

Cornell Hospitality Quarterly

<http://cqx.sagepub.com/>

Evaluation of Hotel Information Technologies and EDI Adoption : The Perspective of Hotel IT Managers in Hong Kong

Rosanna Leung and Rob Law

Cornell Hospitality Quarterly 2013 54: 25 originally published online 3 August 2012

DOI: 10.1177/1938965512454594

The online version of this article can be found at:

<http://cqx.sagepub.com/content/54/1/25>

Published by:



<http://www.sagepublications.com>

On behalf of:



The Center for Hospitality Research of Cornell University

Additional services and information for *Cornell Hospitality Quarterly* can be found at:

Email Alerts: <http://cqx.sagepub.com/cgi/alerts>

Subscriptions: <http://cqx.sagepub.com/subscriptions>

Reprints: <http://www.sagepub.com/journalsReprints.nav>

Permissions: <http://www.sagepub.com/journalsPermissions.nav>


Citations: <http://cqx.sagepub.com/content/54/1/25.refs.html>

>> [Version of Record](#) - Dec 18, 2012

[OnlineFirst Version of Record](#) - Aug 3, 2012

[What is This?](#)

Evaluation of Hotel Information Technologies and EDI Adoption: The Perspective of Hotel IT Managers in Hong Kong

Cornell Hospitality Quarterly
54(1) 25–37
© The Author(s) 2013
Reprints and permission:
sagepub.com/journalsPermissions.nav
DOI: 10.1177/1938965512454594
http://cqx.sagepub.com


Rosanna Leung¹ and Rob Law¹

Abstract

This study examines information technology (IT) applications, the adoption of electronic data interchange (EDI) among hotel systems, and management support for IT departments in a sample of Hong Kong hotels. The empirical results indicate that most hotels have not installed decision support or strategic management tools. In addition, the ratio of EDI implementation between hotel systems and web applications is relatively low. The rate of adoption of automated credit card authorization, which can enhance the security of customer data, is only 6 percent for the property management system (PMS) and 17 percent for point of sale (POS) applications. In keeping with the increased importance of hotel IT systems, the background of hotel IT managers has changed dramatically in the past decade. Many more have IT-related qualifications, with almost 70 percent holding a bachelor's degree or higher. Because of the low adoption of EDI, the authors propose a revised EDI adoption model. The original model includes perceived benefits, external pressure, and organizational readiness. Within organizational readiness are financial resources and IT competence, and to those two factors the new model adds IT managers' attitude toward and awareness of EDI.

Keywords

IT managers, EDI, information technologies, purchase support, knowledge level

Information technology (IT) is inseparable from business operations, customer services, cost control, and strategic planning (Laudon and Laudon 2010; Law, Leung, and Buhalis 2009; Nyheim, McFadden, and Connolly 2005). IT is one of the most important tools for business, especially in the hospitality industry, and its role has changed from supporting operations to assisting strategic decision making (Winata and Mia 2005), marketing (Connolly, Olsen, and Moore 1998; Ip, Leung, and Law 2011), data exchange (Chwelos, Benbasat, and Dexter 2001; Iacovou, Benbasat, and Dexter 1995; Ip, Leung, and Law 2011; Kuan and Chau 2001), and room reservations.

With an increasing number of users searching for and reserving accommodation online (Australian Government 2011; U.S. Travel Association 2009), hotel managers have begun to invest large amounts of staff time in handling room allotments and reservation data received from travel websites. However, apart from chain hotels whose central reservation systems (CRSs) are connected to popular travel websites, most hotels' property management systems (PMSs) are still not interconnected with these online channels. Instant confirmation of online bookings from hotel websites strongly hints at the need for an interface across

various applications. For instance, an interface between the booking engine and the PMS is required, as confirmed online bookings can directly affect room inventory. In addition, payment has to go through an instant credit card authorization process, which involves an interface with bank or payment gateway vendors. Furthermore, to attain better rate management, yield management systems (YMSs) can be used to monitor occupancy and customer booking patterns and hence recommend daily room rates. To make full use of this tool, an interface between YMS and PMS is required. Customers searching for last-minute bookings expect quick responses. For these reasons, hotels should benefit from electronic data interchange (EDI) to improve data and server security, augment operational effectiveness, and speed up applications and reduce clerical errors (Kuan and Chau 2001; Iacovou, Benbasat, and Dexter 1995; Mukhopadhyay and Kekre 2002). EDI enables applications to transfer

¹Hong Kong Polytechnic University, Kowloon, Hong Kong

Corresponding Author:

Rosanna Leung, Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong SAR, China
Email: rosanna.leung@connect.polyu.hk

customer data electronically within organizations “by the most convenient method and to deliver the right information at the right time to the right user at the right cost” (Buhalis and Law 2008, 614). Given the current environment, the need to use IT to connect hotel PMSs to other systems has increased dramatically. To cater to these changes, the role of hotel IT managers has changed from providing operational support to developing technical and strategic solutions.

To study the extent of EDI and the changing role of IT staff, we examined hotels in Hong Kong, where the government has initiated an electronic data ordinance that encourages business organizations to implement EDI (Hong Kong Special Administrative Region 2004), and which already has a comprehensive network infrastructure with a broadband penetration of 68.5 percent (Internet World Stats 2011). Boosted by a significant increase in the number of visitors from Mainland China, Hong Kong has seen rapid growth in recent years. The total number of overnight tourist arrivals in Hong Kong increased by 74 percent between 2003 and 2009, from 9.7 million (Hong Kong Tourism Board [HKTb] 2004) to 16.9 million (HKTb 2010b). The number of hotels in Hong Kong has increased accordingly, from 96 in 2003 (HKTb 2004) to 173 in 2010 (HKTb 2010a), and the number of hotels is expected to reach 233 by 2016. This will create a total of 70,784 guest rooms, an increase of more than 10,000 from the 60,102 available in 2010 (HKTb 2010a). Such a large supply will inevitably lead to fierce competition in an already highly contested industry.

In view of the importance of IT applications to the Hong Kong hotel industry, our study addresses the following research questions:

1. What are the current adoption levels of hotel IT applications and EDI or interface links in Hong Kong?
2. What are the factors that influence the level of EDI adoption among Hong Kong hotels?
3. What have been the main changes in hotel IT departments over the past decade?

