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## **A Framework of Cloud and AI based Intelligent Hotel**

*(Full Paper)*

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### **ABSTRACT**

In the past 10 years, the hospitality industry's discussions on cloud technology have been ongoing to rise, but they had been stuck in the stage of paper talks, and there were no substantive action. In view of the huge potential of the intelligent hospitality industry market, and the related academic research literatures about the virtualized cloud architecture, AI technology application and intelligent virtual housekeeper system among in this industry is still relatively few. Therefore, I selected the industry success case led by Taiwan's Ministry of Science and Technology as a case study for this research, besides, quantified the system's trial operation phase, relevant operational performance results, as the focus of this intelligent hotel case implementation effectiveness evaluation.

*Keywords:* Cloud computing, artificial intelligence (AI), intelligent hotel, innovation service

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### **INTRODUCTION**

Now, more and more companies are starting to offer true cloud-based applications that are flexible, always online and always up-to-date, and offer easy and affordable open integration options. In the past, high costs and difficulties in integration have been a major obstacle to innovation, but hospitality technology is now moving from a closed system to an open platform that can easily interface with each other. We can envision that a "stacked" hotel management solution will soon be born that will integrate all of today's critical system functions, such as PMS (Property Management System), CRS(the Preferred Hotels & Resorts Central Reservation System), CRM(Customer Relationship Management), RMS (Revenue Management System), ERP (Enterprise Resource Planning), etc., form a holistic hotel management platform, hotels could easily choose to join other functions they need, and ultimately realize the "platform" Service(PaaS)and "software-as-a-service"(SaaS) efficient and customized development platform.

Due to the rapid development of information technology applications and artificial intelligence (AI) technologies, virtualization, cloud architecture, Internet of Things, big data and AI are constantly integrated into all walks of life. In the hospitality industry, "intelligent hotels" based on artificial intelligence are gradually entering the public perspective. Many hotels have undergone a series of upgrades. Many hotels have undergone a series of system upgrades and will compete and develop in the market with the appearance of "intelligent hotel".

Throughout these intelligent hotels, the competition factors mainly focus on four aspects: interactive intelligence, scene humanization, experience personalization, and data informatization. The hotel is only the medium and entrance to the accommodation scene. After the real stay, the users will have a series of information and personalized services, such as catering, entertainment, travel, butler service and these are also inextricably linked to the concept of "wisdom".

With regard to data transformation and insight, today's systems are becoming more interconnected, so the way of data being stored, aggregated and accessed is changing. Merging data into the cloud means that a 360-degree view of the guest will be realized. More and more systems will become increasingly efficient in exchanging information. The hotel will be able to access signals anytime, anywhere, and a more intelligent system will be able to predict consumer behavior at a subtle level that has never been seen before.

Having the various applications of cloud technology, but, if lack of consolidated data; or with the integration of data warehousing, but no analysis system to predict and perfect implementation of decision-making, can't achieve the "complete integration, seamless perfect wisdom" realm. The future is beginning to take shape: many hotel brands and hotel technology companies are investing millions of dollars to build this smart system.

However, a true smart system should be intelligent and user-friendly, that is, the center is a human rather than a system device, which not only allows users to experience the ultimate technological experience, but also meet their diverse and individual needs. The hotel is intelligently transformed, and the intelligent system is the core. Generally speaking, the hotel intelligent system has three development directions:

1. Self-learning system based on big data: Hotel intelligence is a system that can realize self-evolution according to the user's living and usage habits as well. Whether it is a hotel operator or a guest, it can be fully intelligently adjusted according to their own needs. For example, after you enter the hotel for the first time, the system will analyze your usage data. When you stay at

the hotel for the second time, the system will provide you with the most comfortable and convenient service according to your previous stay habits.

2. Centralized automatic sensing system: through the use of mobile phones, routers, sockets, and software / hardware / firmware / weak power mode relevant control architecture to make hotel facilities intelligent, allowing users to feel the true technological wisdom experience, through the association equipment to achieve the control of hotel room lighting, air conditioning, curtains, audio and video equipment.

3. Wisdom virtual butler: integrate all hotel information such as guest customization leisure service, value-added service, VIP identification, room service, business service, etc. In the hotel, let the tenants through the anthropomorphic multimedia technology and AI System, virtual characters could easily get information, moreover, all the hotel service personnel will have a butler system to integrate and remind all service items, so that every service staff can become the "most professional reception."

