The following publication Yang, H., Song, H., Cheung, C., & Guan, J. (2021). How to enhance hotel guests' acceptance and experience of smart hotel technology: An examination of visiting intentions. International journal of hospitality management, 97, 103000 is available at https://doi.org/10.1016/j.ijhm.2021.103000

How to Enhance Hotel Guests' Acceptance and Experience of Smart Hotel Technology: An Examination of Visiting Intentions

Abstract

Smart hotel is a novel concept in the hospitality industry, and few studies have examined hotel consumers' intentions to visit smart hotels. This study investigates the relationship between technology readiness (TR) and technology amenities (TA) as antecedents to visiting intentions, using an extended technology acceptance model (TAM). Based on an online survey with 648 valid responses, the results indicate that perceived ease of use and perceived usefulness are correlated with TA, but not with TR. Furthermore, TR affects intentions to visit smart hotels, but TA does not. The findings enrich the hospitality literature and have practical implications for hospitality marketers designing technology-related marketing strategies to maintain competitiveness. This study contributes to raising awareness of the importance of technological amenities and services for the future visiting intentions of hotel consumers.

Keywords: Smart hotel; Technology amenities; Technology readiness; Technology acceptance model; Visiting intentions

1. Introduction

Information technology (IT) applications, artificial intelligence (AI) technologies, virtualizations, cloud architecture, the Internet of Things (IoT), and big data are now integrated into all walks of life. The deployment of new technology serves not only e-commerce businesses but also those with a physical presence offering face-to-face customer experiences, especially in the field of tourism. Hotels are a pillar of the tourism industry, calling for innovation and technological improvements to become 'smart.'

The smart hotel concept emerged around 2008 and has attracted attention in recent years (Jin, 2018). Smart hotels are intelligent hotels with a range of new information and communication technologies (ICT) (Wu and Cheng, 2018), using AI and service concept to provide customers with a new experience of intelligence (Xu, 2018). Through global computer networks, smart hotels directly manage and integrate their technical systems and technological operations (Basyuk et al., 2014). These integrate contemporary IT, such as the IoT, cloud computing, mobile internet, smart devices and big data (Xu, 2018), to provide customers with improved service experiences and far higher levels of personalisation (Lai and Hung, 2018).

With the advancements in IoT and the internet of everything (IoE), hotel operations and services are heading towards smart environments (Buhalis et al., 2019; Leung, 2020; Webster and Ivanov, 2020). Leung (2019) indicated that different stakeholders have a different definition of smart hotels determined by the technology task or role it holds in the organisation. The definition of smart hotels differs between theoretical academic research and the hotel industry in practice, in which smart hotels have not been clearly defined yet (Domanski, 2020). The present study adopted the practical business definition of smart hotel proposed by Jaremen et al. (2016). Smart hotel refers to the hotel implementing ICT to increase efficiency in guest service provisions, associated more with smart technologies than a smart organisation (Jaremen et al., 2016).

Marriott International has teamed up with Samsung and Legrand to launch IoT hotel rooms, which allow multiple responsive IoT systems, devices and applications to communicate with one another to serve guests and optimise hotel operations (Bethesda, 2017). Hilton is delivering its 'Connected Room,' the industry's first truly mobile-centric hotel room, which enables hotel guests to personalise and control every aspect of their stay using the Hilton Honors app (Hilton News Room, 2017). The Shangri-La Group has announced its strategic partnership with Tencent to develop SMART hotels (Shangri-La Hotels and Resorts, 2018). In Japan, the Henn-na Hotel is run by robots that welcome guests and carry their suitcases (Lewis- Kraus, 2016). In America, smart hotels such as Yotel in New York, Aloft Cupertino, and Residence Inn by Marriott in Los Angeles provide various kinds of smart room services (Tung and Au, 2018). The Alibaba Group opened its Flyzoo Hotel in the Chinese Mainland in late 2018, which is equipped with the latest technologies including an AI management system, robotic technologies, and facial recognition (Liu et al., 2020). In Singapore, hotels such as the Bayview Hotel, Conrad Centennial Singapore, and Grand Park City Hall are increasingly developing smart rooms (Chow, 2018).

Smart hotels are developing rapidly around the world (Jaremen et. al., 2016) and they are critical to the hospitality industry (Lai and Hung, 2018). The gradual emergence of smart hotels using AI has changed customers' purchasing intentions and businesses' operational processes (Leung, 2019). Smart hotels are quick to adopt new technology, prompting a need for practitioners and marketers to investigate how consumers perceive smart technologies in hospitality, and the strength of their intentions to visit smart hotels.

Most studies of smart technologies in the hospitality context have focused on IT and AI technologies (Eriksson and Fagerstrøm, 2018; Lai and Hung, 2018; Leung, 2019; Morosan and DeFranco, 2016; Murphy et al., 2016; Ozturk et al., 2016; Petrevska et al., 2016), paying less attention to consumers' intentions to visit smart hotels. The technology acceptance model (TAM) is one of the most influential research models used in the literature to explain individual technology usage. It has been widely adopted in studies of the acceptance of technological innovations, which have focused almost exclusively on cognition-oriented constructs such as *perceived usefulness* (PU) and *perceived ease of use* (PEOU) (Tom Dieck et al., 2017), and the effects of external variables on these two constructs (Kim et al., 2008). Since its emergence, TAM has been empirically tested in a number of tourism and hospitality studies (Binbasioglu and Turk, 2020; De Kervenoael et al., 2020; Joe et al., 2020; Kim and Qu, 2014; Tom Dieck et al., 2017; Tom Dieck and Jung, 2018; Wang and Jeong, 2018; Webster and Ivanov, 2020). However, few studies have investigated the relationship between external variables and the TAM framework in the smart hotel context.

This study seeks to extend the framework by examining the antecedents of visiting intentions. We propose that TAM may be influenced by two external variables: *technology readiness* (TR), and *technology amenities* (TA). This study makes a significant contribution to existing research by distinguishing the effects of antecedents of TAM, and particularly a new construct (TA), which have the characteristics that account for intentions to visit smart hotels. Specifically, the TR refers to consumers' propensity to embrace and use new technologies (Chung et al., 2015), whereas the TA in a smart hotel refers to smart-related applications provided to consumers to enhance their experience.

