solution that streamlines work at reception, not only speeding up the check-in process, but also personalizing the entire process. A SOTI survey (2018) showed that 66% of consumers prefer self-service technology over interaction with retail associates. According to another study, 30% of restaurants in Singapore use kiosks (Heng 2018). Benefits include reduction in waiting time, reduction in operating costs, improvement in customer service, reduction in the reliance on staffing (Heng 2018). Challenges and hindrances include customer mindsets that are difficult to change, different rates of acceptance of new technologies, limited technological options, and technical breakdowns [failures] (Heng 2018).

Artificial voice processing has been very widespread trend for several years, from Siri Apple, through Google Assistant and Amazon Echo, to Microsoft's Cortana, but only recently integrated into hotel areas is voice control of devices. For hotels, VoiK provides a range of new opportunities, from enabling employees to communicate more quickly with each other to allowing them to offer new and more exceptional experiences to hotel guests. Malbec (2020) suggests voice control be employed in kiosks to ensure biological security.

DelR and AccR service robots can interact and communicate with as well as deliver services to customers, allowing for a significant reduction in direct human involvement during the provision of service. They are used to deliver a range of services, from the very simple (*e.g.*: booking, payment, welcome/goodbye, check-in/check-out) to the more complex (e.g. handling customer inquiries, providing product recommendations) (Berezina *et al.* 2019, Choi *et al.* 2019, Ho *et al.* 2020, Yu and Ngan 2019). Their use eliminates a physical human to human contact. For example, the Yotel hotel chain uses room robots to serve its guests, Hilton hotels have introduced robots as their hotel porters and Pepper robots are used to respond to customer inquiries at hotels and airports (Wirtz *et al.* 2018). Henn na Hotel is mostly manned by robots, including reception agents, porters, room assistants and a robot handling the luggage storage room (Rajesh 2015, Wirtz *et al.* 2018). Many more examples of robot applications in hotels are reported by other sources (Castrodale 2016, Miller 2018, Neild 2016, Lukanova and Ilieva 2019, Price 2017, Silverstein 2020, Tussyadiah and Park 2018).

Huang and Rust (2018) distinguish four levels of intelligence: mechanical, analytical, intuitive and empathic. Mechanical intelligence refers to routine and repetitive tasks. Analytical intelligence requires analysis of needs, troubleshooting and the use of machines that execute complex but systematic and foreseen tasks (also called weak AI). Analytical intelligence mainly encompasses data processing algorithms (*e.g.* accounting and consulting services). Intuitive intelligence is associated with the ability to process complex information, with creativity and holistic thinking and activation in new situations (also called strong AI). Huang and Rust (2018) regard the ability to experience things as a characteristic of empathic AI. There is a consensus in the literature that the first three levels of artificial intelligence will develop strongly in the near future and that robots will become the dominant means of providing services.

However, there is a serious debate about whether robots will effectively provide emotional and social services at the same level that people do (Lu *et al.* 2019). Preliminary studies show that people prefer more human-like non-verbal robot behavior over robot-specific behavior (Rosenthal-von der Pütten *et al.* 2018). For example, in one study, when a robot was given human characteristics such as head, trunk and shoulders, people worked with a robot longer than when they interacted with a robot without a body (Rodriguez-Lizundia *et al.* 2015). In addition, when a robot makes eye contact in a human-like manner, a person is more ready to stay in contact with the robot. Riek *et al.* (2009) explains such research results with simulation theory, according to which people mentally simulate the situation of others to understand their mental and emotional state. The more similar to us an observed object is, the easier it is for us to simulate its feelings and the easier it is for us to feel empathy. This is extremely important in the context of the use of DelR and AccR in the HI and creating a friendly relationship between the machine and the customer, as well as earning full confidence in the robotic devices used. According to a study using DelR and AccR can be a key way to create a unique hotel experience (Cain *et al.* 2019). At the same time is beneficial to deal with epidemiological risk, Ivanov and Webster (2017) report that if there are dangerous or unhygienic conditions, the use of a robot is more cost effective than the expense of paying a person and for the protective clothing and equipment required.

There are known cases of DecR robots being used to disinfect rooms and corridors (Samarrai 2020). Another example is UVD Robots, in which a device emitting UV radiation in a 360-degree radius was placed on an autonomous mobile robot (Banker 2020). DecR uses sensors and simultaneous location and mapping (SLAM) technology for fully autonomous navigation. According to Banker (2020), the disinfection process is much faster than when people are employed, and the hospital room is usually disinfected within 10-12 minutes.

There are many examples in the literature of the use of VR/AR technology. These include mobile applications for smartphones (Chung *et al.* 2015, Rauschnabel *et al.* 2017), smart glasses (tom Dieck *et al.* 2016a), Google Glass (tom Dieck *et al.* 2016b), head-mounted VR displays (Marasco *et al.* 2018), GPS-coupled AR applications (Han *et al.* 2018), and printed AR advertisements (Yaoyuneyong *et al.* 2016). The hotel industry is increasingly using VR/AR technology. It allows the digital transfer of potential customers to the hotel or their destination. VR/AR makes it possible to present the hotel virtually as well as to view nearby attractions. According to Ilhan and Celtek (2016), thanks to VR/AR, hotel chains are better able to identify the purchasing preferences of their potential customers and enter into their awareness more effectively. The tourism and hotel industries also have high hopes for TouD technology. Jung *et al.* (2017) qualitatively studied the experiences of tourists with VR content created using TouD, using the Lake District National Park as a case study. Their findings reveal the potential of using VR/AR and TouD to engage tourists and increase their desire to visit destinations. Moura *et al.* (2017) compared the impact of different communication media (VR/AR, websites and brochures) on the behavioral intentions and observations of older Germans in a four-star hotel. It turned out that the VR/AR significantly effected a higher level of travel intentions compared to two other media. Griffin *et al.* (2017) compared the impact of the targeted promotional material viewed in VR with other forms of visual promotion

(video and websites). The study showed that VR is a more engaging form of advertising that helps evoke more positive emotions in people.