Regarding the case study of this research, in terms of technical aspects, most of the current hotel industry in Taiwan is limited to the size of the company and the low level of awareness of the enterprise leaders. Normally, they do not willing to invest in relevant innovation and technology. In this practical case, the innovations that differ from traditional hotels are mainly: the technical architecture uses information technology integration applications such as virtualization, cloud computing and artificial intelligence.

As far as the application and operation of the hotel industry is concerned, the traditional hotel competition projects focus on the building internal hardware, appearance, decoration, hotel facilities, service quality and price of the hotel. Nowadays, the era of technological application is gradually maturing, and these traditional competition projects have progressively relegated to the second line. In the near future, the degree of hotel intelligence and informatization will be the main key factor for the industry market competition. Therefore, thinking about how to use cloud technology and artificial intelligence to establish the differentiation of hotel operation characteristics will be the key to the competitive advantage of the hotel industry.

The main purposes of this paper are: 1) to explore the architecture of cloud computing technology applied to intelligent hotels, and to build a "virtualized + cloud technology" operation mode of intelligent hotels, which could provide a successful model reference for cloud computing system architecture in related practical industries; 2) Combining AI with intelligent hotels can more effectively enhance the technology innovation of the hospitality industry, improve customer satisfaction, enterprise competitiveness, and improve operational performance; 3) Analyze relevant smart application for intelligent hotel practice cases and business operations as well. Under the relevant system platform data, analyze the target hotel service innovation development process, and determine how various related activities affect the final innovation results. Moreover, to explore the hospitality industry further AI innovation service business opportunities.

## LITERATURE REVIEW

### Cloud Computing

According to the definition of the National Institute of Standards and Technology (NIST), there are five behavioral frameworks such as (Figure 1) NIS definition cloud computing architecture diagram: 1) Cloud Consumer, 2) Cloud Provider (servo Device provisioning, cloud service management, security and privacy), 3) Cloud Auditor, 4) Cloud Broker, 5) Cloud Carrier Actor has five behavioral frameworks and a total of four deployment modes and three service types state(Qu *et al.*, 2018).

Types of Cloud Computing Systems include public, private, community, and hybrid clouds.

(1) Public Cloud: It is an open cloud computing platform. It is cheaper. If you pay, you can use the resources of the cloud computing platform. However, using public cloud data is easy to steal, so there is often privacy security (Hintze & Mike, 2018).

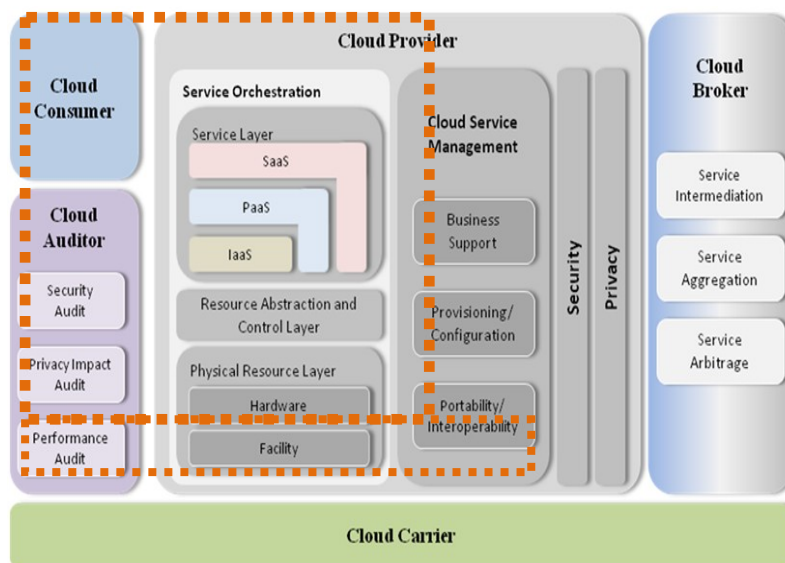
(2) Private Cloud: It is the establishment and management of maintenance, all of which are the company itself. The cloud computing platform is only used by internal companies and is not open to the public. In this way, it can protect the internal data security of the company (Neville & George, 2018; Ogrea & Claudia, 2018).

(3) Community Cloud: It combines the characteristics of a public cloud and a private cloud. It consists of multiple clouds. Non-enterprise public data is processed on the public cloud, and enterprise confidential information is placed in a private cloud. This saves some costs. The security of the data can also be maintained (Zhang *et al.*, 2018).