There are three key reasons for investigating the determinants of consumers' visiting intentions. First, with respect to the personality traits, TR has been shown to be an effective and consistent predictor in TAM (Lin and Chang, 2011). However, knowledge of its effect on consumers' intentions to visit smart hotels is limited. The robustness of the integrated technology readiness and acceptance model (TRAM) in the smart hotel context has yet to be investigated. Second, given a strong trend for smart hotels to install more TA, understanding of the relationship between TA and TAM is important, particularly in terms of intentions to visit. Lastly, the study provides additional theoretical insights into the scale of development of TA in smart hotels and its relationship to TAM. These three identified research gaps in the hospitality literature prompted the study of the influence of the external variables on intentions to visit smart hotels. To fill the research gaps, this study has developed a theory-based framework by using the extended technology acceptance model (TAM). Thus, this study conceptualises key TAM dimensions by investigating consumers' intentions to visit smart hotels in order to assess the effects of the two external variables (TR and TA) on PEOU and PU, to determine how the dimensions of TR, TA, PEOU, and PU influence consumers' visiting intentions and to test relationships between these dimensions; to develop a measurement of TA that can be applied in the context of the smart hotel industry; and to provide managerial recommendations to hotel managers and marketers seeking to improve consumers' visiting intentions in relation to smart hotel applications and suggest future research directions.

2. Literature review

2.1 Theoretical foundations

Cutting-edge technologies can be used as a real-time interactive channel to co-create value with consumers (Buhalis and Sinarta, 2019). The value co-created by applying smart technologies in the hospitality industry lies in the construction of a balanced ecosystem through the combination of technological intelligence, convenience and humanisation to enhance consumers' experience (Buhalis and Leung, 2018; Law et al., 2019). The concept of smart technologies encompasses new forms of cooperation and value creation technologies (Koo et al., 2019). Understanding what motivates consumers to engage value co-creation contributes to hotel competitive advantages (Roberts et al., 2014). Consumers' motivation for using new technologies affects their behavioural intentions (Chenoweth et al., 2009). Hotels rely on technology amenities to provide high-quality customised and diversified services and such technology attributes can increase hotel guests' visit intentions (Bilgihan et al., 2016; Chen, 2015) and to differentiate the hotels in the competitive marketplace (Beldona and Cobanoglu, 2007).

Technologies have transformed value creation into a consumer-centric approach (Buhalis and Sinarta, 2019; Leung, 2019). Given the difficulty of conceptualising consumer behaviour, most studies rely on surrogate measures, such as intentions (Oliveira et al., 2016). Intentions have generally been defined as consumers' plans to engage in behaviours that refer to their intents to visit (Wang et al., 2017) and have been adopted as indispensable theoretical concepts in smart technologies (Eriksson and Fagerstrøm, 2018; Lai and Hung, 2018; Webster and Ivanov, 2020). Previous studies mostly investigated the intention to use cutting-edge technologies by adopting TAM as the base of research design (De Kervenoael et al., 2020; Lai and Hung, 2018; Ozturk et al., 2016; Wang and Jeong, 2018).

TAM is regarded as one of the most influential research models for identifying users' technology acceptance and behavioural intentions (Davis, 1989). TAM adopts the theory of reasoned action (Fishbein, 1979) as a basis for investigating causal linkages between PEOU, PU, and users' intentions. The model has been widely applied to various settings and technologies (Chung et al., 2015; Kim et al., 2008, Wang and Jeong, 2018), such as in IT (Kim et al., 2008), mobile commerce services (Jun et al., 2016), e-learning (Cheung and Vogel, 2013; Park et al., 2008), and e-commerce (Ashraf et al., 2014).

TAM proposes that users' acceptance of a new system is determined by their intentions to use the system, which is influenced by their beliefs about its PU and PEOU (Lin et al., 2007). The intentions, which is the main dependent variable identified in studies based on TAM, plays an important role in the actual use of new technology (Davis, 1989), and smart hotels, regarded as a 'fashion trend', attract customers' attention (Leung, 2019). Researchers have applied TAM to explain various behaviours in adopting technology in the tourism and hospitality context, including social media (Tom Dieck et al., 2017), mobile technology (Binbasioglu and Turk, 2020; Tom Dieck and Jung, 2018), self-service technology (Kaushik et al., 2015; Kim and Qu, 2014), the sharing economy (Wang and Jeong, 2018), and AI robots (De Kervenoael et al., 2020; Webster and Ivanov, 2020).

Despite its frequent applications, TAM has been criticised for neglecting any barriers that would prevent the individual from adopting technologies (Alomary and Woollard, 2015; Taylor and Todd, 1995) and for being too simple that might leave out important variables (Bogozzi, 2007). This study integrates technology readiness (TR) into the TAM context, to understand consumers' adoption of smart hotel technology by assessing personality traits (Walczuch et al., 2007). Moreover, consumers' adoption of technologies in emerging domains with an array of new technological products has raised concerns about the relevance of TAM (Lowe et al., 2019). It is necessary to examine consumers' intentions to use smart technologies in terms of the applications by adopting extended TAM (Lim, 2018). Therefore, TAM was chosen as a theoretical foundation for this study as it has been deemed appropriate for testing intentions to visit smart hotels. The research model of this study is shown in Figure 1.

[Insert Figure 1 about here]

2.2 Technology amenities in smart hotels

As technology changes, smart hotels must develop new amenities, capabilities and service innovations that are important to customers (Beldona et al., 2018). A hotel's TA can be defined as extra supplies or facilities provided to guests within or outside their guestrooms for no extra charge (Vallen and Vallen, 2009). The availability of TA is on the rise and evolving rapidly (Bilgihan et al., 2016), and many types of TA used in smart hotels are identified in the literature. These include free wi-fi (Eriksson and Fagerstrøm, 2018; Sheck, 2015), face or voice recognition (Liu, 2018; Liu et al., 2020; Morosan, 2020; Revfine, 2020), service robots (De Kervenoael et al., 2020; Liu et al., 2020; Zhong et al., 2020), smart TV (Bilgihan et al., 2016; Melián-González and Bulchand-Gidumal, 2016), smart room keys (Ozturk et al., 2016), and VR headsets (Roberts, 2015). Touchscreen panels allow hotel guests to control their lighting, temperature (Shoenfeld, 2019), music (Dutilly et al., 2015), and curtains (Lai and Hung, 2018). Mobile devices can provide proper check-in and check-out processes to enhance customers' hotel stay experience (Leung, 2019), customers may also use mobile apps for convenient self-service (Keith et al., 2015; Ozturk et al., 2016). Smart gadgets play an important role in the hotel business, and hotel rooms equipped with smart gadgets can offer a personalised experience to the customers (Jangid, 2019), such as smart mirror, rollable TV, smart glass in the shower (EHL Insights, 2019; Prabhu, 2019). In hospitality, it is important to keep abreast of the latest technology available to maximise energy saving by using occupancy sensors, infrared sensors, and motion sensors (DePinto, 2017). Table 1 summarises smart hotel TA identified in the literature.

