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Predicting the Adoption of Virtual Reality Tourism in the Post COVID-19 Pandemic Era

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Abstract

The purpose of this study was to investigate the adoption of virtual reality (VR) tourism technology in the post-COVID-19 pandemic using the Technology Readiness Index (TRI) and Technology Acceptance Model (TAM). Data were collected from 456 users of VR tourism technology using an online survey. The structural equation model was employed to evaluate the hypotheses. All TRI constructs, except for the "discomfort," affect two TAM constructs are perceived usefulness and perceived ease of use. Attitude is significantly influenced by perceived usefulness and perceived ease of use. At the same time, it significantly affects intention. In increasing users' intention to adopt VR tourism technology, this study will encourage VR tourism technology creators to develop high-quality VR tourism technology to provide visitors with helpful and useful. Furthermore, marketing managers, local governments, and other parties concerned about the future of tourism also have to create an effective way to promote VR tours to enhance users' intentions. Empirically, this study is the first to examine VR tourism adoption using TRI and TAM after the COVID-19 pandemic.

Keywords: Virtual reality tourism; technology readiness index; technology acceptance model; COVID-19

Introduction

As the tourism industry heavily relies on physical presence, The COVID-19 pandemic had one of the biggest impacts on this industry due to the necessity to apply social distancing and travel restrictions to reduce the virus transmission rate (El-Said & Aziz, 2022; Rahim et al., 2021). This situation is troubling since the travel and tourism sector has always been one of the most significant contributors to GDP, making up to 10.3% of Global GDP in 2019 but only 6.1% in 2021 (World Travel & Tourism Council, 2022a). The tourism sector also largely contributes to the employment rate, with more than 211 million jobs globally (World Travel & Tourism Council, 2022a). Therefore, many parties are paying great attention to help this sector recover. Technology has been proven to be effective in helping many industries survive the prolonged COVID-19 pandemic (Özekici & Küçükergin, 2022; Rafdinal & Senalasari, 2021), and tourism

is no exception (Godovykh et al., 2022; Yang et al., 2022). Even before COVID-19, the rapid development of technology had a significant impact on the expansion of the tourism industry, creating new ways for tourists to travel using VR tourism technology (Zhang et al., 2022).

Virtual tourism technology is a simulation of an attraction or tourism site composed of video images of the real landscape, using virtual reality technology to make it possible for tourists to visit the place without physically being there (Bogicevic et al., 2019; Osman et al., 2009). VR tourism technology allows its travellers to have a real sense of traveling experience without being physically present (Guttentag, 2010; Matikiti-Manyevere & Rambe, 2022). The popularity to adopt VR technology in the tourism industry increased during the COVID-19 pandemic since it was perceived as a safer and more affordable alternative to conventional travel (Lee & Kim, 2021; Merkx & Nawijn, 2021; Schiopu et al., 2021). Following the two-year period of pandemic, the tourism industry tries to address the innovative way to travel after the lockdowns in many countries end, which includes new protocols and standards such as improving hygiene standards, ensuring guest safety, using digital check-in technology, using contactless payment, and maintaining social distancing (World Travel & Tourism Council, 2022b). Implementing VR tourism technology would help the tourism sector transform and become more resilient to survive the COVID-19 pandemic (Yang et al., 2022). From a more critical point of view, adopting this technology would contribute to achieve sustainable tourism (Schiopu et al., 2021). Therefore, it is important to maximize the adoption of VR tourism technology. However, research explaining the adoption of VR tourism technology after the COVID-19 pandemic still needs to be explored. Thus, it is also important to analyze the current use of VR tourism technology. Furthermore, this study will make contributions to the tourism marketing literature by examining the new insight of the adoption of VR tourism technology in the post COVID-19 pandemic.

VR tourism technology adoption is currently limited, especially in developing countries. The next question is which factors affect intentions of travellers to use VR tourism technology, especially in the post COVID-19 pandemic. The Technology Acceptance Model (TAM) is one of the most widely used models for explaining how new technology is adopted (Davis, 1989). Several studies have explored the adoption of virtual tourism during the COVID-19 pandemic (Chirisa, 2020; El-Said & Aziz, 2022; Godovykh et al., 2022), and used the TAM is the primary framework in exploring virtual tourism adoption (Schiopu et al., 2021; Yang et al., 2022). However, given its least popularity in developing countries (El-Said & Aziz, 2022), a more thorough explanation is needed. Numerous studies related to the community's readiness in adopting technologies such as mobile payment, web-based encyclopedias, online classes, and building information modelling (Lai & Lee, 2020; Rafdinal & Senalasari, 2021; Warden et al., 2022) have been done by implementing the Technology Readiness Index (TRI) (Parasuraman, 2000). However, the TRI remains limitedly applied when discussing the readiness to adopt VR tourism technology. TRI plays a role as a strong predictor of behavioral intentions related to technology and can be used for different consumer backgrounds, professions, and market segments (Parasuraman, 2000; Parasuraman & Colby, 2015). Provided the advantages of TAM and TRI, this will be the first study to integrate both models to discuss the adoption of VR tourism technology to get a more comprehensive result.