(4) Hybrid Cloud: The platform is jointly constructed by several organizations to share resources. This platform supports the same demand services. These cloud systems include private clouds, social clouds, public clouds, etc. (Kietzmann & Treen, 2018).

At present, the current development of Cloud Computing application in the intelligent hotel industry, in addition to foreign companies and Taiwan's group chain five-star, four-star hotel, there is a possibility of introduction, the general hotel industry is

generally based on technology, management and cost considerations, there is no such model.



Source: NIS of NIST.

Figure 1: NIS definition cloud computing architecture diagram

### Artificial Intelligence (AI)

Artificial intelligence refers to science and technology that can imitate human sensing, thinking, reasoning and action, and demonstrates the ability to solve problems with human intelligence. Artificial intelligence uses human input data to acquire knowledge, and enhances problem-solving through machine learning mode. Ability to reduce errors and increase their efficiency (Maurício, da Silva, & Wee, 2018; McCracken, 2017).

The specific reference to the definition of AI depends on the context of the problem we are discussing and the focus of attention. The book lists five definitions: "Definition 1, AI is an incredible computer program (La Porte, 2018). It refers to the machine to complete what people think the machine is impossible to do. Definition 2, AI is a computer program similar to human thinking, It means that AI can have logic and thinking similar to human beings. Definition 3 is a computer program similar to human behavior, and the behavior of AI is similar only in similar environments. Definition 4, AI is the computer that will learn. The program is similar to machine learning. Definition 5: AI is a computer program that makes the best interests based on the perception of the environment.

The core issues of artificial intelligence include reasoning, planning, learning, communication, and the ability to perceive. There are a large number of tools that apply artificial intelligence, including search and logical deductions, etc. (Hollebeek, Elina & Matthew, 2018; Wirth, 2018). The development of artificial intelligence is simply divided into three waves [8]. The third wave began in the 2010s with the analysis of big data and the development of the Internet. Machine learning began to emerge. Among them, deep learning focused on deep learning, which is a kind of machine learning. Vauhini (2018) proposed that machine learning aims to apply statistical learning and artificial intelligence techniques to automatically learn hidden knowledge or patterns from training data or past experience.

Schuller(2018) listed four technologies used by AI in the use of network security, including: Application of Intelligent Agents, Application of Neural Nets, Expert System Applications, Application of Learning Description and Definition.

The use of artificial intelligence in life and household goods is more common and widespread, such as AI smart refrigerators, smart boxes, artificial intelligence TVs and many other home appliances. In addition to the temperature adjustment, the smart refrigerator can also recommend recipes, food ingredients, and even the function of the refrigerator touch screen to buy ingredients (Lee, 2018). Amazon's smart speaker Echo Dot, which is the best gift of Christmas in 2017, is the best-selling item on the site. AITV can control voice commands and automatically recommend programs, while learning the habits of user use and search, providing more precise interaction. Wagner and Howard (2018) studied the technological development of smart families to meet the services and living spaces that households need.

At present, the current development of AI application in the intelligent hotel industry, in addition to foreign companies and Taiwan's group chain five-star, four-star hotel, is more likely to have, the general hotel industry is generally based on technology, management and cost considerations, there is no introduction of this model.

### Intelligent Hotel

The hotel occupies a status that cannot be ignored in today's economic system and leisure industry. Therefore, the importance

of hotel management has its significance and value. However, the hospitality industry is changing and will continue to change; therefore, modern hotel management technology must adapt to changing circumstances. Hotel management refers to the management of hotels, restaurants, and tourism related units. Information Technology (IT) Definition: A general term for information technology used primarily to manage and process information. It mainly uses computer science and communication technology to design, develop, implement and install information systems and application software. It is also often referred to as Information and Communication Technology (ICT) (Jose, Gautam & Jörg, 2018; Joshi *et al.*, 2017; Panos, Ola & Geoffrey, 2018). With the continuous development of information technology (IT), Internet of Things and communication network technology, IT is also widely used in the hospitality industry (Alessandra *et al.*, 2018; Wikipedia, 2018). In addition to investing in IT hardware, inter-organizational and external information systems are also important. Among these companies, many hotels use a more efficient system to manage. In terms of corporate governance, the first application of network systems also appeared in the aviation and hospitality industries. The most obvious example is the automated booking and central reservation system (Nathalie & Béchir, 2018).

