Smart mobile tourism app featuring augmented reality and big data analytics: an empirical analysis using UTAUT2 and PCT models

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Abstract

Purpose – Considering the limited understanding of determinants influencing the adoption of smart mobile tourism app (SMTA) featuring augmented reality (AR) and big data analytics (BDA), privacy concern (PC) and the risk of privacy information disclosure (PI) have threatened SMTA adoption. This study aims to propose an expanded consumer acceptance and use of information technology (UTAUT2) model by including new contextual components, integrated with privacy calculus theory (PCT) model to examine the determinants influencing behavioural intention (BI) to use SMTA.

Design/methodology/approach – Personal innovativeness (IN) and privacy information disclosure (PI) are incorporated in UTAUT2 model to determine its effect on SMTA featuring AR and BDA technologies from smart perspective. Both privacy concern (PC) and privacy risk (PR) derived from PCT model are also included to determine its influences on an individual's willingness to disclose privacy information for better-personalised services. We collected responses from 392 targeted participants, resulting in a strong response rate of 84.66%. These responses were analysed statistically using structural equation modeling in both SPSS 22.0 and SmartPLS 3.0.

Findings – Findings showed that personal innovativeness (IN), habit (HT) and performance expectancy (PE) significantly affect behavioural intention (BI) while privacy concern (PC) significantly affect privacy information disclosure (PI) to use SMTA. In contrast, effort expectancy (EE), hedonic motivation (HM) and privacy information disclosure (PI) had no significant effects on behavioural intention (BI) while privacy risk (PR) had no significant effects on privacy information disclosure (PI) to use SMTA.

Originality/value – The study findings help tourism practitioners in better comprehending recent trends of SMTA adoption for establishing targeted marketing strategies on apps to improve service quality. In addition, it enables app development companies acquire app users' preferences to enhance their app development for leading app usage.

Keywords Smart mobile tourism app, Augmented reality, Big data analytics, Behavioural intention, UTAUT2, PCT

Paper type Research paper

Introduction

Tourism as a global industry has grown with the advent of mobile devices and applications. Tourism applications currently rank seventh among the most downloaded app categories.

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Travel businesses were expected to generate $1,091bn in revenue from investments of $10bn in travel technology by 2022 (Sharma, 2018). The rise of artificial intelligence (AI) technology and the constant growth of mobile apps has shifted mobile tourism app (MTA) towards smart technologies and change travellers' behaviour. MTA provide travellers with a solution that offers high value-added services, namely, convenience, interactivity and search information without geographical and time constraints (Bakar *et al.*, 2019).

An AI-powered smart tourism app not only gives information, guidance, tips, insights and warnings but also works in real time to notify travellers and provides suggestions to help them have a pleasant and stress-free vacation. Innovative technology specifically mobile augmented reality (AR) which overlays virtual objects with real objects in a mobile display has the potential to reduce mental effort by guiding travellers to unfamiliar places with visual, audio and three dimensions (3D) location-based information (Shukri *et al.*, 2017; Kontogianni and Alepis, 2020). Apps that leverage big data analytics (BDA) technology create personalised customer experiences based on specific user preferences and ultimately improve decision-making for travellers and create value for stakeholders (Mariani *et al.*, 2018). Travel recommender systems were developed to aid travellers from being overwhelmed by a flood of tourist information and selecting sites of interest that best suit their preferences (Dorcic *et al.*, 2018). According to MacHale (2019), modern travellers are using augmented reality (AR)/virtual reality (VR) apps to determine if their luggage size falls within airline baggage allowances. Furthermore, they expect these apps to have planning or thinking features that are intelligently tailored to their specific needs and preferences. The extensive application of AR and BDA technology is thus a recent trend in the development of MTAs (Stfalcon.com, 2018; Vakhnenko, 2019).

Despite being the seventh most downloaded category of mobile applications, travel apps have the highest uninstall rate of any industry, with 35% of users churning an app within two weeks due to no longer use, annoying push notifications, intrusive ads, limited storage space, technical issues and confusing to use (Karnes, 2021). Malaysia is still in the juvenile stage of industrial automation with the integration of the Internet of Things, VR and AR, BDA and cloud computing, owing to fear of investment, reluctance to change business models and low expertise (Amarthalingam, 2017). Malaysia has launched MySejahtera, an app that allows visitors register and manage their admission as well as tracks COVID-19 infection and hotspot tracing through health self-assessment (Tariq, 2020). The adoption of smart MTA (SMTA) featuring AR and BDA raises users' concerns about location-tracking data being exploited by outsiders for inappropriate purposes. Malaysia's current legislation is insufficient to address privacy and cyber security concerns (Lee, 2020). Furthermore, providing personal information to the app such as phone numbers, identification card numbers, home addresses or current locations may result in citizen surveillance (Malek, 2020).

Because the use of smart mobile tourism apps (SMTA) is still new to the majority of travelers, it is more important to investigate their behavioral intention to use SMTA rather than their intention to continue using it. Numerous previous studies, including investigate what motivates users to continue using theme parks apps with an extended of expectation confirmation theory (Long and Suomi, 2022) and analysis of young generation's continued use intention of travel apps with the integrated theory of planned behaviour and an extension of technology acceptance model (Zhou *et al.*, 2021b), place more emphasis on continued use intention of travel apps. Several studies have analysed the development of AR/VR apps in the tourism industry using text mining and topic modeling approaches with secondary data (Moro *et al.*, 2019), as well as the user acceptance of location-based mobile apps that feature interactive maps, push notification services with geofencing, and AR tour guides (Chan and Lau, 2020). However, few of these studies have provided a deep insight

into behavioral intention to use SMTA based on theoretical model approaches with primary data. In addition, most of them neglected the risks of privacy information disclosure with the adoption of SMTA featuring AR and BDA.

Considering the limited understanding and lack of study on the determinants driving SMTA adoption towards smart, AR and BDA technologies, privacy concerns (PCs) and risks of privacy information disclosure have threatened the adoption of SMTA. Thus, a further investigation of SMTA towards smart, AR and BDA intend to address the research gap by answering the following research questions:

RQ1. What determinants affect BI to use SMTA towards smart?

RQ2. What determinants affect BI to use SMTA featuring AR and BDA?

RQ3. How PC and PR affect PI on BI to use SMTA?

The research model in this study aimed to provide a comprehensive finding in different aspects. Firstly, the extended consumer acceptance and use of information technology (UTAUT2) model is adopted due to it was the most predictive model for measuring user adoption of technology. Secondly, the UTAUT2 model is extended to include constructs: IN and PI, PC and PR derived from Privacy Calculus Theory (PCT) model to determine its effect on SMTA featuring AR & BDA technologies. Thus, the extended UTAUT2 is integrated with PCT model to examine the determinants influencing travellers' BI to use SMTA.

The findings showed that PC, PE, HT, and IN significantly affect BI to use SMTA, whereas PR, EE, HM and PI have no significant effect on BI to use SMTA. Existing research has added to our understanding of the primary factors of BI to use SMTA in numerous ways. It will assist industry practitioners in better understanding recent trends in the use of SMTA for leading app usage and alignment with current or future app trends. Most importantly, the research seeks to understand how these determinants could affect and increase travellers' loyalty to the apps to ensure the longevity of apps.

