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RESEARCH ARTICLE



Smart hotel in the eyes of the silver: developing and testing the silver tourists' behavioural intention scale

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ABSTRACT

Numerous studies have highlighted the behavioural intention of AI and robotics in the hospitality industry. Nevertheless, the impact of smart hotels on tourists' willingness has been underexplored. Moreover, a lack of awareness exists of the attitude and behavioural intention of silver tourists towards smart hotels. Hence, the current study addresses the gap by investigating the antecedent factors of behavioural intention among silver tourists towards smart hotels. A mixed-method design was employed to analyse the depth and breadth of the subject. Study 1 was a qualitative study exploring silver tourists' perceptions. Meanwhile, Study 2 utilised an online survey on silver tourists in China to investigate the hypotheses derived from Study 1. Structural equation modelling (SEM) results with partial least squares (PLS) path analysis demonstrated that perceived usefulness, perceived ease of use, safety and security, perceived personalisation, perceived enjoyment, and perceived value formed a positive attitude. Additionally, the present study contradicted past research and revealed that perceived convenience and reliability did not support the relationship with smart hotel attitude. This research contributes to the sparse literature on smart hotels and provides valuable insights for hotel management concerning silver tourists' consumption intention.

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Silver tourists; smart hotel; behavioural intention; mixed-methods; hotel industry; China

Introduction

Existing literature has extensively examined smart technologies, such as AI and robotics, in the hospitality field. Nonetheless, smart hotels have rarely been emphasised (Yang et al., 2021) despite their rapid expansion (Jaremen et al., 2016). FlyZoo Hotel in China is an establishment hailed as the 'hotel of the future', which is furnished with sophisticated mobile application technology, face recognition features, and in-room robot attendants (Zhao, 2020). Moreover, an alliance between Tencent and the Shangri-La Group for the development of smart hotels has been announced (Yang et al., 2021). The changing business model of the hotel industry, specifically after the coronavirus disease 2019 (COVID-19) pandemic underlines the advantages of studying smart hotels in the long term.

Wu and Cheng (2018, p. 42) defined a smart hotel as 'an intelligent hotel in which a range of information technologies work together to let the guests have an honourable and convenient vacation environment'. Additionally, Kim et al. (2020) verified that the perceived performance (efficiency, ease of use, reliability, convenience, and control) of smart hotels is essential in generating customers' favourable attitude and positive word-of-mouth intention. Yang et al. (2021) proved that perceived usefulness and perceived ease of use are linked with technology amenities in smart hotels. Similarly, Chen et al. (2021) documented that sense experience and feel experience positively influenced customer satisfaction in smart hotels.

Although past literature (Cheng et al., 2023; Wang et al., 2022; Yang et al., 2021) identified multiple characteristics of smart hotels based on responses from diverse demographics, the outcome of silver tourists remains unknown. As the financial and time resources of the silver population could affect global tourism (Wen et al., 2020) and China faced the most significant level of older adult population in the world (Zhang et al., 2023), disclosing the characteristics and outcomes of smart hotels as perceived by silver tourists is vital. Older adults are also negatively stereotyped as being less adept at using smart technology due to their age as compared to younger individuals who are considered digital natives (Alexopoulou, 2020). Therefore, developing a comprehensive understanding of the attributes that silver tourists attach to smart hotel experiences is necessary by collecting mixed data to gain deep insight and overcome the limits of a single approach.

China was selected as the research site for the current study due to the following reasons. Firstly, the aging population growth in China is accelerating as the China National Committee on Aging predicts that the number of people over 60 will increase to approximately 487 million by 2050, which accounts for 34.1% of the total population (China Aging Research Centre, 2019). Previous literature also suggested differences in needs and expectations among generations. Thus, a significant population of silver citizens is a crucial issue to examine. Secondly, considering that over 3,000 hotels in China have implemented service robots and are transitioning to smart hotels (Liu & Hung, 2021), investigating the attributes of smart hotels under the perceptions of silver citizens is critical.

Based on the above, it remains unclear how the silver tourists in China perceive smart hotels and what are the antecedents of their behavioural intentions (Kim et al., 2020; Yang et al., 2021). To fill the gap, the present study aimed to analyse the depth of perceived perception of silver tourists towards smart hotels in China by adopting a mixed-methods approach. Given the limited research on smart hotels, an exploratory study was conducted to thoroughly explore silver tourists' perception and the relationship between perceived attributes and behavioural intentions was tested. Study 1 is a qualitative study that aims to comprehend how silver tourists perceive smart hotels. Study 2 is a quantitative study that empirically tested the conceptual framework derived from Study 1. Therefore, the present study contributes to the literature by providing a comprehensive understanding of the behaviours of silver tourists in China on smart hotels. The statements analysed also provide timely and meaningful insight for hotel management and smart device manufacturers.

Literature review

Smart hotel

The potential hazards associated with the adoption of novel technologies are addressed (Wu & Cheng, 2018). However, the hotel industry development trends remain primarily driven by technological advancements (Yang et al., 2021). Smart hotels are an example of how the rapid development of modern technologies has facilitated new operational practices in the hotel industry (Ivanov et al., 2017). For instance, hotel operational procedures and service flow have been transformed with the emergence of smart hotels that employ AI and service robotics (Leung, 2019). The mass adoption of novel technologies in smart hotels increased the need for practitioners and academics to investigate how customers perceive smart hotels and how to strengthen their intentions to stay.

Prior research on smart hotels has mainly emphasised advantages and disadvantages of smart hotels (Cheong & Law, 2023), factors of visiting intentions (Yang et al., 2021), tourists' satisfaction and intention to return (Lim et al., 2024), expected benefits and experiential quality among customers (Chang et al., 2022; Kim et al., 2021), memorability of smart hotel experience (Sthapit et al., 2024), incentives and barriers for smart hotel stay (Wang et al., 2022), features of smart service interactional experience (Zhang et al., 2024), customers perceived performance of smart hotels (Kim et al., 2020) and hotel managers' perspectives on smart hotel sustainability (Akel & Noyan, 2024). Indeed, a rising interest has emerged in empirical testing in the smart hotel studies regarding the dimensions of characteristics (Cheng et al., 2023; Kim et al., 2020; Wang et al., 2022; Yang et al., 2021).

Nevertheless, most studies have applied online survey (e.g. Chang et al., 2022; Cheng et al., 2023; Kim et al., 2021; Lim et al., 2024; Wang et al., 2022; Yang et al., 2021) or online reviews (Cheong & Law, 2023). Hence, few studies have provided a comprehensive understanding of the underlying mechanisms that encourage customers' stay intentions via thoroughly examining customer needs. The present study aims to bridge this gap.

