Progress and development of information and communication technologies in hospitality

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533

Abstract

Purpose – In order to enhance operational efficiency, improve service quality and reduce costs, practitioners in the hospitality industry have widely adopted and implemented information and communication technologies (ICTs) in their businesses. Understanding what has been done and how ICTs have performed in the past and are performing in the present could assist practitioners and researchers in identifying research gaps and formulating future plans. This paper aims to address these issues

Design/methodology/approach – This study analyzed 88 full-length ICT-related research articles that were published in the period 1999-2008 in eight leading hospitality journals. The research focuses on all selected articles were in suppliers' perspectives, and each article was analyzed by content analysis.

Findings – Seven dimensions were formed after content analysis including human resources and training, security, reservation, revenue management, marketing, guest services, as well as strategic and operational management. Published articles were comprehensively overviewed on ICT usage in suppliers' perspectives. In this paper, suppliers refers to the providers of hospitality services.

Research limitations/implications – The major limitation of this study is the inclusion of only eight leading journals. Nevertheless, findings should be of use to researchers and practitioners to understand various ICT applications in the hospitality industry.

Originality/value – A major contribution of this paper is its comprehensive review of previous studies and their contributions to hospitality. Future research areas on ICT development and implementation in suppliers' perspective are also offered.

Keywords Communication technologies, Hospitality services, Tourism, Serials

Paper type Literature review

Background

Ever since the 1980s, ICTs have been changing the way in which business is conducted in the hospitality and tourism industries (Buhalis and Law, 2008). Progress in ICTs has transformed business practices, strategies and industry structures dramatically (Porter, 2001). The development of computer reservation systems (CRSs) in the 1970s, global distribution systems (GDSs) in the late 1980s, and the internet in the 1990s not only generated a new paradigm-shift, but also changed operational practices in the industries (Buhalis, 2003; Buhalis and Law, 2008; Emmer *et al.*, 1993; O'Connor, 1999). As ICTs have become more important, they have had a great impact on hospitality and tourism organizations and destinations, as well as the entire set of industries as a

whole (Buhalis and Law, 2008; United Nations World Tourism Organization, 2001). For instance, more travelers are now using search engines to plan and experience their trips because of the search engines' carrying capacity and speed of information retrieval (Buhalis and Law, 2008).

ICTs not only enable customers to search for and purchase customized hospitality and tourism products, but also benefit suppliers by developing, managing, and distributing their products without any time limits and geographical constraints to support the globalization of the industries by providing effective tools (Buhalis and Law, 2008). Since the rapid development and commercialization of ICTs are advantageous to the hospitality and tourism industries, hotels and other tourism-related companies are prompted to adopt these technologies (Sahadev and Islam, 2005). The adoption of ICTs is expected to improve service quality, enhance operational efficiency and reduce costs (Law *et al.*, 2009), as well as to provide a platform for accessing the global market (Sahadev and Islam, 2005). According to Connolly and Olsen (2000), ICTs are the largest forces that affect the changes in hospitality and tourism.

As stated, it is beneficial for hospitality and tourism operators to understand and use ICTs to support their daily operations and managerial decision-making (Leung and Law, 2005). Research journals, which serve as an important channel of knowledge distribution, can offer rigorous findings and unbiased viewpoints on IT analyses and evaluations. Hospitality and tourism practitioners could then apply these new academic findings to their businesses and strategies in order to remain competitive. Hence, analyzing academic publications can reflect the growth and trends of ICT applications (Leung and Law, 2005). Although there is a need for an analysis of published ICT-related studies, only a limited number of review articles were published since the early 1980s (Buhalis and Law, 2008; Frew, 2000; Kirk and Pine, 1998; Kluge, 1996; Law *et al.*, 2009; Leung and Law, 2005, 2007; O'Connor and Murphy, 2004).

Considering the importance of ICT applications and a general dearth of review articles on recent ICT development in hospitality, this paper makes an attempt to analyze the content of ICT-related articles published in leading hospitality journals in the period 1999-2008 in suppliers' perspectives. In other words, the paper aims to provide a comprehensive review of the key ICT applications on hospitality suppliers' side.