Literature review

Numerous research has been conducted on MTA but have neglected to study app towards smart such as an investigation of the elements that influence travel app adoption by visitors visiting China's rural areas (Lu *et al*., 2015) and a study to examine consumers' intention to adopt mobile applications in tourism (Tan *et al*., 2018). SMTAs are continually evolving, resulting in more automation in smart apps, which will always have an impact on users' technology behaviour. Thus, this study seeks to determine determinants influencing BI to use MTA towards smart. Although there have been numerous studies on smart apps, there is a lack of research on smart apps' acceptability in the travel aspect. For example, Tang *et al*., 2020 explored the intent to disclose information via apps based on personality traits such as agreeableness, neuroticism, conscientiousness, extraversion, and openness (Tang *et al*., 2020); Gutierreza *et al*. (2019) conducted an empirical examination of the specific risks and benefits that influence consumers' acceptance of mobile location-based advertising (MLBA) using PCT model (Gutierreza *et al*., 2019); Chen and Tsai (2017) determined BI to use the personalised location-based mobile using technology acceptance model and DeLone–McLean information system success model (Chen and Tsai, 2017). Therefore, research should be extended to include elements from other behavioural theories such as UTAUT2 to examine how personality traits and user behaviour may influence the acceptance of MTA towards smart in travel aspects.

Previous study found that EE and PE significantly affected travellers' emotional states, whereas pleasure, arousal and IN significantly affected BI to use MAR by using Mehrabian

and Russell's pleasure, arousal, and dominance theory (Kourouthanassisa *et al.*, 2015). IN moderates the effects of content quality, personalised service quality and system quality on individuals to use AR technologies (Jung *et al.*, 2015). Furthermore, the propensity of individuals to adopt new technologies determines whether they will use mapping apps when travelling (Gupta and Dogra, 2017). However, personal information acquired from users is critical to the success of a smartphone app using BDA technology. If users agree to share their personal information via mobile devices, they will receive fully personalised services at the right time and in the right place (Wang *et al.*, 2016). Some hospitality staff use location-based services (LBS) to identify a customer's location via their smartphone and send location-based personalised content to their customer (Chen and Tsai, 2017). MLBA is a new way for advertisers to reach their audience by sending customised messages based on the consumer's geographic location (Mariani *et al.*, 2018). As a result, the willingness of mobile app users to share their personal information is critical for SMTA to provide hyper-personalised information. Thus, the IN construct and PI construct are included in determining factors influencing BI to use SMTA featuring AR and BDA technology from a smart perspective.

Simultaneously, previous research also neglected the effect of PCs and PRs upon sharing personal information for apps using BDA technology. For example, disclosing the user's current location through SMTA featuring AR creates a potential safety risk. It had raised PCs because an LBS provider can collect, store, use and reveal a user's location, and users are aware that disclosing personal information to others can lead to data misuse or inappropriate usage (Wang *et al.*, 2016). Users with insecurity and discomfort characteristics substantially increase their PCs as a potential risk may occur from faulty app recommendations upon sharing personal information. Besides, people who travel frequently and have more experience with innovative technologies have a higher awareness of the usage risks and consequences. Therefore, the constructs of PC and PR are incorporated to determine their negative effects on SMTA adoption from a smart perspective to mitigate the research gap and to gain deeper insight into the determinants that resist the use of SMTA.

Underlying theory: UTAUT2 and privacy calculus theory models

The UTAUT2 model, as shown in Figure 1, is chosen as the primary model due to its common use (with 8,731 citations), high predictive power (Mardiana *et al.*, 2015) and a large number of variables (comprises of PE, EE, social influence, facilitating conditions, HM, price value and HT) for assessing BI to use technology in the consumer context (Huang and Kao, 2015). Tourists are likely to adopt mobile technologies and applications if they are useful, easy to use and compatible according to a study that applied technology acceptance model, innovation diffusion theory and social cognitive theory (Lu *et al.*, 2015). Users can save time and be more efficient and productive using a smart mobile application when performing travel-related tasks. However, the motivation to use MTA is not limited to only utilitarian values but also hedonic values (Dorcic *et al.*, 2018). The user is more enthusiastic about adopting mobile AR in tourism with technological advancement that can experience joy and pleasure, offer usefulness and practical uses before their trip (Paulo *et al.*, 2018). In addition, previous research using the UTAUT2 model to examine smart traveller behaviour found that HT significantly influences tourists' intention to use mapping apps (Gupta and Dogra, 2017). Therefore, variables including PE, EE, HM and HT in the UTAUT2 model are adopted to examine determinants influencing BI to use SMTA towards smart.

AR and VR technologies have dominated the technology industry, offering enormous benefits to a wide number of industries. The innovation diffusion theory could explain that the intention to use MTA is heavily influenced by personality traits with studies showing that people who exhibit optimism or IN are more receptive to new ideas and keen to accept

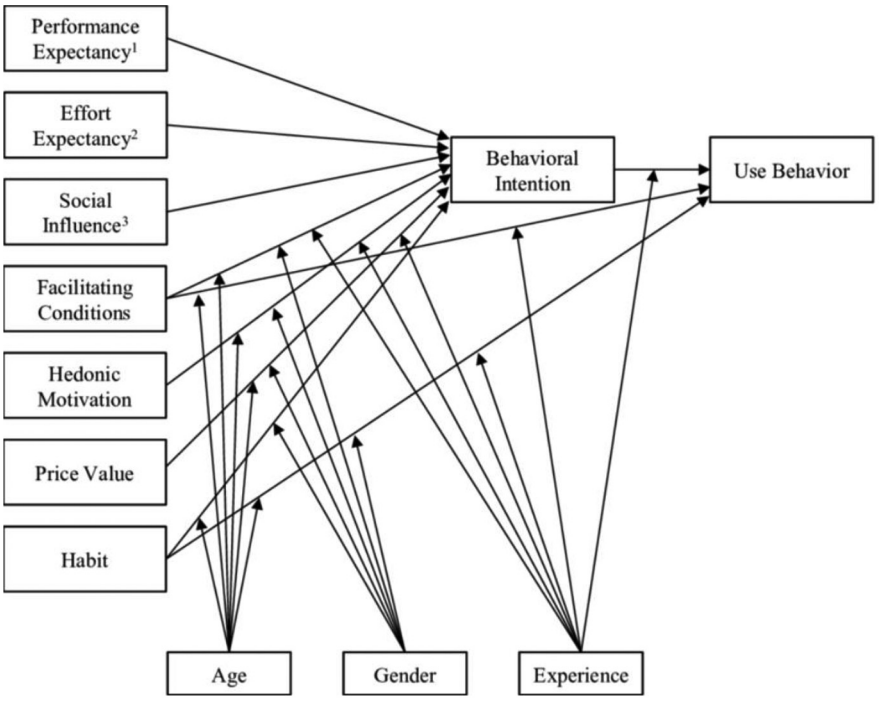

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Figure 1.
UTAUT2 model

new technology (Dorcic *et al.*, 2018; Hamouda, 2022). As a result, the IN construct is used to measure users' willingness to adopt SMTA featuring AR and BDA.