Mixed methods was defined by Creswell and Clark (2017) as a developing research methodology that facilitates the systematic integration of qualitative and quantitative data in a single investigation. Summarily, researchers are able to perform a comprehensive examination of the research context by applying mixed methods (Enosh et al., 2015) and facilitate generalising findings and implications of the research subject to a larger population. In order to gain insight into the dimensions of attributes in smart hotels, implementing a mixed-methods approach to advance smart hotel research is necessary.

Technology adoption and silver generation

The silver generation refers to the population over 50 years old (Griesel, 2018) who are considered 'digital immigrants' (Prensky, 2001). Contrary to the younger generation, who are considered 'digital natives', digital immigrants are usually sceptical of the newest technologies and acquire them at a later age (Wang et al., 2018). The cognitive readiness and quickness of information processing of the elderly are declining as their natural age increases (Farivar et al., 2020). Meanwhile, older adults are more resistant to change and more cautious before they act compared to younger people (Zhao et al., 2021). Thus, in the smart hotel context, older individuals may possess different perspectives and needs.

Fung et al. (2023) obtained data on digital usage and the relationship with perceived well-being of older adults in Hong Kong. The result showed that increasing the usage of digital services enhances life satisfaction of older adults. Kabacińska et al. (2023) found that promotion of independence, affordability, ease of use and ethics are the most important digital assistive technology evaluation criteria for older adults. Bansal and Choudhary (2023) conducted a qualitative study on digital usage among Indian older adults, addressing the need for exceptional attention on challenges and demands of silver generation.

In China context, past literature revealed that perceived usefulness and perceived reliability affected the willingness to continue using smart wearable devices among older adults (Wang et al., 2023). Yang et al. (2023) also discovered that increasing the usefulness, ease of use, and observability of smart mobile payment encourages older Chinese adults to improve their attitudes and intentions to use this option. Zhang et al., (2023) disclosed that perceived value, performance expectancy, and effort expectancy positively influence older people's attitudes and intentions to adopt mobile technologies in the Chinese market. Moreover, Zhang et al., (2023) conducted exploratory research regarding the interplay between social networks and older adults' usage of ICT (information and communication technology) in western China. The result highlighted the crucial role of a stable and long-term supportive social network in learning and mastering ICT for older adults. Indeed, existing literature has shed light on the attributes and perceptions of older adults towards technology adoption, specifically ICT usage. Nonetheless, little is known about their perceptions for smart hotels, which differ from the daily life context.

Silver tourism

Silver tourism concerns travel endeavours undertaken by retired older persons who possess greater leisure time, which enables them to engage in more frequent and longer travel than younger generations (Stončikaitė, 2022). Due to the greater availability of time and money and the propensity to travel, the silver group has become a significant niche market for travel agencies, tour operators, and hospitality businesses globally (Zhang, 2023). The government pension policy in China has gradually

improved as the population ages. The silver tourism group is also growing rapidly, which accounts for 20% of the total tourism market, hence becoming a new growth point for the tourism economy in China (Yin & Cheablam, 2022).

Silver tourists' well-being and related travel experience has received considerable attention in silver tourism research. For instance, Asan et al. (2024) showed that tourists well-being has a positive spill over effect on the life satisfaction of the elderly. Yu et al. (2024) developed four attributes of virtual reality (VR) and augmented reality (AR) for senior tourism and analysed the effects of these attributes on older adults' travel experience. Xiang and Qiao (2023) explored the relationship between mind and body interactions and continuum theory perspectives on senior tourism and well-being. In the same vein, Zhang (2023) conducted exploratory research on how leisure travels have contributed to the subjective well-being of older adults.

However, little attention seems to have been paid to the relationship between silver tourists' usage of smart technologies and their travel behaviour (Wang et al., 2017). Various parties in the travel industry, including businesses, marketers, and stakeholders, are operating with a shallow understanding of the requirements of elderly travellers and a conventional perception of their travel habits (Balderas, 2019).

A common perception is that the older generation and smart technology are distinct entities (Mariano et al., 2022). Nevertheless, acknowledging the significant impact that the silver population has on global tourism in terms of financial and temporal resources is imperative (Wen et al., 2020). Therefore, further research on the usage of smart technologies among silver tourists is needed.

Research questions

The review of the extant literature identifies the need to investigate the antecedents of stay intention among silver tourists towards smart hotels. The balance of novel technology adoption, and the demand of silver tourists remains a significant gap in the literature. Given the importance of silver tourists to the contemporary hospitality industry, this study serves as a much-needed investigation by addressing the gap through the following research questions (RQ):

RQ1: What are the potential demands of silver tourists regarding smart hotels?

RQ2: What are the antecedents of behavioural intention with regards to silver tourists towards smart hotels?

Study 1: Qualitative phase

Study 1 aims to answer RQ1 and seeks to obtain deep insight into how silver tourists in China perceive smart hotels.

Data collection and procedure

A total of 18 participants with varying ages and educational backgrounds participated in Study1. Table 1 presents an overview of the research participants' demographic information. In order to fully explore the attributes of stay intention among silver tourists, participants were chosen based on three criteria: (1) 50 years old and above, (2) rich travel experience during the past three years, (3) having stayed in a hotel with service robot or smart technologies. Participants were recruited via convenience sampling and snowball sampling.

Interviews are often employed in a sequential exploratory mixed-methods approach to obtain initial data before quantitative research (Qu & Dumay, 2011). Therefore, in-depth, semi-structured interviews are conducted in this phase. All of participants were informed that their interviews would be recorded and transcribed. Signatures were collected on the form of Informed Consent before the interviews. At the beginning of each interview, participants were asked to recall their stay experience in smart hotels with every service scenario, from the stage of check-in until

Table 1. Overview of participants in Study 1.