Previous studies have focused on a limited range of hotel TA. Given that many smart hotels are implementing more items of TA, it is important to design a study that can empirically test the most up-to-date TA to develop a comprehensive, appropriate, and contemporary approach to TA for smart hotels.

[Insert Table 1 about here]

Smart technologies have been portrayed as instrumental tools with specific functionalities, enabling consumers to co-create their experiences (Buhalis and Foerste, 2015). It is worth noticing that most consumers tend to use various technology devices instead of only one in a smart hotel (Shashou, 2019) and smart is not the advance of a single technology but the interconnection and collaborative progress/advance of various technologies simultaneously (Shen et al., 2020). Smart technologies typically do not operate in isolation, and they are often part of a larger interconnected network of firms often visible to the consumers (Lowe et al., 2019). Though, it is a trend for the hospitality industry to adopt smart technologies, whilst those with limited technology offerings are yet to be put under the category of smart hotels. Smart hotel consumers are therefore confronted with the offerings of different TA with different usage contexts. Yang et al. (2017) indicated that smart applications in service settings consolidate a set of different technologies and services within one complex system. Furthermore, Shih (2013) examined the acceptance of various technologies in the smart home system by using an extended TAM, and Hubert et al. (2019) tested the influence of PU and PEOU on usage intentions in a smart home applications context. Thus, previous studies have provided support that smart technology applications (TA) can be adopted as an antecedent by using an extended TAM in this study.

2.3 Hypotheses development

2.3.1 Perceived ease of use and perceived usefulness

TAM identifies two dimensions of individual perceptions, PU and PEOU, that are relevant to attitudes to using technology (Davis, 1989). PU is defined as the extent to which individuals believe that using a particular system will enhance their performance, whilst PEOU refers to the extent to which people believe that using a particular system will be free of effort (Lin et al., 2007). TAM describes PU as being influenced by PEOU (Chung et al., 2015; Lin et al., 2007; Lin and Chang, 2011; Roy et al., 2018), and PU and PEOU as influencing usage intentions (Lee et al., 2012; Davis and Venkatesh, 1996). It proposes that users' PU and PEOU affect their intentions to use a new system (Lin et al., 2007; Lin and Chang, 2011). Following this logic, the following hypotheses are proposed:

H1. Perceived ease of use has a positive effect on perceived usefulness.

H2. Perceived ease of use has a positive effect on visiting intentions.

H3. Perceived usefulness has a positive effect on visiting intentions.

2.3.2 Technology readiness

TR refers to consumers' propensity to embrace and use new technologies (Parasuraman and Colby, 2015). People who favour innovation tend to be early adopters and to think about new technology (Karahanna et al., 1999), and innovative functional usage plays an important role in their intentions (Huh and Kim, 2008). As one dimension of TR, innovativeness appears to be the concept most often studied in previous research and is also closely related to an overall self-reported TR construct (Liljander et al., 2006). Customers with high levels of innovativeness feel comfortable using technology and require little proof of its outcomes (Agarwal and Prasad, 1998). Thus, this study considers TR in terms of innovativeness because this has been proved to be a stable individual dimension (Chung et al., 2015).

Lin et al.'s (2005) TRAM extends TAM by integrating TR to consider individual differences. TR is a causal antecedent of both PU and PEOU, which subsequently affect consumers' intentions to adopt new technology (Chung et al., 2015; Lin et al., 2005). TRAM takes account of this causal antecedent and can be used to explain consumers' usage intentions in the context of new technology (Chung et al., 2015; Lin and Chang, 2011; Lin et al., 2007; Oh et al., 2014).

The relationship between TR and TAM has been widely discussed. For example, innovativeness may have a positive effect on PU, PEOU and intentions (Chung et al., 2015; Godoe and Johansen, 2012; Walczuch et al., 2007), customers with higher TR may perceive technologies to have higher usefulness (Chung et al., 2015; Walczuch et al., 2007), and TR may enhance PU and PEOU when adopting self-service technology (Lin and Chang, 2011). The integrated TRAM model has the best explanatory power in terms of intentions to use technology (Koivisto et al., 2016), and TR has a direct effect on the use intentions construct in TAM (Lin and Chang, 2011). Hence, the following hypotheses are proposed:

H4. Technology readiness has a positive effect on the perceived ease of use.

H5. Technology readiness has a positive effect on the perceived usefulness.

H6. Technology readiness has a positive effect on visiting intentions.

2.3.3 Technology amenities

TA plays a significant role in consumers' decision-making processes and service experiences (Bilgihan et al., 2016; Verma and Thakur, 2020). Contemporary consumers demand technological applications and amenities in hotels, which may significantly enhance their intentions to visit (Kucukusta, 2017). Many guests value hotels that offer up-to-date TA, and such technology directly influences hotel guests' overall satisfaction and intended behaviour (Chen, 2015). TA is considered to be a vital factor in hotel selection and visiting intentions (Cobanoglu et al., 2011). Go et al. (2020) point out that the hotel TA, such as robot, voice/facial recognition, sensors and mobile device, may influence consumers' acceptance of technology. The more an up-to-date technological application is perceived to be, the more likely the application will be used (Moslehpour et al., 2018). When consumers perceive technology applications as easy to use (PEOU), they are more confident in adopting the technology (He et al., 2018). Thus, TA is proposed to exert significant effects on PEOU and PU. Hence, the following hypotheses are posited:

H7. Technology amenities have a positive effect on perceived ease of use.

H8. Technology amenities have a positive effect on perceived usefulness.

H9. Technology amenities have a positive effect on visiting intentions.

