

Applications of disruptive digital technologies in hotel industry: A systematic review

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ABSTRACT

This study aims to review and synthesise the contributions of disruptive digital technologies to hotel performance. A sample of 3,914 articles was extracted from the Web of Science and Scopus databases. After screening by two content assessors, a total of 79 articles related to the applications and adverse impacts of digital technologies in the hotel industry were identified and reviewed. The study synthesised the literature on the contributions of various technologies to six hotel performance dimensions: financial, competitiveness, quality of service, resource utilisation, flexibility, and innovation. The directions for future studies were suggested based on the identified gaps in existing studies. The study contributes to the literature by synthesising and giving structure to what we know about the applications of disruptive digital technologies in the hotel sector and suggests future research directions.

1. Introduction

The digital revolution has dramatically changed the operation and management of hotels, and digital technologies have been recognised as the primary sources of efficiency and competitive advantage in the hotel sector (Shin et al., 2019). Digital technologies have influenced hotels' operation and performance, which are traditionally recognised as a labour-intensive industry (Ahmad and Scott, 2019). Digital transformation refers to "a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies" (Vial, 2019). Digital technologies, such as self-service technologies, robots, blockchain, big data analytics, mobile apps, social media, and information systems, can transform how hotels manage their operations and value chains (Anser et al., 2020; Choi et al., 2020; Mingotto

et al., 2020). Hotels can use these technologies to manage service, order process, demand, capacity and resource, the customer relationship, and the supplier relationship and consequently achieve a better performance in terms of financial performance, competitiveness, quality of service, resource utilisation, flexibility, and innovation (Cho et al., 2012; Ivanov et al., 2020; Lenuwat and Boon-itt, 2021).

To adopt appropriate technologies, it is crucial that hotel managers know how various digital technologies may influence the performance of hotels. Accordingly, prior studies have investigated the contributions of a wide range of digital technologies, such as big data analytics (Antonio et al., 2019), social media (Gupta, 2019), self-service technologies and robots (Liu and Hung, 2020), virtual reality (Leung et al., 2020), front desk technologies (Shin et al., 2019), and mobile apps (Lee, 2018) to hotel performance. Although the applications of digital technologies in the hotel sector have been elaborated on in various

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theoretical and empirical studies (Ivanov et al., 2020; Yadegaridehkordi et al., 2020), there is a lack of any review article that offers a comprehensive overview of the applications of digital technologies in the hotel industry. This study aims to address this gap by systematically reviewing the articles on applications of digital technologies in the hotel industry.

Digital technologies can be classified into enabling digital technologies and disruptive digital technologies. Enabling technologies are the basic technologies such as the internet and websites that facilitate the adoption of other technologies (Mendez-Alva et al., 2021). Disruptive digital technologies refer to "the advanced technologies which give rise to a new market or a new avenue of business or research" (Munawar et al., 2022, p. 2). This study focuses on disruptive digital technologies. By reviewing the studies published on digital technologies in the hotel sector after 2011 (the year that the Industry 4.0 term originated), we identified social media, mobile apps, big data and artificial intelligence, self-service technologies and robots, virtual reality, e-commerce and social commerce, information systems, smart systems, and front desk technologies as the disruptive digital technologies and their applications in the hotel sector as having attracted the attention of scholars. This systematic review article aims to address the following objectives:

- to explore the contributions of disruptive digital technologies to hotel performance dimensions
- to synthesise what is known and give directions for future studies

By synthesising the literature on the contributions of disruptive digital technologies in the hotel industry, this study contributes to the theory in two aspects. Firstly, the literature regarding the applications of disruptive digital technologies in the hotel industry is structured around six service performance dimensions (Table 2) proposed by Cho et al. (2012). To the best of our knowledge, this study is the first attempt to review and provide a comprehensive literature review on the contributions of disruptive digital technologies to the hotel industry. Secondly, the study identifies the gaps and suggests directions for future research. Understanding the applications of adopting disruptive digital technologies can help hotel managers and owners make decisions with greater awareness and invest in suitable technologies. In terms of implications for teaching, the study presents a structured and comprehensive summary of the applications of digital technologies in the hotel industry, which provides an updated and valuable starting point for students in the fields of tourism and hospitality.

2. Systematic review protocol

The articles published between 2010 and 2020 were reviewed using a systematic review approach to accomplish the research objectives of this study. The timescale allowed us to focus on emerging digital technologies that correspond with the digital industrial transformation known as Industry 4.0, providing valuable and recent insights for scholars and practitioners in the hotel industry. Several emerging digital technologies have been used in the hotel sector to improve the performance of hotels. By reviewing the studies on the applications of digital technologies in the hotel industry, we identified social media, mobile apps, big data analytics and artificial intelligence, self-service technologies and robots, virtual reality, e-commerce and social commerce, information systems, smart systems, and front desk technologies as the common emerging digital technologies in the hotel sector. The definitions of these technologies are provided in Table 1. The details of article sources, search terms, and inclusion and exclusion criteria are provided in the following sub-sections.

2.1. Database and search terms

The predefined search terms were used to extract the articles from Web of Science (WoS) and Scopus databases. These two databases were selected as the leading hospitality and tourism journals are indexed by

Table 1

Description of the emerging digital technologies in the hotel sector.

Digital Technology	Description
Social Media	Social media tools are defined as a "set of online tools that supports social interaction between users, facilitating the creation and sharing of knowledge, and transforming monologue (company to customer) into dialog" ((Hansen et al., 2010)p. 12). Social media includes a wide range of Web 2.0 tools, such as forums, blogs, chat rooms, social networking sites (e. g., Twitter and Facebook), and discussion boards (Leung and Baloglu, 2015).
Mobile Apps	Mobile apps refer to software systems designed for smartphones, tablets, and other digital platforms (Jeong et al., 2016). Hotel mobile apps include various functions, such as making a hotel booking, getting basic information, acting as a room key, and requesting service (Lee, 2018).
Big Data Analytics and Artificial Intelligence	Big data refers to "the massive amounts of data, including both unstructured and structured, which is accessible in real-time" (Maroufkhani et al., 2022, p. 3). Big data analytics refers to "using advanced analytics techniques to analyse the large data set of firms" (Maroufkhani et al., 2022, p. 3). Artificial intelligence is an analytic technique that simulates human intelligence in machines (Noriega, 2020). Hotels use big data analytics and artificial intelligence to extract insights from big data (Chen et al., 2019). Kucukusta et al., (2014, p. 55) defined self-service technology as "any technological interface that allows customers to be served without the direct involvement of service employees." Hotels use various self-service technologies, such as robots, self-check-in/check-out systems, and automated service ordering systems. A robot is a type of self-service technology that interacts with hotel guests and delivers human-like services (Xu et al., 2020).
Self Service Technologies and Robots	Virtual reality refers to "an interactive computer-generated 3D environment completely immersing a user inside it" (Leung et al., 2020, p. 1). Virtual reality enables hotel guests to have near-real-life experience beforehand.
Virtual Reality	E-commerce refers to conducting transactions using the internet platform alongside the value chain (Theodosiou and Katsikea, 2012). Social commerce is an extension of e-commerce integrated with Web 2.0 and social media (Halawani et al., 2020a).
E-Commerce and Social Commerce	Information systems refer to computer-based systems that facilitate capturing, storing, managing, and transmitting information (Chevers and Spencer, 2017). Information systems include enterprise resource planning (ERP), supply chain management (SCM), customer relationship management (CRM), and knowledge management system (KMS).
Information Systems	Smartness refers to "the integration of smart features that automate and simplify daily business activities" (Leung, 2019, p. 52).
Smart Systems	Front desk technologies provide information that allows employees to deliver timely, effective, and customized services (Shin et al., 2019).
Front Desk Technologies	