Literature Review

IT Applications and EDI Adoption

Contrary to the common perception that the hospitality industry does not use information systems, IT systems are used throughout hotels. Fuchs, Witting, and Höpken (2009) list eleven applications that are typically employed in hotels. These include PMSs, costing and accounting systems, enterprise resource planning, yield management, human resources management (HRM), electronic customer relationship management, intranet, email marketing, websites

with booking functionality, e-procurement, and online platforms. The core applications installed in most major hotels are PMS and cost and accounting systems, which handle front- and back-office operations.

Needless to say, the reason that hotels install IT systems is to improve operations, although the record is mixed. In part, this has been a situation of IT catching up with operations. The findings of a 1996 study conducted by David, Grabski, and Kasavana (1996) indicated that hotel chief financial officers (CFOs) believed that using computer applications in a front office would have a large impact on productivity but that enhancements to back-office systems would have less effect. Shortly after that, researchers suggested that the functionality of existing back-office systems did not provide enough in the way of management tools to enhance managers' strategic planning and marketing decisions (Siguaw, Enz, and Namasivayam 2000). We could find no further studies. Since that time, with the increasing desire for rate management and the growing number of online marketing channels, the demand to improve back-office applications has also increased.

Studies that have examined the relationship between IT and hotel management have confirmed the value of IT. For instance, Kim and Ham (2006) found that all core front-office IT applications significantly improved service quality in upscale hotels, and Chathoth (2007) showed the value of implementing IT for full-service hotels to improve service and increase employee morale. Even as late as 2008, O'Connor's (2008) interviews with European chief information officers (CIOs) found that the industry was half a generation behind other industries, despite rapid IT adoption. Looking at this record, we believe that hotels are generally conservative about implementing IT. Two studies of IT in Hong Kong (Law and Au 1998; Law and Jogaratnam 2005) concluded that Hong Kong hotels tend to have low levels of new technology adoption. That said, there's no doubt that Hong Kong hotels use numerous IT systems. We are aware of no studies that have examined EDI adoption in the context of hotel IT.

As indicated, hotel IT incorporates a range of applications using numerous platforms and vendors. Sokol (1995) investigates the business environments that are suitable for EDI adoption and suggests that they include industries that are people intensive, involve rapid information processing and speedy delivery of goods, or are paper intensive. Clearly, the hotel industry perfectly matches these characteristics. Findings of prior studies identify three factors that affect an organization's EDI adoption, namely, perceived benefits, organizational readiness, and external pressures (Kuan and Chau 2001; Iacovou, Benbasat, and Dexter 1995; Mukhopadhyay and Kekre 2002). From this EDI model, our study focuses on the two internal factors of perceived benefits and organizational readiness.

Organizational Readiness for EDI Adoption

Although numerous studies show that hotel managers agree that IT can improve customer service quality (van Hoof, Verbeeten, and Combrink 1996; Law, Leung, and Buhalis 2009) and increase revenue (Huo 1998; Siguaw, Enz, and Namasivayam 2000), other findings indicate that the hospitality industry has generally been conservative in adopting new technologies and has lagged behind in terms of IT adoption (Namasivayam, Enz, and Siguaw 2000; O'Connor 2008). O'Connor (2008) indicates that two of the main challenges faced by CIOs in chain hotels are data consolidation and interfacing. In addition, because there is no industry-wide interfacing standard for data exchange among dissimilar systems, hotels need to invest in interface program development. However, the return on this type of investment is often difficult to measure (Watkins 2000). Hence, many hotel managers hesitate to make such an investment.

Many hotel managers consistently rank their knowledge on IT as low (Kay and Moncarz 2004), a factor that may delay IT adoption (Nambisan and Wang 2000). Communication issues may also interfere with adoption. In Hong Kong, most hotel IT managers report directly to the CFO, and they find it difficult to communicate with nontechnical supervisors (Law and Au 1998). As a result, hotel managers think it is difficult to grasp the advantages of adopting the latest technologies or fail to understand the importance of IT. Perhaps as a consequence, IT managers in hotels are likely to have difficulties in getting budget allocation for new facilities (Burgess 2000).

Traditionally, hotel IT managers have mainly performed a supporting role, and some were not even originally educated in the computing field. Instead, many were either front office or finance staff who were adept at handling general computer operations (Hsu 1995). American researchers found that only a small percentage of hotel IT managers are graduates of computer-related programs; 86 percent of IT managers also reported that their hotels do not require any IT-related qualifications for the position (Cobanoglu, Dede, and Poorani 2006). A study conducted in Hong Kong shows that in 1997 around 38 percent of hotel IT managers were graduates of IT-related programs, a figure that grew to 50 percent by 2003 (Law and Jogaratnam 2005). As the network infrastructure becomes more complicated, hotel IT managers need to handle not only internal network administration but also data interchange among various systems, data security, infrastructure design, and web applications. As such, hotel IT managers now need to provide operational support as well as technical advice.

Method

The interview instrument used in this study was developed based on prior research by adapting a list of hotel IT

applications and guest room devices from Law and Jogaratnam (2005). The guest room devices include a call accounting system, in-room fax, movies, and wired or wireless internet connection, automatic minibar, IP phone, electronic door lock, energy management system, and express checkout via TV. In addition, we used questions on EDI adoption from Kuan and Chau (2001). To test this list, we arranged two focus group discussions in April 2009. The first focus group comprised one hotel IT manager, one industry practitioner (a hotel software sales executive), and one university faculty member, while four hotel IT managers participated in the second group. We presented the list of applications and invited group members to review it and make changes. We also asked them to indicate which areas of IT implementation and EDI adoption interested them. The participants said they would like to know more about what other practitioners did in terms of data security and contingency planning, and the IT managers group was interested in the relationship between senior managers' IT knowledge and their support for IT purchasing.