Methodology

ICT-related publications in eight leading research journals in hospitality were chosen in this study. These journals included:

- *Cornell Hospitality Quarterly* (*CQ*), previously known as *Cornell Hotel and Restaurant Administration Quarterly*;
- *FIU Hospitality Review* (*FIU*);
- *International Journal of Contemporary Hospitality Management* (*IJCHM*);
- *International Journal of Hospitality Management* (*IJHM*);
- *Journal of Hospitality & Tourism Research* (*JHTR*);
- *International Journal of Hospitality & Tourism Administration* (*IJHTA*);
- *Journal of Hospitality & Leisure Marketing* (*JHLM*); and
- *Journal of Hospitality & Tourism Education* (*JHTE*).

These eight research journals were selected because they were perceived as the best hospitality journals in a global survey recently conducted by McKercher *et al.* (2006). Law and van der Veen (2008) further stated that these are the most prestigious hospitality journals. In the second half of 2009, hard copies and online versions of the published articles in these journals were accessed and the abstract of each journal article was read carefully by the researchers. If the objective of an article was related to any ICT components, the paper was downloaded for further analysis. At the end of the database search, a total of 88 published articles were determined to be relevant in suppliers' perspectives. These articles were then examined using content analysis. During the selection process, the authors read the abstract of each article to decide whether it is related to this study. In order to further confirm their appropriateness, full-length articles of the abstracts identified were then thoroughly read again. This study only analyzed full-length papers and research notes, as they are refereed articles. Book reviews, abstracts, editor prefaces, internet columns as well as conference reports were thus excluded in this study. Table I shows the distribution of articles in each journal.

Seven dimensions, representing the stakeholder on the supply side, were identified as the main streams of the hospitality industry. These dimensions consist of human resources and training, security, reservation, revenue management, marketing, guest services, as well as strategic and operational management. These seven dimensions are basically the functional departments in a hotel. By reviewing the content of previous studies, this study shows the contributions of these publications and provides managerial implications.

ICT adoptions and development in suppliers' perspectives
Human resources and training
Since it is convenient to use the internet and the cost of using it is relatively inexpensive, many hospitality businesses have started to use web-based training. Clemenz *et al.* (2000) illustrated a computer-based multimedia training program which includes text, graphic, animation, pictures, video and sound to present information for on-the-job training. They also pointed out that the successful development of the program required high human involvement. Similarly, van Hoof *et al.* (2001) conducted an exploratory study among property-level lodging managers in the USA to determine

Name of journal	ICT-related publications	
	n	Percent
Cornell Hospitality Quarterly	21	24
International Journal of Contemporary Hospitality Management	18	20
International Journal of Hospitality Management	16	18
Journal of Hospitality & Leisure Marketing	13	15
FIU Hospitality Review	8	9
Journal of Hospitality & Tourism Research	5	6
Journal of Hospitality & Tourism Education	4	5
International Journal of Hospitality & Tourism Administration	3	3
Total	88	100

Table I.
Distribution of each journal

their perceptions of web-based training. It is generally known that the internet has brought a lot of advantages to the workplace. However, the internet is also a source of distraction to employees at the same time. "Cyberslacking" is one of the big problems when employees are permitted to gain access to the internet during their work. "Cyberslacking referred to describe the activities involved in wasting time on the internet while people are supposedly at work. And, it is recreational web surfing on the job or using the internet at work for one's own purposes" (Mills *et al.*, 2001a, p. 34). Misusing the internet not only abuses company resources but also leads to productivity and financial loss, as well as legal liability (Mills *et al.*, 2001a). Another potential liability faced by a company is hiring telecommuters. Although there are numerous benefits of home offices, telecommuting between employers in offices and employees in their homes may encounter legal liabilities. Mills *et al.* (2001b) suggested different criteria to identify suitable employees and recommended various areas to employers for minimizing the liability of telecommuting employees in various areas, such as assisting employees to set up a home working environment, to secure data, and keep records on their work schedule.

Apart from the pros and cons of using ICTs in hospitality, a few studies have investigated the intentions of employees to use ICTs. For instance, Lam *et al.* (2007) carried out a study to find out hotel employees' intentions towards the adoption of ICTs. Their study concluded that attitude, self-efficacy, and subjective norm are positively related to behavioral intention, and recommended ways to enhance employees' intention to use new information technologies. Another study performed by Ham *et al.* (2008) analyzed the computerized restaurant operations by the technology acceptance model (TAM), and their findings suggested point-of-sale (POS) system developers should pay attention to restaurant users' expectations regarding system functionality, performance, layout, and maintenance, because there is a direct relationship among perceived ease of use, perceived usefulness and the POS system adoption process. Although the food service industry has incorporated ICTs into its training techniques and tools, research findings have shown that there is a need to improve the quality of current training programs and overall effectiveness as they are still in traditional formats (Harris and Bonn, 2000).