WoS and Scopus (Mariani and Baggio, 2020; Okumus et al., 2018). The relevant terms related to digital technology and hotels were found by reviewing the title, abstract, and keywords of the articles published on digital transformation in the hotel industry. Accordingly, the words related to digital technologies ("Information Syst*" OR "techno*" OR "big data" OR "data analy*" OR "Social Media" OR "Web 2.0" OR "Internet of Things" OR "Blockchain" OR "Robot*" OR "Self Service" OR "Mobile" OR "Smart") AND the word "Hotel" were used to search the title, abstract, and keywords of articles in WoS and Scopus. The search was conducted on 08-May-2021.

2.2. Article inclusion and exclusion criteria

The following inclusion and exclusion criteria were applied to select the relevant articles: 1) journal and article, 2) articles should be written in English, 3) articles should be published after 2011, 4) applications and contributions of digital technologies in the hotel industry should be discussed in the article, 5) articles published in Quartile 1 (Q1) and Quartile 2 (Q2) journals, and 5) full-text of articles should be available. The study limited the reviewed articles to Q1 and Q2 journals to ensure quality articles were reviewed (Ditta et al., 2019). The article selection procedure is demonstrated in Fig. 1.

2.3. Search results

Applying the search terms and language (English), year of publication (2011–2020), and document type (article), 1947 and 1884 articles were retrieved from Scopus and WoS, respectively. After removing 1398 duplicates, the 2433 remaining articles were considered for the screening of the title and the abstract. The screening and selection processes were conducted by two authors independently, and 79 articles were selected for further analysis (Fig. 1). Any disagreements between these two authors regarding the inclusion or exclusion of some articles were resolved by consensus after discussion among all the authors.

3. Descriptive analysis

Descriptive results illustrate the trend of previous studies. Fig. 2 demonstrates the distribution of articles based on the publication year. According to this figure, the rise in interest in digital transformation in

the hotel industry has been fast and recent. Most of the studies on applications of digital technologies have been published in the last two years (50.6 %).

To better picture the trend of previous studies, the distribution of articles based on the studied technology is presented in Table 2. Although some information and communication technologies, such as social media (35.4 %), big data analytics (19.0 %), and self-service technologies and robots (16.5 %), have attracted the attention of scholars, some other technologies, such as front desk technologies (1.3 %), smart systems (2.5 %), e-business (3.8 %), and virtual reality (3.8 %) have received less attention. Considering the importance of social media, big data analytics, self-service, and robots in the current competitive business environment, a greater focus on these technologies was expected. Because information systems and e-business are two critical systems that play a crucial role in resource and operation management and decision making, the lack of attention from scholars is surprising. The studies on social media in the hotel industry peaked in 2015. The sudden growth in social media studies can be related to the appearance of new platforms, such as Instagram (released 2010) and WeChat (released 2011). In 2015, there were above 400 million and 690 million active users of Instagram (Statista, 2022a) and WeChat (Statista, 2022b), respectively. The exponential growth of these platforms attracted the attention of practitioners and scholars in the hotel industry to applications of social media. Later, scholars shifted their focus to recent disruptive technologies, such as big data and robots. The studies on big data, artificial intelligence, and robots have increased rapidly in recent years.

The descriptive analysis of the type and size of hotels that have been studied reveals that most of the studies ignored the fact that the

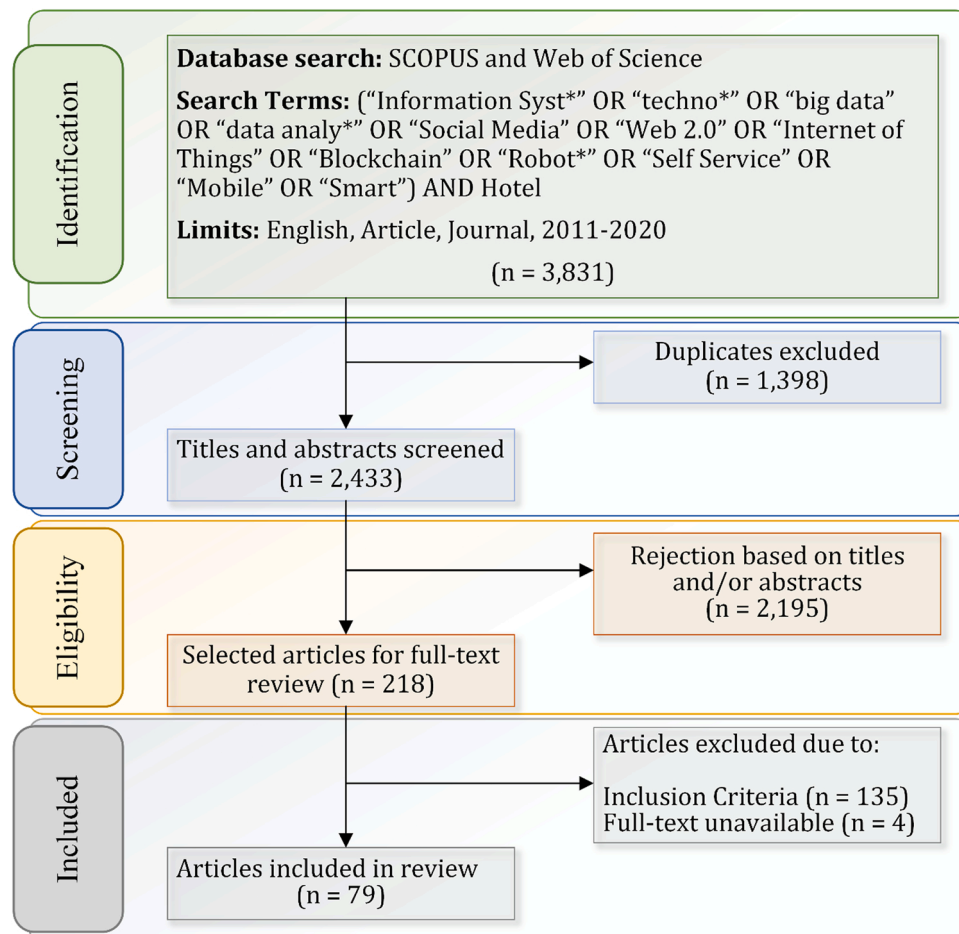


Fig. 1. Flow diagram of the article search and selection process.