The resulting questionnaire consisted of four sections. The first section covered the technical aspects of software applications and hotel EDI and interface adoption. Participants were asked to express their level of satisfaction with hardware, software, and operating systems using a 7-point Likert-type scale. Using the list generated by the focus group, the IT managers were asked to list the brands and current version numbers of the applications currently in use in their hotels. In addition, they were asked to indicate whether these applications were communicating with others via an interface or EDI. In the second part of the questionnaire, participants were asked to indicate whether their hotels had installed any of the guest room devices on the list. They were also asked to describe any aspects of their current IT setup that they thought could be improved. The third part of the questionnaire focused on management support for technology adoption. We used the two internal factors proposed in the EDI adoption model (Kuan and Chau 2001), namely, perceived benefits and organizational readiness. To examine the perceived benefits, the IT managers were asked whether they or their managers had adopted the EDI applications listed in part 1. Organizational readiness comprises financial resources and technical competence. We also asked the IT managers to evaluate their hotel managers' level of support for IT investment, and the level of technical knowledge of management and general staff, using both 7-point Likert-type scale items and open-ended questions. The final part of the questionnaire covered the current situation of each participant's IT department. To examine longitudinal changes, we adopted the demographic attributes and scales used in two previous studies (Law and Au 1998; Law and Jogaratnam 2005), including academic qualifications and years of experience in hotel IT. To provide a clear picture of the IT situation in these Hong Kong

hotels, our study further evaluated these results based on hotels' star ratings.

In May 2009, we sent out invitations to all members of the Hong Kong Hotels Association, inviting their IT managers to participate in a thirty-minute in-depth interview. A total of ninety-six letters were sent to the general managers of the member hotels. After several rounds of follow-up contacts, managers from thirty-two hotels agreed to take part (5 three-star properties, 18 four-star, and 9 five-star), representing a 32 percent response rate. As some participants were group IT managers who supported several hotels, we interviewed twenty-five people in total. Although we collected our data in Hong Kong, fifteen of the hotels are affiliated with international chains and are thus managed according to international standards. Therefore, our findings are likely to be relevant to hotels elsewhere in the world.

Findings and Discussion

Interhotel IT Applications and Interface Adoption

The major IT applications installed in Hong Kong hotels have changed little over the past decade, as documented in prior studies (Law and Au 1998; Law and Jogaratnam 2005). Most applications are for handling daily operations, such as PMS, finance, sales and catering, POS, HRM, and inventory management. All hotels in our study had installed PMS, finance, and HRM systems. Two hotels were not equipped with POS systems because they did not have food and beverage outlets. Other than these core systems, twenty-nine hotels (91 percent) had installed inventory management systems to process procurement and monitor inventory levels. In addition, twenty-one (66 percent) hotels had installed sales and catering systems to monitor the daily activities and productivity of their sales staff.

Exhibit 1 lists the popular IT applications and brands adopted by the hotels in our study. Overall, 60 percent of the hotels had installed PMSs, 34 percent inventory management, 24 percent sales and catering, and 6 percent finance applications. After examining the market share of each provider, we found Micros-Fidelio to be the most popular brand. We also noticed that although over half of the hotels used the Micros-Fidelio PMS, only 5 percent had also installed that vendor's sales and catering module. Instead, two-thirds (67 percent) of the hotels with sales and catering applications had installed Delphi's application, which focuses solely on sales and catering management, because (according to the IT managers) Delphi's functions are stronger. Thus even though it cost more to use different vendors' apps, hotels were willing to invest additional funds to acquire the Delphi system. Similarly, Oracle's E-Business Suite for accounting and inventory accounted for 27 percent

of accounting installations and 21 percent of inventory applications, as compared to 6 percent of the hotels that used the Micros-Fidelio finance applications. Seeking to integrate the front and back of the house, Micros-Fidelio formed an alliance with Sun Accounting to market a package to hotels, resulting in some increase in the number of Sun applications. A unified application may not yet be ideal for hotels, though, since we found that only 19 percent of the hotels had interconnected their core PMS and finance applications. One IT manager stated that his hotel's interfaces automatically transfer daily PMS data to the finance system, but this still required lots of manual back-office adjustments, such as meal allowances and rebates. As a result, the automatic transfer of PMS data sometimes created confusion.

Our findings also show that the majority of software applications adopted by Hong Kong hotels are from North American vendors, with the exception of human resources applications, all of which were locally developed. Because Hong Kong has significantly different taxation and labor laws than those of Western countries, respondents chose locally developed HRM packages rather than trying to modify international modules. Hong Kong's HRM system vendors not only worked with hotels but also were experienced in local HRM issues. Therefore, general and IT managers alike felt comfortable using these applications, as they matched the Hong Kong government's requirements exactly.

The most popular brand of POS application is Infrasy, which had a 55 percent market share in our study. Similar to the HRM apps, Infrasy was developed by a Hong Kong-based company and was designed to handle the unique operational procedures of Chinese restaurants, which elude American and European POS systems. Although branding is important, in this case it is overridden by functions. Interestingly, we found that one Hong Kong-based hotel chain had developed its own PMS to interconnect all affiliated hotels, while another local hotel had developed its own sales and catering applications to address its special needs. All of these POSs interfaced with the PMS in hotels.

Guest Room Devices and Interface Adoption

The hotels' installation of guest-related devices ranged widely. All hotels used call accounting for guest telephone use, and all had installed electronic door lock systems. Most offered in-room movies (88 percent) and internet connections (97 percent wired, 81 percent wireless). Other devices that were not found as frequently included fax (41 percent), IP phone (14 percent), energy management system (50 percent), and express checkout services (59 percent). All participating hotels had installed at least three guest room devices, while four of the five-star hotels had equipped their guest rooms with seven such devices.

Exhibit 1:
Popular Brands of Core IT Applications in Hong Kong Hotels

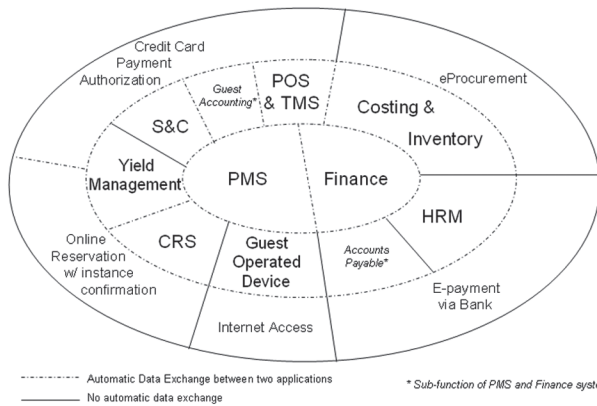
	%	Dev	5 Stars (%)	4 Stars (%)	3 Stars (%)
Property management system (n = 32)					
Micros-Fidelio	63	A	25	55	20
MIRO-Hotel self-developed	16	L	40	60	0
Hotel Information Systems	13	A	0	75	25
Springer Miller Systems	6	A	100	0	0
CIF	3	L	0	100	0
Total	100				
Finance (n = 32)					
Oracle E-Business Suite	25	A	38	63	0
Solomon	18	A	0	67	33
Sun Accounting	18	A	50	50	0
Micros-Fidelio	6	A	50	0	50
CIF	6	L	0	100	0
Iscalar	6	A	0	100	0
Hotel Information Systems	3	A	100	0	0
Others	12		25	50	25
Total	100				
Point of sale applications (n = 30)					
Infrasys	55	L	50	38	13
Micros	26	A	25	69	6
Others	19		17	67	17
Total	100				
Human resources management (n = 32)					
IPL	25	L	38	50	13
MRC	19	L	33	67	0
CIF	9	L	67	33	0
HR21	9	L	33	33	33
Others	38	L	8	67	25
Total	100				
Inventory system (n = 30)					
Micros-Fidelio	36	A	30	50	20
Oracle E-Business Suite	18	A	40	60	0
Solomon	14	A	0	75	25
CheckEAM	11	Aust	67	33	0
Iscalar	7	L	0	100	0
CIF	7	A	0	100	0
Others	7		100	0	0
Total	100				
Sales & catering (n = 21)					
Delphi	62	A	54	46	0
Micros-Fidelio	33	L	29	57	14
Hotel self-developed	5	L	0	100	0
Total	100				