As demonstrated in Figure 2, the PCT refers to an individual's decision to provide personal information based on a risk–benefit analysis (Culnan and Armstrong, 1999). SMTA with BDA technology could automatically prompt travellers with value proposals from a large amount of data on travellers' experiences, behaviours, characteristics and preferences available. However, it depends on how much privacy and travel data users are willing to share for apps making prediction and recommendations. Therefore, construct PI from PCT model is adopted to determine individuals' willingness to disclose their privacy information on SMTA for experience benefits through apps personalisation (Nikkhah and Sabherwal, 2022).

In addition, SMTA with AR feature potentially enhanced the tourist's experience by providing LBS via global positioning system (GPS) to offer the most preferred services and information based on tourists' current location (Chen and Tsai, 2017). However, PCs and risks arise as LBS providers can collect, store, use and disclose user's location (Kim *et al.*, 2017; Zhou, 2016), which increases the possibility of personal information exploitation for inappropriate purposes. In 2019 alone, there were 6,543 data breaches, resulting in 12.6 billion records of data being exposed. Reports of illegal collection of personal information and data abuse, all stress the difficulty of controlling the consequences of users disclosing

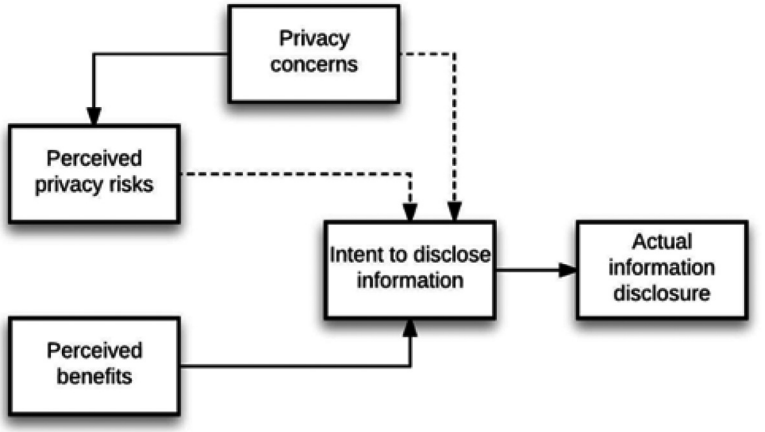

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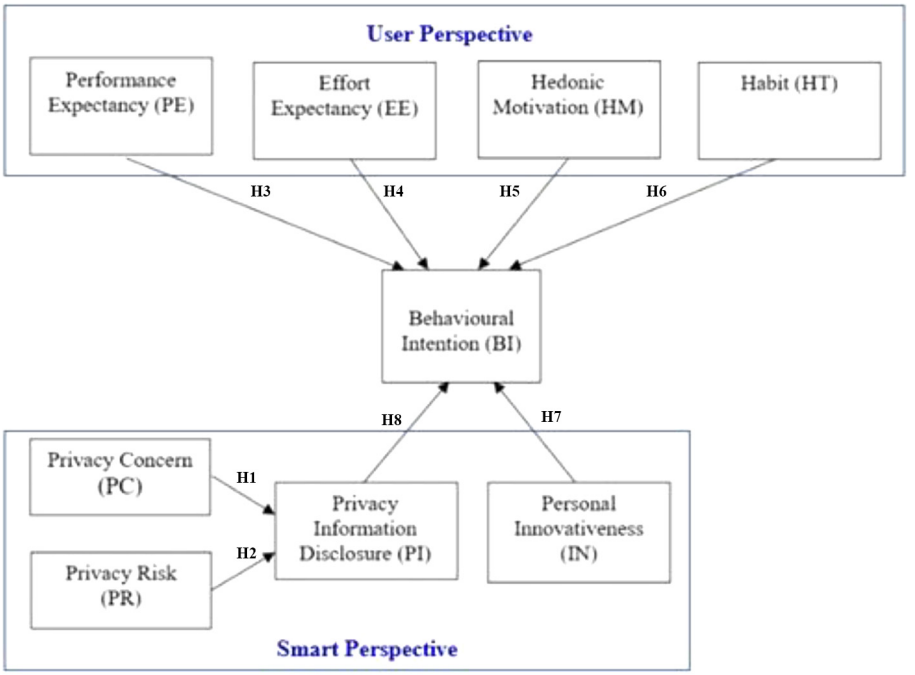
Figure 2.
PCT model

personal information (Tang *et al.*, 2020). Consequently, both the PC and PR constructs from the PCT model are incorporated for measuring the negative effect on an individual's willingness to disclose private information for SMTA adoption. The PCT model has been applied in a variety of research, including anticipating individual's intentions to disclose personal information in the adoption of health-care wearable devices and predicting technology acceptability (Li *et al.*, 2016), analysing users' intentions to share personal information via mobile apps (Wang *et al.*, 2016), the effect of privacy fatigue on users' intentions to expose personal information via mobile apps (Tang *et al.*, 2020) and examining the impact of security and assurance procedures with users' disclosure information to mobile cloud computing apps despite PCs (Nikkhah and Sabherwal, 2022).

The expanded UTAUT2 model provide a comprehensive finding by including new contextual components and integrated with PCT model to examine the determinants influencing BI to use SMTA towards smart, AR and BDA innovative technologies. Despite the potential benefits of SMTA, concerns and risks over privacy information disclosure remain the primary barriers on SMTA adoption. This integration also aimed to determine the negative effects of determinants influencing BI to use SMTA towards smart.

Theoretical framework and hypotheses development

The proposed theoretical framework for this study is presented in Figure 3, primarily UTAUT2 model with its four constructs, namely, PE, EE, HM and HT, to determine the BI of using SMTA from the user perspective. BI is the core determinant used to evaluate the determinants influencing the adoption of SMTA. The IN construct is integrated into the UTAUT2 model, which is then integrated with the PCT model by incorporating the PI construct to determine an individual's BI to use SMTA featuring AR and BDA technologies. Furthermore, the two antecedents PC and PR from the PCT model are included in determining their negative effect on an individual's willingness to disclose private information for SMTA adoption.



Source: Author's own creation

Figure 3.
Proposed theoretical framework

Users are concerned about their location and personal information being obtained inadvertently for unwanted purposes when they are shared in the digital world (James *et al.*, 2017). Growing concerns about privacy issues may cause individuals to be hesitant to disclose personal information or even provide spurious information on MLBA (Gutierreza *et al.*, 2019). SMTA featuring BDA technology is extensively used to deliver useful travel information at the appropriate place and at the right time based on personal information received from users. Users' high level of PCs deters them from sharing information to avoid the risk of being misused by an unauthorised person (Sun *et al.*, 2019). As a result, PC has a detrimental impact on users' desire to share personal information for the adoption of SMTA. Thus, the study hypothesised that:

H1. Individual's PC negatively affects PI for SMTA adoption.