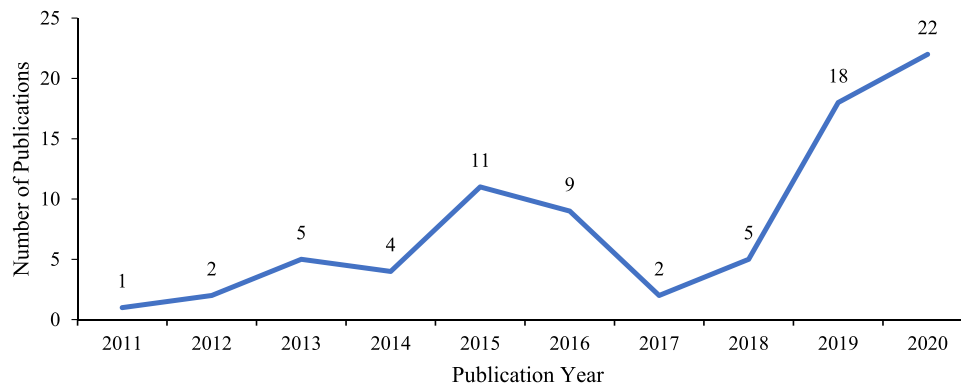


Fig. 2. The number of publications over time.

Table 2

The distribution of technologies studied over the years.

Digital Technologies	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Social Media			4	1	9	2		3	3	6	28
Mobile Apps				1	1	3		1	2		8
Big Data and Artificial Intelligence				1		2		1	5	6	15
Self Service Technologies and Robots				1	1	2	1		1	7	13
Virtual Reality			1							2	3
E-Commerce and Social Commerce		1							1	1	3
Information Systems		1			1		1		1	3	7
Smart Systems	1								1		2
Front Desk Technologies									1		1

customer types, needs, and expectations depend on hotel type and size, and accordingly, the applications of digital technologies among luxury, budget, small, and large hotels can differ. For instance, [Chan and Tung \(2019\)](#) and [Choi et al. \(2020\)](#) argued that although robots can have a positive influence on the brand experience of guests in small and budget hotels, they may negatively influence the experience of luxury hotels as guests pay expensive room rates and expect human staff interaction and customer service. Most of the studies have been quantitative (73.4 %), and there is a significant lack of qualitative (21.5 %) and mixed-methods studies (5.0 %). Furthermore, very few studies have collected data from employees (7.6 %), with data collected mainly from managers (40.5 %) or customers (32.9 %), or have used secondary data (24.1 %) ([Table 3](#)).

4. Thematic analysis

4.1. Hotel performance dimensions

Following [Cho et al. \(2012\)](#), the hotel performance dimensions were categorised as financial performance, competitiveness, quality of service, resource utilisation, flexibility, and innovation. The performance

Table 3

Research approach.

	Frequency
Hotel Type	
Luxury Hotel	18
Budget Hotel	8
No Specific Hotel Type	53
Hotel Size	
Small or Medium	5
Large	5
No Specific Hotel Size	69
Type of Study	
Qualitative	17
Quantitative	58
Mixed-Method	4
Source of Data	
Primary-Customers	26
Primary-Managers	32
Primary-Employees	6
Secondary Data	19

domains developed by [Cho et al. \(2012\)](#) were selected because they proposed performance dimensions for the hotel industry. Structuring the literature based on the performance dimensions enables hotel managers to identify suitable technologies for achieving their performance goals. The dimensions, issues, and measures of performance are provided in [Table 4](#).

The following sections introduce the technologies relevant to each performance dimension and their contributions to the hotel performance discussed. The first paragraph of each section defines the definition of a performance dimension and introduces the relevant digital technologies. Later, we discuss what the literature reveals about the contributions of each technology to the performance dimension.

[Table 5](#) presents the distribution of studied technologies according to performance dimensions. The contributions of each digital technology to a particular performance dimension have received more attention. For instance, the contributions of social media, self-service technologies and robots, and information systems to competitiveness, quality of service, and resource utilisation respectively have received more attention compared to other performance dimensions. Although 60.7 % of studies on social media have investigated its contribution to hotel competitiveness, no study has explored its potential contributions to hotel flexibility. The studies on virtual reality have examined the contributions of this technology to resource utilization. The only study on the applications of front desk technologies investigated their benefits to the innovation capability of hotels. Fluctuation in the number of studies on the contributions of technology to a specific performance dimension can be a reflection of its dominant benefit or due to a lack of scholars' attention. For instance, social media is a crucial source of competitive advantages, and the greater attention paid to its contributions to competitiveness compared to other performance dimensions is reasonable. However, the lack of attention to some contributions of technologies is surprising. For instance, information systems can enhance hotel flexibility and require more attention in future studies.

4.1.1. Financial performance

Financial performance refers to hotel profitability, which can be

Table 4
Six service performance dimensions, issues, and type of measure.

Dimensions	Issues	Types of Measure
Financial	Asset turn over Control of labour and capital costs Profit per serve	Profitability
		Liquidity
		Capital structure
Competitiveness	Ability to win new customers Customer loyalty	Market ratios
		Relative market share and position
		Sales growth
Quality of Service	Relationship between customer and organisation Setting of clear customer expectations Measurement of customer satisfaction	Measures of the customer base
		Overall service indicators:
		Reliability
		Responsiveness
		Aesthetics/appearance
		Cleanliness/tidiness
		Comfort
		Friendliness
		Communication
		Courtesy
Resource Utilisation	Utilisation of facilities, equipment, and staff	Competence
		Access
		Availability
Flexibility	Building volume, delivery speed, and specification flexibility into service design in the long term	Security
		Productivity
		Efficiency
Innovation	Use of level capacity strategies Employment of part-time and floating staff Use of price and promotion strategies to smooth demand Measurement of the success of the innovation process and the innovation itself	Specification flexibility
		Volume flexibility
		Delivery speed flexibility
		Performance of the innovation process
		Performance of individual innovations

Source: Cho et al. (2012)

measured by profitability, liquidity, capital structure, and market ratios (Cho et al., 2012). Enhancing and maintaining financial performance is crucial for the survival of hotels. The contributions of social commerce, smart systems, e-commerce, big data, artificial intelligence, social media, mobile apps, self-service technologies, websites, and robots to the financial performance of hotels have been discussed in the literature. Table 6 presents the summary of the contributions of digital technologies to hotel financial performance.

Social media positively affects the financial performance of hotels by influencing customers' decisions, enhancing brand reputation, reducing the costs of marketing activities, enabling hotels to understand the needs and wants of customers, and enhancing hotels' innovation capability (Garrido-Moreno et al., 2020; Kim and Chae, 2018; Palacios-Marqués et al., 2015). Kim and Chae (2018) analysed the Twitter activities and Twitter user profiles of hotels in the USA and found that hotels' use of social media positively influences their financial performance through

positive electronic word of mouth (e-WOM). They argued that e-WOM affects customers' decisions on room purchase and hotel brand reputation. Garrido-Moreno et al. (2020) collected data from hotels in Spain and found that social media use has a positive influence on hotel performance by enhancing customer engagement capabilities and social customer relationship management (CRM). In another study on four- and five-star hotels in Spain, Palacios-Marqués et al. (2015) found that the use of social media leads to higher performance and enhanced innovation capacity. Furthermore, hotels can reduce the costs of marketing activities and communicate directly with customers by using social media platforms which, in turn, may lead to overall cost reduction, higher brand image, and sales growth (Garrido-Moreno et al., 2020). Social media use also enhances the hotels' innovation capability by enabling them to understand customers' wants and needs (Palacios-Marqués et al., 2015). Innovation is the primary source of value and competitive advantage.