Note: Dev = country of development: A = North America; Aust = Australia; L = local.

To provide guests with a more comprehensive internet connection service, twenty-six hotels (81 percent) had installed both wired and wireless connections. Beyond that, one four-star hotel had installed only Wi-Fi, and six hotels provided only wired connections. On average, 71 percent of the guest room devices were interfaced with hotels' PMSs.

The interface programs were mainly used for transferring the charges incurred directly to customers' bills, thereby saving frontline staff's time on transaction input. Nineteen hotels (59 percent) had adopted express checkout systems, but ten of them indicated their system had not yet been released for customer use. The main reason for this was that

Exhibit 3:
Interconnectivity of core hotel IT applications



Note: CRS = central reservation system; HRM = human resources management; OTA = online travel agent; PMS = property management system; POS = point of sale; S&C = Sales & Catering; TMS = Table Management System.

internal control for both the issuing bank and the hotel compared to paper checks. When we asked the remaining three-quarters of the hotels “Why was electronic banking not adopted in your hotel?” several IT managers explained that their senior managers did not feel comfortable simply punching authorization codes into the system to authorize batches of direct payments. These managers felt that signing individual checks forced them to review payments one by one.

As well as online payments from websites, a few hotels use credit card authorizations within their PMS and POS, which improves security and accuracy since card numbers are no longer visible to hotel staff and all payments are processed automatically on the PMS server, avoiding any discrepancies in charges. Unfortunately, this function is not fully supported by banks in Hong Kong. At the time of our study, IT managers told us that only one bank provided a payment gateway interface program to PMS vendors, and the cost of subscribing to it was high. As a result, only 6 percent of PMS and 17 percent of POS systems in our study used direct credit card authorization.

Given the increasing number of interhotel and web applications, we propose an ideal interconnectivity scheme for core hotel IT applications to minimize clerical errors, increase operational efficiency, and ensure data security (Exhibit 3). Rate strategies on the hotel website, CRS, and online distribution channels (i.e., GDSs and OTAs) are controlled by yield management price rules to maximize potential revenue. The advantages of adopting an online payment gateway within this scheme are twofold. First, without human input to credit card terminals, direct authorization lowers the rate of data discrepancies, saving the time of frontline and finance staff in locating errors. Furthermore,

Exhibit 4:
Levels of Satisfaction with Hong Kong Hotel IT Settings

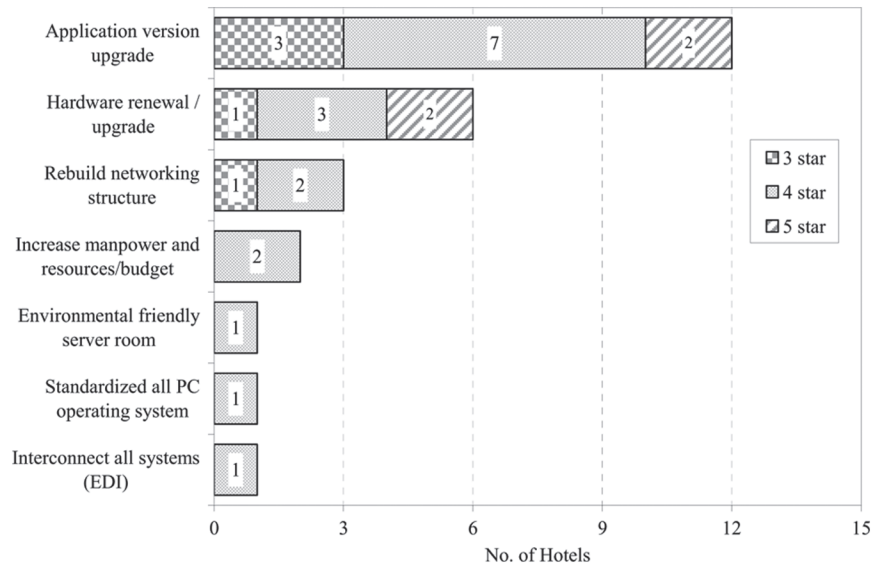
		5 Stars (n = 9)	4 Stars (n = 18)	3 Stars (n = 5)	Overall (n = 32)	F	Sig.
Hardware satisfaction	M	5.89	5.39	5.00	5.47	1.920	.165
	SD	0.33	1.04	0.71	0.88		
OS satisfaction	M	5.44	5.17	5.40	5.28	0.361	.700
	SD	0.73	0.92	0.89	0.85		
Application satisfaction	M	5.33	5.11	5.40	5.22	0.375	.690
	SD	0.50	0.96	0.55	0.79		
Overall satisfaction	M	5.56	5.00	5.20	5.19	2.063	.145
	SD	0.53	0.69	0.84	0.69		

all credit card information is encrypted and stored on a secure server, thus providing protection against theft. When interfaced with POS and inventory management systems, menu engineering systems can easily generate costing reports and provide strategic analyses of item popularity. As a result, food and beverage managers can alter their menu items to maximize profit and minimize costs. The interconnectivity of inventory systems with e-procurement applications can assist procurement departments in automating item replenishment. Quotes from selected vendors automatically update on the procurement system, and purchase orders can be transmitted to suppliers without delay. Last, an internet connection is the most important guest-room device in a hotel (Beldona and Cobanoglu 2007). Hotel managers must therefore ensure their connection performs well and train frontline staff in handling in-room internet connectivity problems.