An increasingly significant trend, including in the HI, is the use of an growing number of devices forming a network of physical buildings, systems, platforms and applications that have the ability to communicate and share data with each other, their external environment, and with people. Such solutions include information markers with touch or presence sensors (VisM), thermal imaging cameras and temperature sensors, and RTLS location systems (WarL). An appropriately calibrated individual identification system allows these devices to interact and cooperate with each other in order to achieve common goals, e.g. gathering information about the health and location of staff and guests. Such aggregated information can be presented on screens using VisH. The key usability of VisM and VisH is based on the very clear, easy to see and credible information presented to the guests. Other examples of uses are biometrics and personal recognition technologies. An example that could be given here is the FlyZoo Hotel - Alibaba Future in China, where a facial recognition device replaces keys and magnetic cards. In general, biometrics may eventually become an all-in-one technology, optimizing all stages of guest travel. An example of the use of WarL is the fully automated Ekahau RTLS system, which continuously locates personnel and equipment on site. Location is tracked in real time and the data is sent via the local network to authorized users (Ekahau 2020). In terms of maintaining an appropriate level of epidemiological safety and increasing the social distance, VisM, VisH and WarL devices connected to a common network should be assigned a special role. WarL solutions can also help to increase the sense of security for hotel guests. Examples include the Sodar app (Sodar 2020), which helps people to stay two meters away from other people or the TraceTogether app (Panetta 2020), which uses Bluetooth to track interactions between users of the application.

In the process of providing hotel services, a large amount of data is generated from sources such as mobile transactions, user-generated content, social media, websites, sensors, etc. Systematic collection of this data gives hotel companies great opportunities to (1) gain better insight into customer interactions and behavioral patterns, (2) develop more effective strategies to improve business performance (McAfee and Brynjolfsson 2012, McColl-Kennedy 2019), and (3) optimize business processes (Malthouse and Li 2017). Organizations can even collect data in real time and then use it to improve services as they grow (Lim *et al.* 2019). The benefits of this use of data are demonstrated by the studies by McAfee and Brynjolfsson (2012). They found that CL based companies are 5% more efficient than their competitors and up to 6% more profitable. Large companies that provide accommodations are able to record a vast number of complex interactions during so-called increased consumption, often in real time (Buhalis and Sinarta 2019). Hotels that use CL can collect customer satisfaction data and use social media announcements to determine what changes should be introduced in future market offers (Line *et al.* 2020).

Additional important usability for hotel guests can be provided by the decontamination cabins for their personal belongings (DesC) available on request. Test results (van der Veen 2020) revealed that coronavirus is sensitive to ultraviolet and heat. Exposure to 56°C for 30 minutes and lipid solvents such as ether, 75% ethanol, chlorine-containing disinfectant, peracetic acid, and chloroform can effectively inactivate the virus (van der Veen, 2020). Such features of coronavirus caused that nowadays there is a large number of different devices, such as: box, tunnel, chamber, gate using the above-mentioned methods of disinfection. The disinfection procedure usually consists of automatic exposure or spraying of the disinfectant inside the chamber where the objects are placed. A condition for the widespread implementation of DesC is the development of effective, fast, safe for users and environmentally friendly disinfection methods.

It can be concluded that, in the context of epidemiological risk, solutions promoting cashless payments are highly beneficial and eliminate one element of contact with an infected person. It should also be noted that cashless payments cannot be the only acceptable form of payment. Guests who are used to using cash on a daily basis, may feel uncomfortable, put off and constrained if their ability to make cash payment for services is restricted. In addition, the complete service, in most cases, requires paper documents. In this case, a CasD cash and paper document disinfection devices may be helpful. Cash disinfection methods are used in practice, *e.g.* with UV-C light and high temperature or using ActivePure® RCI technology (Activetek 2020). The obstacle here is the lengthy time the decontamination process requires and its destructive impact on documents with current equipment.

Malbec (2020) also discusses offering e-receipts in lieu of paper. With EbIG solutions for reporting and monitoring the status of the receipts and invoices issued, it is possible to more quickly and effectively identify where there are significant delays and take appropriate steps before late payments affect the company's liquidity. However, the motivation for such an arrangement is to protect guests from possible transmission of infection through paper printouts. This also has a symbolic meaning for guests' subjective sense of safety. EbIG relieves

employees who can then devote time to other tasks. The automation of invoicing processes within internal financial systems also improves the time frame by reducing human errors and improving invoicing accuracy. Legal systems in countries that require paper-based documentation may be an obstacle.

4. Discussion

There is no doubt that the human component is essential in the HI. Hospitableness is a nodal point of this kind of service, hospitableness and the human component are what make the product special (Tasci and Semrad 2016). The dimension of hospitableness in the hotel industry facilitates favorable experiential outcomes (Mody *et al.* 2019). Since "consumers seek positive hedonic emotions in the consumption process" (Ding and Tseng 2015, 998), service providers induce positive hedonic emotions through the whole of their customer service paths. These emotions appear whilst service products are co-created; however, some authors suggest that value co-creation and co-destruction should be studied together (Tuunanen *et al.* 2019, Li and Tuunanen 2020), particularly when considering the implementation of technology into service processes. Value co-destruction refers to customer perceptions of goal prevention or net deficits (Prior and Marcos-Cuevas 2016, Jarvi *et al.* 2020) when customers do not achieve their desired goals and negative perceptions occur or when they face excessive costs in doing so.

The concepts of service value co-creation and co-destruction form a convenient framework for discussion the consequences of the implementation of technological devices in the HI under the conditions of pandemic restrictions. Therefore, each technological device concept is analyzed in terms of the additional value delivered to the customer and the value lost by the customer, along with challenges for hospitality operators. Oertzen *et al.* (2018, 670) mention several aspects of co-creation, namely the personal dimension, the social dimension, which relies on developing relationships, the enjoyment experienced during collaborative activities (the hedonic dimension), the new knowledge and skills gained (the cognitive dimension), the monetary compensation (the economic dimension) and the improvement of service–customer fit (the pragmatic dimension). All these factors must be considered whilst discussing the technological device concepts elaborated in the previous chapter. A systematic summary is given in Table 2.