The operation of 21st century hotels will have to rely on more and more information technology to enhance the value of personalized services (Alessandra *et al.*, 2018). Hotel managers face the challenge of quality of service and diversity. They need the ability to manage and implement IT operations, so that they can have a competitive advantage (Kumar & Vikas, 2018). Murphy, Chen and Cossutta (2016) also pointed out that IT has become the necessary tool for providing customers with room facilities, adding concierge services and private information, checking out, providing wake up service and room service, on-demand movies or personal TV shows. In many cases over the past decade, business or academics have agreed to the benefits of using information technology in the hospitality industry, including the upgrading of service quality, the design of long-term development of enterprises, the improvement of efficiency and efficiency, and the integration of departments; the specialization in human resources management. Aspects, speed up communication, reduce costs, differentiation and cooperation, and improve performance (Naseeb Ullah, Shahid & Bakhsh, 2018).

The IT revolution is reshaping the hotel industry, which is an inevitable trend for international tourists to use IT (Scorțe, 2017). While investing in IT applications, the international tourism industry is most concerned about whether IT will improve operational performance. Therefore, the development of intelligent hotels can help solve the limitations and problems encountered in this industry (Naseeb Ullah, Shahid & Bakhsh, 2018). The intelligent system can mainly control the hotel operation and optimize the service mode. So far, there have been many researches on intelligent hotels, mainly based on technical applications, resource management and peripheral business (Murphy, Chen & Cossutta, 2016). However, there is relatively little research on the technical architecture of the overall solution for hospitality service innovation.

### **Innovation Service**

Tourism and tourism has become an important driving force for economic growth in various countries (iThome, 2016). Thinking about how to create "service innovation" is the top priority of all walks of life, and the hotel industry is no exception (Hollebeek & Andreassen, 2018; Shi *et al.*, 2018). Den Hertog and Bliderbeek (1999) proposed a service innovation model that points out the technology choices of service delivery, new service concepts, new customer interfaces and new delivery systems; among them, (1) New Service Concept (New Service Concept), that is, a new method to generate services, the focus is on providing customers with new service processes or new service connotations, which may be specific or abstract; (2) New Client Interface, usually referred to It is to use IT technology to improve the existing service interface and to connect existing customers with potential customers. (3) New Service Delivery System, which focuses on transforming the internal organization of service providers and Education and training enable employees to realize their potential to stimulate new services and professional services. (4) Technical Options means that information technology (IT) is the most innovative technology choice used by the industry. The promotion or the use of technology can implement the above three aspects of innovative ideas faster and more efficiently.

### **METHODOLOGY**

Based on the above research background and motivation, purpose and problems, and related literature, this study develops research methods and implementation, using case study method and questionnaire survey method. First, the case study method used in this study is described. The second is the selection of case study subjects. The selection criteria are based on the consideration of service innovation. The organizations with exemplary role in the industry are research cases. The third is customer satisfaction. Questionnaire design, based on the research purpose and the service innovation in the important literature and the learning experience of the intelligent hotel industry, the customer design and implementation of the system satisfaction survey, the questionnaire data and the subsequent analysis.

The case study is to explore the nature of the activity of a case in a specific context, and hope to understand its uniqueness and complexity. A case study is a review of a particular phenomenon. Yin (2009) considers a "case" to be a bounded system and has its boundaries. It describes a well-defined object rather than a specific process.

The study covered three main topics: 1) virtualized cloud and network intelligence management; 2) virtual butler service, and 3) "innovative service model to improve operational efficiency and shape digital features." Why is this research focused on the virtual butler service platform? In addition to the brand strategy of smart learning companies, the company also creates future business blueprints and goals through the following projects: 1) improving hotel intelligence; 2) continuing service innovation,

thereby enhancing customer satisfaction.