E-learning refers to all technology-enabled learning (Buhalis and Law, 2008). The internet serves as an effective and innovative tool for students and educators to facilitate e-learning (Cheng and Piccoli, 2002). Rimmington (1999) also pointed out that ICTs have the greatest potential impact to bring about changes in hospitality education. Since the hospitality and tourism industries are knowledge-based businesses, organizations require employees to know how to take advantage of ICTs in order to build leadership competency (Cox, 2003). O'Neill and Bagdan (2002) developed effective strategies to teach hospitality students how to generalize technological concepts into applications. Also, Dopson (2005) stated that hospitality graduates need to acquire knowledge of e-commerce competencies as hoteliers are going to manage revenues online. Universities are thus urged to offer e-commerce subjects to students. Studying an E-MBA can enable hospitality practitioners to understand how e-learning leads to the development of analytical interaction and critical thinking, as well as building leadership competency and capability (Cox, 2003).

Security
Security in the hotel industry normally refers to guarding and loss prevention. However, additional security responsibilities of the present hotel industry have been extended to IT security, health and safety, disciplinary action, fire safety, and insurance (Gill *et al.*, 2002). Since IT security plays an important role in industries, a prior study of 234 hotels regarding their networks and prevention techniques indicated that the size of the hotel is positively related to the number of attacks (including virus and "denial of service" attacks), and many hotels use the most basic tools/techniques while neglecting some important network security tools/techniques such as biometric devices (Cobanoglu and DeMicco, 2007).

ICTs provide a platform for hospitality practitioners to collect detailed information about their customers. Many hospitality websites invite customers to register and state their preferences. Hotel managers can then make use of these preferences and tailor personalized services and products to their customers in order to increase customer satisfaction (O'Connor, 2007). Additionally, Piccoli (2008) provided a set of frameworks in terms of information systems, strategy and marketing to evaluate the opportunities for value creation using customer data in the hospitality industry. The findings contributed to the industry whether hospitality firms would be in agreement for the current chasm between the unprecedented volume of data and lack of guidance. However, using such data is associated with the potential problem of personal privacy. O'Connor (2007) analyzed hotel behaviors in terms of online consumer privacy. Surprisingly, websites were found to outline only some statements, such as which data are being collected and how they are being used. None of them conformed to all privacy legislation regarding where data are being transferred, who can gain access to the data, and whether customers have the option to know how the data is used (O'Connor, 2007). A later study conducted by the same author found that international hotel chains in the USA were the best and the most ethical example regarding the use of customers' personal data (O'Connor, 2008a).

Reservation
Being one of the most effective applications of ICTs to hospitality, an online computerized reservation system (CRS) enables customers to complete hotel reservations on the internet at any time, anywhere. Lee *et al.* (2006) applied the technology acceptance model (TAM) to examine users' intentions to use CRS. Their results found that users' intentions are invoked by their different perceptions of a specific system. Law and Cheung (2006) conducted a study to determine online hotel reservations on different region-based travel websites and found that the performance of North American-based websites exceeded the others. Although using online reservation is convenient, there exists a "terms and conditions" trap for customers. Hotels in the USA generally comply with the law requiring customers to be alerted to the terms and conditions for making reservations. However, different hotels use different approaches, as a reservation can still be transacted without customers having to click the "agree" button on terms and condition (Wilson, 2007).