Prior study confirmed that privacy fatigue synchronised with PR had a significant effect on users' intention to disclose personal information on an app (Tang *et al.*, 2020). Most smart apps require access to tourists' personal information on social media and real-time positions to improve tourist services and predict visitors' future demands for getting better insights to offer services suited to tourists' preferences (Gretzel *et al.*, 2016). For example, a travel app's LBS capture users' locations using GPS to route them to the desired place (Kourouthanassisa *et al.*, 2015) which has increased the risk of personal information being accessible by irresponsible personals for inappropriate purposes. As a result, PR negatively influences users' willingness to disclose their personal information to adopt SMTA. Thus, the study further hypothesised that:

H2. Individual's PR negatively affects PI for SMTA adoption.

A mobile app's user perception is influenced by its response time, speed, aesthetic design and performance (Erwanti *et al*., 2018). The PE has also proved to significantly affect tourist adoption of mapping apps (Gupta and Dogra, 2017) and has a positive effect on BI to use mobile travel apps (Gupta *et al*., 2017; Tam *et al*., 2018). SMTA optimises user processes to complete a task faster and is equipped with AI technology that intelligently auto-fills certain information based on the user profile to eliminate user processes by skipping irrelevant pages. Thus, the study hypothesised that:

H3. PE has a positive effect on BI to use SMTA.

Consumers are more likely to accept mobile apps due to their simplicity and user-friendly interface according to previous empirical studies (Erwanti *et al*., 2018). The adoption of mobile AR travel apps has supported the idea that EE affects usage intention (Kourouthanassisa *et al*., 2015). SMTA with smart features in place can constantly send instant in-app notifications and push notifications to users, reducing users' effort and time to perform travel-related tasks. Thus, the study hypothesised that:

H4. EE has a positive effect on BI to use SMTA.

An empirical study found that HM and utilitarian values were the main contributors to influencing users' decisions to adopt the app for travel planning (Ho and Amin, 2019). Smartphones with GPS, internet of things (IoTs), LBS, internet connection, cameras and AR or virtual reality (VR) technologies can provide travellers with a fun, personalised and contextually aware tourism experience (Jung *et al*., 2015). Features such as camera, GPS, AR and VR in SMTA facilitate users to share their destination experience interactively by capturing and sharing photos. In addition, virtual experience through live video significantly affects users' BI to use SMTA. In light of these findings, the study hypothesised that:

H5. HM has a positive effect on BI to use SMTA.

The ability to continue using the same mobile apps is motivated by the HT of using them as individuals tend to behave automatically (Tam *et al*., 2018). Extant research observed that habitual use of mapping apps is a significant predictor of BI (Gupta and Dogra, 2017). HT is the automatic triggering of behaviours outside of conscious awareness or deliberate control. As a result of the common features of the small touch screen and the idea that learning will be intuitive, most smart mobile apps are created similarly (Shaw and Sergueeva, 2019). Thus, the study hypothesised that:

H6. HT has a positive effect on BI to use SMTA.

The willingness of users to try out new information technology is mostly determined by the anticipated benefits that could be acquired through the suggestion of marker-based AR applications (Jung *et al*., 2015). A study postulated that IN influences the co-creation of visitor experiences using advanced mobile technology such as cell phones, AR/VR and gamification techniques (Dorcic *et al*., 2018). Tourists' intense use of ICTs is highly influenced by their capability and willingness to use smart technology. Thus, the study hypothesised that:

H7. IN has a positive effect on BI to use SMTA.

Individuals' readiness to share personal information in exchange for valuable benefits in the smart app environment is referred to as PI (Linton and Kwortnik, 2019). The amount of privacy and personal information obtained via BDA technology determines the degree of appropriate information provided to assist travellers in their decision-making process, boost traveller engagement and efficiently manage resources. According to a study on mobile recommender systems for personalised services, users are willing to disclose personal information in exchange for something beneficial (Linton and Kwortnik, 2019). Despite the internet world increases the risk of personal information leakage and is full of terrorist acts and cyber-attacks. Innovative technology is aimed to improve safety by offering tools to combat the risks and threats that exist. As a result, determining travellers' views of privacy information exposure in SMTA adoption featuring BDA is necessary. Thus, the study hypothesised that:

H8. PI has a positive effect on BI to use SMTA.

Research methodology

Questionnaires design and measures

A survey instrument consisting of 39 items to measure nine constructs in the model is created to collect responses for further analysis in the form of a questionnaire. There are two sections to the questionnaire. Section A of the survey includes demographic information such as birth year and gender, as well as questions about respondents' willingness to use SMTA, most purpose to use SMTA, most expected beneficiaries to use SMTA, and most reason uninstall SMTA. Section B includes nine SMTA-relevant constructs, and the developed measurement scales are presented in Table 1 for each construct. A seven-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly disagree) was used to measure each construct question, and all the constructs are briefly described as follows:

- *Privacy concern* – Defined as concerns regarding who may have access to personal information disclosed on SMTA, and has been used in previous studies to measure the degree of user concern regarding potential inappropriate access to their personal information (Smith *et al*., 2010; Xu *et al*., 2011).
- *Privacy risk* – Referring to (Smith *et al*., 2010; Xu *et al*., 2011), this construct involves an assessment of the potential losses associated with the disclosure of personal information. It is used to measure users' perceptions of the potential risks and losses that may occur when their personal information is disclosed on SMTA.
- *Performance expectancy* – Defined as an individual's belief that using a particular system/app will improve their performance and bring benefits in performing activities (Venkatesh *et al*., 2012). This construct is used to measure users' beliefs regarding the benefits of adopting SMTA in terms of app performance, quality, and response.
- *Effort expectancy* – Defined as the ease of use associated with a system/app (Venkatesh *et al*., 2012). This construct is used to measure the degree to which users perceive the adoption of SMTA to be free of effort.
- *Hedonic motivation* – Defined as an individual's perceived enjoyment of using technology (Venkatesh *et al*., 2012). This construct is used to measure the extent to which users perceive SMTA adoption as a fun, pleasurable, and enjoyable experience.

Construct	Measurement items
Privacy concern (PC)	PC1: I will be concerned that the information I submit to SMTA could be misused PC2: I will be concerned that others may obtain my private information from SMTA PC3: I will be concerned on providing personal information to SMTA, knowing that others may take inappropriate actions on it PC4: I will be concerned on providing personal information to SMTA, knowing that it may be used in a way which I do not foresee
Privacy risk (PR)	PR1: In general, it will be risky to provide personal information to SMTA PR2: Privacy losses may occur when personal information is provided to SMTA PR3: Personal information may be used inappropriately by SMTA PR4: Providing SMTA with personal information may cause unexpected problems
Performance expectancy (PE)	PE1: It will be useful to use SMTA for my travel journey PE2: Using SMTA will improve my productivity in traveling PE3: Using SMTA may help to accomplish things that are important for travel PE4: Using SMTA may help to accomplish things more efficiently for travel PE5: Overall, I would find SMTA to be advantageous
Effort expectancy (EE)	EE1: Learning to use SMTA will be easy EE2: It will be easy to become skilful using SMTA EE3: SMTA might be easy to interact with and understandable EE4: It will be easy to operate SMTA EE5: SMTA will be easy to use
Hedonic motivation (HM)	HM1: SMTA will be entertaining HM2: SMTA will be fun HM3: SMTA will be enjoyable HM4: SMTA will be pleasant HM5: SMTA will be exciting
Habit (HT)	HT1: The use of SMTA will become a habit for me HT2: I will be addicted to using SMTA HT3: I will have to use SMTA HT4: Using SMTA will become natural to me HT5: I'll be able to use SMTA without thinking
Personal innovativeness (IN)	IN1: I would like to experience SMTA IN2: If I heard about AR on SMTA, I will look for ways to experiment it IN3: Among my peers, I will be the first to explore SMTA IN4: I will have fewer problems than other people in using SMTA
Privacy information disclosure (PI)	PI2: I will share my personal photo on SMTA PI3: I will add my addresses and smartphone numbers on SMTA PI4: I will disclose my income situation on SMTA
Behavioural intention (BI)	BI1: I will be intended to continue using SMTA in future BI2: I am expecting to use SMTA in future BI3: I will use SMTA frequently in future BI4: I will recommend others to use SMTA