Smart systems can be used to cut energy consumption. Leung (2019) interviewed stakeholders of hotels in Taiwan to identify the benefits of implementing smart technologies. The interviewees highlighted the reduction in energy consumption as one of the benefits of smart systems. Smart lights and smart air conditioners can automatically adjust lighting and air-conditioning, which, in turn, reduces energy consumption (Leung, 2019). Jung et al. (2014) and Makki et al. (2016) found in-room and hotel reservation mobile apps positively influence the financial performance of hotels. A hotel's profitability is highly dependent on its occupancy rate. Last-minute hotel reservation apps provide a platform offering real-time information and advertising empty rooms, which, in turn, enhances the hotel's occupancy rate (Makki et al., 2016).

The contributions of self-service technologies and robots to hotel financial performance have been discussed frequently in the literature (Ivanov et al., 2020; Liu and Hung, 2020; Xu et al., 2020). Hotels can reduce their operational costs by using robots for routine tasks and, consequently, reducing the number of low-skilled workers (Xu et al., 2020). In addition, robots can enhance financial performance through reduced operational costs and additional revenue generation (Ivanov et al., 2020). Operational costs can be indirectly slashed by enabling the employees to perform more efficiently and effectively. Furthermore, robots can generate additional revenue by delivering additional services, enabling hotels to charge higher prices for robotic experiences, and freeing up employees so they can focus on added value activities (Ivanov et al., 2020). Self-service technologies also can replace humans and reduce labour costs. However, the profit of investing in self-service technologies depends on situational factors, such as labour costs, hotel age, and hotel infrastructure (Liu and Hung, 2020). In countries with a high labour income, replacing human services with self-service technologies is more profitable in comparison to the countries with a low labour income. Furthermore, the costs of investing in self-service technologies for hotels under construction are lower than for built hotels. Ivanov et al. (2020) argued that although robots and self-service technologies may reduce the operational costs of hotels, they should be used with care due to the importance of customised service, interaction, and emotion in the hotel industry.

Big data analytics and artificial intelligence influence hotel financial

Table 5
The distribution of studied technologies according to performance dimensions.

Digital Technologies	Financial	Competitiveness	Quality of Service	Resource Utilisation	Flexibility	Innovation
Social Media	5	17	5	3	–	2
Mobile Apps	3	3	3	1	–	–
Big Data and Artificial Intelligence	6	3	5	2	2	–
Self Service Technologies and Robots	3	5	8	5	2	–
Virtual Reality	–	–	2	–	–	–
E-Commerce and Social Commerce	3	3	1	2	–	–
Information Systems	1	2	2	4	–	–
Smart Systems	1	1	2	1	–	–
Front Desk Technologies	–	–	–	–	–	1

Table 6
Contributions of digital technologies to hotel financial performance.

Digital Technologies	Contributions	Sources
Social Media	• Influence on customers' decision on room purchase through positive e-WOM • Enhancing brand reputation • Reducing costs of marketing activities • Enabling hotels to understand the needs and wants of customers • Enhancing hotels' innovation capability	Kim and Chae (2018), Garrido-Moreno et al. (2020), Palacios-Marqués et al. (2015), Özgen and Kozak (2015), Halawani et al. (2020b)
Smart Systems	• Cutting energy consumption	Leung (2019)
Mobile Apps	• Providing real-time information • Enhancing the occupancy rates of hotels	Makki et al. (2016), Jung et al. (2014), Law et al. (2015)
Self-Service Technologies and Robots	• Reducing the number of low skill workers • Enhancing the efficiency and effectiveness of the operation • Work longer than humans • Perform human work more correctly • Freeing time of employees • Enabling hotels to charge higher prices	Liu and Hung (2020), Ivanov et al. (2020), Xu et al. (2020)
Big Data Analytics and Artificial Intelligence	• Reducing costs • Enhancing innovation capabilities • Accurate prediction of hotel occupancy rate • Minimise overbooking level • Optimise pricing • Efficient capacity control • Managing auctions • Enhancing decision quality and speed	Yadegaridehkordi et al. (2020), Saito et al. (2019), Egan and Haynes (2018), Yang et al. (2014), Alsetoohy and Ayoun (2018), Antonio et al. (2019)
E-commerce and Social Commerce	• Reducing transaction costs • Increasing room revenue through ease of booking	Hua et al. (2019), Theodosiou and Katsikea (2012), Halawani et al. (2020a)
Information Systems	• Enhance brand visibility • Enhancing productivity • Reducing operational costs • Enhancing decision quality	Ahmad and Scott (2019)

performance in various ways. The rate of last-minute cancellations has increased in the hotel industry due to the convenience of the booking system (Saito et al., 2019). Overbooking is a strategy that hotels practise to minimise the influence of last-minute cancellations on their profits. Big data analytics techniques can analyse online hotel booking data to calculate the overbooking level and determine the room charge that maximises a hotel's financial performance (Saito et al., 2019). Egan and Haynes (2018) and Antonio et al. (2019) highlighted the importance of using big data analysis and machine-learning techniques in dealing with revenue management, auctions, overbooking, capacity control, and pricing issues. Accurate prediction of the hotel occupancy rate is crucial for hotel revenue management. Web traffic is an essential source of data, enabling hotels to refine pricing strategies and manage resources

efficiently (Yang et al., 2014). Furthermore, Egan and Haynes (2018) collected data from hotel managers worldwide through LinkedIn and found that big data provides insights and real-time information for hotel managers, leading to better and more agile decision making (Egan and Haynes, 2018).

E-commerce and social commerce have grown fast recently in the hotel industry. Investment in e-commerce initiatives can enhance room revenue by facilitating booking and reducing costs through economies of scale and operation efficiencies (Hua et al., 2019; Tseng et al., 2021). According to Halawani et al. (2020a), who studied hotels in Lebanon, investing in social commerce positively influences brand visibility, the number of customers, and sales transactions, which, in turn, enhances financial performance. In addition, using information systems can enhance hotels' productivity and efficiency and reduce costs. For instance, the human resource system can reduce the number of staff in the human resource department and cut labour costs. In a study in Malaysia, Ahmad and Scott (2019) found that besides cost reduction, information systems can positively influence the financial performance of hotels by providing information for managers to make better decisions and by providing staff with time to focus on strategic functions and be proactive in planning.

4.1.2. Competitiveness

Competitiveness refers to the hotel's ability to compete profitably and effectively in the marketplace (Vanhove, 2002). Attracting new customers and retaining the current ones are the main aims of gaining a competitive advantage. Growing customer expectations and competition in the hotel industry have forced hotels to seek to create and sustain their competitive advantages (Chevers and Spencer, 2017). Digital technologies can serve as sustainable sources of competitive advantage. The contributions of social media, mobile apps, self-service technologies and robots, big data analytics and artificial intelligence, e-commerce and social commerce, smart systems, information systems, and virtual reality to hotel competitiveness have been discussed in the literature. These contributions are listed in Table 7.