All the devices, which are quite close to wide scale use and those that still require some time to be applied en masse could in fact substantially support the perception of being protected against Covid-19. There are solutions which are applied to assisting with the maintenance of social distancing, both between staff and guests as well as between guests, there are solutions supporting undertaking disinfection measures, early detection of possible threats along with information provided to guests which gives them a sense of being secured. Some of the devices combined several of the functions mentioned above. For example, visual devices such as VisH and VisM aim at forcing the service system to make health checks and disinfect equipment, which is absolutely crucial, but at the same time, the reliable visual information provides guests with a strong impression of being looked after and microbiologically secured.

As presented in Table 2 all the devices might lead to some value destruction. First of all, it is connected with a novelty in itself, much more so when the novelty is a technology, it quite very often provokes resistance (Cobos *et al.* 2016, Takayama and Pantofaru 2009). At the same time a new added value far exceeds merely protection against the threat of the virus. The technologies as proposed in this study can, for example, noticeably increase the accessibility to some services typical in the HI, provide quite tailored and individualized treatment to guests, and many more positive experiences. This is consistent with what the literature supposes in terms of the positive service experiences that result from the implementation of new technologies. According to Kabadayi *et al.* (2019) smart service provides empowerment, a seamless experience, enjoyment, privacy and security, and precise delivery of service. Samala *et al.* (2020) also report that AI implemented in tourism services make them automated, customized and insightful, while it additionally allows travelers to learn about their behaviors, interests and inclinations and provides a personalized experience. The set of pandemic technological devices presented here along with their evaluation from the point of value co-creation/destruction supports the claim that the benefits from the implementation of technology in the HI might far exceed protection of guests alone.

The identified value components are mostly hedonic, social and personal in nature (according to systematization by Oertzen *et al.* 2018). These components require special attention when technologies are being applied to HI processes. Robots operate autonomously and AI support can to a great extent engage customers on a social level (Van Doorn *et al.* 2017, Colby and Parasuraman 2016), which is something self-service technologies usually cannot do (Colby and Parasuraman 2016). Some carefully designed and intelligent combination of human and automated services (Aarthy and Badrinarayanan 2019) is what should be advised in this regard.

Table 2. Consequences of the implementation of protection technologies for value co-creation

Device	Additional Value to the Customer	Value Destruction to the Customer	Service Providers' Challenges
KioS	▪ High availability and convenience	▪ Fear of an unusual situation that requires human assistance ▪ Fear of using this type of device (in particular older people)	▪ Ensuring frequent use without spreading infection ▪ Appropriate number and placement of devices in the hotel space
VoiK	▪ High availability ▪ Convenient contact with a machine ▪ Imitating contact with humans	▪ Need to learn and practice new behaviors ▪ Lack of full confidence in voice technology, fear of not being understood and left without assistance	▪ Appropriate number and placement of devices in the hotel space ▪ Matching algorithms (AI) to a guest's profile and culture
DelR	▪ Higher flexibility in terms of deliveries to rooms, e.g. meals ▪ Increased sense of security ▪ Higher availability of services	▪ Limited real-time responsiveness ▪ Deficiency of human-human relations	▪ Training and teaching staff how to handle ▪ Organizing the hotel space to accommodate delivery robots
AccR	▪ Better accessibility to information and guidance ▪ Better comfort because of an individual guest carer	▪ Fear of the occurrence of an unusual situation ▪ Lack of trust in robotic devices and privacy protection	▪ Adapting devices to individual service applications ▪ Teaching guests to use and trust AccR
TouD	▪ Eliminated restrictions to accessibility to difficult to access but attractive places	▪ Limiting the range and level of impressions	▪ Training and teaching staff how to use ▪ Supplementation of existing means of tourism transport with drones
DecR	▪ Directly increased sense of security	▪ Lack of trust in the quality of work performed by the robot ▪ Fear about the health consequences of the methods used	▪ Development of a disinfection system that is safe for people and equipment ▪ Ensuring transparency of the operation of equipment
VisM	▪ Directly increased sense of security ▪ Facilitates decision making regarding how to spend time	▪ Possible fear of negative effects on health	▪ Placing appropriate markers on each device in the hotel and maintaining them
VisH	▪ Directly increased sense of security	▪ Discomfort with monitoring of activity and health status ▪ Privacy concerns	▪ Assurance of employee privacy
WarL	▪ Improved planning of activities during the stay ▪ Increased sense of security	▪ Perception of privacy threats ▪ Sense of restricted freedom	▪ Integration of all devices and clear and understandable display of the results of data processing
DesC	▪ Important safety system option ▪ Experience of being looked after by the host	▪ A fear of the effect of a disinfectant for health and guest's stuff	▪ Rearrangement of guest zones
CasD	▪ Increased sense of security, if information is entered	▪ Possible fear about the health consequences of the methods used	▪ Introduction of appropriate devices, including self-service on demand
EblG	▪ Faster transactions and settlements	▪ Fear of unauthorized use of data	▪ Introduction of the system

Source: own study

Researchers suggest greater anthropomorphism, which could be achieved by robots being given an apparent or implied gender, ethnicity, culture, and even age (Takayama and Pantofaru 2009, Belanche *et al.* 2020), by the use of human instead of robotic names or claims of human-like skills (Araujo 2018). However, in regard to the proposed devices the most important might be to create a vivid impression that a real human, in real time, is standing in a distance behind these machines. This can be achieved by individualized messages and remote voice and visual contact with service staff. Tangibles and responsiveness are two significant factors that positively affect the general expectations of guests in AI-based robotic hotels (Zhang and Qi 2019).