Table 1. Construct measurements

Source: Authors' own creation

- *Habit* – Refers to an individual's natural behaviour, including automatic behaviour and behaviour learned through past experiences (Venkatesh *et al.*, 2012). This construct is used to measure the extent to which users tend to adopt SMTA automatically based on their learning and past experiences.

- *Personal innovativeness* – Defined as an individual's willingness to try out new information technology for accomplishing goals (Kourouthanassisa *et al.*, 2015; Jung *et al.*, 2015; Li *et al.*, 2016). This construct is used to measure the user's willingness to adopt SMTA with AR capability to enhance their travel experiences by navigating and discovering unknown areas through visual, auditory, and 3D location-based information.
- *Privacy information disclosure* – Defined as an individual's willingness to share their personal information for obtaining benefits while considering the risks associated with the adoption of new technology (Culnan and Armstrong, 1999). This construct is used to measure the willingness of users to disclose their personal information to SMTA with BDA capability, which offers personalized services that intelligently provide information suited to their preferences and expectations.

The completed questionnaire was sent to six experts for evaluation and content validity testing. Subsequently, a pre-testing evaluation was carried out by piloting the questionnaire with 30 people to confirm that the developed questions make sense, are easy to comprehend and the instructions were provided in the correct order. Based on internal consistency analysis in SPSS, all measuring items passed the validity and reliability tests, suggesting that each construct component has a high level of item discrimination and inter-relation.

Data collection

An online questionnaire containing multi-scale items was constructed to collect data from respondents in Malaysia. The questionnaire outlines the research study, including a brief introduction to SMTA, a view link on Smart Tourism App, a view link on SMTA featuring AR and a download link on the SMTA app for respondents to view or experience before responding to the questionnaire. The survey collected 463 responses from Malaysians born between 1965 to 2002, using a convenience sampling method. Furthermore, the following obligatory question was used to eliminate respondents who had used SMTA before:

Q1. Have you ever used smart mobile tourism app before?

We collected responses from 392 targeted participants, resulting in a strong response rate of 84.66%, which were compiled and imported into SPSS and SmartPLS for further analysis.

Furthermore, this study assessed the common method variance by adopting Harman's single factor test in SPSS (Podsakoff *et al.*, 2003) and full collinearity statistics SmartPLS for statistical control. The exploratory factor analysis using the unrotated principal component analysis extraction approach revealed 41.342% variance which was considerably below 50% (Inma and Antoni, 2020). According to the full collinearity statistics, the inner variance inflation factors value for all factors level was ≤5 (Hair *et al.*, 2017). Thus, both assessments indicated that the common method variance was not apparent in this study.

Data analysis and results

The proposed model is analysed using the two-step partial least squares structural equation modelling (PLS-SEM) technique (Hair *et al.*, 2017). Firstly, an initial reflective measurement model demonstrates the correlation between empirically observable items and each latent variable is used to determine the constructs' reliability and validity. Subsequently, a structural model assessment is carried out to evaluate the path coefficients, hypotheses and correlation analysis and R^2 coefficient to determine the hypothesised relationships between constructs and the overall prediction of the proposed model.

Profile of respondents

A demographic profile consisting of 392 respondents is presented in Table 2. Of the 392 respondents, 90 (23.0%) were born between 1965 and 1980, 110 (28.0%) between 1981 and 1995 and 192 (49.0%) between 1996 and 2002. Female respondents are slightly higher at 225 (57.4%) than male respondents at 167 (42.6%). The respondents' desire to use SMTA is quite encouraging, with 356 (90.8%) indicating that they will adopt SMTA during their trip. Real-time information is the most common purpose to use SMTA for 105 (26.8%), whereas gamification is the least for 2 (0.5%). Travel time savings is the most expected benefit to use SMTA for 122 (31.1%), whereas gamification is the least for 5 (1.3%). Regarding the most common reason for uninstalling SMTA, 141 respondents (36.0%) cited no longer using it, followed by too much advertising with 94 (24.0%) respondents, insufficient storage with 40 (10.2%) respondents, and privacy concerns with 36 (9.2%) respondents.

Table 2. Summary of respondents' profile

Demographic profile	Definition	Frequency	%
Birth year	1965–1980	90	23.0
	1981–1995	110	28.0
	1996–2002	192	49.0
Gender	Male	167	42.6
	Female	225	57.4
Willing to use SMTA	Yes	356	90.8
	No	36	9.2
Most purpose to use SMTA	Real-time information	105	26.8
	Travel itinerary generator	66	16.8
	App personalisation and recommendation	61	15.6
	Location tracking services	56	14.2
	Virtual reality	18	4.6
	Others	18	4.6
	Augmented reality	17	4.3
	In-app language	16	4.1
	Incentives	14	3.6
	Currency converter	10	2.6
	Weather/climate forecasting	9	2.3
	Gamification	2	0.5
Most expected beneficiaries to use SMTA	Travel time savings	122	31.1
	Financial savings	91	23.2
	Enhancing travel experiences	85	21.7
	24/7 virtual travel agent	48	12.2
	Incentives	27	6.9
	Others	14	3.6
	Gamification	5	1.3
Most reason uninstall SMTA	No longer use	141	36.0
	Too much advertising	94	24.0
	Insufficient storage	40	10.2
	Privacy concerns	36	9.2
	Technical issues	20	5.1
	Complicated registration	19	4.8
	Irritating notification and in-app message	17	4.3
	Others	15	3.8
	Inadequate app monetisation strategy	10	2.6

Source: Authors' own creation

Descriptive statistics

To estimate the central tendency of variables, the mean and standard deviation were chosen and have been presented in Table 3. The PE scores highest mean of 5.72, followed by the PC of mean 5.57. In contrast, the least central tendency is PI which has a mean of 3.40, followed by a HT with a mean of 4.51. Meanwhile, PI has the highest variation with a standard deviation of 1.261, followed by PC with 1.230. In contrast, EE has the lowest variation with a standard deviation of 0.989, followed by PE with 1.047.