Revenue management
The development of ICTs has dramatically changed the way that customers communicate, search for information, and well as purchase products and services. One

of the key issues faced by customers is how to locate the best room rates and availability through different distribution channels. Kasavana and Singh (2001) stated that the way customers book hotel rooms has transformed from traditional channels to online distribution channels and online auctions. An auction-based model is "market-centric" instead of "supplier-centric", so the traditional business model has been further extended to a market-oriented model. A study conducted by O'Connor (2003) found that most large hotels have the same online pricing strategies for both hotel websites and online booking channels. However, Thompson (2005) investigated the rates and availability of rooms in the US hotel industry across five booking channels. Empirical findings indicated that only about 55 percent of room rates offered by hotel websites were the best rate. Another study conducted by Tso and Law (2005) analyzed online pricing practices in the Hong Kong hotel industry. The authors found that local travel agents delivered the lowest rates among all distribution channels and in all hotel categories. Later, Law *et al.* (2007) conducted a large-scale study in Hong Kong to determine online pricing strategies, and concluded that local travel agents and local reservation agents offered the lowest room rates. In another study that focused on the pricing strategies and room availability of global hotel chains through different online booking channels, Gazzoli *et al.* (2008) stated that US hotels performed better than other regions regarding best rate guarantee, rate parity, and room availability across different online channels, but that rate consistency is still a problem in the US hotel industry. Since it is easy for customers to identify the lowest hotel room rates among different online distribution channels, the rate has an impact on both the distribution channel and profitability in the hotel industry (Carvell and Quan, 2008). Carvell and Quan (2008) suggested that a best rate guarantee offered by hotels is a way to provide value to customers. Apart from a best rate guarantee, hoteliers should also understand consumer behavior towards pricing strategies, since the internet is the most powerful marketing force in the hospitality industry. Otherwise, pricing strategies could be controlled by third-party distribution channels (Enz, 2003).

In the view of hoteliers, when compared to telephone reservations, electronic distribution systems are cost-effective and labor-efficient. However, one of the challenges faced by hotel operators is deciding the number of rooms to allocate to each channel for sale (Christodoulidou *et al.*, 2007). Emmer *et al.* (2003) forecast the effect of electronic distribution systems in the hotel industry and recommended that hotels should use a global distribution network to maximize benefits by providing the negotiated rate for high-volume agencies and corporate customers, and keeping the package information simple. O'Connor and Piccoli (2003) updated Emmer *et al.*'s (2003) study and highlighted some key issues that were faced by hotel managers when using electronic distribution channels. They expressed the reflection about the future of electronic distribution. Likewise, Christodoulidou *et al.* (2007) conducted two focus group studies to identify the challenges and solutions of electronic distribution channels for hotel managers. Although previous studies stated the importance of distribution channels, rate and length of a stay are still the key determinants in revenue management in the hotel industry (Choi and Kimes, 2002).

Since the importance of electronic distribution channels is increasing, it is important to determine the performance of electronic and traditional distribution channels based on hotel revenue performance. Sanchez and Satir (2005) explored a study to evaluate hotel revenues in terms of different reservation modes. Their results showed that the

hotel groups using online reservation system have a substantial revenue increase compared to those using offline modes. Also, hoteliers select appropriate electronic distribution channels based on the impact that the channel has on the hotel image and reputation (Gilbert *et al.*, 2005). The results of the study further support the impact of electronic distribution channels towards the hospitality industry.

Although using electronic distribution channels in the hotel industry is a global trend, some hotels still resist such an adoption. Dabas and Manaktola (2007) examined the situation of mid-segment hotels in India in terms of room inventory distribution strategies. Their results showed that managers from mid-segment hotels do not have the knowledge of electronic channels. As such, they still strongly rely on traditional booking channels.

Moreover, Burgess and Bryant (2001) demonstrated that the success of revenue management in the hotel industry largely depends on the development of revenue management systems that can analyze data and make appropriate predictions for hotel managers. Also, ICTs play an essential role in restaurant revenue management (Kimes, 2008). In a study to examine the financial success of an organization, adoption of ICTs is one of the key factors that has a great impact on company financial performance (Gursoy and Swanger, 2007). As revenue management systems play an important role in the hospitality industry, it is therefore critical for hoteliers to protect it (Kimes and Wagner, 2001). However, the findings in Kimes and Wagner's (2001) study illustrated that revenue management staff lack the knowledge on how to protect their systems from their former employees, extensions, and competitors. Hence, suggestions were provided to hoteliers and five dimensions were offered to prevent the leaking of important data to unauthorized people.