IT Managers’ Perceptions of Their Hotels’ IT Settings

Our study also examined IT managers’ satisfaction with their current IT setup in regard to the four key areas of hardware, operating systems, applications, and overall performance. Exhibit 4 sets out the descriptive statistics of satisfaction evaluations. In terms of speed, functionality, and user satisfaction, the ratings ranged from 4 to 6, with a mean value of 5.19 and standard deviation of 0.69. The majority of IT managers were happy with the systems they were using, which they described as being stable. Although the mean scores for the five-star hotels in three areas (except applications) were higher than the scores for four- and three-star hotels, ANOVA test results showed no statistically significant difference among hotels with different star levels. Hardware satisfaction received the highest mean score of 5.47, with a standard deviation of 0.88, indicating IT managers were quite satisfied with their current infrastructure. Four IT managers (12 percent) working in three- and four-star hotels indicated that they were “neutral” or

Exhibit 5:
Areas for improvement suggested by the Hong Kong hotel IT managers



“not very satisfied” with hardware performance, but the majority were “somewhat satisfied” or “satisfied.” The overall satisfaction ratings for operating systems were slightly lower than the ratings for hardware, with a mean score of 5.28 and standard deviation of 0.85. Five IT managers (15 percent) indicated that they were “somewhat unsatisfied” or “neutral” in relation to their operating systems, and two stated that their computers used a mix of new and old versions that were not easy to support or maintain. Application software received the lowest rating, with a mean value of 5.22 and a standard deviation of 0.79.

The IT managers’ list of suggested improvements included system and software upgrades and standardizing computer operating systems. Twelve respondents indicated that software upgrades were needed, and six wanted hardware upgrades. Lack of time was one reason that applications had not been upgraded. Managers’ hesitation was another reason. For example, one IT manager from a four-star hotel indicated his managers were concerned that new software might have hidden bugs, and so they would not upgrade their system until the majority of Hong Kong hotels had done so and found that the system was bug free. Another manager, from a five-star hotel, stated that as an upgrade takes four to five hours to complete and so would affect morning checkout guests. Hence, many front-office managers were reluctant to upgrade their systems until periods of low occupancy. Standardization of all personal computer operating systems, interconnecting all applications, and making the server room more environmentally friendly were other areas recommended for improvement (see Exhibit 5). Interestingly, only one IT manager (from a

four-star hotel) mentioned the need for interconnectivity among various systems. Asked which technologies would improve the quality of service, most of the IT managers recommended adopting mobile phones as the in-room remote control system (30 percent). Other suggestions included self-service kiosks, additional wireless access points, touch-screen terminals, and iPhone applications. These results indicate that these IT managers focused mostly on the internal network and tended to overlook EDI.

Organizational Readiness for EDI Adoption

Kuan and Chau (2001) point out that organizational context is one of the internal factors affecting a company’s adoption of EDI. Without support from senior management, hotel IT managers cannot make full use of available technologies to assist business growth. The results of our ANOVA test indicated that from the IT managers’ perspective, management’s knowledge of IT was significantly higher in five-star hotels than in the other two categories. This is shown by the mean score for five-star hotels of 5.22, as compared to 4.00 for three-star properties and 4.39 for four-star hotels’ scores. However, when we looked at the IT knowledge level of staff, there were no significant differences among star ratings (Exhibit 6).

Most of the hotel managers participating in this study were unwilling to provide details of their annual IT budget. As such, we were unable to assess the financial factors affecting EDI adoption. When we examined management support for IT purchasing using an ANOVA, the mean level of support in five-star hotels (6.11) was significantly higher

Exhibit 6:
Hotel Employees' IT Knowledge Levels and Management Support for IT Purchasing

		5 Stars (n = 9)	4 Stars (n = 18)	3 Stars (n = 5)	Total (n = 32)	F	Sig.
Management IT knowledge level	M	5.22 ^{1,2}	4.39 ¹	4.00 ²	4.56	5.533	.009*
	SD	0.44	0.85	0.71	0.84		
Staff IT knowledge level	M	5.44	4.72	5.00	4.97	1.760	.190
	SD	0.53	1.07	1.00	0.97		
Management support for IT purchasing	M	6.11 ^{3,4}	4.72 ³	4.60 ⁴	5.09	3.798	.034*
	SD	0.60	1.60	0.89	1.42		

Mean values in the same row with the same superscript number are significantly different at $p < .05$.

*Significant at $p < .05$.

than in the levels in three- (4.60) and four-star hotels (4.72). However, the interviewees expressed different views. Two IT managers from four-star hotels indicated that their senior management was very unsupportive and allocated only a limited amount of the hotel budget to their departments. While six (18 percent) managers expressed neutrality, nineteen (58 percent) indicated their management was very supportive of IT purchasing. To explore the reasons for the slow pace of EDI adoption in the Hong Kong hotel industry, our study also examined the relationship between the IT knowledge level of management staff and their support for IT purchasing. From the perspective of IT managers, the overall correlation between hotel managers' IT knowledge level and their support for investment was 0.63 (significant at the 5 percent level). This indicates there is a positive relationship between the two factors. However, when we examined the correlation in terms of star rating, the difference was significant only for four-star hotels, with a Pearson correlation of .56 (significant at the 5 percent level). One participant from a five-star hotel indicated that his hotel was technology based, so the management fully supported IT purchasing to maintain a "high-tech" image, regardless of their own personal knowledge of IT. That comment suggests that many five-star hotels need to be "high tech" to cater to their customers' needs. So management (whatever their own knowledge level) tends to be strongly supportive of IT purchasing and development. Conversely, one IT manager from a three-star hotel explained that although management knew that IT could help them improve yield management and strategic planning, they were unable to deploy the latest technologies because of budget constraints.

Changes in IT Departments

By comparing our findings with those of prior studies (Law and Au 1998; Law and Jogaratnam 2005), it can be clearly seen that the academic background of IT managers has changed dramatically (see Exhibit 7). The earlier studies both indicate that the highest academic qualification among

IT managers was generally a bachelor's degree, but we found that many IT managers had obtained their master's degrees (28 percent) and one participant even had a doctorate. Furthermore, Law and Au (1998) found that only 38 percent of IT managers graduated in computing-related disciplines, while that percentage was 76 in our study. This strongly suggests that the nature of an IT manager's job has changed from provision of operational support to giving technical advice. The increasing complexity of IT infrastructure and the dependency of operational staff on IT systems also strongly suggest the growing importance of this department.