Measurement model

Internal consistency reliability was used to establish the instrument's stability and consistency across numerous variables. Cronbach's alpha of all constructs ranged from 0.840 to 0.958 and the composite reliability of all constructs ranged from 0.896 to 0.968, above the threshold of 0.70, indicating all constructs are consistent and reliable (Table 4). In Table 5, all items had loadings ranging from 0.769 to 0.950, which were higher than cross-loadings on other constructs, indicating the discriminant validity is good. All constructs had an average variance expected (AVE) ranging from 0.716 to 0.876, which was significantly over the criterion of 0.50, showing that there was no convergent validity issue and different instruments measuring the same concept were highly associated. The square roots of AVE generated in the Fornell–Larcker criterion (Table 6) are greater than the relevant inter-construct correlations of all other latent variables, and all heterotrait–monotrait values between 0.85 and 0.90 were generated (Table 7), which prove that the structural validity is good.

Construct/Variables	*N*	Min	Max	Mean	SD
Privacy concern (PC)	392	1	7	5.57	1.230
Privacy risk (PR)	392	2	7	5.21	1.147
Performance expectancy (PE)	392	2	7	5.72	1.047
Effort expectancy (EE)	392	2	7	5.33	0.989
Hedonic motivation (HM)	392	2	7	5.22	1.075
Habit (HT)	392	1	7	4.51	1.303
Personal innovativeness (IN)	392	2	7	5.12	1.177
Privacy information disclosure (PI)	392	1	7	3.40	1.261
Behavioural intention (BI)	392	1	7	5.11	1.222

Source: Authors' own creation

Table 3. Descriptive statistics

Construct/Variables	Cronbach's alpha	Composite reliability	Average variance expected (AVE)
Privacy concern (PC)	0.942	0.958	0.851
Privacy risk (PR)	0.924	0.943	0.805
Performance expectancy (PE)	0.948	0.960	0.828
Effort expectancy (EE)	0.945	0.958	0.820
Hedonic motivation (HM)	0.958	0.968	0.857
Habit (HT)	0.932	0.949	0.787
Personal innovativeness (IN)	0.867	0.910	0.716
Privacy information disclosure (PI)	0.840	0.896	0.743
Behavioural intention (BI)	0.953	0.966	0.876

Source: Authors' own creation

Table 4. Matrix of internal consistency reliability

Constructs	BI	EE	HM	HT	IN	PC	PE	PI	PR
BI1	0.943								
BI2	0.933								
BI3	0.936								
BI4	0.932								
EE1		0.899							
EE2		0.897							
EE3		0.911							
EE4		0.911							
EE5		0.910							
HM1			0.907						
HM2			0.925						
HM3			0.944						
HM4			0.927						
HM5			0.925						
HT1				0.892					
HT2				0.880					
HT3				0.894					
HT4				0.896					
HT5				0.873					
IN1					0.868				
IN2					0.888				
IN3					0.839				
IN4					0.785				
PC1						0.889			
PC2						0.918			
PC3						0.932			
PC4						0.950			
PE1							0.915		
PE2							0.908		
PE3							0.895		
PE4							0.916		
PE5							0.917		
PI2								0.769	
PI3								0.903	
PI4								0.907	
PR1									0.922
PR2									0.930
PR3									0.879
PR4									0.856

Table 5.
Loadings and cross-loadings

Source: Authors' own creation

Structural model

The significance level of each hypothesis as shown in Table 8 is evaluated using the PLS-SEM technique with a two-tailed test and a bootstrapping size of 5,000. Results indicate that PC has a significantly negative effect on PI ($\beta = -0.200$***, $t = 3.013$, $p < 0.05$), while PE ($\beta = 0.100$**, $t = 1.969$, $p < 0.05$), HT ($\beta = 0.295$***, $t = 6.225$, $p < 0.05$), and IN ($\beta = 0.386$***, $t = 7.257$, $p < 0.05$) have a significant effect on BI to use SMTA. Therefore, the findings support *H1*, *H3*, *H6*, and *H7*. In contrast, the relationship between PR and PI and the relationship between EE, HM, PI and BI are found to be insignificant due to their *t*-values being below the threshold value of 1.96 and *p*-value higher than the threshold value of 0.05. Therefore, *H2*, *H4*, *H5* and *H8* are not supported. The PLS result also revealed that the coefficient of R^2 for endogenous construct BI

Constructs	BI	EE	HM	HT	IN	PC	PE	PI	PR
BI	*0.936*								
EE	0.544	*0.906*							
HM	0.682	0.603	*0.926*						
HT	0.732	0.375	0.456	*0.887*					
IN	0.800	0.560	0.679	0.636	*0.846*				
PC	0.315	0.416	0.373	0.250	0.376	*0.923*			
PE	0.677	0.688	0.671	0.507	0.697	0.438	*0.910*		
PI	–0.026	–0.011	–0.008	0.106	–0.086	–0.226	–0.175	*0.862*	
PR	0.190	0.263	0.188	0.193	0.213	0.639	0.279	–0.168	*0.897*

Notes: The significance of the italic values in Table 6, i.e., the square roots of AVE values greater than the correlation coefficients, indicates that the constructs have good discriminant validity
Source: Authors' own creation

Table 6.
Fornell–Larcker criterion

Constructs	BI	EE	HM	HT	IN	PC	PE	PI	PR
BI									
EE	0.572								
HM	0.713	0.633							
HT	0.775	0.397	0.631						
IN	0.878	0.616	0.742	0.707					
PC	0.331	0.441	0.390	0.267	0.414				
PE	0.711	0.727	0.702	0.536	0.761	0.464			
PI	0.109	0.091	0.117	0.159	0.175	0.227	0.168		
PR	0.195	0.268	0.184	0.205	0.226	0.667	0.282	0.154	

Source: Authors' own creation

Table 7.
Heterotrait–monotrait ratio (HTMT)

Hypotheses	Path/Relationship	Path coefficient	*t*-value	*p*-value	Result	Significant level
H1	Privacy concern → Privacy information Disclosure	–0.200	3.013	0.003	Support	***
H2	Privacy risk → Privacy information disclosure	–0.040	0.645	0.520	Reject	–
H3	Performance expectancy → Behavioural intention	0.100	1.969	0.049	Support	**
H4	Effort expectancy → Behavioural intention	0.019	0.418	0.676	Reject	–
H5	Hedonic motivation → Behavioural intention	0.053	0.963	0.336	Reject	–
H6	Habit → Behavioural intention	0.295	6.225	0.000	Support	***
H7	Personal innovativeness → Behavioural intention	0.386	7.257	0.000	Support	***
H8	Privacy information disclosure → Behavioural intention	–0.018	0.621	0.535	Reject	–

Source: Authors' own creation

Table 8.
Path coefficient and correlation analysis

associated with SMTA adoption was 0.753 or 75.3%, which is greater than 0.500, indicating that the study was well-fit.