Marketing

The increasing popularity of the internet has transformed the basis of marketing in the hospitality industry. A group of suppliers, consultants, analysts, academics, researchers and development specialists, government officials, and industry-association executives and leaders stated that training marketers to use ICTs and having ICT reports for marketing are the most urgent and important for the future of marketing in the hospitality industry (Dev and Olsen, 2000). In order to improve the performance of hospitality firms, hospitality organizations are thus strongly encouraged to make use of web-based marketing (Gray *et al.*, 2000). Moreover, the internet and word-of-mouth are the most powerful promotional methods used by hospitality-related firms (Stewart and Barr, 2005). Although ICTs play a crucial role in the hotel industry for service delivery, product differentiation, and organizational economies, some luxury hotels are still reluctant to take advantage of automation as they largely rely on human resources to deliver more customer-oriented and personalized services to their guests (Connolly, 2000).

Competition among hotels is vigorous, so the manner of setting up proper e-marketing strategies is also crucial. E-marketing practices in the hospitality industry are no longer involve simply establishing of an information website. Murphy and Kielgast (2008) highlighted that the most important marketing strategy for small and medium-sized hotels is not only to establish their own hotel websites, but to ensure that their websites are visible and easily found by search engines. They also focused on how to market, promote, and advertise a website in the current competitive hospitality

industry (Collins and Murphy, 2002). If hotels fail to do so, they may be marginalized, lose contact with customers, and fail to maximize their revenues (Murphy and Kielgast, 2008). Using bed and breakfast (B&B) marketing strategies in Canada as an example, Hudson and Gilbert (2006) identified B&B hotel owners who were going to adopt the internet as a marketing tool with the aim of increasing their customer base. However, only half of them used the internet to develop long-term relationship with their customers. Similar cases showed that many small and medium-sized hotel managers in Spain and Brazil used their hotel websites as a media tool, but they neglected the potential of direct contact with customers (Schmidt *et al.*, 2008).

Although the internet is an effective and efficient marketing tool in hospitality, it strongly reduces the human touches between suppliers and customers (Law *et al.*, 2009). Since relationship marketing is an integral part of hospitality that develops close relationships between customers and service providers, Gilbert and Powell-Perry (2002) explored web-based relationship marketing in the hotel industry, since hotel websites can serve as an innovative communication channel to deliver multimedia information. Additionally, Murphy *et al.* (2003) analyzed how hotels adopted ICTs for online relationship marketing and electronic customer services. They concluded that hoteliers have become more familiar with using websites and e-mail services. Later, Hu *et al.* (2005) proposed a framework to evaluate electronic relationship marketing (e-RM) characteristics on hospitality and tourism program websites in the USA. Han *et al.* (2005) also mentioned that the development of ICTs can be coupled with relationship marketing in order to create e-relationship marketing and then cater for customer needs. Other than the hotel industry, e-marketing is also strongly promoted by the restaurant industry. An effective website design can be the most powerful marketing tool as proved by Kasavana's (2002) study. Apart from the application of websites, e-mail services can serve as another marketing tool to build relationship with customers. Permission e-mail marketing could record customer preferences and predict future purchasing intentions, thereby better segmenting the targeted customers. Moreover, personalized e-mails will decrease the opt-out rate (Marinova *et al.*, 2002).

Although the implications of ICTs in marketing are stated, it is important to know which factor is the determinant of e-marketing strategy. In this regard, Gregory and Breiter (2001) emphasized that customers' feelings are the most important indicator for lodging properties to determine their marketing and management activities.

Guest services
As mentioned previously, one of the benefits of the adoption of ICTs is to improve guest service quality. Two studies conducted in the UK showed that hoteliers could track customers' stay patterns and preferences through information technology and provide personalized services (Palmer *et al.*, 2000), thereby improving customer loyalty (Martin, 2004). In addition, Chathoth (2007) emphasized that the use of information technology acts as a replacement in the hotel industry for service production and process delivery. The study concluded that the effective use of ICTs not only improves service quality, but also maximizes guest satisfaction, thereby increasing profitability. Singh *et al.* (2006) investigated the impacts of ICTs on guest satisfaction, guest convenience, and operational efficiency in the Korean hotel industry. Their findings suggested that the impacts of ICTs vary in terms of category of hotels. It is important for managers to select and implement the most appropriate technologies in their hotels

in order to enhance service quality. Beldona and Cobanoglu (2007) assessed guest preferences in terms of guestroom technologies and their importance. Their results showed that internet access is an essential facility in the lodging industry. Also, the performance of basic technologies, such as in-room temperature controls and an alarm, do not meet the standard of customers' expectations; while new technologies, such as plasma TVs and in-room printers and fax machines, are ranked as less important but perform better (Beldona and Cobanoglu, 2007). Hence, hoteliers could conduct similar studies in order to provide appropriate technologies to customers for enhancing services to guests. Similarly, Murphy *et al.* (2007) focused on the application of e-mail to customer services. Their findings supported the dimensions of e-mail service quality corresponding to SERVQAL-P's four dimensions including, i.e.:

(1) tangibles;

(2) responsiveness;

(3) personalization; and

(4) reliability.