3. Methodology

3.1 Instrument development for TA

This study adopted both qualitative and quantitative research methodologies. The development of measurement items for TA followed the procedure proposed by Churchill (1979), which is appropriate for the development of reliable and valid measures (Getty and Thompson, 1994). Preliminary measurement items were derived from the previous literature (see Table 1) and eight in-depth interviews were conducted in April 2020 with interviewees who had smart hotel working experiences or had visited smart hotels. The researchers approached a Senior Executive of a large technology company in mainland China for assistance to recommend participants for this study. The selected interviewees were able to recall their experiences in smart hotels or they were working in smart hotels and they knew the types of TA provided by smart hotels (see Table 2). The interviewees were thought to have understanding of TA. This process design is helpful as it is regarded as an expert sampling for the initial generation of items (Hayes et al., 1995). The list of preliminary measurement items was provided to interviewees to ascertain whether the attributes are suitable to represent TA in smart hotels. The interviews were conducted in Chinese and transcripts of the interviews were translated and back-translated using Brislin's (1970) prescribed methodology. The following are a few selected examples of interview questions:

- What kinds of TA are adopted in a smart hotel?
- To what extent has the TA distributed in smart hotels?
- What TA attributes are important for consumers? Why? Give some examples.
- How do you perceive the TA attributes in delivering customer service in a smart hotel?

[Insert Table 2 about here]

Content analysis was conducted based on the guidelines of Churchill (1987) and Berg (2007). The text extracted from the recording of the in-depth interviews was first synthesised and coded by two experienced hospitality and tourism researchers (the first author and one data analysis specialist). Then they verified the results of the content analysis and transferred to the measurement items. Differences in results between the coders were discussed until a consensus was reached (Au et al., 2014), two experienced academic researchers carefully reviewed and refined the items. After coding and analysing, the authors grouped the similar items together. For example, similar keywords 'mobile key' was removed from 'Smart room key' into 'Mobile devices'. As a result, the in-depth interviews generated a list of 10 items for TA.

For almost every interviewee interviewed, a unique guest experience was the focal point of the smart hotel. One interviewee described that "I enjoy greater convenience and comfort", adding, "Tmall Genie (smart speaker) helps me control various aspects of my room, such as lighting, air-conditioning and audio-visual system." Another one indicated her visit as a unique service experience provided by robots to deliver food and other items. Most interviewees cited "mobile phone app and touchscreen panel enable safer hotel stays and increased peace of mind." Some interviewees disclosed the importance of the facial recognition, because it is safer, more hygienic, and more convenient for guests. One interviewee opined that “sensors help control and maintain comfortable room temperatures.” Two interviewees who have work experiences at smart hotels also mentioned as “sensors can monitor electricity usage and feedback on occupancy information.”

3.2 Measures

Most measures were adopted from previous studies with slight modifications, including five items for TR (Chung et al., 2015; Oh et al. 2014), four items for PEOU (Chung et al., 2015; Van der Heijden, 2004), four items for PU (Davis et al., 1992; Wang and Jeong, 2018), and three items for visiting intentions (Han et al., 2010; Chen and Tung, 2014). As previously explained, ten items for TA were developed. The research instrument is shown in Table 3.

The survey questionnaire had six parts, comprising demographic questions (gender, age, marital status, education level, number of hotels visited during the past three years), TA, TR, PEOU, PU, and intentions to visit. A total of 26 attributes were measured on a Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). The questionnaire was prepared in Chinese to mainland Chinese hotel guests. The questionnaire was piloted with 40 participants who enjoyed travelling, to test its efficacy and clarity. Reliability analysis was performed, and the Cronbach’s alpha coefficients were all higher than the recommended criterion of 0.70. The questionnaire was then finalised.

3.3 Data collection and sampling

The target respondents were travellers from the Chinese Mainland. According to Lui (2018), cutting edge technology is a major drawcard in hotels for Chinese travellers. The notion of AI is much more deeply rooted in the Chinese mindset than in the Westerners, in which 75% of Chinese travellers would be influenced by AI (Noël, 2019). With the strong consumer demand for smart hotels in China (Liu, 2019), the context is ideal for testing the model as smart hotels in recent years are fast developing in the Chinese Mainland.

A snowball sampling technique was used in this study via a social media platform. Snowball sampling is a non-probabilistic sampling technique with the advantage of getting responses from a large number of relevant respondents (Baltar and Brunet, 2012). To qualify for participation in this study, participants were selected based on two main criteria, including had travelled during the past three years, and had stayed in hotels during their trips. Using social network sites as a sampling frame provides a good sample size with good geographical scope, which may improve the representativeness (Baltar and Brunet, 2012), and a higher response rate than traditional snowball sampling owing to the personal connection between the researcher and the respondents of the sample (Yadav et al., 2016).

In China, WeChat, has one billion users in 2018 (Statista, 2020), is a multi-purpose App that has rapidly emerged as one of the world's most popular social networking platforms (Harwit, 2017). It has become 'a better WhatsApp crossed with the social features of Facebook and Instagram, mixed with Skype and a walkie-talkie' (Svensson, 2013). This App provides unique opportunities for researchers to collect data without physical immersion in sampling (Skavronskaya et al., 2019), and to develop high levels of trust and support sustained interactions with participants (Ma et al., 2019). Thus, the sampling frame of the present study was taken from the WeChat's 'friend list' of one of the authors. In May 2020, an online questionnaire was created on Wjx.cn (https://www.wjx.cn/), which was distributed via WeChat. Initially, 50 respondents were selected from the 500 'friends' in WeChat's list. Using the snowball sampling approach, these initial 50 respondents were requested to pass the online questionnaire to 15 of their WeChat friends through multiple functional layers embedded within WeChat, such as individual and group chats and WeChat 'Moments'. A total of 648 valid responses were finally collected in about two months' time.

Before conducting the data analysis of the responses, the dataset was first examined for irregularities, missing data, or unrealistic responses. Listwise deletion method was employed, to remove all incomplete cases from the dataset before the analysis. To locate outliers, descriptive statistics, box plots and the bootstrap technique, with the Mahalanobis d-squared values used as the measure of distance (Byrne, 2010). The univariate skewness, univariate kurtosis, and multivariate kurtosis were typically used to evaluate variable distribution (Finney and Distefano, 2006) to ensure that the data have a multivariate normal distribution before conducting SEM (Byrne, 2010). Thus, the data could be regarded as following multivariate normal distribution and could be used for further analysis (Mardia, 1970).

3.4 Data analysis

To analyse the collected data, the authors of this study first conducted exploratory factor analysis (EFA), then confirmatory factor analysis (CFA), and finally structural equation modelling (SEM) (Anderson and Gerbing, 1988). EFA was implemented to explore underlying components of the constructs (Anderson and Gerbing, 1988). CFA was conducted to assess the discriminant/convergent validity and composite reliability of the constructs. In the last step, the hypothesised theoretical model using SEM was assessed and the parameters were estimated.