Participant	Gender	Age	Education level	Occupation (Before retire)	Travel frequency
P1	Male	Mid 60s	Diploma	School teacher	1–2 times per year
P2	Female	Mid 60s	Diploma	School teacher	1–2 times per year
P3	Female	Late 50s	Diploma	Government servant	2–3 times per year
P4	Male	Early 60s	Bachelor	School teacher	1–2 times per year
P5	Male	Early 60s	Diploma	School teacher	2–3 times per year
P6	Female	Mid 60s	Diploma	Government servant	2–3 times per year
P7	Female	Mid 60s	Diploma	School teacher	1–2 times per year
P8	Male	Mid 60s	Bachelor	National company manager	4–5 times per year
P9	Female	Late 50s	Diploma	Headmaster of primary school	3–4 times per year
P10	Male	Mid 60s	Diploma	School teacher	1–2 times per year
P11	Female	Late 70s	Bachelor	University professor	1–2 times per year
P12	Female	Early 70s	Diploma	Private company manager	3–4 times per year
P13	Female	Early 50s	Bachelor	Beauty salon owner	Above 5 times per year
P14	Female	Early 50s	Diploma	School teacher	Above 5 times per year
P15	Female	Late 50s	Diploma	Government servant	3–4 times per year
P16	Male	Early 50s	Bachelor	Government servant	Above 5 times per year
P17	Female	Mid 50s	Master	Medical doctor	3–4 times per year
P18	Female	Late 60s	Doctor	Medical doctor	3–4 times per year

check-out. The interviewer had a list of questions aimed at probing participants to elaborate on their perceptions and expectations towards smart hotels: (1). How do you imagine smart hotel in the first place? (2). When you consider staying in the smart hotel, what kind of products and services would you like to receive and which aspects are your most concern? (3). How was your stay experience in the smart hotel? (4). When you consider traditional or smart hotels when travelling, what are the reasons? (5). What is your personal opinion towards smart hotel? The participants were encouraged to talk freely regarding their perceptions and the anonymity of their identities was ensured. Each interview session lasted between 33 minutes to an hour. The conversation was audio recorded and later transcripts in Chinese and then back translated into English. Five participants reviewed their transcripts for accuracy. Additionally, data were collected between November 9, 2023, and January 6, 2024. Interviews stopped when no new substantive information emerged.

Data analysis

Data from the individual interviews were analysed at several stages. Using MAXQDA software, a first round of open coding was performed to ground the prominent themes. Subsequently, selective coding was conducted based on the literature that linked the codes to existing scales. For opening coding, 989 codes were derived based on how they reflected the domains of smart hotel behavioural intentions. In reference to the previous literature, participants' responses were further grouped into the following categories: (1) perceived usefulness: intelligence level, working ability and emergency handling; (2) perceived ease of use: technology anxiety, ease of use and effort expectancy; (3) perceived convenience: automation and friendly design; (4) perceived reliability: machine failure, working assurance and function stability; (5) safety and security: personal safety and information security; (6) perceived personalisation: aging service and tailor-made service; (7) perceived enjoyment: novelty point, hedonic motivation and advanced experience; (8) perceived value: worth for value and affordability. Moving towards scale development, the selective codes were then evaluated in parallel with the literature to consider existing scales and items (Lott & Lott, 1974). The scales were examined for a pre-test with three academic experts on the AI of the hotel industry to confirm face validity and content validity (Gould et al., 2008). The reviewers had to examine and critique each item to confirm if the items were clearly stated and represented the categories (Gould et al., 2008). The items were subsequently modified and revised based on the reviewers' opinions.

Theoretical framework and hypotheses

Most studies applied the technology acceptance model (TAM) (Davis, 1989) as the foundational theory to develop their conceptual framework regarding smart hotels. Meanwhile, the artificial intelligence devise use acceptance model (AIDUA) (Gursoy et al., 2019) is applied sometimes, which is developed from the TAM. The unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al., 2003) and the cognitive appraisal theory (CAT) (Lazarus, 1991) also served as the theoretical foundations. TAM and the value-attitude-behaviour theory (VAB) were incorporated to validate the qualitative phase results (Ajzen, 1991) and support the hypothesised conceptual framework.

TAM have been broadly utilised in the smart hotel context (Han et al., 2021; Kim & Han, 2022; Yang et al., 2021) as well as technology adoption among older adults (Ma et al., 2023; Wang et al., 2023; Zhang et al., 2023; Zhao et al., 2021) to predict respondents' behavioural intentions. The VAB model is a cognitive hierarchy that depicts how values, attitudes, and behaviour are related (Homer & Kahle, 1988). In this model, attitude acts as a bridge between customers' values and behaviours (Milfont et al., 2010), which values serve as antecedents of attitudes (Ajzen, 1991). Attitude is the extent to which silver tourists have a favourable or unfavourable evaluation of smart hotels. This construct is also an antecedent of stay intention.

Perceived usefulness

Under the TAM model, perceived usefulness refers to technology users' belief that new technology enhances the performance of a given task (Davis, 1989). Study 1 participants treated usefulness as a vital factor that influences the attitude towards smart hotels:

P3: For example, if we suddenly have a heart attack, because humans can be flexible, they have the ability to deal with emergencies, but for robots, after all, they are some fixed programmes, for sure not as good as humans for any emergency.

P9: I hope the smart machine can ask me what kind of dishes I prefer and what my taste is and give me some suggestions accordingly.

P11: Smart hotels can provide better consultancy; this is also an advantage because humans are not as good as machines with information and data.

Accordingly, we propose the following:

H1. Perceived usefulness has a significant positive effect on silver tourists' attitude towards smart hotels.

Perceived ease of use

Perceived ease of use describes the degree of ease and convenience of utilising new technology (Davis, 1989). Similar to perceived usefulness, this construct in TAM has also been discussed as a concern by most participants:

P7: Regarding expectations, I just hope the smart hotel can be easy; which button is for what function is very clear; we do not need to study, and it is very easy to operate.

P10: I am concerned because we are old, not young anymore, and the adjusting ability also cannot compare with young people.

P12: For older people who stay in the smart hotel, the most thing I worry about is the instruction of the smart devices; it must be very clear and easy to understand.

Thus, the following hypothesis was proposed:

H2. Perceived ease of use has a significant positive effect on silver tourists' attitude towards smart hotel.

Perceived convenience

Kim et al. (2020) included convenience as a factor of perceived performance in smart hotels and proved the effect on attitude and WOM intention. Convenience displays the quality of cutting-

edge technologies that enable customers to experience products and services with no time and location restrictions (Meuter et al., 2000). Several participants mentioned smart hotel should have significant advantage on convenience:

P4: If you speak, open the curtain, then it will open automatically, so anything you just open your mouth, then it will do for you, very convenient.

P9: In traditional hotels, I need to spend time looking for the remote control and the lights, which are sometimes very troublesome to operate. But in smart hotel, I just lie in bed and talk with the smart device; you do not even need to get up.

Accordingly, we put forth the following hypothesis:

H3. Perceived convenience has a significant positive effect on silver tourists' attitude towards smart hotels.

Perceived reliability

An and Noh (2009) defined reliability as the capacity to deliver the promised services with precision and complete accountability. Kim et al. (2020) included reliability as an additional determinant of perceived performance in smart hotels. Meanwhile, Wang et al. (2023) stated perceived reliability positively affects the continued use intention of smart wearable devices among Chinese elders. Some participants expressed their concern about the reliability of smart devices:

P6: If I want to enter the room to get some rest, but I cannot open the door by scanning my face, then I do not know what to do next.