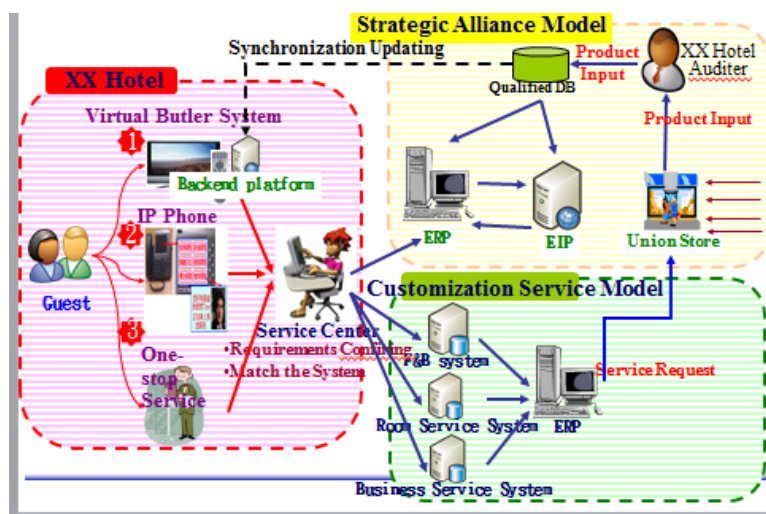
According to the four dimensions of service innovation of Hertog and Bliderbeek (1999), the link corresponds to the research structure of this case (see Figure 2); the fourth dimension of "Technological Options" facet, this case through the virtual housekeeper technology platform Use, in order to more effectively implement innovative models of service new methods, new service interfaces and new service delivery systems.

In the first dimension of the "Service Innovation Method" section, the virtual butler information system can be linked to the service center to provide relevant ;1) customized services such as catering services, room service and business services; 2) Combine with strategic alliances to make subscription services to provide customers with new service processes and innovative service connotations.

The second dimension of "innovation service system delivery" is based on smart network TV design, combined with hotel services, private tours, business secretaries, omnipotent butlers and customer-related customer service packages, etc. The type, combined with the education of artificial intelligence, continues to inspire new professional services.

In the third dimension of the "new service interface" section, through the development and design of IT application systems, combined with virtual butler information system technology components and customized service models, the interface and service quality of hotel intelligent services are greatly improved. Therefore, it can enhance existing customer satisfaction and more effectively integrate virtual and real channels through intelligent network platform, in order to strive for a larger global potential customer.

Finally, the results of the innovation platform related to this research case are presented. Based on the information generated by the innovation system platform of this case, the business operation data report generated by the annual, monthly, weekly and daily time related to the application system database is compared with the research. A "key performance indicator" that measures case management practices. In addition, according to the data analysis results of engineering, marketing, financial and operational performance, as the operational performance measurement indicators and benchmarks of this cloud intelligent virtual butler platform case.



Source: This study.

Figure 2: The framework of Virtual Butler Information System

## RESULTS AND DISCUSSIONS

### Virtual Butler System

In the current case study, we found that an intelligent hotel can be built on the integration of the following pillars. First, the innovation of service model: using smart network services to create differentiation of competitive advantage, and using IT intelligence to provide a new model of virtual butler service; Second, improve operational efficiency: improve operational efficiency can allow hotel staff to have more time To provide better services; third, to adopt and provide virtual housekeeper related functions: hotel-related artificial intelligence devices can actively provide more friendly, convenient and efficient functions, and provide customers with more intimate personalized services. Using the virtual cloud related technology application and intelligent room control function in the smart virtual service system can improve the rapid response capability, store valuable service records, reduce unnecessary resource waste, and thereby improve customer housing related consumption.

Integrate hotel information such as leisure services, value-added services, VIP identification, room service, business services. Through personalized multimedia-related technology, hotel guests can easily access relevant information through personalized

tour guides, business secretaries and the role of the all-round butler; in addition, all hotel service personnel should have a housekeeping system to integrate and track their services. Let each service staff turn into the most professional receptionist. See Table 1 for the smart virtual housekeeping system architecture of the relevant research model.

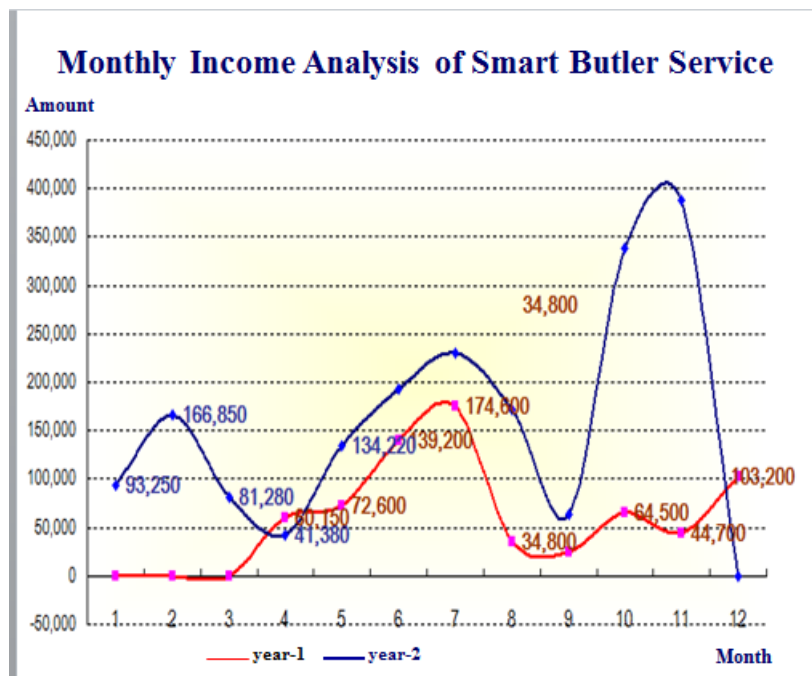
Table 1: Architecture of the Virtual Butler Management System