4. Results

4.1 Profile of participants

Through online distribution, 648 valid questionnaires were return, to which 320 (49.4%) respondents were male and 328 (50.6%) female. Among the respondents, 330 (50.9%) were married, 573 (88.4%) had a higher diploma or above, most (83%) were aged between 18 and 44, and 467 (72.1%) had stayed in hotels more than three times within the last three years.

According to the results of demographics analysis, majority of respondents (83%) were aged between 18 and 44. This implies that young adults to early middle-aged adults are more active in the age of high-tech savvy compared to older adults. The results of this study are consistent with previous studies, as young generations are more easily influenced by the increasing availability of sophisticated ICT devices (Circella, et. al., 2016; Garikapati et al. 2016), and the elderly preferred self-service technologies less compared to young people (Liu and Hung, 2021).

4.2 Exploratory factor analysis

The whole sample (N=648) was randomly split into two halves, one as a calibration sample (N=320) for exploratory factor analysis (EFA) and the other as a validation sample (N=328) for CFA (Huang and Hsu, 2009). EFA was first conducted by using the principal component method and the Varimax Rotation to explore underlying components of the constructs (Anderson and Gerbing, 1988). The EFA results indicated that the items measuring the construct of technology amenities were loaded into two distinct components, namely “contactless” and “value-added”. “Contactless” TA enables guests to check-in/check-out online, turn on the lights, draw the curtains and adjust the air conditioners by mobile devices or touchscreen panel. As for “value-added”, TA can automatically meet and anticipate customer needs for hotel services by monitoring, providing feedback or interacting with guests across multiple integrated systems, such as sensors, voice/facial recognition, robots, etc. This would create value-added services to the guests.

After using EFA, the factor structure of the model was considered reliable based on the results of Bartlett's χ^2 test, the Kaiser-Meyer-Olkin test, and Cronbach's alpha. The item '*the technology amenities of a smart hotel should include: SMART TV* was deleted from TA owing to a low factor loading of 0.430, which was below the threshold of 0.50. The Cronbach's alpha of all constructs was above 0.70, indicating satisfactory reliability of the overall scale and all of the extracted factors (see Table 3).

[Insert Table 3 about here]

4.3 Measurement model

CFA was carried out after the EFA. As shown in Table 4, the CFA results (goodness-of-fit index: $\chi2$ = 337.640, df = 122, $\chi2$/df = 2.768, CFI = 0.929, TLI = 0.911, IFI = 0.930, RMSEA = 0.074) demonstrated that the measurement model fitted the data well. Since technology amenities were loaded into two sub-components, namely contactless and value-added, they were considered the first-order construct, whereas technology amenities itself was second-order construct (Van Riel et al., 2017). Also, the convergent realiability, convergent validity, and discriminant validity of all the multi-item scales (Hair et al., 2010) were assessed. First, the composite reliability of the research constructs indicated adequate internal consistency of multiple indicators for each construct, ranging from 0.74 to 0.86 (Bagozzi and Yi, 1988). The Cronbach's alpha values (ranging from 0.72 to 0.86) also indicated adequate internal consistency. Second, convergent validity was assessed in terms of factor loadings and average variance extracted (AVE). AVE is the average variance shared between a construct and its measurement. The factor loadings of all items were higher than 0.60, and the AVE values were higher than 0.50; thus, convergent validity was confirmed (Fornell and Larcker, 1981). Third, discriminant validity was examined by examining correlations between the constructs and the square roots of each construct's AVE values (Fornell and Larcker, 1981). As shown in Table 5, all correlations between the paired constructs were smaller than the square roots of AVE estimates; thus, discriminant validity was achieved.

[Insert Tables 4 and 5 about here]

4.4 Structural equation model and hypothesis testing

In the next step, the proposed structural model was analysed using AMOS. The structural model yielded a good fit (goodness-of-fit index: $\chi^2 = 384.994$, $df = 120$, $\chi^2/df = 3.208$, CFI = 0.955, TLI = 0.942, IFI = 0.955, RMSEA = 0.058). Table 6 summarises the proposed structural model and the results used to test the research hypotheses. More specifically, TR influenced neither PEOU ($\beta = 0.085$, ns) (H4 was rejected) nor PU ($\beta = 0.027$, ns) (H5 was rejected), but had a significant direct effect on visiting intentions ($\beta = 0.213$, $p < 0.01$) (H6 was accepted). TA affected consumers' PEOU ($\beta = 0.467$, $p < 0.01$) (H7 was accepted) and PU ($\beta = .153$, $p < .01$) (H8 was accepted), but no significant impact was observed on consumers' visiting intentions ($\beta = 0.100$, ns) (H9 was rejected). In addition, PEOU significantly influenced PU ($\beta = 0.821$, $p < 0.01$) (H1 was accepted) but, surprisingly, had a negative impact on visiting intentions ($\beta = -0.570$, $p < 0.01$) (H2 was rejected). PU significantly affected visiting intentions ($\beta = 0.976$, $p < 0.01$) (H3 was accepted). Of the nine research hypotheses, five were accepted, and four (H2, H4, H5 and H9) were rejected (see Table 6).

[Insert Table 6 about here]

5. Discussion

This study sought to extend the framework by examining the external variables of TAM. The results show that PEOU positively affects PU and that PEOU negatively affects visiting intentions. In other words, the easier the use of smart hotel technologies is perceived to be, the more likely that consumers will perceive them to be useful. This finding corroborates the results of previous studies (Chung et al., 2015; Kim et al., 2008; Lin and Chang, 2011; Roy et al., 2018). Moreover, consumers are less likely to visit smart hotels with higher PEOU. PEOU has a negative impact on visiting intentions, which is inconsistent with previous studies (Lee et al., 2012; Lin and Chang, 2011). PEOU supposedly contributes to making people's travel easier and more enjoyable but appears to have a negative impact on their visiting intentions. Mathieson (1991) suggests that TAM is predictive, but that it does not provide a sufficient understanding of users' acceptance of new technologies. This may be because consumers want to try the most cutting-edge technology whilst staying in smart hotels, and lower PEOU may motivate their visiting intentions. Furthermore, users' perseverance and flexibility may reduce the effect of PEOU on usage, since it takes a little time for difficult systems to become easy to use (Ndubisi et al., 2001). The results also suggest that consistent with previous findings, PU has a positive effect on visiting intentions (Garrity et al., 2005; Joe et al., 2020). PU leads to greater behavioural intentions (Nysveen et al., 2005), and consumers with a more positive POEU will rate PU higher (Porter and Donthu, 2006). Therefore, Hypotheses H1 and H3 are accepted whilst H2 is rejected.