P9: the maintenance and the upgrade must catch up; otherwise, if the robots and the smart machine encounter an issue during my stay, it will certainly affect the service quality and my experience.

P11: By applying all the smart devices, maybe it is more convenient, but also easy to get issue at the same time, because anyway it is a system, if too many processes in between, it will be easy to have problems. If it is always having issues or mistakes, not only can you not increase the efficiency, but will also delay things or cause more trouble.

We thus predict the following:

H4. Perceived reliability has a significant positive effect on silver tourists' attitude towards smart hotels.

Perceived safety & security

Perceived security is considered a key factor influencing technology acceptance in numerous industries, including smart hotels (Han et al., 2021). Kim and Han (2020) emphasised that a great level of safety and security is the core attribute of smart hotels given that smart technologies may incur data privacy concerns. Thus, some participants voiced that they would be concerned about the data and information security in smart hotels and their personal safety:

P1: What I'm most concerned about is that since the smart hotel will not have security staff, so is can everyone enter? How can robots fight if there are some bad people?

P11: Like face recognition, for me, my feeling is fear because anything could happen nowadays, especially the face. I think it should be easy to copy; what if other people got my face image? For example, at night, I am sleeping, then suddenly the door is open, and someone copies my face and then enters. Is it terrible?

P17: As far as I know, if I scan the face, then all my information is inside already, so if some bad people took my face or IC to do some bad thing, I do not even know. Besides, if use face scanning to open the door, then my personal information will be fully exposed; I feel there is no privacy at all.

On the contrary, few participants clearly stated that they would not worry about safety issues:

P9: Although the smart hotel has face recognition and fingerprint, I do not worry so much. Because I do not think the bad people will be able to do something. Since the bank nowadays must personally go, cannot get money only by a photo or some fingerprint. I believe we also have some ability nowadays to identify scams, and getting cheated will not be that easy.

P15: If the smart hotel cannot even manage the safety of the guest's information or privacy, then I believe there will be no future for it, so I am not worried at all. I believe that a smart hotel should be safe in this aspect.

Even though the views were mixed, we still hypothesise the following:

H5. Perceived safety & security have a significant positive effect on silver tourists' attitude towards smart hotels.

Perceived personalisation

Personalisation leverages machine learning and big data, which involves delivering content, products and services tailored to consumers' individual traits (Xiao and Benbasat, 2007). In the hospitality industry, cutting-edge technologies have been recognised to engage customers more personally (Foris et al., 2020). According to Kim et al. (2021), the implementation of personalised service based on customers' choices can promote operational excellence and positively affect their perceived value and attitude. Study 1 participants expressed their wishes towards smart hotels regarding personalisation, specifically for aging service:

P11: I still believe the smart service designed according to the different ages of elders is really in a great need; you can divide the group into 50s, 60s and 70s. Then, the room facilities and dining facilities can all be different. Especially in the future, in an aging society, there will be more and more seniors in the world, so I think the smart hotels should consider seniors as much as possible.

P12: I think the smart hotel can also focus on the aging service because I have thought about it before; I think it will be more suitable than the nursing home, from the food and the service. For example, maybe I am interested on the senior's lecture if the hotel able to do it, it will be good, something different from the traditional one.

P16: Since my personal file has already been saved in the system, the hotel will arrange and set up the room according to my hobbies, health, personal character, and likes or dislikes. I think it will be a significant advantage of smart hotels.

Hence, we hypothesise as below:

H6. Perceived personalisation significantly positively affects silver tourists' attitude towards smart hotels.

Perceived enjoyment

Davis et al. (1992) suggested that the motivating factor that influences an individual's adoption of new technology is enjoyment. Additionally, the authors highlighted that enjoyment is a noteworthy predictor of usage intention. Past literature provided empirical evidence that validated the critical role of enjoyment by smart technologies in the hotel industry to shape customer's behaviour (Kim et al., 2021; Lin et al., 2020; Tussyadiah et al., 2018). Similar to Study 1, most participants stated that the fun and enjoyment brought by robots and AI technologies in smart hotel matters:

P2: The hotel robots are very interesting, and they are very polite as well, and the service they provide is very special, I am very interested. And next time, if I get a chance, I will stay in the robots hotel again.

P13: If I stay in the hotel decorated like a palace, so maybe the smart devices can call me king or queen; something interesting and different can bring the pleasure to guests. Or even the Xiaodu can reply with some local dialect, which will be more interesting.

P14: I think the smart hotel should be very modern and fashionable; if I stay in the smart hotel, I can experience modern life.

Accordingly, we hypothesise the following:

H7. Perceived enjoyment has a significant positive effect on silver tourists' attitude towards smart hotels.

Perceived value

The idea of perceived value is usually understood as the balance between price and quality, sometimes called value-for-money (Monroe, 1990; Sweeney and Soutar, 2001). Consequently, this idea is often linked

to customers' perceived benefits with a product or service (Prebensen et al., 2013). The aforementioned aspect has been widely recognised as a prominent determinant in shaping customer decision-making and purchasing patterns (Chiang and Lee, 2013; Kuo et al., 2009). Previous literature constantly highlighted that the perceived value towards hotel smart technologies created value co-creation and aided customers in developing a favourable attitude (de Kervenoael et al., 2020; Kim et al. 2021; Sigala, 2018). Several participants commented in detail about the importance of value:

P7: I think if the price is a bit expensive, for me it is okay, as long as not too high. If it is only a bit higher, which I can accept, and at the same time I want to try and experience, maybe I will choose it.

P14: As long as I think the smart hotel is worth the value, it should be okay. But if the normal hotel is around RMB300 to RMB500, but the smart one is RMB1000 to RMB1200, for sure I will not consider it because it is too much higher. If RMB100 or RMB200 higher, I can accept.

P16: Although smart one is more expensive, for example, a traditional hotel is RMB300, this one is RMB1000, but for me is okay as long as I feel the price is worth this money, not I spend RMB1000, but the experience is even worse than others, so I will not come again next time. The key point is whether I can get a good experience.

Thus, the following hypothesis was proposed based on the VAB model:

H8. Perceived value has a significant positive effect on silver tourists' attitude towards smart hotels.

As mentioned earlier, the attitude of customers will eventually affect their behaviour intentions (Kim et al., 2021, Quan et al., 2022), thus:

H9: Silver tourists' attitude towards smart hotels significantly positively affects their intention to stay.