1	front desk guest subsystem (including 4 design modules)
2	front desk service subsystem (including 4 sub-modules)
3	backend management subsystem (including 3 integrated interfaces)
4	backend 4 databases and 1 integration interface

### Service Innovation Concept and its System Performance Reward

The intelligent virtual housekeeping system related to the intelligent hotel in this case integrates the virtual cloud technology component development and related information application system, and fully presents the new service concept, new customer interface and new service delivery in Hertog and Bliderbeek (1999) "Service Innovation" concept. Key elements such as systems and new technology choices.

A series of surveys were conducted in this study to measure the performance of intelligent hotels in this case: system operation and financial income data [see Figure 3], and use it as the basis for project performance measurement information collection and analysis. The results of this survey show that the smart housekeeping system of intelligent hotels can reduce long-term operating costs and improve the overall operational performance of the company.



Source: This study.

Figure 3: Monthly Income Analysis of Smart Butler Service

### CONCLUSION

This research focuses on the use of virtual cloud technology combined with information system architecture to achieve the virtual housekeeper function of intelligent hotels. The implementation of the relevant virtual butler application system architecture, combined with the service innovation model concept proposed by den Hertog & Bliderbeek (1999), results in the service model, operational process and operational performance of the innovative hotel.

The main contributions of this paper are 1) proposing an intelligent virtual hotel system architecture based on virtualized cloud technology, which can provide a successful model reference for the virtual butler intelligent system architecture in the relevant practical industry; 2) combined with virtual cloud, green energy and carbon reduction Technology in the hotel industry application, can more effectively strengthen the technology innovation of the hotel industry, improve customer satisfaction, corporate competitiveness, and improve operational performance; 3) according to recent development trends in international smart properties, smart hospitals and smart homes, Based on the relevant technology applications that have been successful in intelligent hotel, explore the extension of its related smart applications in this area.

Virtual butler's intelligent hotels need to be integrated and innovative with technological innovation; they should be customer-driven rather than purely focused on the technology itself. Technological innovation and application is an ongoing



process in the world, and it is no exception to the smart tourism industry. This case study introduces Taiwan's five-star luxury business hotel - P company and explains how they built their smart hotel through the integration and innovation of cloud IoT technology architecture and friendly and convenient service model. Furthermore, this five-star luxury business hotel can be classified into a differentiated strategy for niche innovation services. In addition, the hotel has strong coordination in the development of interactive creative systems that ensure high quality services and maintain its core competencies. Become a quality intelligent hotel by leveraging and combining IoT architecture, information technology, services, operations and marketing activities to create a differentiated effect. We also found that integrating a comprehensive innovation structure with relevant features, technologies, operations and service models to retain old customers, attract potential customers, improve business operations performance and improve customer satisfaction is the key to building intelligent hotels.

It is recommended that the follow-up research direction, through the Big Data, the Cloud IoT of the Intelligent Hotel System, further explore the relevant consumer behavior and market consumption trends, and further revise the business strategy and competition strategy of the enterprise marketing strategy. Second, it can also be combined with other cloud IoT applications, biometrics cloud computing, big data, Blockchain and artificial intelligence applications (robots), big health technologies (sleep technology, smart sleep detectors, sleep houses, etc.). 5G (ICT), 3D printing and smart wearable device technology are used in related industries to effectively upgrade the intellectual and intellectual energy of the enterprise, enhance the loyalty and adhesion of international customers, and at the same time strengthen the technological competition project and net profit rate of enterprises increase.

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