The idea of this study is to present concepts of useful technological devices; however, these are not devices currently used on a wide scale. They are on different levels of technology readiness; the necessary developments are presented in Table 1 above. It would appear that those with greatest chances for rapid development in the future are KioS, VoiK, WarL and EbIG. This is suggested by the high prevalence of similar solutions already introduced in hotels and catering services. The development of DelR and AccR devices may face certain obstacles related to the safety of their use and their social acceptance. Certain concerns regarding their acceptance may also be raised by the development of WarL in terms of tracking people, as indicated in Tables 1 and 2.

The introduction of new technologies is inherently linked to the problem of their social acceptance (Davis and Venkatesh 1996). Early adopters are the best group to start introducing new technologies to, as they are people who travel a lot, enjoy personalized interactions and are spontaneous. As the literature indicates (Cobos *et al.* 2016), a technology is more likely to be accepted among users if it is perceived to be easy to use. Therefore, as technology is being developed, particular attention should be devoted to making it easier to use the devices, increasing the intuitiveness of use, with a strong emphasis on their usefulness. Observing this condition in the development of the technology will mitigate many of the factors of value destruction indicated in Table 2, increasing the chances of achieving good occupancy of recreational spaces and high guest satisfaction, even under the conditions of a persistent pandemic.

Conclusions

Under the conditions of an epidemiological threat, hotel companies find themselves under enormous pressure from reduced demand, as well as the absolute necessity to ensure the safety of their guests. This study proposes twelve technological device concepts which might noticeably support HI operators in fulfilling pandemic restrictions assuring maximum safety of guests. The devices are at different stages of readiness to use, from cases which are already used in the industry on a limited scale, to concepts which are very likely to be developed because they share very similar components with some already used, e.g. in different industries. The proposed devices provide solutions regarding social distancing, between staff and guests as well as between guests, disinfection of spaces and equipment, early detection of threats of infection, information and guidance; at the same time, they aim at making full use of leisure and other hospitality services possible.

As value analysis has shown, devices implementation can provide many more benefits to hospitality operations, mostly by improving accessibility and individualization. However, their implementation requires a carefully considered combination of human and machine services. Robots need to make a real human impression – preferably by the staff being in remote contact, which assures the perception of real hospitableness. Another issue is increasing the anthropomorphism of machines, which is a general challenge in the development of automatization and robotics. One more important issue is to make the technologies easy to use, which makes them more likely to be accepted by guests.

The set of pandemic technological devices presented in this study meet the urgent and clear needs of protection against the threat of the virus. As it was demonstrated the technology can change to a far extent hospitality processes allowing to take advantage of the services in a safety manner. Hospitality operators and technology suppliers to the industry can follow the concepts elaborated in this study. The possible/necessary developments provide frameworks for device improvements, value analysis can help hospitality operators in a reasonable implementation of presented devices, part of them will be very beneficial even beyond pandemic period. This is a practical meaning of this study.

The study allows also a more general conclusion that the spread of the pandemic all over the world, which is truly damaging to the industry, at the same time provides a very important opportunity for hospitality operators to start the transformation towards Industry 4.0. A strong need may be the most effective causative agent for the industry. It should be emphasized that in such a pandemic situation it is much easier for guests to accept a technology. The enterprises which start the transformation earlier might win a competition game of future position in the sector. The intensive work by researchers and technology developers is absolutely indispensable. The

issue of the implementation of technology to HI operations generally needs to be studied more intensively. This is a conceptual study; the particular technology developments need to be investigated empirically.

Acknowledgements

This research was funded by a grant from the Minister of Science and Higher Education received by the Bialystok University of Technology, grant number WZ/WIZ-INZ/3/2019.

References

[1] Aarthy, C.J. and Badrinarayanan, M.K. 2019. Automation and enhanced service delivery through process improvement in hospitality industry, *International Journal of Recent Technology and Engineering,* 8(4): 2842-2848. DOI: https://doi.org/10.35940/ijrte.D8361.118419

[2] Araujo, T. 2018. Living up to the chatbot hype: The influence of anthropomorphic design cues and communicative agency framing on conversational agent and company perceptions. *Computers in Human Behavior* 85: 183-189. DOI: https://doi.org/10.1016/j.chb.2018.03.051

[3] Auh, Seigyoung, Bell, S. J., McLeod, C. S. and Shih, E. 2007. Co-production and customer loyalty in financial services. *Journal of Retailing* 83(3): 359-370. DOI: https://doi.org/10.1016/j.jretai.2007.03.001

[4] Banker, S. 2020. Decontamination robots and industrial worker safety. Forbes. Available at: https://www.forbes.com/sites/stevebanker/2020/05/05/decontamination-robots-and-industrial-worker-safety/#22c4b467726a

[5] Belanche, D., Casaló, L.V., Flavián, C. and Schepers J. 2020. Service robot implementation: a theoretical framework and research agenda. *The Service Industries Journal* 40(3-4): 203-225. DOI:https://doi.org/10.1080/02642069.2019.1672666

[6] Berezina, K., Ciftci, O. and Cobanoglu, C. 2019. Robots, artificial intelligence, and service automation in restaurants. In Ivanov S., Webster C. (Eds.), *Robots, Artificial Intelligence, and Service Automation in Travel, Tourism and Hospitality*, Emerald Publishing Limited, Bingley, England. DOI: https://doi.org/10.1108/978-1-78756-687-320191010

[7] Bolton, R. and Saxena-Iyer, S. 2009. Interactive Services: A Framework, Synthesis and Research Directions. *Journal of Interactive Marketing*, 23: 91-104. DOI: https://doi.org/10.1016/j.intmar.2008.11.002

[8] Buhalis, D. and Sinarta, Y. 2019. Real-time co-creation and nowness service: lessons from tourism and hospitality. *Journal of Travel & Tourism Marketing* 36(5): 563-582. DOI:https://doi.org/10.1080/10548408.2019.1592059

[9] Buhalis, D. *et al.* 2019. Technological disruptions in services: lessons from tourism and hospitality. *Journal of Service Management,* 30(4). DOI: https://doi.org/10.1108/JOSM-12-2018-0398