Social media is a crucial source of competitive advantage in the hotel industry and enables hotels to win new customers and make the current customers loyal (Tanford et al., 2020). Tanford et al. (2020) found that a positively framed CRM advertisement on social media positively influences hotel image in the USA, which in turn leads to higher intention to book. Social media creates competitive advantages in various ways (Table 7). Social media platforms allow hotels to communicate with customers directly and spread information on products, services, promotions, and upcoming events (Phelan et al., 2013; Sánchez-Casado et al., 2019). In a study on US residents, Raab et al. (2016) found that the positive e-WOM significantly influences the customer's decision-making process and hotel choice (Raab et al., 2016). Current hotel customers can share their experiences with hotel products and services through social media platforms and create e-WOM. Positive feedback from customers also has a positive influence on hotel reputation and brand (Sánchez-Casado et al., 2019; Tatar and Eren-Erdogmus, 2016). Tatar and Eren-Erdogmus (2016) found that social media marketing positively affects trust and loyalty toward Turkish hotels. Furthermore, Phelan et al. (2013) found that favourable conversations and comments between customers and hotels lead to customers' loyalty towards US four- and five-star hotels. Hotels can build a relationship with customers by reading their comments and feedback and responding to their complaints and questions. Both hotel-created communications and customer-created information help attract new customers and retain the current ones (Raab et al., 2016). Furthermore, the big data generated by customers can be used as a source of information by hotels to get insights and customise their products, services, and promotions (Sánchez-Casado et al., 2019). Thus, social media platforms are a crucial tool for creating competitive advantages (Garrido-Moreno et al., 2020). Besides social platforms, in a study on luxury hotels in Vietnam, Vo et al. (2020) found that hotel websites significantly influence customers' first impressions of

Table 7
Contributions of digital technologies to hotel competitive advantage.

Digital Technologies	Contributions	Sources
Social Media	- Promoting hotel products and services - Communicating loyalty programs - Advertising promotions and upcoming events - Providing explicit and current information - Understanding the needs and wishes of customers - Responding to customers' questions and complaints - Increasing hotel website traffic - Enhancing hotel visibility - Enhancing brand awareness - Enhancing brand image - Gaining reputation - Relationship marketing - Enhancing customer trust - Improving customer engagement with the brand - Fostering long-term relationships with customers - Influencing customer decision - Cost reduction	Halawani et al. (2020b), Sánchez-Casado et al. (2019), Gupta (2019), Garrido-Moreno et al. (2018), Chevers and Spencer (2017), Puangmaha et al. (2020), Tanford et al. (2020), Garrido-Moreno et al. (2020), Tatar and Eren-Erdogmus (2016), Raab et al. (2016), Su et al. (2015), Özen and Kozak (2015), Aluri et al. (2015), Inversini and Masiero (2014), Phelan et al. (2013), Vo et al. (2020), Moliner-Velázquez et al. (2019)
Mobile Apps	- Enhancing brand trust - Enhancing customer engagement - Increasing customer awareness - Providing a unique and memorable experience - Reducing waiting time - Lowering costs	Lee and Lee (2019), Lee (2018), Law et al. (2015), Jung et al. (2014)
Self-Service Technologies and Robots	- Providing a unique and memorable experience - Reducing waiting time	Wei et al. (2016), Kucukusta et al. (2014), Chen et al. (2015), Ivanov et al. (2020), Morosan and DeFranco (2019)
Big Data Analytics and Artificial Intelligence	- Understanding customer needs and wants - Optimise operation - Enhancing innovation capability	Wang et al. (2020), Chen et al. (2019), Garrigos-Simon et al. (2016)
E-commerce and Social Commerce	- Reducing transaction costs - Convenient booking - Improve operational efficiency	Halawani et al. (2020a), Hua et al. (2019), Theodosiou and Katsikea (2012)
Smart Systems Information Systems	- Enhancing service - Enhancing productivity - Reducing operational costs	Leung (2019), Anser et al. (2020), He et al. (2015)
Virtual Reality	- Creating the experience of visiting - Reducing travel anxiety	Leung et al. (2020)

and engagement with hotels.

Mobile apps are another important digital tool for attracting new customers and keeping the current ones. Lee and Lee (2019) argued that hotel apps positively influence customer engagement and brand trust in the US, which, in turn, leads to customer loyalty. Hotel managers found mobile apps to be a low-cost and effective platform for enhancing customer awareness and reaching potential customers (Law et al., 2015). Furthermore, the hotels can enhance customer experience and reduce operational costs by using mobile apps for unlocking guestroom doors, performing check-in/out, making reservations, and adding loyalty points (Jung et al., 2014).

Robots and self-service technologies create competitive advantages by providing memorable and unique experiences and reducing waiting times (Ivanov et al., 2020; Wei et al., 2017). Kucukusta et al. (2014) found that providing quick and convenient processes and standard services using robots and self-service technologies in a luxury hotel brand in Hong Kong positively influences customer satisfaction and loyalty. Hotels can analyse the big data generated by customers to get insights into customer experiences with hotel products and services, understand customers' needs and wants, and, consequently, enhance the service quality and meet customer expectations (Chen et al., 2019). Besides that, analysing the organisational and operational information enables hotels to optimise their operation and reduce operational costs (Prentice et al., 2020).

E-commerce and social commerce improve operational efficiency by streamlining processes. Furthermore, social commerce reduces the response time to customer requests which, in turn, increases customer loyalty (Hua et al., 2019). Convenient booking and transaction cost reduction are other competitive advantages that hotels can gain by using e-commerce (Hua et al., 2019). According to stakeholders in Taiwanese hotels, smart systems can enhance hotel service quality and provide accurate, convenient, and speedy service, which, in turn, can improve the brand image (Leung, 2019). Leung et al. (2020) assessed the effects of a virtual reality commercial in China and argued that the hotels could use virtual reality to generate competitive advantages by creating the experience of visiting and reducing travel anxiety (Leung et al., 2020).

4.1.3. Quality of service

Quality of service refers "to how well a customer is being served" (Alan, 2001, p. 11). Cho et al. (2012) proposed reliability, responsiveness, aesthetics, cleanliness, comfort, friendliness, communication, courtesy, competence, access, availability, and security as service quality indicators. The contributions of social media, smart systems, mobile apps, self-service technologies and robots, big data analytics and artificial intelligence, e-commerce, information systems, and virtual reality to hotel service quality have been discussed in the literature (Table 8). Among them, social media, robots, and self-service technologies have received the greatest attention.