The purpose of this study is to explain the adoption of VR tourism technology in the post-COVID-19 pandemic. This study will: (1) will employ the integrated TAM and TRI model to assess the adoption of VR tourism technology. This assessment will result in a theoretical framework as a reference to promote a more sustainable tourism industry, and (2) provide empirical evidence for the VR tourism technology developers to create or improve their technology based on the insights resulting from this work. Furthermore, the perception of customers gained from this study will help the developers understand customers' attitudes

towards the VR tourism technology that will be useful in predicting their intention to adopt it. This study describes the adoption of VR tourism technology in developing country, Indonesia. There are two basic reasons for choosing Indonesia; First, the Indonesian Ministry of Tourism has prepared 360 leading tourist destinations in Indonesia that are integrated with VR tourism technology, and this number will continue to grow (Indonesia.go.id., 2021). Second, the number of tourists in 2021 is 1,557,530, which has decreased from 2020 of 4,052,923 tourists (BPS, 2022). However, in 2022 from January to August, the number of foreign tourist arrivals was even higher than in 2021 of 1,858,866 showed a significant increase (BPS, 2022). This provides a separate challenge for adopting VR tourism technology, whether it is sustainable or not. Considering the finding, the tourism industry has the opportunity to expand in the future through the application of VR technology, it is essential to identify theoretical and practical factors for adopting VR tourism technology.

Literature review

COVID-19 and virtual tourism

On December 31st, 2019, 27 unidentifiable pneumonia cases were found in Wuhan city, Hubei, China (Lu et al., 2022). As a result, World Health Organization (WHO) stated the Coronavirus outbreak, or COVID-19, a Public Health Emergency of International Concern that poses a significant risk to countries with vulnerable health systems (Sohrabi et al., 2020). Globally, there have been 543,352,927 confirmed cases of COVID-19 as of June 29th, 2022, where 6,331,059 of them were reportedly dead (World Health Organization, 2022). This situation has obligated the government to create standardized system to prevent virus spread and reduce the number of virus transmissions. Large-scale social restrictions were applied; this restriction required people to wear a mask and enforce social distancing. Mandated schools, offices, and public spaces to close, and simultaneously, limiting movements by applying travel restrictions (Rahmanti et al., 2021; Yang et al., 2022). The COVID-19 pandemic has caused a significant negative impact on the tourism industry. Globally, about 50 million people have lost their job in the tourism sector due to this pandemic, and 75 million more are at risk (World Travel & Tourism Council, 2022a). One of the most possible solutions to this problem is by applying virtual tourism. This technology can help promote sustainable tourism during the pandemic and even after that because the technology does not require people's physical presence (during the pandemic) (Yang et al., 2022), and it also has an impact on future visitation (Pour Rahimian et al., 2014).

The term virtual tourism is discoverable in many literatures. Virtual tour means "a simulation of an existing location that is composed of a sequence of video images" (Osman et al., 2009). This simulation is a set-up of pictures, videos, and graphics such as text, sound effects, and audio that have been purposively taken and edited with the technology to create super-real scenes in the three-dimensional form (3D), allowing participants to experience the "real scenes" by only accessing the sites from their devices (PC, smartphone, etc.) (El-Said & Aziz, 2022; Zhang et al., 2022). The goal of virtual tourism is to increase sensory experience by producing a virtual form of tourism (Yang et al., 2022). Thus, Tourists can use VR tourism technology to experience a tourist attraction without having to physically visit the location.