[10] Cain, L.N., Thomas, J.H. and Alonso, M.Jr. 2019. From sci-fi to sci-fact: the state of robotics and AI in the hospitality industry. *Journal of Hospitality and Tourism Technology,* 10(4). DOI: https://doi.org/10.1108/JHTT-07-2018-0066

[11] Castrodale, J. 2016. This small, multilingual robot is now answering travelers' questions in the Tokyo airport. Aailable at: https://eu.usatoday.com/story/travel/roadwarriorvoices/2016/02/11/this-small-multilingual-robot-is-now-answering-travelers-questions-in-the-tokyo-airport/83284386/

[12] Chathoth, P. *et al.* 2013. Co-production versus co-creation: A process based continuum in the hotel service context. *International Journal of Hospitality Management* 32. DOI: https://doi.org/10.1016/j.ijhm.2012.03.009

[13] Choi, Y., Choi, M., Oh, M. M. and Kim, S. S. 2019. Service robots in hotels: understanding the service quality perceptions of human-robot interaction. *Journal of Hospitality Marketing & Management* 29(6). DOI: https://doi.org/10.1080/19368623.2020.1703871

[14] Christophe, F., Coatanea, E. and Bernard, A. 2014. Conceptual Design. In Laperrière, L. and Reinhart, G. (Eds.), *CIRP Encyclopedia of Production Engineering*, Springer, Berlin. DOI: https://doi.org/10.1007/978-3-642-20617-7_6444

[15] Chung, N., Han, H. and Joun, Y. 2015. Tourists' intention to visit a destination: the role of augmented reality (AR) application for a heritage site. *Computers in Human Behavior* 50. DOI:https://doi.org/10.1016/j.chb.2015.02.068

[16] Cobos, L.M., Mejia, C., Ozturk, A.B. and Wang, Y. 2016. A technology adoption and implementation process in an independent hotel chain. *International Journal of Hospitality Management* 57, DOI:https://doi.org/10.1016/j.ijhm.2016.06.005

[17] Colby, C. L., and Parasuraman, A. 2016. Service robotics: How ready are consumers to adopt and what drives acceptance? *25th Annual Frontiers in Services Conference*. Available at: https://www.slideshare.net/ccolby/frontiers-2016-colby-parasuraman

[18] Danaher, P.J., and Mattsson, J. 1994. Customer Satisfaction during the Service Delivery Process. *European Journal of Marketing* 28(5). DOI: https://doi.org/10.1108/03090569410062005

[19] Davis, F.D., and Venkatesh, V. 1996. A critical assessment of potential measurement biases in the technology acceptance model: Three experiments. *International Journal of Human-Computer Studies* 45(1). DOI: https://doi.org/10.1006/ijhc.1996.0040

[20] Ding, C. G., and Tseng, T. H. 2015. On the relationships among brand experience, hedonic emotions, and brand equity. *European Journal of Marketing* 49(7/8). DOI: https://doi.org/10.1108/EJM-04-2013-0200

[21] Etgar, M. 2008. A descriptive model of the consumer co-production process. *Journal of the Academy of Marketing Science* 36. DOI: https://doi.org/10.1007/s11747-007-0061-1 (accessed November 20, 2020).

[22] French, M.J. 1999. *Conceptual design for engineers*. 3rd Edition. The Design Council.

[23] Griffin, T., *et al.* 2017. Virtual Reality and Implications for Destination Marketing. *Travel and Tourism Research Association: Advancing Tourism Research Globally* 29, Available at: https://scholarworks.umass.edu/ttra/2017/Academic_Papers_Oral/29

[24] Grissemann, U. S., and Stokburger-Sauer, N.E. 2012. Customer co-creation of travel services: The role of company support and customer satisfaction with the co-creation performance. *Tourism Management* 33(6). DOI: https://doi.org/10.1016/j.tourman.2012.02.002

[25] Grönroos, C., and Voima, P. 2013. Critical service logic: making sense of value creation and co-creation. *Journal of the Academy of Marketing Science,* 41(2). DOI: https://doi.org/10.1007/s11747-012-0308-3

[26] Han, Dai-In, Dieck, C. t. and Jung, T. 2018. User experience model for augmented reality applications in urban heritage tourism. *Journal of Heritage Tourism* 13(1). DOI:https://doi.org/10.1080/1743873X.2016.1251931

[27] Heng, M. T. 2018. *Lifting productivity in Singapore's retail and food services sectors: The role of technology. Manpower and Marketing*, World Scientific Books.

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

[29] Huang, M.-H., and Rust, R.T. 2018. Artificial intelligence in service, *Journal of Service Research* 21(2). DOI:https://doi.org/10.1177%2F1094670517752459

[30] Ilhan, I., and Celtek, E. 2016. Mobile marketing: usage of augmented reality in tourism. *Gaziantep University Journal of Social Sciences* 15(2). DOI: https://doi.org/10.21547/jss.256721

[31] Ivanov, S., and Webster, C. 2017. Adoption of robots, artificial intelligence and service automation by travel, tourism and hospitality companies – a cost-benefit analysis. Paper presented at the *International Scientific Conference "Contemporary Tourism – Traditions and Innovations"*, 19-21 October 2017, Sofia University, Bulgaria. Available at: https://ssrn.com/abstract=3007577

[32] Jarvi, H., Keranen, J., Ritala, P. and Vilko, J. 2020. Value co-destruction in hotel services: Exploring the misalignment of cognitive scripts among customers and providers. *Tourism Management* 77, DOI: https://doi.org/10.1016/j.tourman.2019.104030

[33] Jung, Timothy, tom Dieck, C. M., Moorhouse, N. and tom Dieck, D. 2017. Tourists' experience of virtual reality applications. *2017 IEEE International Conference on Consumer Electronics (ICCE),* DOI:https://doi.org/10.1109/ICCE.2017.7889287

[34] Kabadayi, S. *et al.* 2019. Smart service experience in hospitality and tourism services: A conceptualization and future research agenda. *Journal of Service Management* 30(3). DOI: https://doi.org/10.1108/JOSM-11-2018-0377

[35] Kattara, H.S., and El-Said, O.A. 2014. Customers' preferences for new technology-based self- services versus human interaction services in hotels. *Tourism Hospitality Research* 13(2). DOI: https://doi.org/10.1177/1467358413519261 (accessed November 12, 2020).