With the increasing importance of the role of websites in hospitality, the channel no longer only serves as a platform for sharing information and facilitating transactions between customers and hotel companies – it also enhances service quality (Law and Liang, 2005). Jeong and Lambert (2001) conducted a study to evaluate the performance of lodging websites on customers' purchase behavior intentions. The study concluded that perceived usefulness and attitudes are the most powerful determinants that influence customers' purchase behavior. Jeong (2004) conducted another study regarding the performance of B&B hotel websites in terms of customers' behavioral intentions. The empirical findings showed that customers' satisfaction with information provided by websites is the most significant indicator of customers' intentions to re-use those websites. Later, Law and Liang (2005) evaluated the performance of China-based hotel websites and US-based hotel websites. Their conclusion was that hoteliers in China should spend more time and pay more attention to developing their websites in order to meet their customer's needs. Apart from studying the overall performance of websites, it is important to find out the barriers that inhibit e-business. A study conducted on five Chicago hotels indicated that hotels should provide multilingual communications through their websites to improve guest services based on customer preferences (Ho, 2002). Law and Chung (2003) further examined the performance of Hong Kong hotel websites among different hotel categories. The results indicated that the performance scores among luxury, mid-priced, and economy hotels are significantly different. In addition to the customer-oriented business website, the performances of restaurant and hospitality school restaurant websites were analyzed to identify good practice standards (Moreo *et al.*, 2007). In addition, implementation of radio frequency identification (RFID) on playing cards not only allows casinos to keep track of and monitor their guests' preferences, but also provides personalized services and rewards to frequent guests, thereby enhancing customer loyalty (Wyld, 2008). These are the ways for hospitality and tourism practitioners to implement ICT applications in order to improve customer services.

However, although using ICTs in the hospitality industry is a new trend because of its cost effectiveness and productivity, lack of consideration of the national cultures of

customers could worsen customer service and organizational performance (Fisher and Beatson, 2002).

Strategic and operational management

ICTs can act as a strategic and operational tool for hospitality managers (Law and Jogaratnam, 2005). At an early stage, hotel managers were reluctant to use ICTs and this problem could negatively impact the future of the hotel industry (Law and Lau, 2000). Later, Law and Jogaratnam (2005) found that hotel decision makers did not understand the importance of ICTs in business practices, and for this reason, ICTs were not used in high-level business decision-making processes. A case study in Hong Kong and Singapore has demonstrated that leveraging information technology and product differentiation had the least confidence of competitive strategies in hotels (Wong and Kwan, 2001). Also, the impact of new technology was categorized as one of the key issues in the future of the hospitality industry (Burgess, 2000) but it is also a challenge to manage this properly (O'Connor, 2008b). In addition, Paraskevas and Buhalis (2002) pointed out that managers of independent hotels are resistant to implementing ICTs, and would thus encounter difficulties in competitive advantages. Also, Croes and Tesone (2004) noted that hospitality-related small to medium-size enterprises have not made enough effort to use technology applications in both back offices and front offices. Ayeh (2006) commented that organizational characteristics are a major determinant for Ghanaian hotels in adopting the internet for business practices, while costs and inadequate knowledge are the challenges to implementing ICTs. Although e-business is encouraged in the hotel industry, uncertainties have arisen in different departments. For example, Kothari *et al.* (2005, 2007) conducted two studies to determine the benefits of the adoption of e-procurement, and the studies found various challenges faced by hoteliers in the adoption and implementation of e-procurement.

