

Hospitality technology progress towards intelligent buildings: a perspective article

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Abstract

Purpose – *The purpose of this study is to review the past technology in hotel and forecast the future direction of technology adoption in hotels.*

Design/methodology/approach – *Academic papers not only from hospitality journals but also from technology-related journals were collected and reviewed to propose the future hospitality technology development trends.*

Findings – *The hospitality software application has moved from local-based to server-based to Web-based to cloud-based platforms. Business data analysis methods have also undergone an evolution from descriptive analysis using historical data to predictive analysis by mining big data collected from the sensors and web-crawlers, which consolidates both commercial data and macro-environment data. Future hotel buildings could provide ambient management that responses to external environments automatically to provide an eco-friendly and cosy environment to hotel guests. Responsive building envelopes, façade systems and autonomous furniture will allow hotel managers to customised the function space layout according to customers' needs and maximise unoccupied space utilisation.*

Originality/value – *Reviewed 75 years of IT evolution and forecast future hotel intelligent building with ambient intelligence to provide customizable, eco-friendly and cosy environment for hotel guests.*

Keywords *Ambient intelligence, Future perspective, Hospitality, IT, Intelligent building*

Paper type *General review*

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Introduction

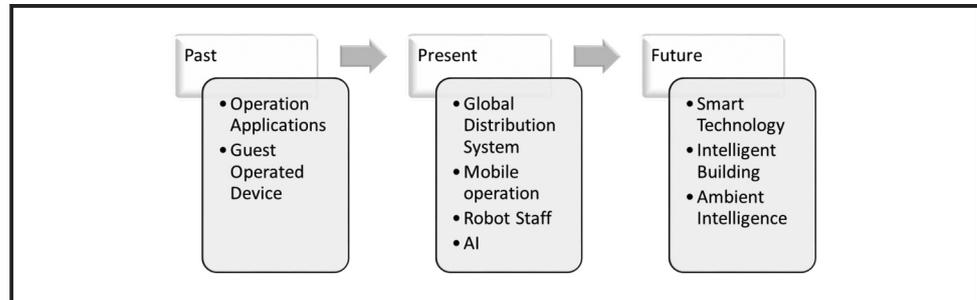
Technology plays a vital role in business management. Every business activity from operations, marketing and management to strategic management requires technology as a tool to assist customer service delivery, data analysis, decision-making and strategic planning. The hospitality industry uses technology extensively to address labour shortage and costs, unsociable working hours and operational efficiency. Technologies have become indispensable parts from operations to strategic management in this customer-centric and highly competitive industry. This paper explore how hospitality uses technology and demonstrates the progress from automation and computer-aided operations towards smart hotel in intelligent buildings to ambient intelligence.

Past perspective 75 years of developments 1946-2020 technology evolution in hospitality

Since the early years of the digital era, hotels have adopted technologies to enhance their operational efficiency and effectiveness (Collins *et al.*, 2017; O'Connor, 2004). Figure 1 summarises the timeline of technology development in the hospitality industry. Commercial computers were introduced in the 1950s and the first automatic electronic hotel reservations system "Reservation" launched in 1958 (Sheraton, 2019). International hotel chains developed their own central reservation systems (CRS) that enable cross-country hotel reservations, but Intercontinental Hotels Group had announced fade out their CRS and

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Figure 1 Hotel technology development timeline



collaborate with Amadeus on the cloud-based guest reservation system with global distribution systems optimisation for channel management (Sheldon, 1997; IHG, 2015). In the decades before the internet era, operation-oriented applications and guest-operated in-room devices played a key role but interconnecting them required costly custom-made propriety interfaces (Collins *et al.*, 2017; O'Connor, 2004). The internet-enabled wider distribution and greater price transparency (O'Connor, 2020; Buhalis, 2020). Managing large numbers of online channels has become one of the most challenging tasks for revenue managers (Viglia and Abrate, 2020). Search engine ranking affect the competitiveness of hotels (Paraskevas *et al.*, 2011). Electronic-word of mouth has changed ways of contemporary hospitality reputation management (Law *et al.*, 2014).