[36] Krstic, B., Kahrovic, E. and Stanisic, T. 2015. Business process management in hotel industry: A proposed framework for operating processes. *Journal for Economic Theory and Practice* 61(4). DOI:https://doi.org/10.5937/ekonomika1504021K

[37] Li, Mengcheng, and Tuure Tuunanen. 2020. Actors' dynamic value co-creation and co-destruction behavior in service systems: A structured literature review. *Proceedings of the 53rd Hawaii International Conference on System Sciences*, Hawaii, Maui. DOI: https://doi.org/10.24251/HICSS.2020.143

[38] Lim, C. *et al.* 2019. Customer process management. *Journal of Service Management* 30(1). DOI:https://doi.org/10.1108/JOSM-02-2017-0031

[39] Line, N. D. *et al*. 2020. Control, use and ownership of big data: A reciprocal view of customer big data value in the hospitality and tourism industry. *Tourism Management* 80. DOI:https://doi.org/10.1016/j.tourman.2020.104106

[40] Liu, C. and Hung, K. 2020. Self-service technology preference during hotel service delivery: A comparison of hoteliers and customers. In Neidhardt, J., Wörndl, W. (Eds.), *Information and Communication Technologies in Tourism 2020.* DOI: https://doi.org/10.1007/978-3-030-36737-4_22

[41] Lu, L., Cai, R. and Gursoy, D. 2019. Developing and validating a service robot integration willingness scale. *International Journal of Hospitality Management* 80. DOI: https://doi.org/10.1016/j.ijhm.2019.01.005

[42] Lu, Y. 2017. Industry 4.0: a survey on technologies, applications and open research issues. *Journal of Industrial Information Integration,* 6. DOI: https://doi.org/10.1016/j.jii.2017.04.005

[43] Lukanova, G. and Ilieva, G. 2019. Robots, Artificial Intelligence and Service Automation in Hotels. In S. Ivanov and C. Webster (eds.), *Robots, Artificial Intelligence, and Service Automation in Travel, Tourism and Hospitality*, Emerald Publishing Limited, Bingley, England. DOI: https://doi.org/10.1108/978-1-78756-687-320191009

[44] Malbec, T. 2020. Restaurant Technology in the Post-COVID-19 World, Hospitality Technology. Available at. https://hospitalitytech.com/restaurant-technology-post-covid-19-world

[45] Malthouse, E.C., and Li, H. 2017. Opportunities for and pitfalls of using big data in advertising research. *Journal of Advertising* 46(2). DOI: https://doi.org/10.1080/00913367.2017.1299653

[46] Marasco, A. *et al*. 2018. Exploring the role of next-generation virtual technologies in destination marketing. *Journal of Destination Marketing and Management* 9. DOI: https://doi.org/10.1016/j.jdmm.2017.12.002

[47] Markopoulos, P. *et al.* 2016. *Collaboration in creative design. Methods and tools.* Springer International Publishing.

[48] McAfee, A. *et al.* 2012. Big data: the management revolution. *Harvard business review*, 90(10).

[49] McColl-Kennedy, J.R., *et al.* 2019. Gaining customer experience insights that matter. *Journal of Service Research* 22(1). DOI: https://doi.org/10.1177/1094670518812182

[50] Miller, P. 2018. The relay hotel delivery robot will soon spot Wi-Fi dead zones and mingle with guests. Available at. www.theverge.com/2018/1/11/16879432/savioke-relay-hotel-delivery-robot-wi-fi-dead-zones-mingle-ces-2018

[51] Mody, M., Suess, C. and Lehto, X. 2019. Going back to its roots: Can hospitableness provide hotels competitive advantage over the sharing economy? *International Journal of Hospitality Management* 76, Part A. DOI: https://doi.org/10.1016/j.ijhm.2018.05.017

[52] Moura, F. T., Nobis, C. and Filho, S. C. 2017. Virtual reality and the decision making process of German senior travelers: A cross-media comparison. In Lee C., Filep S., Albrecht J.N., Coetzee W.J.L. (Eds.), *CAUTHE 2017: Time for big ideas? Re-thinking the field for tomorrow*, Department of Tourism, University of Otago, Dunedin.

[53] Neild, B. 2016. A hotel staffed by robots? It's not science fiction - it's now. Available at. https://edition.cnn.com/travel/article/hotels-robot-future-travel/index.html

[54] Neuendorf, K. A. 2016. *The content analysis guidebook*. Second Edition, SAGE Publications, Los Angeles.

[55] Nunkoo, R., Teeroovengadum, V., Ringle, C. M. and Sunnassee, V. 2020. Service quality and customer satisfaction: The moderating effects of hotel star rating. *International Journal of Hospitality Management* 91. DOI: https://doi.org/10.1016/j.ijhm.2019.102414

[56] Oertzen, A. S., Odekerken-Schröder, G., Brax, S.A. and Mager, B. 2018. Co-creating services - conceptual clarification, forms and outcomes. *Journal of Service Management* 29(4). DOI: https://doi.org/10.1108/JOSM-03-2017-0067

[57] Özdemir, A.I., Çolak, A. and Shmilli, J. 2019. Business process management in hotels: with a focus on delivering quality guest service. *Quality & Quantity* 53. DOI: https://doi.org/10.1007/s11135-018-0727-4

[58] Panetta. 2020. How Technology Can Curb the Spread of COVID-19. Available at. https://www.gartner.com/smarterwithgartner/how-technology-can-curb-the-spread-of-covid-19/

[59] Price, E. 2017. You Rang? I Called Hotel Room Service—and Got A Robot. Available at. https://www.fastcompany.com/3068401/you-rang-i-called-hotel-room-service-and-got-a-robot