Study 2: Quantitative hypotheses testing

Study 2 aims to answer RQ2 by testing the hypotheses derived from study 1.

The research framework is depicted in [Figure 1](#).

Survey instrument

A pilot test was conducted using samples of 80 silver smart hotel customers through an on-site survey. Principle component analysis (PCA) and exploratory factor analysis (EFA) were applied to confirm the reliability of the instruments using Statistical Package for the Social Sciences (SPSS 29.0). First, PCA was used to identify the ideal number of factors of each construct. Second, based on the PCA results, EFA was performed to test the adequacy of the proposed factors. All items were properly loaded onto a single factor, which resulted in no items. Thus, the questionnaire was finalised.

The questionnaire comprised two parts. Part 1 covered socio-demographic variables, such as gender, age, marital status, education, employment before retirement, and travel experience. Measurement items for the latent constructs in Part 2 were developed based on the participants' responses in Study 1 and past literature. All items were captured via a seven-point Likert scale from 1 (strongly disagree) to 7 (strongly agree). All the measurement items are listed in [Table 3](#).

Sample and procedures

The main study was launched online via the Credamo platform. A smart hotel live video was included in the questionnaire with brief descriptions. Respondents were instructed to imagine themselves staying in a smart hotel while completing the survey. Screening questions were presented at the beginning of the questionnaire to qualify the respondents: (1) Have you travelled during the past three years? (2) Have you stayed in hotels during the trips? The survey took an average of about 10 minutes to complete and was conducted from February 1 to February 22, 2024.

The sample size was evaluated based on G*Power (Faul et al., 2009), where a statistical power of 0.95 required a minimum sample of 305. A total of 480 respondents aged over 50 were recruited

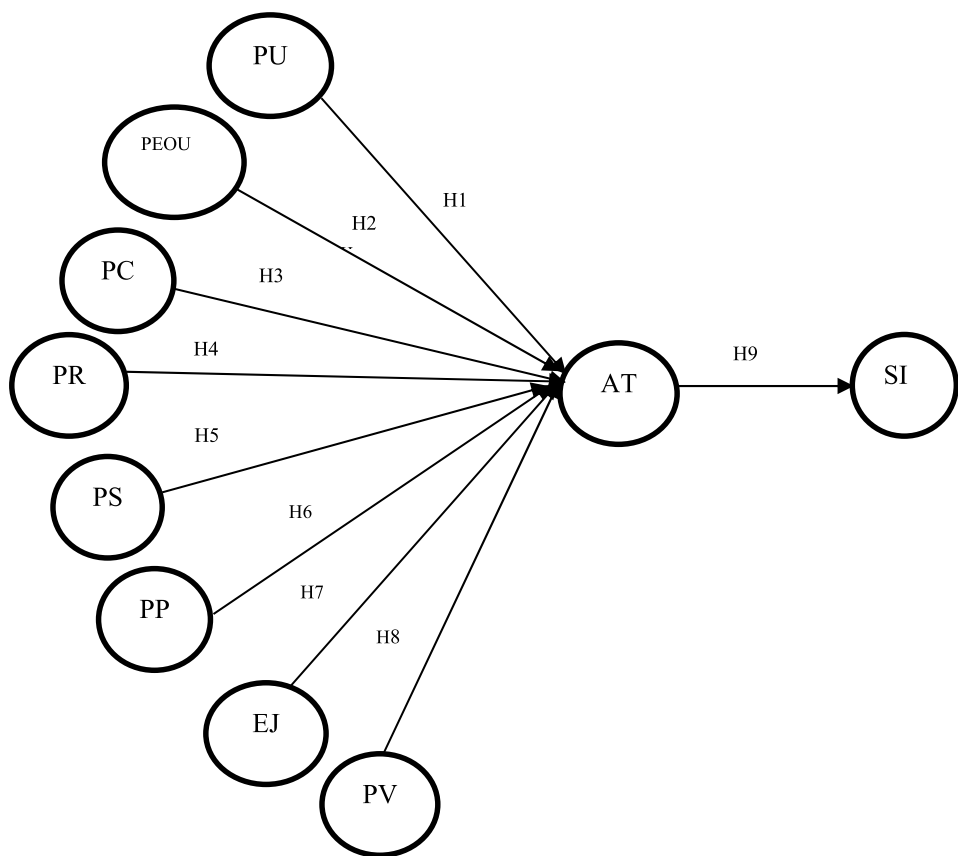


Figure 1. The research model.
Note: PU = Perceived usefulness; PEOU = Perceived ease of use; PC = Perceived convenience; PR = Perceived reliability; PS = Perceived safety & security; PP = Perceived personalisation; EJ = Perceived enjoyment; PV = Perceived value; AT = Attitude towards smart hotel; SI = Stay intention.

from Credamo, a third-party marketing research firm with qualified criteria. Finally, 50 of them were removed due to the unusable responses. Thus, the total data set was 430, which met the minimum sample size requirement. Table 2 displays an overview of the participant’s demographic information.

Table 2. Demographic profile.

Variable	Category	<i>n</i> = 430	%
Gender	Male	229	53.3
	Female	201	46.7
Marital status	Single	8	1.9
	Married	422	98.1
Age	50–55	79	18.4
	56–59	227	52.8
	60–64	90	20.9
	65–69	23	5.3
	70 and above	11	2.6
Education	High school and below	126	29.3
	Diploma degree	91	21.2
	Bachelor degree	182	42.3
	Master degree and above	31	7.2
Annual income	less than 100,000¥	81	18.8
	100,000–200,000¥	213	49.5
	Above 200,000¥	136	31.7

Table 3. Descriptive analysis.