It is generally known that ICTs help hotels to increase competitiveness (Camisón, 2000). Pernsteiner and Rauseo (2000) suggested that the hospitality industry should remove some barriers towards e-business and encourage the development of ICTs at different organizational levels. On the other hand, the reasons for Thailand hotels to adopt ICTs are divided into location-related and firm-related factors (Sahadev and Islam, 2005). Likewise, a study on Cuban hospitality organizations identified group management skills, project management skills, learning culture, and government support as the factors for the development of technological capability (Kumar *et al.*, 2008). ICTs also help managers to increase their job performance. Mia and Patiar (2001) indicated that general managers and department managers make use of management accounting systems for short- and long-term strategies and the performance of hotel managers is positively related to the interaction of their use of ICTs and budgetary participation (Winata and Mia, 2005). However, Patiar and Mia (2008) later performed a similar study and concluded that there is no relationship between market competition and managers' use of management account systems. No matter how powerful the application of ICTs in hospitality is, it is important to know that practitioners should be satisfied with the performance. Green and Weaver (2008) indicated that staff from the food service industry are generally satisfied with the approaches, techniques, and information systems that are implemented in their companies. Additionally, the adoption of ICTs can be used in environmental scanning in hotels (Jogaratnam and

Law, 2006). Regarding the food industry, Aghazadeh (2004) emphasized that business-to-business and e-commerce are the ways to improve logistics operations in a food supply chain process, but the lack of formal capital might explain the reason why restaurants lack ICT leadership (Oronsky and Chathoth, 2007).

Table II shows a summary of the 88 hospitality ICT research articles in the seven dimensions.

Managerial implications and conclusions

It is inevitable that some hotel practitioners fail to appreciate the benefits of ICT applications, since the hospitality industry is customer-oriented and service-oriented. As discussed previously, some managers do not have adequate knowledge of ICTs and thus do not rely on their applications to business practices. In order to remain competitive in the current business environment, hospitality managers have to understand the potential advantages of ICT applications, and devote their time and effort to taking advantage of new technologies. To achieve this goal, hospitality managers should maintain a good relationship with their existing customers by using appropriate ICTs, integrating ICTs into the company's strategies, and enhancing their employees' knowledge on ICT proficiency and ICT trends (Law et al., 2009).

In summary, this study analyzed 88 ICT-related research articles from 1999 to 2008 in order to provide a comprehensive overview of the development of ICTs in the hospitality industry. As mentioned previously, the adoption of ICTs is evident in different departmental areas in a hotel, including human resources and training, security, reservations, revenue management, marketing, and guest services, as well as strategic and operational management. In terms of human resources and training, as the hospitality industry is a knowledge-based business (Cox, 2003), employees in a hotel should catch up with up-to-date information in order to enhance operational efficiency and improve service quality. Therefore, using the internet is a way for hoteliers to offer web-based training (Clemenz et al., 2000) to employees in order to remain competitive. Customers can make use of online computerized reservation systems to complete hotel reservations without any temporal or geographical constraints. Not only can customers benefit from the applications of ICTs, hotels can also take advantage of using web-based marketing for promotion (Gray et al., 2000) and developing electronic customer relationship management through websites and e-mail services (Kasavana, 2002). The use of ICTs could record customers' preferences

Dimension	ICT-related papers	
	n	Percent
Strategic and operational management	21	24
Revenue management	19	22
Marketing	15	17
Guest services	14	16
Human resources and training	11	12
Security	5	6
Reservation	3	3
Total	88	100.0

Table II.
Number of hospitality ICT studies in different dimensions

and then provide more personalized services, thereby developing long-term relationships with customers.

Although the use of ICT-related applications could benefit the hospitality industry, there are some challenges that hoteliers should not overlook. For instance, no one should fail to notice the importance of IT security. As mentioned, ICTs could provide a platform for hospitality managers to collect customers' personal details, including names and credit card information. Retaining these data could lead to the potential problem of personal data privacy if there is a lack of guidance and legislation (Piccoli, 2008). Also, it is obvious that the internet has significantly changed how hotels distribute and price their products. As such, it is desirable for consumers to use online distribution channels for convenience, detailed information, and attractive prices (O'Connor and Murphy, 2004). However, a strong reliance on these online intermediaries may lead to a chain of challenges including a reduced room rate and decreased hotel profitability (Carroll and Siguaw, 2003), as well as survivability. Furthermore, it is commonly known that the adoption of ICTs can help hotels to increase their competitiveness (Camisón, 2000). Still, different studies have shown that hotel practitioners are reluctant to use ICT applications (Law and Lau, 2000; Croes and Tesone, 2004; Law and Jogaratnam, 2005; Kothari *et al.*, 2005, 2007). In order to counteract these difficulties, it is suggested that hoteliers should work closely with IT managers to examine the possibility of adopting new technologies, and change their marketing strategies from time to time in order to cater for these changes.