One IT manager pointed out that although his role has changed as described above, many hotel executives were not yet aware of this and still saw the primary role of an IT department as the provision of operational support. One of the main reasons for this appears to be that IT managers do not usually sit on hotel executive committees and are thus excluded from the decision-making process. In many cases, most of the IT-related information delivered to senior executives came from either the financial controller or the director of engineering. As a result, many technical issues were not clearly communicated to senior management. Nevertheless, the size of IT departments has increased, from an average of 1.60 personnel and a maximum of 3 full-time IT staff in 1997 to an average of 2.15 and a maximum of 6 in 2009.

Conclusions

Our study examined the adoption of IT in Hong Kong hotels according to three dimensions: perceived benefits, financial resources, and IT competence. First, all the participating hotels in our study had equipped themselves with core IT applications and interfaces among different systems. However, the level of EDI was relatively low. Many applications were run on a stand-alone basis, requiring staff to input data manually into one system from the reports generated by another. The adoption rates of strategic management and decision-support applications, such as yield

Exhibit 7:
Changes in IT Departments 1997–2009

	Law and Au (1998)	Law and Jogaratnam (2005)	This Study
Year of data collection	1997 (n = 48)	2003 (n = 21)	2009 (n = 25 ^a)
IT Managers' Background			
Percentage of Total			
Highest academic qualification			
Secondary school or below	39	35	0
Diploma/higher diploma	29	20	32
Bachelor's degree	32	45	20
Postgraduate diploma	0	0	4
Master's degree	0	0	28
PhD	0	0	4
Not available	0	0	12
Major			
Computer science/engineering	38	52	76
Management/business admin/accounting	33	14	16
Other	29	33	8
Number of IT full-time staff			
0	7	5	3
1	39	14	25
2	41	76	47
3	13	5	16
5	0	0	6
6	0	0	3
Number of IT part-time staff			
0	97	80	0
1	3	20	0

a. In all, 32 hotels were included in the study. However, some IT managers represented more than one hotel, so the total number given is 25.

management and menu engineering, were relatively low. The majority of hotels, other than those that were part of chains, did not provide EDI between their PMS and travel websites. Consequently, with the increasing number of online bookings, the workload of reservation departments has increased dramatically. Although many hotel managers admitted that IT offered many direct and indirect benefits, they preferred to maintain control rather than increase efficiency. Signing printed checks rather than using electronic payment and preventing customers from using in-room express checkout systems are two examples of this attitude.

The overall level of satisfaction with IT infrastructure was high, with a mean score of 5.19 out of 7.00, even though many managers knew their systems and hardware needed to be upgraded. From the IT managers' perspective, hotel managers' IT knowledge ranged from neutral to satisfactory. The managers of five-star hotels were perceived to have significantly better IT knowledge than those of three- and four-star establishments.

Even without seeing actual IT budgets, we could get a sense of their financial resources by looking at the level of support for IT purchasing among senior management. We found that managers of five-star hotels were more

supportive than those in the other categories, and we further found that our data suggest that hotel managers with better IT knowledge are more likely to be supportive of investment in this area. Finally, we identified noticeable changes in hotel IT managers' backgrounds over prior years. In terms of academic qualifications, most held postgraduate academic qualifications, rather than simply a bachelor's degree, and had graduated in computing-related disciplines. The average size of hotel IT departments has also increased in recent years.

Managerial Implications

Some of Hong Kong's hotel managers see IT as a tool for strategic planning and decision making. Decision-support applications can provide guidelines for implementing sales strategies for room rates as well as food and beverage costing. While investing in these applications may not provide instant financial returns, it can enhance competitive power in the long term. Unfortunately, five years after the Law and Jogaratnam (2005) study, most IT in Hong Kong hotels is still concentrated on clerical or operational functions.

With the increasing number of reservations coming from online channels, it is now imperative to have web-based EDI between hotels' PMSs and travel websites—and to plan to continue upgrading these systems (Ramdeen, Santos, and Chatfield 2009). Managers should also pay attention to the impact of IT investment decisions because technologies and customer requirements are constantly changing. IT investment and employee training should be established on a long-term basis to maintain competitiveness (Ham, Kim, and Jeong 2005). Since many hotel managers admit to a low level of IT knowledge (Kay and Moncarz 2004), IT managers should actively communicate with them to enrich their understanding of the issues and possibly increase their support for investment.

We noted that e-procurement had not been adopted by any of the participating hotels. Some managers stated that frequent changes of suppliers and vendors would make such an implementation difficult, as would the fact that many suppliers are small firms with limited or no ability to set up such a system (Soares-Aguiar and Palma-dos-Reis 2008). As a result, e-procurement is still an underdeveloped area in the hotel industry.

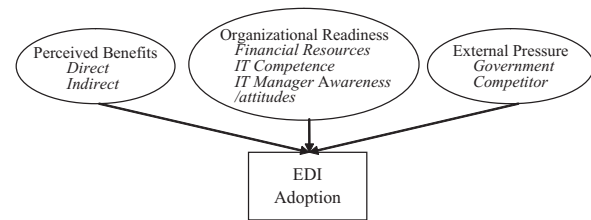
When we asked the participating IT managers to suggest applications that could improve customer service, none of them mentioned social media sites, commonly known as web 2.0. We suggest that hotels need to include Facebook, TripAdvisor, and mobile apps in their strategies, given the increasing number of users using web 2.0 sites and internet applications.

Hotel managers need to be alert to the changes in the role of IT staff. It is no longer sufficient to draw from the ranks of frontline or finance staff who are enthusiastic about IT. IT managers should receive formal technical training and have sufficient expertise to provide professional advice for strategic planning purposes. Beyond that, IT managers' essential skills should include balanced specialization and cross-functional expertise, the ability to develop strong working relationships and communicate well with others, logical thinking, and capacity to manage risk (Weston 2010). According to Prewitt and Ware (2004), when a CIO recruits a new IT manager, the candidate must have a strong knowledge of the technological infrastructure of multiple platforms and systems and understand the hotel business process. While hotel managers use IT for strategic planning, users depend on applications for their daily operations. Now that an increasing number of hotel guests travel with portable computers, hotels need to be able to provide technical support for their customers, or provide training for frontline staff so that they can manage an establishment's internet connectivity. As a result, guest contact staff need to increase their IT proficiency.