The analysis reveals several interesting points which have not been raised in previous studies. In terms of TR and TAM, the study shows that TR has a positive effect on visiting intentions and negative effects on PEOU and PU. These results contradict previous findings of a positive association between TR, and PEOU and PU (Chung et al., 2015; Godoe and Johansen, 2012; Lin and Chang, 2011; Walczuch et al., 2007). Consumers' readiness to accept new technology is important for the use of state-of-the-art technology, as in smart hotels. When making choices, consumers may deploy general beliefs about technology gained from prior experience to anchor perceptions of usefulness and ease of use (Lin et al., 2007). Yet smart hotels are a relatively recent development (Leung, 2019), so consumers may have no prior experience and hence no specific PU or PEOU. As smart hotels are not currently widespread, PEOU and PU may be underestimated by consumers. Furthermore, one personality trait of TR, innovativeness, indicates a tendency to be the first users of new technologies (Walczuch et al., 2007). Consumers who have innovative personality traits are more likely to adopt new technology and thus have more experience than others (Chen et al., 2009). Technology adopters have been characterised in a range from innovators to laggards (Rogers, 2003). Early adopters are more willing to accept the risk, so their decisions to use a system may not rest solely on ease of use (Carroll and Thomas, 1988). Customers with high levels of innovativeness may also feel comfortable using technology without taking account of the characteristics of the technology (Agarwal and Prasad, 1998), such as PEOU and PU. TR affects consumers' behavioural intentions (Lin et al., 2007), and intentions relate positively to users' innovativeness (San Martin and Herrero, 2012). This study confirms this suggestion by demonstrating that the innovativeness aspect of TR is positively associated with visiting intentions. Hence, Hypotheses H4 and H5 are rejected whilst H6 is accepted.

As hypothesized, the results show that TA is positively related to PEOU and PU. Taken together, to consumers, technology means an easy life, and hotels must evolve, change, and adjust to new demands to meet guests' appetite for this lifestyle. User-friendly technologies with clear and easy instructions should be implemented to lower customers' levels of effort and technological anxiety (Kim et al., 2013). Smart hotels belong to a new category that contains many innovative amenities using futuristic technologies (Sbounias, 2020). Most consumers tend to use various technology devices instead of only one in a smart hotel (Shashou, 2019), the finding that TA has no significant effect on visiting intentions is somewhat surprising. Results of the current study can be interpreted that consumers perceive TA as convenient and easy to use and they do not necessarily intend to use TA with steadfast enthusiasm. The findings of this research echo the study of Rosenbaum and Wong (2015) that hotel customers may view Self-Service Technologies (SST) positively overall whilst many complex SST systems may remain under-utilized though. Thus, the findings may help hotel practitioners to better design and implement the systems that fulfil customers' needs and lessen the operational expenses.

Prior experience is regarded as an important determinant of behavioural intentions (Bagozzi, 1981), and a stronger link has been found between intentions and technology acceptance by more experienced users (Taylor and Todd, 1995). Smart hotels have grown up only recently, so many consumers may not have experience of visiting them and using the TA. Consumers' prior experiences of TA in smart hotels may influence their visiting intentions. Furthermore, two types of the barrier may affect consumers' intentions to adopt technology: functional barriers and psychological barriers. Consumers evaluate functional barriers in terms of usage, value, and risk, and psychological barriers arise mainly from conflicts with consumers' prior beliefs (tradition and image) (Lunsford and Burnett, 1992; Porter and Donthu, 2006). Consumers may be assumed to oppose new technologies owing to lack of trust, the risks involved (Huang et al., 2007), or having no previous experience of visiting (Taylor and Todd, 1995). Thus, Hypotheses H7 and H8 are accepted, and H9 is rejected.

6. Conclusion

This study conceptualizes crucial factors in terms of external variables of TAM, and intentions to visit smart hotels. The results indicate that PEOU and PU are correlated with TA but not with the TR because consumers' mental preparation regarding new technologies and their recognition of the convenience of smart hotels are separate issues (Chung et al., 2015). Moreover, TR affects intentions to visit smart hotels, whereas TA does not.

6.1 Theoretical implications

This study makes four major theoretical contributions. First, it presents a novel framework that distinguishes the effects of external variables of TAM to enhance an understanding of the relationship between consumers' perceptions of smart hotels and their visiting intentions. Researchers have generally neglected the barriers that would prevent the individuals from adopting technologies (Alomary and Woollard, 2015; Walczuch et al., 2007), and have not examined the external variables (Kim et al., 2008), such as TR (Kim and Han, 2020) and TA. In addition to filling a research gap of TAM model, this study enriches the understanding of consumers' adoption of smart hotel technology by integrating TR, and consumers' intentions to use smart technologies to the TAM context, developing a more robust model. Furthermore, findings may serve as a starting point to systematically incorporate TR and TA into the multidimensional model and to advance consumers' smart hotel decision-making process theoretically and empirically.

Second, this study contributes to the existing hospitality literature by developing a smart hotel TA instrument. Research on smart hotels is still in its infancy and no research has identified the attributes of a smart hotel (Kim and Han, 2020). In the present study, TA literatures were reviewed and in-depth interviews with smart hotel guests or employees were conducted. It has a substantial research value in terms of exploring TA in smart hotels through the development of a two-dimensional measurement scale. The dimensional structure of TA was confirmed by checking the diversity of reliability or validity. Thus, it could help to create new knowledge and extend to subsequent research.