Future perspective 75 years 2020-2095 move towards smart hotels

Increasingly free Wi-Fi and low-cost mobile data services, mobile applications allow guests to self-check-in to hotels and use their smartphone as a room key (Law *et al.*, 2014). Self-service and robotic technologies disrupted service delivery in hotel operations (Buhalis *et al.*, 2019). The first robot hotel had shed light on the future of human-less service in hotels. As then, discussions on this topic, especially on robot adoption, user-robot interaction, employee job security and education and training needs have gone viral (Ivanov *et al.*, 2019; Webster and Ivanov, 2020). Artificial intelligence (AI)-powered voice assistants with machine learning ability, installed in guest rooms, perform tasks requested by customers and to voice-activated in-room ambient control (Buhalis *et al.*, 2019). However, many customers are concerned about privacy issues (Costa, 2016). Hotel managers have to make an effort to monitor and respond to user reviews so as to protect their hotels' image (Au *et al.*, 2014; Schuckert *et al.*, 2019). Marketing materials have migrated from text and images to 360-degree videos and are now moving towards virtual reality (Beck *et al.*, 2019). Big data in an interconnected and interoperable hospitality ecosystem enable stakeholders' applications data interchange for more accurate business analysis and forecasting (Buhalis and Leung, 2018; Mariani, 2020). Hospitality technologies have moved from local-based to server-based to Web-based to cloud-based platforms (Law *et al.*, 2020). Business data analysis methods have also undergone an evolution from descriptive analysis, using historical data stored in the data warehouse, to predictive analysis. Mining big data, collected from the sensors and Web-crawlers, consolidates both commercial data and macro-environment data. Machine learning and AI empowered by internet of things (IoT) and the internet of everything (IoE) empower end-user decision-making process and optimise organisation performances (Buhalis, 2020). With advancements in IoE, robots and AI, future hotel operations and service are heading towards automated environments (Webster and Ivanov, 2020; Buhalis *et al.*, 2019).

More importantly the needs of future space tourism, hotel buildings have to respond to the dramatic change of the external environment and to provide effective energy management

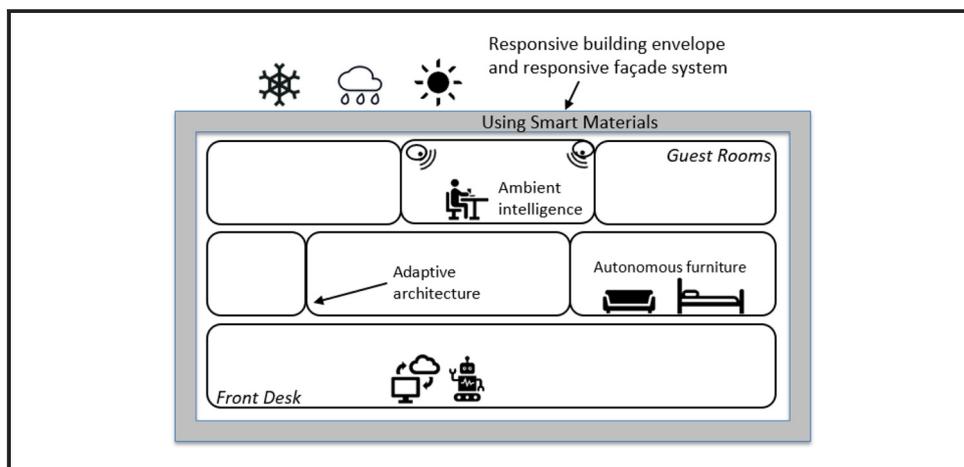
and maintain resources supply in the building. Future eco-friendly design hotel buildings will minimise energy consumption. The exterior of intelligent hotel buildings, equipped with smart materials and responsive façade systems, can react according to outside stimuli, such as temperature and electric or magnetic fields, thus changing their characteristics in reaction to heat, moisture or light. Adaptive architecture converging biometric devices, IoT, machine learning and AI set a new form of ambient intelligence. This requires user-profiles that contain preferences, interests, characteristics and interaction behaviour for personalisation (Nijholt *et al.*, 2009). The interior of the hotel assemble will also be designed with adaptive architecture. This will allow hotel managers to customise the function spaces, restaurant and guest rooms layout according customer’s need. They will also analyse real-time data on consolidated hotel occupancy, restaurant and event bookings and accordingly convert guest rooms to event venue or vice versa according to demand. This will optimise space utilisation and maximise usage and increase income. Autonomous furniture and fixtures can be relocated automatically after the customisation completed (Urquhart *et al.*, 2019) so minimise manpower is required. (Buhalis, 2020). The IoT and IoE shape the next generation of guest rooms and hotel public areas. Sensor-augmented environments can act dynamically to both human action and the surrounding environment to adapt to context. Figure 2 illustrates the future intelligent building infrastructure.

Conclusion

Hospitality and hotel design has gone through dramatic transformation in the past few decades. The future smart infrastructure with high-speed network provides efficient data exchange amongst databases in real time, enabling the service of now (Buhalis and Sinarta, 2019).

Ambience management responds automatically to context. According to data collected from external environments it provides an eco-friendly and cosy in-room environment for customers. Future IoT/IoE devices in an ambient intelligence environment work in concert to support hotel guests to carrying out their everyday life activities, tasks and rituals in a natural way. The in-room ambience adjusted automatically according to the guest’s movements, supplemented with external environment data. However, with an increasing number of sensors and IoT/IoE installed around hotels, personal privacy concerns have been raised. Future research should investigate how privacy could be protected without influencing the technology implementation. Equally technology will lead to more efficient and profitable hotels in the future.

Figure 2 Future intelligent hotel building with ambient intelligence



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