Theoretical Implications

This study applied the EDI adoption model to examine the current IT setup among Hong Kong hotels. The model

Exhibit 8: A proposed revised electronic data interchange (EDI) adoption model



examines the adoption level in three dimensions, namely, perceived benefits, organizational readiness, and external pressure. The two factors under organizational readiness in this model are financial resources and IT competence. Based on our study, we propose a third element in organizational readiness: IT managers' attitudes toward and awareness of adoption. In our study, only one IT manager mentioned interconnecting the system via EDI as a needed system upgrade. We believe that this finding indicates a low awareness of EDI. Therefore, we would like to propose a revised EDI adoption model that includes IT managers' attitude toward, and awareness of, EDI (Exhibit 8).

Limitations and Future Research

Our study has several limitations that make it impossible to generalize the findings to the hotel industry as a whole. The first limitation is that we focused on only a limited sample of Hong Kong hotels. A natural extension of this study would be to include more hotels, both locally and internationally, to examine the issue more generally. Since only one-third of the members of the Hong Kong Hotels Association participated in this study, certain sectors may be underrepresented, particularly three-star hotels (only five of which responded). Our interviews yielded information on the annual IT budgets of only eleven hotels. These figures showed a high standard deviation, and for this reason the information was not included in our analysis. Furthermore, we discussed only the core IT applications and excluded many supplementary systems, such as information dispatching, message delivery, in-house mobile phones, hotel- or chain-specific applications, and web 2.0 (such as Facebook and Twitter pages and customers' reviews in the online travel community).

Most system servers of the hotels participating in this study were connected to the internet. With an increasing number of EDI applications having been installed, a tremendous volume of personal information about customers, including their credit card details, was stored on the hotels' servers. Protecting this valuable information by setting up

comprehensive data and system security policies thus becomes one of the primary goals of IT managers (Huseyin and Kerem 2011). To achieve a more comprehensive understanding of hotel IT applications in general, these areas should also be examined in future studies. Siguwaw, Enz, and Namasivayam (2000) concluded about a decade ago that back-office systems do not provide sufficient strategic management tools. A future study could examine whether this is still the case. As mentioned by several IT managers in five-star hotels, their businesses had allocated an adequate amount of budget to maintain a “high-tech” image for their customers. The increase in customer power will force hotels to adopt new technologies that streamline operational procedures and increase data security (Wu, Mahajan, and Balasubramanian 2003). Future research should, therefore, examine customers’ influence on technology adoption.

Acknowledgments

The authors would like to thank the anonymous reviewers, the editor of *Cornell Hospitality Quarterly*, Dr. Norman Au, Dr. Andy Lee, and Dr. Alice Hon for their constructive comments and suggestions that improved an earlier version of this article.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: The work described in this article was supported by a grant funded by the Research Grants Council of the Hong Kong Special Administrative Region, China (project no. PolyU 5461/11H, 546111) and an internal grant funded by the Hong Kong Polytechnic University.

References

- Australian Government. 2011. “Snapshots 2009—Internet Use in Trip Planning.” <http://www.ret.gov.au/tourism/Documents/tra/Snapshots%20and%20Factsheets/2011/Internet-Snapshot-2011.pdf>
- Beldona, S., and C. Cobanoglu. 2007. “Importance-Performance Analysis of Guest Technologies in the Lodging Industry.” *Cornell Hotel and Restaurant Administration Quarterly* 48 (3): 299-312.
- Buhalis, D., and R. Law. 2008. “Progress in Information Technology and Tourism Management: 20 Years on and 10 Years after the Internet—The State of eTourism Research.” *Tourism Management* 29 (4): 609-23.
- Burgess, C. 2000. “The Hotel Financial Manager—Challenges for the Future.” *International Journal of Contemporary Hospitality Management* 12 (1): 6-12.
- Chathoth, P. K. 2007. “The Impact of Information Technology on Hotel Operations, Service Management and Transaction Costs: A Conceptual Framework for Full-Service Hotel Firms.” *International Journal of Hospitality Management* 26 (2): 395-408.
- Chwelos, P., I. Benbasat, and A. S. Dexter. 2001. “Research Report: Empirical Test of an EDI Adoption Model.” *Information Systems Research* 12 (3): 304-21.
- Cobanoglu, C., P. Dede, and A. Poorani. 2006. “An Analysis of Skills and Competencies of Full Service Hotel Technology Managers.” *Journal of Teaching in Travel & Tourism* 6 (4): 19-35.
- Connolly, D. J., M. D. Olsen, and R. G. Moore. 1998. “The Internet as a Distribution Channel.” *Cornell Hotel and Restaurant Administration Quarterly* 39 (4): 42-54.
- David, J. S., S. Grabski, and M. Kasavana. 1996. “The Productivity Paradox of Hotel-Industry Technology.” *Cornell Hotel and Restaurant Administration Quarterly* 37 (2): 64-70.
- Fuchs, M., C. Witting, and W. Höpken. 2009. “E-Business Readiness, Intensity and Impact—An Austrian Hotel Study.” In *Information and Communication Technologies in Tourism 2009*, edited by Wolfram Höpken, Ulrike Gretzel, and Rob Law, 431-42. Vienna: Springer.
- Ham, S., W. G. Kim, and S. Jeong. 2005. “Effect of Information Technology on Performance in Upscale Hotels.” *International Journal of Hospitality Management* 24 (2): 281-94.
- Hong Kong Special Administrative Region. 2004. “OGCIO—Electronic Transactions Ordinance.” http://www.ogcio.gov.hk/en/regulation/eto/ordinance/eto_introduction.htm
- Hong Kong Tourism Board. 2004. “Hotel Supply Situation—as at Jun 2004.” *Research Statistics*. http://partnernet.hktb.com/pnweb/jsp/doc/listDoc.jsp?doc_id=73050&cat_id=4647&logs=yes&type=FREE.
- Hong Kong Tourism Board. 2010a. “Hotel Supply Situation as at Jun 2010.” *Research Statistics*. http://partnernet.hktb.com/pnweb/jsp/doc/listDoc.jsp?doc_id=133709&cat_id=6116&logs=yes&type=FREE.
- Hong Kong Tourism Board. 2010b. “A Statistical Review of Hong Kong Tourism 2009.” *Research Statistics*. http://partnernet.hktb.com/pnweb/jsp/doc/listDoc.jsp?doc_id=133789&cat_id=3632&logs=yes&type=FREE.
- Hsu, C. H. C. 1995. “Computer Skills Needed and Demonstrated by Hospitality Management Graduates: Perceptions of Hotel Operators.” *Hospitality & Tourism Educator* 7 (2): 25-29.
- Huo, Y. H. 1998. “Information Technology and the Performance of the Restaurant Firms.” *Journal of Hospitality & Tourism Research* 22 (3): 239-51.
- Huseyin, T., and E. Kerem. 2011. “Password Management Difficulties in System and Network Management.” *Procedia Computer Science* 3:801-4.
- Iacovou, C. L., I. Benbasat, and A. S. Dexter. 1995. “Electronic Data Interchange and Small Organizations: Adoption and Impact of Technology.” *MIS Quarterly* 19 (4): 465-85.