	Constructs and items	Mean	Standard Deviation
PU	Perceived Usefulness		
PU1	Smart hotel devices will be effective	5.444	1.519
PU2	My travel needs will be satisfied at a smart hotel by using smart hotel devices	5.442	1.580
PU3	A smart hotel would enable me to enjoy products and services more efficiently	5.537	1.518
PU4	Overall, smart hotel devices are useful	5.623	1.515
PEOU	Perceived Ease of Use		
PEOU1	It looks easy to use high-technologies products and services employed at a smart hotel	5.184	1.366
PEOU2	Using smart hotel devices will require little effort	5.219	1.509
PEOU3	Interactions with advanced technologies and robots available at a smart hotel seem to be clear and understandable	5.288	1.483
PEOU4	I believe I can use smart hotel devices without any significant help and guidance	5.051	1.547
PC	Perceived Convenience		
PC1	A smart hotel would enable me to request and receive products/services conveniently	5.365	1.432
PC2	A smart hotel would enable me to be connected for assistance with no regard to time and place	5.219	1.440
PC3	Advanced technologies and robots employed at a smart hotel would offer the benefits of convenience	5.486	1.409
PC4	High-technology products and services available at a smart hotel seem to be convenient	5.433	1.402
PR	Perceived Reliability		
PR1	High-technology products and services provided at a smart hotel would be reliable	5.100	1.485
PR2	Using high-technology products and services provided at a smart hotel, I would get just what I wanted	5.149	1.607
PR3	Advanced technologies and robots employed at smart hotel would not result in errors	4.202	1.587
PR4	Advanced technologies and robots employed at a smart hotel would not result in failures	3.828	1.623
PR5	High technologies employed at a smart hotel would reduce mistakes that generally occurred by the human	4.840	1.464
PS	Perceived Safety & Security		
PS1	High-technologies employed at a smart hotel, such as fire detection technology would provide a high level of safety	5.188	1.508
PS2	High-technologies employed at a smart hotel, such as door-lock by the facial recognition would provide a high level of security	5.258	1.578
PS3	High-technologies employed at a smart hotel would provide a strong data security and I will feel safe about my personal data	4.912	1.538
PS4	I would be immediately alerted and saved in case of any emergency at a smart hotel	5.088	1.488
PS5	I believe in general, using smart devices to receive service from a smart hotel is safe and secured	5.235	1.556
PP	Perceived Personalisation		
PP1	Smart hotel offers me personalised service	5.293	1.344
PP2	Smart hotel understands my specific needs as elders and can be adaptive to what I need during the whole stay	5.214	1.364
PP3	Smart hotel offers recommendations that match my needs and situations	5.298	1.374
PP4	At a smart hotel, customised assistance would be available to improve my well-being, such as diet or exercise therapy based on my health condition	5.023	1.427
PP5	At a smart hotel, I can get personalised information which beyond hotel that is tailored to my interest and needs	5.302	1.363
EJ	Perceived Enjoyment		
EJ1	I have fun when interacting with smart hotel devices and robots	5.572	1.414
EJ2	I find the smart hotel enjoyable and fascinating	5.577	1.385
EJ3	Stay at a smart hotel which has no human staff at all is such a novel and interesting experience	5.737	1.422
EJ4	It is very comfortable and pleasant to stay in a smart hotel	5.565	1.359
PV	Perceived Value		
PV1	A smart hotel would offer good value for the money I spend	5.435	1.303
PV2	A smart hotel would provide a good deal compared to other hotels	5.244	1.404
PV3	High technologies employed at a smart hotel can enrich my travel experience	5.605	1.325
PV4	The overall expected value of staying a smart hotel is very high	5.612	1.321
AT	Attitude toward Smart Hotel		
AT1	For me, staying at a smart hotel would be good	5.619	1.210
AT2	For me, staying at the smart hotel would be wise	5.495	1.329
AT3	For me, staying at the smart hotel would be pleasant	5.788	1.246

(Continued)

Table 3. Continued.

Constructs and items		Mean	Standard Deviation
AT4	For me, staying at the smart hotel would be beneficial	5.523	1.236
AT5	For me, staying at the smart hotel would be attractive	5.963	1.248
SI	Stay Intention		
SI1	I am willing to stay at smart hotel when travelling	5.195	1.707
SI2	I plan to stay at a smart hotel when travelling	5.107	1.678
SI3	I will recommend the smart hotel to my friends	5.074	1.748
SI4	I will share my experience at the smart hotel to my friends	5.247	1.752

Data analysis

Partial least squares-structural equation modelling (PLS-SEM) was used with Smart Partial Least Squares (SmartPLS) 4 software (Hair et al., 2017) to analyse the proposed theoretical model and test the hypotheses. The measurement model was examined based on the construct reliability and validity, while the structural model was evaluated using the R^2 , Q^2 , and confidence intervals. Table 3 depicts the results of the descriptive analysis of the constructs of the proposed model.

Measurement model

The first step of the measurement model of PLS-SEM is to assess the reliability and validity criteria (Ali et al., 2018). The composite reliability (CR), rho_A, Cronbach's alphas, and average variance extracted (AVE) should exceed 0.7, 0.7, 0.7 and 0.5, respectively, to establish construct reliability and convergent validity (Hair et al., 2019). The results presented in Table 4 reveal acceptable reliability and convergent validity for all constructs.

Discriminant validity was evaluated using the Fornell-Larcker and by examining the Heterotrait-Monotrait Correlation (HTMT) ratio (Hair et al., 2019). Tables 5 and 6 list the scores of discriminant validity of all the constructs.

Structural model

The current study is a prediction-oriented study, therefore the prediction power of the model was assessed. The predictive accuracy of the model was assessed by examining the coefficient of determination (R^2) (Hair et al., 2019). The results identified the values of 0.593 and 0.312 for R^2 of attitude towards smart hotels and intention to stay, respectively, which are considered high and acceptable (Hair et al., 2017). Additionally, the Q^2 values of all endogenous constructs were positive, which were 0.566 and 0.316, respectively. Thus, the results revealed acceptable in-sample predictive power for the model (Hair et al., 2017). Henseler et al. (2016) also suggested using the standardised root mean square residual (SRMR) to evaluate model fit, which should remain < 0.08 . The result in this study was 0.042, which revealed adequate model fit.

Table 7 illustrates the results of hypothesis testing, where a bootstrapping procedure with 5000 subsamples was applied to test the significance of the relationships (Hair et al., 2017). The results supported H1 ($\beta = 0.278$; $p < 0.001$) and H2 ($\beta = 0.225$; $p < 0.001$). Nevertheless, the results did not support the effects of perceived convenience and perceived reliability on attitude, thus not supporting H3 and H4. Furthermore, perceived enjoyment positively influenced attitude, hence supporting H7 ($\beta = 0.113$; $p < 0.01$). The results depicted a strong relationship between perceived safety and security, perceived personalisation and attitude, and perceived value and attitude, which supports H5 ($\beta = 0.218$; $p < 0.001$), H6 ($\beta = 0.141$; $p < 0.001$), and H8 ($\beta = 0.185$; $p < 0.001$). Lastly, attitude towards smart hotels strongly affected intention to stay, therefore supporting H9 ($\beta = 0.559$; $p < 0.001$).

Table 4. Results of assessment of measurement model.