[60] Prior, D.D., and Marcos-Cuevas, J. 2016. Value co-destruction in interfirm relationships: The impact of actor engagement styles. *Marketing Theory* 16(4). DOI: https://doi.org/10.1177/1470593116649792

[61] Rajesh, M. 2015. Inside japan's first robot-staffed hotel. The Guardian. Available at. www.theguardian.com/travel/2015/aug/14/japan-henn-na-hotel-staffed-by-robots

[62] Ramaswamy, V. 2009. Co-creation of value – towards an expanded paradigm of value creation. *Marketing Review St. Gallen* 26 (6). DOI: https://doi.org/10.1007/s11621-009-0085-7

[63] Rauschnabel, P.A., Rossmann, A. and tom Dieck, C. M. 2017. An adoption framework for mobile augmented reality games: the case of pokémon go. *Computers in Human Behavior* 76. DOI:https://doi.org/10.1016/j.chb.2017.07.030

[64] Riek, L. D., Rabinowitch, T.-C., Chakrabarti, B. and Robinson, P. 2009. How anthropomorphism affects empathy toward robots. *Proceedings of the 4th ACM/IEEE international conference on Human robot interaction (HRI '09). Association for Computing Machinery*, New York, USA. DOI:https://doi.org/10.1145/1514095.1514158

[65] Rodriguez-Lizundia, E., *et al.* 2015. A bellboy robot: study of the effects of robot behaviour on user engagement and comfort. *International Journal of Human-Computer Studies* 82, DOI:https://doi.org/10.1016/j.ijhcs.2015.06.001

[66] Rosenthal-von der Pütten, Astrid M., Krämer, N. and Herrmann, J. 2018. The effects of humanlike and robot-specific affective nonverbal behavior on perception, emotion, and behavior. *International Journal of Social Robotics* 10. DOI: https://doi.org/10.1007/s12369-018-0466-7

[67] Samala, N., Katkam, B. S., Bellamkonda, and Rodriguez, R.V. 2020. Impact of AI and robotics in the tourism sector: a critical insight. *Journal of Tourism Futures*, Vol. ahead-of-print, No. ahead-of-print., DOI:https://doi.org/10.1108/JTF-07-2019-0065

[68] Samarrai, F. 2020. Mechanical engineers develop coronavirus decontamination robot. UVAToday. Available at. https://news.virginia.edu/content/mechanical-engineers-develop-coronavirus-decontamination-robot

[69] Sanders, L., and Stappers, P. 2013. *Convivial toolbox: Generative research for the front end of design.* BIS Publishers, Amsterdam.

[70] Schwab, K. 2017. *The Fourth Industrial Revolution*, Crown Publishing Group.

[71] Silverstein, E. 2020. Robot bartender at the bionic bar on royal Caribbean cruises. Available at. https://www.cruisecritic.co.uk/articles.cfm?ID=2454

[72] Sodar. 2020. Sodar: Google's new AR social distancing tool. Available at. https://www.bbc.co.uk/newsround/52888355

[73] Stamenov, S. 2018. 5 Benefits of Check-In/Out Hotel Kiosks. Available at. https://www.clock-software.com/blog/benefits-hotel-kiosks.html

[74] Takayama, L., and Pantofaru, C. 2009. Influences on proxemic behaviors in human-robot interaction. *EEE/RSJ International Conference on Intelligent Robots and Systems*, St. Louis, MO, 5495-5502. DOI:https://doi.org/10.1109/IROS.2009.5354145

[75] Tasci, Asli D.A., and Semrad, K. J. 2016. Developing a scale of hospitableness: A tale of two worlds. *International Journal of Hospitality Management* 53. DOI: https://doi.org/10.1016/j.ijhm.2015.11.006

[76] Thompson, G. 1999. *Improving maintainability and reliability through design*, Professional Engineering Publishing.

[77] tom Dieck, C. M., Jung, T. and Dai-In Han. 2016a. Mapping requirements for the wearable smart glasses augmented reality museum application. *Journal of Hospitality and Tourism Technology* 7(3). DOI:https://doi.org/10.1108/JHTT-09-2015-0036

[78] tom Dieck, C. M., Jung, T. and tom Dieck, D. 2016b. Enhancing art gallery visitors' learning experience using wearable augmented reality: generic learning outcomes perspective. *Current Issues in Tourism* 21(17). DOi:https://doi.org/10.1080/13683500.2016.1224818

[79] Tussyadiah, Iis. P. and Park, S. 2018. Consumer evaluation of hotel service robots. In Stangl, B. and Pesonen, J. (Eds.). *Information and Communication Technologies in Tourism 2018*, DOI:https://doi.org/10.1007/978-3-319-72923-7_24

[80] Tuunanen, T., *et al.* 2019. From digitalization to cybernization: Delivering value with cybernized services. *Scandinavian Journal of Information Systems* 31(2). Available at. http://iris.cs.aau.dk/tl_files/volumes/volume31/431-2Tuunanenetal(IRIS).pdf

[81] Van der Veen, S. 2020. Diagnosis and Treatment Protocol for Novel Coronavirus Pneumonia (Trial Version 7). *Infectious Microbes & Diseases,* 2(2). DOI: https://doi.org/10.1097/IM9.0000000000000022

[82] Van Doorn, J. *et al.* 2017. Domo arigato Mr. Roboto: Emergence of automated social presence in organizational frontlines and customers' service experiences. *Journal of Service Research* 20(1). DOI:https://doi.org/10.1177/1094670516679272

[83] Vargo, S. L., and Akaka, M. A. 2009. Service-dominant logic as a foundation for service science: *Clarifications. Service Science* 1(1). DOI: https://doi.org/10.1287/serv.1.1.32

[84] Wirtz, J. *et al.* 2018. Brave new world: service robots in the frontline. *Journal of Service Management* 29, no. 5. DOI: https://doi.org/10.1108/JOSM-04-2018-0119

[85] Yaoyuneyong, G., Foster, J., Johnson, E. and Johnson, D. 2016. Augmented reality marketing: consumer preferences and attitudes toward hypermedia print ads. *Journal of Interactive Advertising* 16(1). DOI:https://doi.org/10.1080/15252019.2015.1125316