As mentioned earlier, in a study in Lebanon, Halawani et al. (2020b) found that social media enhances the customer experience by facilitating direct communication between customers and hotels. Customer online comments are now an important part of quality management, and hotels can enhance the quality of services based on posted reviews (Özen and Kozak, 2015). Smart systems, mobile apps, robots, and self-service technologies also enhance the customer experience by providing a convenient process (Leung, 2019; Wei et al., 2017). Mobile apps offer convenience and reduce waiting time in queues by providing online check-in and check-out (Jung et al., 2014); they also offer in-room technology control (lights, TV, thermostats, etc.), ease service reservations, such as spa, restaurant, and room reservations, and provide real-time personal services, such as laundry pick up and housekeeping services, order room amenities, and any other special requests (Gibbs et al., 2015). Moreover, Lei et al. (2019) argued that mobile apps facilitate innovation, service recovery at the individual level, and understanding of customer needs and wants and, consequently, help hotels to avoid repeating mistakes and enhance customers' future stay

Table 8
contributions of digital technologies to hotel quality of service.

Digital Technologies	Contributions
Social Media	- Facilitate communication - Create relationships - Quality management based on posted reviews
Smart Systems	- Proper check-in and check-out - Provide convenience
Mobile Apps	- Anticipate customer needs and preferences - Avoid repeating mistakes - Service recovery at the individual level - Tracking customers' behavioural patterns - Reducing waiting time - Provide convenience - Information delivery - Provide personal service
Self-Service Technologies and Robots	- Offering attractive, funny, and engaging ways of delivering services - Offering standardised service - Provide convenience - Quick service delivery - Easing check-in and check-out
Big Data Analytics and Artificial Intelligence	- Market segmentation - Understanding target customer needs and preferences
E-commerce	- Decreasing response times to customers - Maintaining a database of customer preferences
Information Systems	- Provide data for personalised service - Enabling informed action
Virtual Reality	- Improve the feeling of familiarity and security - Form customer opinion about service quality

experiences.

In addition to mobile apps, robots and self-service technologies offer convenience by providing quick processes, especially for customers who prefer self-empowerment (Chen et al., 2015). Robots and self-service technologies can enhance the customer experience by providing attractive and convenient ways for service delivery, offering standardised services, and speeding up service delivery (Choi et al., 2020; Liu and Hung, 2020; Mingotto et al., 2020). Liu and Hung (2020) also found that customers prefer standardised services and argued that in the services delivered by humans, the service quality is inconsistent and depends on service employee mood and skills.

Hotels can use big data analytics to understand the needs and preferences of the target market and provide appropriate services and products (Ahani et al., 2019; Chen et al., 2019), while the use of machine-learning techniques assists in market segmentation and in understanding the needs of the target market (Ahani et al., 2019). Market segmentation enables hotels to organise marketing activities based on target customer preferences. E-commerce can also enhance service quality by decreasing customer response time and maintaining a database of customer preferences (Hua et al., 2019). According to Bonaretti et al. (2020), information systems, such as customer service systems, enable hotels to take informed action and provide personalised services to customers. Virtual reality is another technology that can help hotels

enhance service quality by shaping customer opinion about the service atmosphere and enhancing their feelings of security and familiarity (Ahn and Lee, 2013; Surovaya et al., 2020). According to Surovaya et al. (2020), virtual reality makes it easier for customers to know a hotel's service quality without actually experiencing it. Customers can evaluate the cleanliness, comfort, and aesthetic of hotels through virtual reality. Furthermore, virtual reality reduces customers' anxiety by making them familiar with the hotel environment.

4.1.4. Resource utilisation

Resource utilisation is "a performance criterion which evaluates how efficiently resources are utilised in the delivery of services" (Cho et al., 2012, p. 807). Hotels can enhance their profitability by delivering the same level of service with fewer resources. The contributions of social media, smart systems, mobile apps, self-service technologies and robots, big data analytics and artificial intelligence, e-commerce and social commerce, and information systems to hotel resource utilisation have been discussed in the literature. A summary of the contributions of these technologies to hotel resource utilisation is provided in Table 9.

According to Yang (2020), social media facilitates collaboration, communication, and information sharing among staff, which, in turn, enhances their productivity. Investment in collaborative information and communication systems facilitates knowledge management as a significant driver of human resource productivity. Besides collaborative systems, smart systems enhance hotel employees' productivity and

Table 9
Contributions of digital technologies to resource utilisation.

Digital Technologies	Contributions	Sources
Social Media	Facilitate communication and collaboration among staff	Yang (2020), Gibbs et al. (2015), Chevers and Spencer (2017)
Smart Systems	- Facilitate information sharing - Automating processes - Access to customer records	Leung (2019)
Mobile Apps	- Reduce human errors - Enabling employees to perform their work at any places - Building interactive and personalised relationships with customers	Jeong et al. (2016)
Self-Service Technologies and Robots	- Simplified service delivery - Automating repetitive tasks - Performing a variety of human tasks - Facilitate decision-making process - Increase service capacity - Work 24/7	Liu and Hung (2020), Choi et al. (2020), Melián-González and Bulchand-Gidumal (2020), Ivanov et al. (2020), Xu et al. (2020)
Big Data Analytics and Artificial Intelligence	- Reducing operating waste - Optimise operation	Kahn and Liu (2016), Prentice et al. (2020)
E-commerce and Social Commerce	- Reducing management activities - Streamlining processes - Economic of scales - Operation efficiencies - Facilitating proper resource allocations	Theodosiou and Katsikea (2012), Hua et al. (2019)
Information Systems	- Reduce paper works - Data-driven decision making - Automating operations - Operation management	Kaya and Azaltun (2012), Ahmad and Scott (2019), Chevers and Spencer (2017), Kaya and Azaltun (2012)

operation efficiency by automating processes, facilitating access to customer records, and reducing errors (Leung, 2019). Mobile devices are another disruptive digital technology that positively influences the productivity of hotel staff. Jeong et al. (2016) empirically tested the impacts of using mobile devices on the staff of luxury hotels in the US and found a positive association between the use of mobile devices and the performance of hotel staff. They argued that mobile devices enable hotel staff to perform work-related tasks at any location efficiently.

The contributions of self-service technologies and robots to efficient resource utilisation have frequently been discussed in the literature. Robots and self-service technologies improve staff productivity and hotel operations by automating repetitive tasks, reducing service delivery steps, and assisting human workers (Choi et al., 2020; Liu and Hung, 2020). Robots do not replace the staff, but they assist the staff to be more productive, efficient, and effective (Ivanov et al., 2020). Robots enhance the service capacity of hotels with the same number of staff due to their superiority over humans in doing tasks quickly, precisely, and efficiently (Ivanov et al., 2020). Hotels can analyse operational and organisational information using big data analytics to optimise the process and reduce wastage (Kahn and Liu, 2016). For instance, hotels can analyse and visualise energy consumptions using big data analytic techniques and optimise operations and energy consumption accordingly.

Using e-commerce also plays a critical role in optimising resource utilisation. E-commerce makes booking easy and enables hotels to share with the public information about discounts, which, in turn, leads to economies of scale (Hua et al., 2019). Attracting more customers and better predicting demand using e-commerce leads to operational efficiency and proper resource allocation. Using information management systems, such as human resource management or property management systems, can enhance efficiency and productivity (Ahmad and Scott, 2019); these systems reduce workforce size by automating the processes. Furthermore, information systems enhance productivity by enabling data-driven decision-making, reducing the amount of paperwork, facilitating operation management, and enabling hotel staff to allocate more time for delivering a better service (Ahmad and Scott, 2019). In a study on Jamaican hotels, Chevers and Spencer (2017) found a positive association between using ICT applications in the “front office” and productivity.