- Internet World Stats. 2011. "Asia Internet Use, Population Data and Facebook Statistics." <http://www.internetworldstats.com/stats3.htm#asia>.
- Ip, C., R. Leung, and R. Law. 2011. "Progress and Development of Information and Communication Technologies in Hospitality." *International Journal of Contemporary Hospitality Management* 23:533-51.
- Kay, C., and E. Moncarz. 2004. "Knowledge, Skills, and Abilities for Lodging Management." *Cornell Hotel and Restaurant Administration Quarterly* 45 (3): 285-98.
- Kim, W. G., and S. Ham. 2006. "The Impact of Information Technology Implementation on Service Quality in the Hotel Industry." *Information Technology in Hospitality* 4 (4): 143-51.
- Kuan, K. K. Y., and P. Y. K. Chau. 2001. "A Perception-Based Model for EDI Adoption in Small Businesses Using a Technology-Organization-Environment Framework." *Information & Management* 38 (8): 507-21.
- Laudon, K. C., and J. P. Laudon. 2010. *Management Information Systems: Managing the Digital Firm*. 11th ed. Upper Saddle River, NJ: Pearson Prentice Hall.
- Law, R., and N. Au. 1998. "Information Technology Applications to the Hong Kong Hotel Industry." *International Journal of Management* 15 (3): 377-84.
- Law, R., and G. Jogaratnam. 2005. "A Study of Hotel Information Technology Applications." *International Journal of Contemporary Hospitality Management* 17 (2-3): 170-80.
- Law, R., R. Leung, and D. Buhalis. 2009. "Information Technology Applications in Hospitality and Tourism: A Review of Publications from 2005 to 2007." *Journal of Travel & Tourism Marketing* 26 (5): 599-623.
- Mukhopadhyay, T., and S. Kekre. 2002. "Strategic and Operational Benefits of Electronic Integration in B2B Procurement Processes." *Management Science* 48 (10): 1301-13.
- Namasivayam, K., C. A. Enz, and J. A. Siguaw. 2000. "How Wired Are We? The Selection and Use of New Technology in U.S. Hotels." *Cornell Hotel and Restaurant Administration Quarterly* 41 (6): 40-48.
- Nambisan, S., and Y.-M. Wang. 2000. "Web Technology Adoption and Knowledge Barriers." *Journal of Organizational Computing and Electronic Commerce* 10 (2): 129-47.
- Nyheim, P. D., F. M. McFadden, and D. J. Connolly. 2005. *Technology Strategies for the Hospitality Industry*. Upper Saddle River, NJ: Prentice Hall.
- O'Connor, P. 2008. "Managing Hospitality Information Technology in Europe: Issues, Challenges and Priorities." *Journal of Hospitality Marketing & Management* 17 (1-2): 59-77.
- Prewitt, E., and L. C. Ware. 2004. "The Survey: It's All About You." *CIO* 18 (1): 57-66.
- Ramdeen, C. D., J. Santos, and H. K. Chatfield. 2009. "EDI and the Internet in the E-Business Era." *International Journal of Hospitality & Tourism Administration* 10 (3): 270-82.
- Siguaw, J. A., C. A. Enz, and K. Namasivayam. 2000. "Adoption of Information Technology in U.S. Hotels: Strategically Driven Objectives." *Journal of Travel Research* 39 (2): 192-201.
- Soares-Aguiar, A., and A. Palma-dos-Reis. 2008. "Why Do Firms Adopt E-Procurement Systems? Using Logistic Regression to Empirically Test a Conceptual Model." *IEEE Transactions on Engineering Management* 55 (1): 120-33.
- Sokol, P. K. 1995. *From EDI to Electronic Commerce: A Business Initiative*. New York: McGraw-Hill.
- U.S. Travel Association. 2009. "The Internet." *Travel Facts and Statistics/U.S. Travel Association*. <http://www.ustravel.org/news/press-kit/travel-facts-and-statistics>.
- van Hoof, H. B., M. J. Verbeeten, and T. E. Combrink. 1996. "Information Technology Revisited—International Lodging-Industry Technology Needs and Perceptions: A Comparative Study." *Cornell Hotel and Restaurant Administration Quarterly* 37 (7): 86-91.
- Watkins, E. 2000. "How Do You Measure Your Tech Investments?" *Lodging Hospitality* 56 (12): 25-26.
- Weston, R. 2010. "7 Skills Every IT Manager Needs to Survive the 2010s." *Info World*, August 30. <http://www.infoworld.com/d/adventures-in-it/7-skills-every-it-manager-needs-survive-the-2010s-072?source=footer>.
- Winata, L., and L. Mia. 2005. "Information Technology and the Performance Effect of Managers' Participation in Budgeting: Evidence from the Hotel Industry." *International Journal of Hospitality Management* 24 (1): 21-39.
- Wu, F., V. Mahajan, and S. Balasubramanian. 2003. "An Analysis of E-Business Adoption and Its Impact on Business Performance." *Journal of the Academy of Marketing Science* 31 (4): 425-47.

Bios

Rosanna Leung, PhD, is a research associate in the School of Hotel & Tourism Management at The Hong Kong Polytechnic University (rosanna.leung@connect.polyu.hk).

Rob Law, PhD, is a professor in the School of Hotel & Tourism Management at The Hong Kong Polytechnic University (hmroblaw@polyu.edu.hk).