[86] Yu, Chung-E., and Boyol Ngan, H. F. 2019. The power of head tilts: gender and cultural differences of perceived human vs human-like robot smile in service. *Tourism Review* 74(3). DOI:https://doi.org/10.1108/TR-07-2018-0097

[87] Yung, E. and Chan, A. 2002. Business traveler satisfaction with hotel service encounters. *Journal of Travel & Tourism Marketing* 11(4). DOI: https://doi.org/10.1300/J073v11n04_03

[88] Zhang, Y. and Shanshan, Qi. 2019. User experience study: The service expectation of hotel guests to the utilization of al-based service robot in full-service hotels. In: Nah F.H., Siau K. (Eds.) *HCI in Business, Government and Organizations. eCommerce and Consumer Behavior. HCII 2019. Lecture Notes in Computer Science* 11588, Springer Cham. DOI: https://doi.org/10.1007/978-3-030-22335-9_24

[89] Activetek. 2020. How it works. ActivPure RCI Technology. Available at: https://activtekhealthsolutions.com/how-it-works/

[90] Co-creation. 2009. Co-creation: New pathways to value. An overview. London: Promise Corporation. Available at: http://www.promisecorp.com/documents/COCREATION_REPORT.pdf

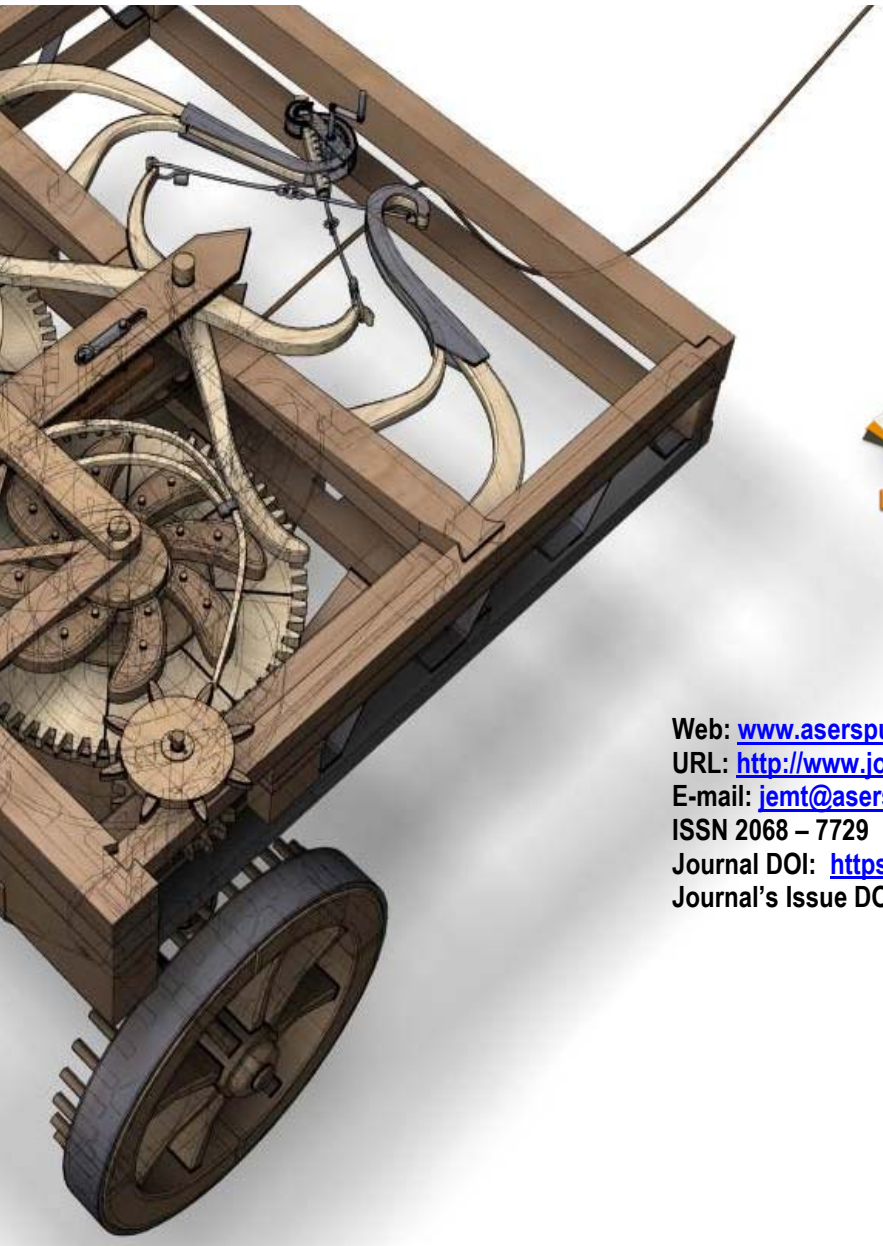
[91] Coronavirus. 2020. *Coronavirus disease (COVID-19), Situation Report – 171*, 9 July 2020, WHO. Available at: https://www.who.int

[92] Ekahau. 2020. Wi-Fi in Hospitality White Paper. Available at: https://wifi.ekahau.com/wifi-hospitality

[93] Operational. 2020. Operational considerations for COVID-19 management in the accommodation sector: interim guidance, 30 April 2020. World Health Organization. Available at. https://apps.who.int/iris/handle/10665/331937

[94] SOTI. 2018. The connected retailer: survey finds consumers prefer self-service technology over traditional interactions with retail sales associates. Available at. https://www.globenewswire.com

ASERS



ASERS Publishing

Web: www.aserspublishing.eu
URL: http://www.journals.aserspublishing.eu/jemt
E-mail: jemt@aserspublishing.eu
ISSN 2068 – 7729
Journal DOI: https://doi.org/10.14505/jemt
Journal's Issue DOI: https://doi.org/10.14505/jemt.v12.1(49).00