4.1.5. Flexibility

Service flexibility refers to “the ability of the service process to adapt to change” (Cho et al., 2012, p. 806). Service flexibility can be categorised into volume flexibility, delivery speed flexibility, and specification flexibility. Volume flexibility illustrates the hotel’s ability to respond to demand fluctuation. Delivery speed flexibility refers to the adaptability of the hotel process to provide timely responses to customer needs, while specification flexibility illustrates the ability of the hotel process to satisfy personal customer needs (Cho et al., 2012). The contributions of self-service technologies and big data analytics have been discussed in the literature (Table 10).

Self-service technologies and robots improve hotels’ volume flexibility, delivery speed flexibility, and specification flexibility by providing a 24/7 service, which speeds up the check-in and check-out process and provides staff with more time to provide a personalised service to customers (Ivanov et al., 2020; Liu and Hung, 2020). Big data analytics and artificial intelligence enable hotels to be agile in responding to demand fluctuation and in addressing and satisfying customer needs by providing accurate and real-time information about future demand and customer needs and wants (Egan and Haynes, 2018; Makki et al., 2016; Yadegaridehkordi et al., 2020).

4.1.6. Innovation

Innovation refers to “any good, service or idea that is perceived by someone as new” (Hassanien and Baum, 2002, p. 7). The contributions of social media and front desk technologies to the innovation capacity of

Table 10

Contributions of digital technologies to flexibility and innovation.

Digital Technologies	Contributions
Flexibility	
Self-Service Technologies and Robots	• Work 24/7 • Speed up service delivery • Freeing time of employees
Big Data Analytics and Artificial Intelligence	• Provide real-time information • Provide accurate information
Innovation	
Social Media	• Facilitating communication • Facilitating collaboration • Facilitating knowledge management
Front Desk Technologies	• Access customer information

hotels have been discussed in the literature. The summary of these contributions is listed in Table 10.

As mentioned earlier, Palacios-Marqués et al. (2015) found that social media significantly influences the innovation capacity of four- and five-star hotels in Spain and can eliminate the innovation obstacles. Enterprise 2.0 tools facilitate collaboration and communication as two important pillars of innovation. Enterprise 2.0 tools enable hotel staff to create and manage knowledge and share their ideas, which, in turn, leads to innovation (Zeng et al., 2015). Knowledge management is crucial to innovation and value creation (Ode and Ayavoo, 2020; Xin et al., 2021). Ode and Ayavoo (2020) found a significant relationship between knowledge management practices and firm innovation in Nigeria. The innovation capacity of hotels depends on their capability to acquire, disseminate, and use knowledge (Palacios-Marqués et al., 2015). The hotels can use social media platforms to acquire knowledge about the customers and understand their needs and wants. Enterprise 2.0 tools facilitate the process of disseminating and using such knowledge, while front desk technologies give access to customer information, which enables hotel staff to be innovative and provide a customised service to customers (Shin et al., 2019).

5. Theoretical and practical implications

From a theoretical perspective, this systematic review contributes to the literature by synthesizing the findings in the literature and shedding light on the current knowledge on the applications of disruptive digital technologies in the hotel industry. We identified social media, mobile apps, big data and artificial intelligence, self-service technologies and robots, virtual reality, e-commerce and social commerce, information systems, smart systems, and front desk technologies as the disruptive digital technologies whose contributions to hotel performance have been studied in the literature. The findings provide an overall picture of what we know about the contributions of these digital technologies to hotel performance. A summary of the contributions of disruptive digital technologies is provided in Fig. 3. For instance, e-commerce and social commerce enhance the efficiency of hotel operations, facilitate effective resource allocation, streamline the processes, and provide a convenient booking system, which, in turn, contribute to hotel performance in terms of financial, competitiveness, quality of service, and resource utilisation. The study also provides a solid foundation for future studies in the area of digital transformation in the hotel industry. Such understanding may help future researchers to study the topics that have received less attention and guide their own literature review based on their topic and digital technology of interest. The findings illustrate the aspects that are

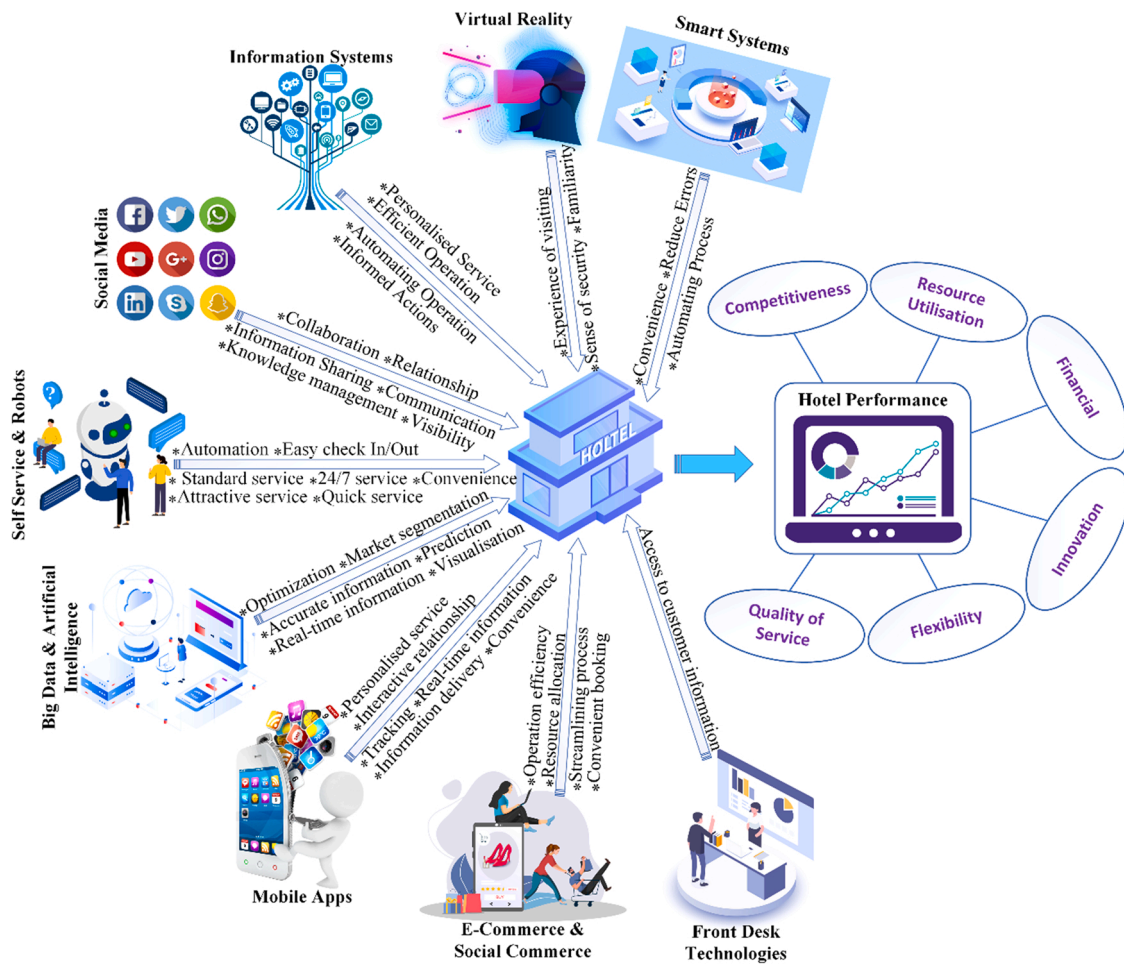


Fig. 3. Contributions of disruptive digital technologies to hotel performance.

not adequately dealt with in the existing literature, and we provide directions for future studies based on the research gaps.