Third, this study contributes to the literature on how consumers' PEOU influences their intentions to visit smart hotels. Although most previous studies (Lee et al., 2012; Lin and Chang, 2011) have commonly acknowledged that PEOU positively predicts visit intentions, some scholars pointed out that types of technology (Kim, 2016) and consumers' age (Assaker, 2020) affect the positive relationship. For most commonly used technologies that make life easier, such as self-service technologies and mobile apps, the easier of using the technology, the more likely that consumers use it (Kim, 2016; Lee et al., 2012; Lin and Chang, 2011). On the other, Assaker (2020) indicated that the positive relationship between PEOU and usage intention is especially obvious to older consumers. The majority of respondents in our study are Chinese young adults and early middle-aged adults. The findings can be interpreted that the more difficult they found using smart hotel technologies, the more likely they will visit smart hotels. A possible reason is that the young to early middle-aged customers choose smart hotels as they have higher acceptance of and more interest in using smart hotel technologies. They are more eager to try new, complicated, and difficult to use smart hotel amenities. Hence, this study helps to categorize consumer differences, which can facilitate hotel organizations to make the right investment decisions on smart hotel TA.

Fourth, this study also contributes to the knowledge of TR in smart hotels. While the majority of studies have confirmed that TR has positive effects on PEOU and PU (Chung et al., 2015; Godoe and Johansen, 2012; Lin and Chang, 2011; Walczuch et al., 2007) for established technologies, several studies have also identified that TR in some new technology contexts did not affect PU (e.g., Kuo and Yen, 2009; Lu, 2014). Smart hotels, as a comparatively innovative hotel, are not well-known by consumers (Leung, 2019) and consumers may underestimate PEOU and PU without prior experience. As a result, TR was not a predictor on PEOU and PU in our study. Studies on smart hotel technology have not yet examined the hotel guests' acceptance and experience in the context of China smart hotels. Thus, findings from the Chinese guest perspective provide new knowledge to the existing literatures.

6.2 Practical implications

This study sheds some light on consumers' intentions to visit smart hotels by examining the external variables of TAM. Hoteliers would be well-advised to be aware of their customers' TR and adjust their promotions to optimize PEOU and PU. Mass media promotions might encourage consumers to visit smart hotels, whilst greater efforts should be made to introduce new technology to make smart hotels' operations easier and faster and to improve scalability and reliability, and users' experiences. Consumers' perceptions of technology might thus be developed from a variety of sources, including mass media and interpersonal channels (Lewis et al., 2003). Although the TA does not have a positive impact on visiting intentions, it impacts strongly on PEOU and PU. In the context of smart hotels, this means that consumers who find it easy to learn how to use amenities may also see their usefulness more clearly in performing tasks. Thus, TA should be developed with cutting-edge technology applications, and guests need to be convinced of the convenience and usefulness of these amenities.

As PEOU negatively affects visiting intentions, hotel operators need to implement smart hotel technology that is easy to use. Hotel operators, smart hotel developers, and hospitality marketers should educate consumers in the use of cutting-edge technology applications relating to smart hotels, supported by an organizational and technical infrastructure (Wu et al., 2011). The development of smart hotels may be dictated largely by characteristics such as usefulness, ease of use, user characteristics and smart hotels' attractive amenities.

Thus, researchers should identify the implications for both consumers' experiences of staying at smart hotels, and smart hotels' profitability once the dynamics of wide-scale cutting-edge technology applications come into play.

Smart hotels' use of innovative cutting-edge technology should be customer-driven rather than focusing purely on the technology itself. The COVID-19 pandemic has forced companies to use robotics and other automated technologies (Yang et al., 2020), including travel, tourism, and hospitality businesses (Wolfe, 2020), and the creation of 'service innovation' is a top priority for the hotel industry (Hollebeek and Andreassen, 2018; Shi et al., 2018). Consumers' confidence about staying at smart hotels might be enhanced by cutting-edge technological applications such as contactless interactions, contactless check-in and housekeeping services, ultraviolet light technology and electrostatic spraying devices (Cheung et al., 2021). Hoteliers are facing herculean challenges and must be prepared to accept new technology and adjust their strategies to maintain competitiveness. This study contributes to shaping new service and consumption patterns, business operations, and customers' visiting intentions by redefining sustainability and productivity.

6.3 Limitations and future research

This study has several limitations that suggest directions for future research. First, the sample for the study was collected online in China, and therefore the results may not be generalisable. A further study might thus be conducted with respondents from more regions and countries. The relationship between visiting intentions and actual stay experiences is a critical issue (Morosan, 2012) which might constitute a second limitation. Although using measures from actual visits to smart hotels would be insightful, the practicality of such an approach may be limited, especially since smart hotels are still in their infancy. Thus, further studies might replicate this setting and use measures of actual visiting experiences once they are more widespread, and comparisons of intentions to visit and actual visits might be taken into consideration in the future. Furthermore, future studies might investigate the differing characteristics of five distinct groups of TR (explorers, pioneers, sceptics, paranoids, and laggards) identified in the literature (Parasuraman and Colby, 2001), as well as consumers' personalities and traits relating to TR to establish if they determine whether or not consumers will use new technology (Parasuraman and Colby, 2001; Massey et al., 2007).

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Table 1. Smart hotel technology amenities

Technology Amenities	Description	Authors
Wi-fi	High-speed, stable and complimentary Wi-fi	Bilgihan, et al., 2016; Eriksson & Fagerstrøm, 2018
Touchscreen panel	Tablet-controlled room system, including lights, music, temperature, curtains, etc.	Dutilly, et. al., 2015; Keith, et. al., 2015; Lai & Hung, 2018
Mobile devices	Guests operate room controls, including check-in/check-out devices, smart keys, temperature, lighting, window blinds, thermostat, through mobile phone apps	Lai & Hung, 2018; Ozturk, et. al., 2016; Shoenfeld, 2019
Smart gadgets	Smart mirror, rollable TV, smart glass in shower, etc.	EHL Insights, 2019; Prabhu, 2019
Voice recognition	Voice commands used to make AI assistant execute tasks, such as voice-based control of in-room devices and travel assistance (e.g. Tmall Genie, Amazon Alexa, Google Home, Apple Siri)	Liu, 2018; Revfine, 2020
Facial recognition	Facial images used for authentication/verification to gain access to guest areas and services (e.g. guestroom, pool, gym, business centre, food & beverages, entertainment products, etc.)	Liu, et al., 2020; Morosan, 2020; Revfine, 2020
Robots	Delivery robots, cleaning robots, etc.	De Kervenoael et al., 2020; Liu, et al., 2012; Zhong et al., 2020
Sensors	Motion sensor, occupancy sensor, infrared sensor, etc.	DePinto, 2017
SMART TV	Digital TV providing hotel services and information	Bilgihan et al., 2016; Melián-González & Bulchand-Gidumal, 2016
VR headsets	Allows guest to visit the tourist spots all around the world and play VR games	Roberts, 2015
Smart room key	Mobile key	Ozturk, et. al., 2016