Wireless network technologies are seeing dramatic developments; adopting mobile devices could enhance customer service quality. Using hand-held wi-fi terminals such as personal digital assistants (PDAs) could allow hotels to provide check-in services inside guest rooms. This could also avoid customers waiting too long at the reception counter, leading to them feeling more comfortable and relaxed. With the increasing volume of business from online channels, hotel managers should put more effort into their online pricing strategies. Although there are some challenges posed by online distribution channels, hotel managers should provide strict rate parity and a best rate guarantee across different channels. Therefore, hotels could take advantage of direct transactions between their websites and customers (Gazzoli *et al.*, 2008). Also, hotel managers could consider offering special products solely on their websites to attract customers to make direct bookings and develop a closer customer relationship (Gazzoli *et al.*, 2008). By increasing direct transactions, hotels would reduce the cost and reliance of online distribution channels to increase profit margins. Moreover, last-minute rates should be offered to maximize yield. Currently, many managers treat websites only as a supplementary marketing channel and they put very little effort into pricing strategies (Dabas and Manaktola, 2007). By linking the hotel's website with the property management system, sales personnel could make immediate adjustments to the website room rate to maximize yield without delay.

Regarding IT security, with the increasing number of hotel bookings being made on the internet, different kinds of customers information such as credit card and passport numbers are stored on database servers. As a result, data security on hotel websites should be enhanced to protect customers' personal data. Implementing data encryption and socket security layer (SSL) could help safeguard confidential data from unauthorized capture. Search engine ranking is another area that is largely overlooked by hotel mangers, even though the visibility of a website directly affects their

e-business performance. If a website does not have a high search engine ranking, the competitive power of that company will be lowered. Apparently, the internet is a main source of information for consumers. Many of them rely highly on the information from consumer-generated media rather than blindly trusting the information provided by service providers. It is thus recommended that hotel managers should provide a "true dialogue" between hotels and customers (Hennig-Thurau and Walsh, 2003) on their websites. An example is to provide instant feedback to customers' comments. At the same time, anyone could read consumers' opinions and companies' feedback, through which those hotels would gain trust from the public. In addition, hotel managers should frequently evaluate guests' reviews/comments posted in different electronic word-of-mouth channels, so that they could better understand the performances of their hotels and customers' preferences, thereby developing better hotel marketing and pricing strategies. This is a new platform for communication between hotels and customers, so there is the opportunity for managers to find out what customers like and dislike. Hotel managers should spend more time and efforts establishing this effective communication strategy by addressing customers' complaints to gain customers' trust and return business.

The rapid development of ICTs has led to an unprecedented revolution in the hospitality industry. At present, ICTs are used as new tools for hospitality marketing and management, as well as a platform that links suppliers and customers. Increasingly, the impacts of ICTs are becoming stronger as they are an integral part of the competitiveness of hospitality firms. This paper reviews the development of ICT usage in hospitality from the perspective of suppliers. It contributes to enabling hospitality practitioners and researchers to better understand the recent research findings and the managerial applications of ICTs. On the basis of the findings of a content analysis of 88 published articles, ICTs appear to play an important role in strategic and operational management. Despite the strong emphasis placed on ICTs by hospitality researchers, some managers are still reluctant to fully implement ICTs in their organizations.

A major limitation of this study is the inclusion of relevant publications only from selected journals. In this study, eight leading hospitality research journals were included. Publications from other journals, particularly information-technology-oriented publications such as *Information Technology & Tourism*, *Information Technology in Hospitality*, and proceedings of the ENTER conferences, the world's largest annual event on tourism technology, were excluded. Moreover, this study focuses only on the perspective of suppliers, and the perspective of consumers and technological development are not examined. Hence, future studies should incorporate these other aspects into the analysis. Also, it is suggested that research should go a little further to compare these categories of studies in hospitality and tourism with those in mainstream business in order to identify gaps in the research that need to be filled regarding hospitality ICT.

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