Discussion

Each hypothesis is further evaluated and discussed considering earlier studies to obtain a new understanding or insight based on the study's research goal. PC has a substantial negative effect on users' willingness to disclose their privacy information for SMTA adoption. This finding is consistent with previous research indicating that many users have privacy concerns and feel the need for better strategies and policies when using mobile apps, including contact tracing apps. Indeed, many respondents reported not having installed contact tracing apps, and either disallowing mobile location tracking altogether or allowing it only under certain circumstances (Duan and Deng, 2022). Previous studies also found that people with higher PCs are hesitant to share information in travel tracking mobile application (Medeiros *et al.*, 2022), MLBA (Gutierreza *et al.*, 2019) or social electronic commerce (Sun *et al.*, 2019) to minimise possible hazards of personal information being misused. The ability of smart AI technology to analyse a user's profile, previous internet browsing or social media activities to serve the user without requiring human interaction raises several PCs. Moreover, PC was listed as the fourth reason for respondents to uninstall an SMTA and revealed a lower willingness among users to disclose information for SMTA adoption. This could be the reason of the MySejahtera contact tracing app to address the COVID-19 pandemic has only 6,366,678 users as of 15 July 2020, which is only about 20% of Malaysia's population of 32.7 million people (CodeBlue, 2020).

Consistent with previous research that has revealed PE has a significant positive effect on tourist adoption of mobile apps (Gupta *et al.*, 2017; Tam *et al.*, 2018), the finding indicates that PE significantly affects users' BI to use SMTA. Performance is the best predictor of a mobile app's quality. The app must launch quickly and never keep users waiting as it affects user satisfaction, retention and ultimately business success. If the installed app does not work properly, keeps crashing or does not respond upon usage, the user may switch to other apps. This is supported by the finding that real-time information was the primary purpose for respondents to use SMTA, while travel time savings were identified as the most expected benefit in this study. Furthermore, personalisation services help users complete their processes more quickly by auto-filling certain information from their profile and skipping over irrelevant pages. Likewise, the finding also shows that HT significantly affects users' BI to use SMTA. Studies found that habitual behaviour is a strong predictor of travellers' BI to use mapping apps or smartphone apps (Gupta and Dogra, 2017; Gupta *et al.*, 2017). A growing number of people are starting to use apps to comfortably and effectively manage their travel concerns, but research on the continued use intention of these apps has not received enough attention (Zhou *et al.*, 2021b). This suggests that people believe in the advantages of SMTA adoption and desire to adopt, but the adoption is still in its earlier stages. However, SMTA has grown in importance and popularity as a resource for travellers seeking information and completing travel-related tasks. It will gradually lead travellers to develop the HT of using it for travel. Moreover, 90.8% of respondents desire to use SMTA in their travel time according to the demographic analysis.

The analysis also demonstrates that IN significantly affects users' BI to use SMTA featuring AR. The finding is consistent with research revealed the adoption of smart technology application in tourism is highly influenced by users' willingness for intensive use of ICTs in tourists (Femenia-Serra *et al.*, 2019) and IN is the strongest determinants effect on users' intention towards adoption of emerging mobile AR games from a developing country context (Faqih, 2022). AR is believed to provide tourists with a more enjoyable,

personalised and context-aware tourism experience by providing a more interactive and diverse experience (Jung *et al.*, 2015). Furthermore, GPS-enabled LBS in mobile tourist apps can provide users with the most relevant services and information based on their current location (Chen and Tsai, 2017). Users have high expectations for the potential benefits of innovative technology. In particular, health and life are their top priority during the COVID-19 pandemic, leading to 90.8% of respondents willing to use SMTA for travel.

Finding is inconsistent with a study regarding privacy fatigue synchronised with PR of personal information security breaches in the network era (Tang *et al.*, 2020). People in the digital age believe that security firms with demonstrated competence can help service providers deal with cyber threats. Many privacy-protection solutions such as online browsers with built-in cookie blockers, ad-blocking software and incognito browsers are now available. This gives users more control over their personal information while all apps are designed to comply with the General Data Protection Regulation (Anant *et al.*, 2021). Some expert feels that it is permissible to provide some personal information for getting to know about potential contacts with a COVID-19 positive individual, as the contact tracing app does not experience personal information leakage (Zhou *et al.*, 2021a). Therefore, PR significantly does not affect the users' willingness to disclose their PI for SMTA adoption.

EE significantly does not influence users' BI to use SMTA. One possible reason could be the increased competency of participants in using smartphone apps, with 88% of Australians owing smartphone and having the highest smartphone penetration rates (Duan and Deng, 2022). The innovative smart apps' simplicity in design and automation aim for ease of use and improvement of the user experience. Besides, features such as camera, GPS, accelerometer and phone calls available on a mobile device also reduce users' effort to perform a task in an app. A similar study showed that pleasure or enjoyment has no significant impact on users' intention to use online grocery apps (Gumasing *et al.*, 2022). Perceived enjoyment is not a key component in SMTA adoption, which could be because users value other factors such as the app's utility, innovative technology, privacy and security. This could explain why gamification is the least purpose and the least expected benefit for respondents to use SMTA in this study. Therefore, HM does not significantly influence the users' BI to use SMTA.

The finding also highlighted tourists are highly concerned about disclosing their personal information, which contrasts with a study which indicated that people are willing to disclose their personal information in exchange for something valuable on a mobile recommender system (Linton and Kwortnik, 2019). People are increasingly concerned about their privacy as more personal information is gathered by contact tracing apps. People who feel their personal information is not adequately protected are reluctant to adopt contact tracing apps (Duan and Deng, 2022). On the other hand, users are more anxious about certain emerging technology's cybersecurity and privacy implications than the potential benefits. As a result, most users are reluctant to submit information for SMTA adoption due to the risk of obligatory information exploitation, such as infrastructure conditions and current location. During the COVID-19 pandemic, some users expressed their apprehension about providing personal information to applications even though this information is expected to be removed after the pandemic (Zhou *et al.*, 2021a). Therefore, PI does not significantly influence the users' BI to use SMTA.

Contributions and implications

Theoretical implications

Theoretically, the UTAUT2 theory is adopted to determine determinants influencing behaviour intention to use MTAs from consumer context. This study is related to but

distinct from prior studies investigating the adoption of smart travel apps, because this research model is expanded and integrated with PCT theory to identify the determinants influencing BI to use SMTA towards smart, AR and BDA technologies from both user and smart perspectives. The theoretical implications are as follows:

- Firstly, the UTAUT2 was extended by incorporating IN to explore users' desire to embrace SMTA for smart AR technology. IN was found to be the strongest predictor of BI to use SMTA, followed by HT and PE. This new conclusion contrasts with previous research that consistently revealed that performance expectation or HT were the main determinants influencing technology acceptance (Ali *et al.*, 2022; Gupta and Dogra, 2017). This demonstrated that SMTA which is embedded with AI-powered algorithms and ML-predictive analytics that are best suited for today's fast-paced environment and intelligently mediates between systems and humans with varied aspects has changed users' behaviour towards SMTA. This transformation removes irrelevant information and delivers contextual information to facilitate automation execution of tasks without user commands, resulting in users' high desire to embrace SMTA featuring AR and BDA technologies. In addition, EE and HM play insignificant roles, which contradicts the findings of most studies that emphasize app adoption only from the user's perspective (Medeiros *et al.*, 2022). Users' expectations have changed as a result of the innovative smart apps' simplicity in design and automation reduced user effort to perform a task in an app. In addition, customers place a greater focus on enjoyment when using the smart app in combination with 3D VR, wearable sensors, robots and drones rather than using the app itself. Thus, HM becomes less significant in the adoption of SMTA as a result of disruptive technologies that offer non-traditional solutions.
- Secondly, as SMTA with BDA technology could deliver a set of potential benefits through app personalisation services based on individual preferences raising PCs and the possibility of risks. The app personalisation services required the extensive collection of data conflicting users' privacy (Schomakers *et al.*, 2022). The determination of privacy information disclosure is needed to predict user adoptions of smart technologies (Nikkhah and Sabherwal, 2022). As a result, the UTAUT2 was also integrated with the PCT model by incorporating PI to determine users' willingness to disclose private information for better-personalised services on SMTA. This privacy-integrated perspective for predicting users' technology acceptance towards smart technology, which contrasts with prior study that focused solely on usefulness-related factors and ease of technology adoption from a user perspective (Tan *et al.*, 2018).
- Furthermore, both PC and PR determinants are also included in determining the effect on users' willingness to disclose private information for SMTA adoption featuring AR and BDA technologies. Therefore, this study investigated the resistance embrace smart technology with an emphasis on PI, whereas the earlier research which mostly focused on PC and PR directly affects BI to use travel mobile application (Medeiros *et al.*, 2022). Although the results demonstrated that PR does not significantly influence users' willingness to disclose their PI for SMTA adoption. Users are reluctant to disclose their PI for SMTA adoption owing to substantial PCs over the PRs. As a result, this integrated research model demonstrates a greater explanatory power in predicting BI to use SMTA from a smart perspective. This enriches our understanding of SMTA adoption towards smart and provides guidance for app developers to enhance their apps development and for travel agencies to have more effective marketing strategies for market competitiveness.

Managerial implications

According to the findings, travel agencies and app development companies should prioritise PC, PE, HT and IN when optimising SMTA usage to boost the tourism market and deliver maximum performance and profits to their organisation. People go on vacations to have new experiences. Travel businesses can capitalise on this desire for novelty by offering new and adventure activities using AR. People are more prone to use technology when they perceive it to have a high relative advantage, low complexity and high trialability. As hypothesised, IN is the primary factor that tourism organisations should consider while revising their advertising and marketing strategy through SMTA in the most effective way. App developers must take advantage of AR's capacity and BDA available on app to promote IN awareness and engagement by inspiring tourists to adopt SMTA for travel. Thus, including innovative technologies such as AR/VR, BDA, IoTs, voice search, image recognition and AI chatbots into a travel app is strongly recommended for enabling travellers to access real-time travel information or track their positions, conveniently construct trip itineraries and receive personalised services. SMTA featuring AR and BDA technologies helps to discover things to do, create a comprehensive itinerary and make your trip more memorable. The app provides approximate travel times and walking distances and plan your trips with friends. Because SMTA is a newly released technology, it takes time to become widespread among its users. Users' BI to use SMTA is significantly influenced by HT, and an app should include popular smart features like AI, AR, VR and GPS, as well as be designed similarly to promote user habitual use.

It was followed by PE significantly influences users' BI to use SMTA. Users must see SMTA as speedy, responsive and bug-free to have a more positive intention to adopt it. Most app developers underestimate perceived performance, especially in the early stages of a new mobile app's development. The app developer is responsible for enhancing perceived performance by tackling all undesirable conditions such as poor internet connection, failed network requests, server exceptions and failures, lack of specific data, transitioning from Wi-Fi to 3G and no internet connection. All the concerns described above must be addressed to improve the performance of mobile apps. Moreover, PC significantly negative affects users' willingness to disclose private information for the adoption of SMTA featuring AR and BDA. A user's privacy is at risk because these technologies can observe who the user is and what they are doing. Mobile AR facilitates the augmentation process, but the content is developed and distributed by third-party companies. As AR is a new domain and authenticated content generation or transmission mechanisms are still evolving, this presents the issue of unreliability. Sophisticated hackers could substitute a user's AR with their own, deceiving users or offering false information. To increase travellers' willingness to submit their personal information when using the SMTA, tourism organisations must present proactive solutions that turn privacy into a benefit rather than a problem. More specifically, practice data security by properly handling data through consent, notice and regulatory obligations.

Research limitation and future research

Although this study has produced several contributions, it is not without limitations. Several information technology experts believe that those who have used SMTA before will provide more useful information. Future research should investigate actual or continuous behaviour using other applicable theories to identify what factors influence SMTA use. This study presents the finding of the statistical data analysis in the Malaysian context. However, SMTA applies to users globally. It is recommended that the research be replicated in other countries. Besides, future research could explore and investigate generational differences, as

well as provide empirical data on the most significant differences. Differences in behaviours discovered among generational groups serve as guidance for tourist providers to execute specialised marketing strategies through SMTA segmentation by generation. Apart from that, the developed theoretical framework, with the integration of UTAUT2 and PCT theories by adopting innovative technologies like AR and BDA, could be used to determine determinants influencing the adoption of other smart apps, such as health and fitness, food and drink, education, entertainment, business and games.

Conclusion

This study comprehensively analysed determinants that influence users' BI to use SMTA from both the user and smart perspectives for leading app usage that are aligned with current or future app trends. Regarding *RQ1*, the results showed that PE and HT significantly affect BI, whereas EE and HM have no significant effect on BI to use SMTA towards smart. To answer *RQ2*, the finding depicts that IN significantly affects BI, whereas PI has no significant effect on BI to use SMTA featuring AR and BDA technologies. Lastly, regarding *RQ3*, the finding demonstrated that PC has a significant effect, whereas PR has no significant effect on users' willingness to disclose private information in relation to their BI to use SMTA.

Ultimately, the implementation of SMTA in the travel industry is intended to streamline their processes by automating travel processes to save time, reduce cost and create a more seamless travel experience for customers. The emergence of travel technology has transformed the behaviour of travellers, with PE or HT no longer being the most impact factor in technology adoption. People realised that significant usage of SMTA can be very beneficial, particularly the intelligent and personalisation services that can help to save travel effort, time and money. Thus, IN demonstrated the highest degree of users' acceptance usage of SMTA in this study. The effectiveness and successful usage of SMTA featuring AR and BDA are reliant on users' willingness to share their private information to enable apps to provide services according to users' preferences. Users are confident in the app's ability to protect them from cyber-attacks as there is no PR associated with information disclosure. However, the high levels of PCs have restricted the information to be disclosed upon SMTA usage. Thus, tourism organisations must emphasise properly on data handling through consent, notice and regulatory obligations to improve user confidence to be free from misuse.

In the coming years, many industry experts foresee an extraordinary surge in travel. This study is significant for mobile apps developers and smart-device manufacturers to include appropriate new features into smart devices and applications to promote their services and products in more successful and sustainable ways. Furthermore, the study's analysis regarding travellers' technological behaviour provides greater insights on tourism demand in adopting effective strategies on travel apps during and after the COVID-19 recovery.

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