Items	Loading	Cronbach's alpha	rho_A	Composite reliability	AVE
Perceived Usefulness		0.937	0.939	0.955	0.840
PU1	0.931				
PU2	0.912				
PU3	0.894				
PU4	0.930				
Perceived Ease of use		0.917	0.918	0.942	0.801
PEOU1	0.889				
PEOU2	0.902				
PEOU3	0.898				
PEOU4	0.892				
Perceived Convenience		0.912	0.914	0.938	0.792
PC1	0.903				
PC2	0.891				
PC3	0.871				
PC4	0.893				
Perceived Reliability		0.899	0.906	0.925	0.710
PR1	0.841				
PR2	0.840				
PR3	0.866				
PR4	0.843				
PR5	0.824				
Perceived Safety& Security		0.939	0.941	0.954	0.804
PS1	0.880				
PS2	0.907				
PS3	0.878				
PS4	0.899				
PS5	0.920				
Perceived Personalisation		0.915	0.921	0.936	0.745
PP1	0.843				
PP2	0.886				
PP3	0.891				
PP4	0.855				
PP5	0.840				
Perceived Enjoyment		0.921	0.936	0.943	0.806
EJ1	0.907				
EJ2	0.903				
EJ3	0.876				
EJ4	0.905				
Perceived Value		0.897	0.912	0.928	0.763
PV1	0.884				
PV2	0.863				
PV3	0.850				
PV4	0.897				
Attitude towards Smart Hotel		0.931	0.931	0.947	0.783
AT1	0.899				
AT2	0.881				
AT3	0.881				
AT4	0.880				
AT5	0.884				
Stay Intention		0.933	0.935	0.952	0.833
SI1	0.927				
SI2	0.911				
SI3	0.899				
SI4	0.913				

Discussions

The present study aimed to predict the attitude and stay intention of silver tourists towards smart hotels. Their perceptions and expectations were analysed to identify the antecedents of behavioural intention of silver tourists towards smart hotels. Pulling from previous literature on smart hotel and older adults technology adoption, this study sought to measure the attributes of stay intention. The TAM and VAB were utilised with reference to the smart hotel

Table 5. Fornell & Larcker criteria.

	PU	PEOU	PC	PR	PS	PP	EJ	PV	AT	SI
PU	0.917									
PEOU	0.553	0.895								
PC	0.231	0.380	0.890							
PR	0.172	0.239	0.386	0.843						
PS	0.259	0.243	0.308	0.623	0.897					
PP	0.189	0.232	0.130	0.431	0.455	0.863				
EJ	0.211	0.244	0.175	0.215	0.199	0.193	0.898			
PV	0.207	0.239	0.137	0.184	0.167	0.223	0.463	0.874		
AT	0.561	0.557	0.328	0.393	0.488	0.423	0.394	0.426	0.885	
SI	0.680	0.581	0.303	0.105	0.211	0.160	0.174	0.166	0.559	0.913

Table 6. HTMT ratio.

	PU	PEOU	PC	PR	PS	PP	EJ	PV	AT	SI
PU										
PEOU	0.597									
PC	0.251	0.415								
PR	0.182	0.254	0.422							
PS	0.275	0.260	0.330	0.680						
PP	0.205	0.252	0.140	0.473	0.488					
EJ	0.221	0.256	0.186	0.225	0.206	0.200				
PV	0.217	0.257	0.147	0.190	0.175	0.243	0.505			
AT	0.599	0.602	0.355	0.423	0.521	0.455	0.416	0.457		
SI	0.729	0.627	0.329	0.116	0.224	0.173	0.182	0.174	0.598	

Table 7. Structural model results.

Hypothesis	Path	β	t-value	p-value	f^2	Confidence Intervals Bias	Result
H1	PU→AT	0.278	5.580	0.000	0.127	[0.181, 0.376]	Supported
H2	PEOU→AT	0.225	4.042	0.000	0.075	[0.115, 0.334]	Supported
H3	PC→AT	0.040	0.992	0.321	0.003	[−0.040, 0.119]	Not supported
H4	PR→AT	0.021	0.519	0.604	0.001	[−0.062, 0.096]	Not supported
H5	PS→AT	0.218	4.282	0.000	0.064	[0.121, 0.320]	Supported
H6	PP→AT	0.141	3.728	0.000	0.035	[0.067, 0.216]	Supported
H7	EJ→AT	0.113	3.060	0.002	0.023	[0.044, 0.188]	Supported
H8	PV→AT	0.185	5.801	0.000	0.063	[0.127, 0.252]	Supported
H9	AT→SI	0.559	13.445	0.000	0.454	[0.473, 0.635]	Supported

attributes scale to interpret antecedents of favourable attitude and stay intention among silver tourists.

The key findings of the current study are as follows. First, the results highlighted a significant positive association between perceived usefulness with attitude toward smart hotels among silver tourists, which aligns with Joe et al. (2022), Yang et al. (2021), Han et al. (2021), and Tuomi et al. (2023). Han et al. (2021) investigated the reception of smart technologies among hotel customers in Hong Kong and discovered that perceived usefulness has a significant direct influence on the attitude of using and an indirect effect on behavioural intentions.

Second, the results disclosed a significant effect of perceived ease of use on attitude. This finding is consistent with earlier studies, which demonstrated that perceived ease of use with smart hotels was positively linked with attitude and behavioural intention of customers (Han et al., 2021; Kim et al., 2020). The findings were also confirmed by Zhao et al. (2021). Yang et al. (2023) and Wang et al. (2023), which emphasised that ease of use is a main factor that encourages older adults' smart technology adoption in China.

The impacts of convenience and reliability deserve extended comments. Perceived convenience had a negligible effect on the attitude of silver tourists, which is similar to perceived reliability. Although the results contradicted past literature in the smart hotel context (Kim

et al., 2020; Kim & Han, 2020), the findings were logical. Kim and Choudhury (2021) proved that perceived benefits in influencing the usage intention of smart voice assistants among older adults have changed over time, which was the convenience of operation at the beginning of digital companionship. This situation happens after older adults are used to using smart devices. Thus, silver tourists nowadays in China no longer focus and highlight the convenience attribute, emphasising other factors instead. Over 3,000 hotels in China applied robots and AI technologies during the COVID-19 pandemic, and this number is increasing by 20% every year. This trend has increased recognition among consumers, even elders, about the convenience smart devices offer. Most participants in Study 1 mentioned that the voice assistant in the room and service robots are convenient compared with the traditional hotels, which simply mean making a phone call or just directly talking to them.

The results of perceived reliability are inconsistent with past literature in the smart hotel context (Kim et al., 2020). Nonetheless, the findings align with Wang et al., (2023), which demonstrated that the perceived reliability of smart wearable devices did not significantly impact the usage intention of older adults. One possible explanation could be that the subjects were older adults, who have more time and patience compared with the younger generation. Thus, they do not pay much attention to smart device reliability. Even if there are issues with smart device reliability (service error or machine failure), silver tourists will not decrease their intention to stay as long as other factors are satisfied.