From a practical perspective, the findings enable hotel managers to understand the possible benefits of investing in digital technologies. Such insights help the managers of hotels that have fallen behind in adopting technologies to understand the benefits that digital technologies can provide. Previous studies have found managers' lack of knowledge to be the main cause of the low digital technology adoption rate (Nadkarni et al., 2019; Nam et al., 2021). Furthermore, the managers of hotels that have invested in digital technologies may understand the other benefits of the technologies that they have. For instance, the findings show that big data analytics have various benefits, such as predicting hotel occupancy rates, optimising pricing, assisting market segmentation, and reducing operational waste. However, a hotel may use big data analytics for pricing and marketing purposes but not be aware of the abilities of this technology to reduce operational waste.

6. Direction for future research

The review of studies on the applications of digital technologies in the hotel industry allows us to identify several research gaps and provide directions for future studies as follows:

- Although smart systems, information systems, e-business, and virtual reality can contribute to various dimensions of hotel performance (Hua et al., 2019; Leung, 2019; Surovaya et al., 2020; Kaya and Azaltun, 2012), such contributions have received little attention in the literature. Nonetheless, these technologies have been shown to

play an important role in overcoming the challenges brought to the fore by the COVID-19 pandemic. For instance, due to COVID-19, people prefer less risky experiences (Schiopu et al., 2021), and virtual reality enables customers to evaluate the risks before booking.

- Although the application of social media, self-service technologies and robots, big data analytics, and mobile apps have been investigated frequently, their contributions to some dimensions of hotel performance, such as flexibility and innovation, have received less attention (Table 5). Future studies should investigate how these technologies may contribute to hotels' flexibility and innovation capability.
- Limited studies have considered the importance of hotel type (luxury against budget hotels) or hotel size (SMEs against large hotels) in the success of digital technologies in the hotel sector. Hotel type and size influence the applications of digital technologies (Chan and Tung, 2019; Choi et al., 2020). As such, future studies should control the potential influence of hotel type and size or limit their studies to a specific type of hotel. Future empirical research can also test the moderating influence of hotel type and size.
- Although hotel employees are the main users of digital technologies, and how they perform their daily tasks is influenced by technology, only six studies have collected data from hotel employees. Future studies are recommended to unpack the hotel staff's views regarding digital transformation in the hotel sector.
- Very few studies have used qualitative and mixed-methods techniques. Most of the studies have used quantitative approaches to investigate the influence of digital technologies on hotel performance, while an interview with various stakeholders may generate

first-hand insights. Furthermore, the findings of mixed-methods approaches are less prone to bias or errors, and scholars agree that such studies are superior to single approach studies.

- Among the six dimensions of hotel performance (Cho et al., 2012), the influences of digital technologies on flexibility and innovation have attracted less attention in the literature. Service flexibility and service innovations are two critical sources of value and competitive advantage in service sectors (Brozovic et al., 2016; Skålén et al., 2015). Thus, future studies should explore the contributions of digital technologies to hotel performance.
- Digital technologies are interrelated, and the success of one technology in enhancing hotel performance may depend on other technologies. For instance, information systems, sensors, and social media provide data for artificial intelligence, and the success of artificial intelligence in predicting hotel occupancy rates and optimising operations depends on the quality of data provided by other digital technologies. Future studies are recommended to explore the relationship and interaction between technologies using mapping techniques such as interpretive structural modelling (ISM).
- Cybersecurity is one of the main concerns of digitalization and so may hinder digital transformation. Surprisingly, this fast-growing challenge has received less attention in the hotel literature. Thus, future studies are needed to unpack the cybersecurity issues that may arise from using digital technologies in the hotel sector.
- Although the commercial application of artificial intelligence systems has increased exponentially in the hotel sector, and several studies have investigated their applications, there is a lack of research on the suitability of various artificial intelligence systems based on hotel characteristics (i.e., hotel type and size). Future studies are required to assess the superiority of artificial intelligence systems over each other based on hotel characteristics.
- Studies have investigated the impact of digital technologies on hotel performance (e.g., Yadegaridehkordi et al., 2020). However, the homogeneity assumption in these studies may reduce the generalizability of their results. Future studies should cluster the samples based on hotel characteristics and investigate the influence of digital technologies in each cluster.
- The use of text mining and big data analytics has become popular among scholars in the hotel sector, and researchers have explored the customers' needs and preferences from their comments (e.g., Chen et al., 2019). However, the cultural differences among nations and personal differences among individuals have received less attention in these studies. Future studies are required to combine clustering techniques with text mining and big data analytics techniques to investigate the role of heterogeneities.

7. Conclusion

This systematic review aims to synthesise and give structure to the literature on applications of digital technologies in the hotel sector. The literature was structured based on six dimensions of performance proposed by Cho et al. (2012). The review of 79 articles revealed that some digital technologies (e.g., social media, self-service technologies, and robots) and some dimensions of performance (financial performance, competitive advantage, quality of service, and resource utilisation) have attracted the most attention from scholars. Future studies should explore digital technologies (e.g., smart systems, information systems, e-business (2.5 %), and virtual reality) and performance dimensions (flexibility and innovation) that have received less attention. Studies have shown that some digital technologies are more suitable for achieving a certain performance goal. For instance, social media is one of the most suitable technologies for enhancing the competitive advantage of hotels. Accordingly, structuring the literature based on performance dimensions in this review provides insight for managers about which digital technologies would be better than others based on the performance goals of the hotels. Furthermore, the studies have shown that the

success of technologies in enhancing performance depends on hotel characteristics. For instance, using self-service technologies and robots to enhance hotel competitive advantage through offering standardised services may be more effective in budget hotels in comparison to luxury hotels (Chan and Tung, 2019). The customers of luxury hotels pay expensive room rates and expect to receive personalised and high-quality human service (Liu and Hung, 2020). Hence, future studies should investigate the contributions of digital technologies to hotel performance dimensions based on hotel characteristics.

This study also proposes directions for future studies based on the recognised gaps in the literature. Although the objectives of the study were addressed, like any other systematic review article, the study has some limitations. Firstly, to ensure quality articles were reviewed, the choice of articles was limited to Q1 and Q2 journals. Secondly, while two authors screened the articles to select the articles relevant to the objectives of the study, the selection may be influenced by subjective judgment. Finally, we structured the literature based on performance dimensions, and future review studies can structure the literature from other perspectives, such as the service value chain.

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