Table 2: Profile of interviewees

Interviewee	Age	Gender	Experience of Smart Hotel	Approximate duration for interviews using WeChat Call
1	25-30	F	Visiting experiences	40 min
2	30-35	M	Visiting experiences	35 min
3	25-30	M	Visiting experiences	30 min
4	30-35	M	Visiting experiences	35 min
5	35-40	M	Visiting experiences	40 min
6	30-35	F	Visiting experiences	30 min
7	30-35	F	Work experiences	35 min

8	40-45	M	Work experiences	40 min

Table 3. EFA results (N =320)

Variable	Measurement items	Factor loading	α
Technology amenities	KMO = .828, χ^2 = 878.745, p < .001		
Contactless	Free Wi-fi	.737	.745
	Touchscreen panel	.766	
	Mobile devices	.764	
	Smart gadgets	.633	
Value-added	Voice recognition	.614	.751
	Facial recognition	.665	
	Robots	.730	
	Sensors	.727	
	VR headsets	.662	
	** SMART TV*	.430	
Technology readiness	KMO = .860, χ^2 = 708.454, p < .001		.863
	I can usually figure out new high-tech products without help from others	.830	
	I can keep up with the latest technological developments in my areas of interest	.856	
	I enjoy the challenge of figuring out high-tech gadgets	.775	
	I have fewer problems than other people in making technology work for me	.797	
	In general, I am among the first in my circle of friends to acquire new technology when it appears	.776	
Perceived ease of use	KMO = .665, χ^2 = 345.616, p < .001		.748
	The amenities of a smart hotel will be clear and easy to understand using the given instructions	.717	
	The interaction with smart hotel amenities will require little effort	.742	
	The amenities of a smart hotel will be easy to use	.784	
	Desired information will be easily accessed to through smart hotel amenities	.786	
Perceived usefulness	KMO = .810, χ^2 = 692.350, p < .001		.882
	Smart hotel amenities will be effective	.856	
	It will be convenient to stay at a smart hotel by using smart amenities	.887	
	My travel needs will be satisfied at a smart hotel by using smart amenities	.857	
	Overall, smart hotel amenities are useful	.841	
Visiting intentions	KMO = .729, χ^2 = 567.971, p < .001		.889

I am willing to stay at a smart hotel when traveling	.871
I plan to stay at a smart hotel when traveling	.926
I prefer to stay at a smart hotel when traveling	.916

Note: α = Cronbach's alpha; KMO = Kaiser-Meyer-Olkin; χ^2 = Barlett's test of sphericity; **SMART TV* was deleted from *technology amenities* owing to a low factor loading.

Table 4. CFA results (N = 328)

Variables	*β*	Bootstrap 95% CI Lower	Upper	*p*	α	CR	AVE
Technology readiness					.844	.841	.516
I can usually figure out new high-tech products without help from others	.747	.661	.817	.001			
I can keep up with the latest technological developments in my areas of interest	.803	.729	.870	.001			
I enjoy the challenge of figuring out high-tech gadgets	.709	.616	.787	.001			
I have fewer problems than other people in making technology work for me	.710	.626	.784	.001			
In general, I am among the first in my circle of friends to acquire new technology when it appears	.608	.504	.698	.001			
Technology amenities					.729	.741	.589
Contactless	.747	.574	.935	.001			
Value-added	.787	.600	.931	.001			
Perceived ease of use					.837	.831	.552
The amenities of a smart hotel will be clear and easy to understand using the given instructions	.682	.563	.769	.001			
The interaction with smart hotel amenities will require little effort	.708	.616	.794	.001			
The amenities of a smart hotel will be easy to use	.812	.705	.875	.002			
Desired information will be easily accessed to through smart hotel amenities	.763	.663	.836	.001			
Perceived usefulness					.862	.860	.606
Smart hotel amenities will be effective	.746	.645	.825	.001			
It will be convenient to stay at a smart hotel by using smart amenities	.766	.664	.836	.001			
My travel needs will be satisfied at a smart hotel by using smart amenities	.805	.734	.862	.001			
Overall, smart hotel amenities are useful	.796	.715	.860	.001			
Visiting intentions					.812	.821	.606

I am willing to stay at a smart hotel when traveling	.703	.601	.784	.001
I plan to stay at a smart hotel when traveling	.870	.805	.921	.001
I prefer to stay at a smart hotel when traveling	.753	.649	.832	.001

Notes: N = 328 with 3,000 bootstraps. Goodness-of-fit index: $\chi^2 = 337.640$, $df = 122$, $\chi^2/df = 2.768$, CFI = .929, TLI = .911, IFI = .930, RMSEA = .074, CR = composite reliability, AVE = average variance extracted, α = Cronbach's alpha, β=standardized coefficient

Table 5. Construct inter-correlations

	Visit intention	*Technology readiness*	*Technology amenities*	*PEOU*	*PU*	*M*	*SD*
Visiting intentions	.778[a]					2.42	1.01
Technology readiness	.381**	.718[a]				2.65	1.00
Technology amenities	.301**	.187**	.767[a]			1.97	.67
PEOU	.248**	.100*	.272**	.743[a]		1.83	.77
PU	.387**	.196**	.321**	.647**	.779[a]	1.91	.86

Notes: [a] Square root of the average variance extracted, ** p < .01, * p < .05, PEOU=Perceived ease of use, PU=Perceived usefulness

Table 6. Results of structural equation model (N = 648)

Hypothesized path	Estimate	Lower	Upper	P	Result
H1. PEOU → PU	.821	.720	.906	.001	Accepted
H2. PEOU→ VI	-.570	-.737	-.419	.001	Rejected
H3. PU → VI	.976	.857	1.107	.001	Accepted
H4. Technology readiness → PEOU	.085	-.027	.191	.140	Rejected
H5. Technology readiness → PU	.027	-.042	.095	.435	Rejected
H6. Technology readiness → VI	.213	.107	.315	.001	Accepted
H7. Technology amenities → PEOU	.467	.331	.594	.001	Accepted
H8. Technology amenities → PU	.153	.049	.272	.004	Accepted
H9. Technology amenities → VI	.100	-.034	.227	.135	Rejected

Notes: PEOU=Perceived ease of use, PU=Perceived usefulness, VI=Visiting intentions