Fourth, the findings have underlined parallel results with Kim et al. (2021) and Han et al. (2021), which revealed a significant relationship between safety and security and customer attitude towards hotel smart devices. Moreover, Yang et al. (2023) and Pal et al. (2018) disclosed safety and security as some of the most important antecedents of smart home acceptance for older adults.

A significant relationship was discovered regarding the effect of perceived personalisation on attitude. This result is consistent with Kim and Han (2020), Chen et al. (2021), and Foris et al. (2020), which discovered that perceived benefits or performance had a significant and favourable impact on the development of customer view towards smart hotels with personalisation serving as one of the fundamental driving forces. This study also confirms that personalisation is not only important to the younger generation, but also is crucial in older adults.

Perceived enjoyment is related to silver tourists' favourable attitude. Previous studies (Mohamad et al., 2021) discovered that users intend to continue using the particular technology if they find it enjoyable and pleasant, similar to the conclusion in the smart hotel context (Kim et al. 2021). Considering that older adults embark on tours after enduring years of demanding workloads, the pursuit of a pleasurable experience is important to them. Furthermore, a positive engagement process with smart hotel technologies reinforces the pleasurable objectives of silver tourists and therefore influences their subsequent behaviours.

The relationship between perceived value and attitude was confirmed, which is consistent with the general findings from past literature (Kim et al., 2021; Zhang et al., 2023). This outcome also supports the VAB model on the silver generation group. The values from the offerings of smart hotels impact the development of silver tourists' attitude, which increases the positive intentions towards smart hotels.

Lastly, attitude significantly influences behavioural intention. This finding confirmed previous results regarding the influence of attitude on behavioural intention in the hotel industry, specifically smart hotels (Kim et al., 2021; Quan et al., 2022).

Conclusion and implications

Smart hotel is a novel concept that needs more empirical studies to be undertaken. Instead of being just a theoretical concept that emerges from the advancement of scientific thinking, smart hotel is more to a pragmatic approach of doing business, whereby the need of incorporating customers' demands into the context of smart hotels is necessary. The current study provided a deep and broad investigation of antecedents of behavioural intentions among silver tourists through an

exploratory sequential mixed methods approach. The qualitative study (Study 1) bridged the research gap of gaining a deeper comprehension of silver tourists' perception of smart hotels. The quantitative study (Study 2) provided a broader picture by investigating a larger number of respondents of silver tourists in China.

Findings obtained based on a structural equation model run over a scale of questions derived from Study 1 together with past literatures. Overall, this study indicated six antecedents of behavioural intentions. Perceived usefulness, perceived ease of use, perceived safety & security, perceived personalisation, perceived enjoyment, and perceived value are the drivers of stay intention among silver tourists towards smart hotels.

This study, and its related findings, is significant for both researchers and hotel managers. First, it is expected to diversify approaches to smart hotel studies by expanding the limited previous research domains that have only covered diverse demographic participants, instead of the particular group of respondents. Most of all, this study provides further insights into the scientific examination on smart hotel by providing a conceptual framework that allows us to interpret the behavioural intentions of silver tourists by exploring, investigating and validating their perceptions using exploratory sequential mixed methods, an approach that has seldom adopted in the past literature. Hence, important attributes were developed, bringing insights into the literature of smart hotel as well as silver tourism.

Through the adoption of TAM and VAB theory, the current study discusses the attributes which formulate the behavioural intentions of silver tourists. The literature on robotics and AI technologies in the hospitality industry has developed the service robot acceptance model (sRAM) and artificial intelligence device use acceptance (AIDUA), which are based on the original TAM. The present study extended the existing body of literature. Meanwhile, we propose the findings can be considered the older adults' version of the smart hotel acceptance model. Further, while the specific smart hotel context has been largely overlooked in most empirical research, this study involved the context of smart hotel to better understand the relationship between smart technology adoption and customers behavioural intentions by listening to the customers' needs- what they want from the smart hotels. Therefore, this study provides useful academic interpretation of recent global debate in which artificial intelligence and service robot adoption within hotel industry.

From a practical point of view, our findings provide useful and novel information to policy makers, smart devices manufacturers and hotel managers attempting to better position or reposition of smart hotel. The findings provide strong evidence that, the aspects of usefulness, ease of use and safety & security of smart hotel devices could enhance silver tourists positive attitude and stay intentions. It is worth nothing that value and personalisation play more essential roles than enjoyment in affecting silver tourists' stay intentions towards smart hotel. However, this may not possibly mean that the aspect of enjoyment can be ignored in the design of smart devices. We argue that enjoyment could be a supplementary force which further enhances silver tourists' stay intentions. Thus, this information can be used as an important factor in the design of smart devices.

Furthermore, our findings help hotel managers understand how silver tourists' stay intentions of smart hotels can be strengthened. According to our study, hotel managers should be sensitive to smart hotel device functions and ensure they are efficient and capable of delivering services anytime. Hotel owners and managers need to collaborate with robot manufacturers to ensure that future hotel robots have improved capabilities in managing any emergency based on safety regulations. Besides, customers' privacy and information security need to be emphasised during daily operation. Naturally, it is important for hotel management to communicate with robot manufacturers on any customer feedback pertaining to challenges encountered during usage. Moreover, according to our qualitative findings, silver tourists expect the support of human service during the stay. Therefore, it is imperative for hoteliers to develop a concise set of guidelines for silver guests, ensuring the provision of human staff support as needed.

Due to the intense competition in the hotel industry, the growth of smart hotels depends on understanding how customers evaluate and choose a hotel. Silver tourists may be more inclined

to visit and stay at smart hotels if they are provided with superior services. Consequently, hotel managers need to work with robot designers and other smart device manufacturers to raise the smart level and ensure the novelty factor remains simultaneously.

The present study also discovered certain limitations. First, the measurement items were developed from qualitative data. Hence, future studies should further refine and strengthen them before attempting to generalise these findings. Meanwhile, the framework should be investigated and compared across various cultures. Second, future research should be conducted in multiple types of smart hotels (budget, midscale, upscale, and luxury) to comprehensively understand the antecedents of silver tourists' behavioural intentions. Third, this study did not demonstrate age and gender differences. Therefore, future research should investigate gender and age as control variables to better understand silver tourists. Additionally, future studies should add several moderating factors to further comprehend the mechanisms behind the impacts of projected attributes on attitude and behavioural intentions. Such investigations might improve the understanding of the mechanisms regarding smart hotels.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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