In the business context, virtual tourism is a new way to engage with potential customers. Virtual tourism allows the potential customers to experience the real image and let them assess the destination deeper before deciding to go there (pre-travel phase) (Rahim et al., 2021). Virtual tourism technology is very useful in many tourism industries, including entertainment, education, and marketing (Guttentag, 2010). For the entertainment aspect, virtual tourism can be an entertaining medium to release stress during the pandemic (Lu et al., 2022). Virtual reality, as the technology used for virtual tourism, is also used in museums and heritage sites

as an educational tourism tool (Carrozzino & Bergamasco, 2010). As for marketing, virtual tourism helps to promote a destination. Virtual tourism has been shown to have a considerable impact on travellers' behavioral intentions, likelihood, and willingness to visit the destination in the future (Marasco et al., 2018; Rahimizhian et al., 2020). Most people choose to do an on-site visit after visiting the tourist destination virtually (Lu et al., 2022). Thus, virtual tourism is a very suitable technology for promoting tourism destinations (Asimah et al., 2022). Therefore, considering the advantage of implementing VR tourism, especially in the post COVID-19 pandemic, this study is imperative.

Technology readiness index (TRI)

TRI was originally developed to understand people readiness to use new technology (Parasuraman, 2000). It is used to predict people's predisposition to embrace and adapt cutting-edge technologies for accomplishing objectives in their lives, personally and professionally, while also relevant to marketing settings (Humbani & Wiese, 2019; Na et al., 2021). In addition, TRI considers the differences between each individual in adopting a technology: the supporters (positive) and the inhibitors (negative) (Parasuraman, 2000), because the purpose of this study is to look into the determinants of VR tourism technology adoption, the model is appropriate for implementation in this study.

In 2015, the construct used in the original TRI was updated into TRI 2.0, by simplifying the 36-item-scale initial constructs of TRI into a 16-item-scale (Parasuraman & Colby, 2015). TRI 2.0 consists of four personal components divided into two categories: positive (optimism, innovativeness) and negative (discomfort, insecurity) (Parasuraman & Colby, 2015; Rafdinal & Senalasari, 2021). Previous research has used TRI to assess the adoption of new technologies such as self-service restaurants (Na et al., 2021), mobile payment apps (Humbani & Wiese, 2019; Rafdinal & Senalasari, 2021), educational apps and websites (Warden et al., 2022), tourism apps (Jarrar et al., 2020), and virtual tourism (Yang et al., 2022). Regarding VR tourism, Yang et al. (2022) only used two out of four personal components of TRI 2.0 in their study; optimism and discomfort. Therefore, this study will be the first to use all the four components of TRI in the context of VR tourism to understand people's readiness to adopt VR tourism technology in the post COVID-19 pandemic.

Technology acceptance model (TAM)

Davis (1989) initially proposed TAM to analyze what factors influence people's adoption of new technology. This theory proposes that behavioral intention could predict one's acceptance of new technologies, which is influenced by two other salient internal beliefs: perceived usefulness and perceived ease of use (Davis, 1989; Scherer et al., 2019). First, Perceived usefulness is a measure of how much someone thinks a certain technology will enhance performance (Davis, 1989). Moreover, perceived ease of use describes a person's assumption that using a specific technology will save them time and effort (Davis, 1989). TAM also states that perceived usefulness and perceived ease of use can influence one's attitude toward adopting a particular technology, which influences one's intention to accept and adopt the technology (Davis, 1989).

TAM has been majorly used in literature as the main theory to examine people's acceptance of technology, such as mobile payment applications (Rafdinal & Senalasari, 2021), social media (Rauniar et al., 2014), and electronic ticketing systems (Kusdibyo et al., 2020). Moreover, TAM has been widely implemented in immersive technology acceptance studies related to tourism such as online tourism booking (Chen & Li, 2020), hotel websites (Yılmaz, 2014), smartphone travel apps (Lin et al., 2020), and virtual tourism (Yang et al., 2022). Considering the massive use of TAM in previous studies to observe numerous technologies

and industries, this study employs TAM as its primary model to evaluate the reasons for VR tourism adoption.

Hypotheses development

Optimism is a positive belief in using a particular technology and improving efficiency, control, and flexibility (Sinha et al., 2019; Yang et al., 2022). The optimism will face challenges that arise from using new technology and will try their best to positively use the technology (Jarrar et al., 2020). The more people feel optimistic about a particular technology, the more they perceive its usefulness and ease (Parasuraman, 2000). Previous studies have shown optimism as the factor affecting one's intention to adopt new technology (Humbani & Wiese, 2019; Jarrar et al., 2020; Özekici & Küçükergin, 2022). In the specific tourism context, optimism affects the perceived usefulness and ease of VR tourism (Yang et al., 2022). Therefore, two hypotheses stated are as follows:

H1: Optimism has a significant and positive effect on perceived usefulness
H2: Optimism has a significant and positive effect on perceived ease of use

Innovativeness is the degree to which a person embraces new ideas before the majority of their social group and is willing to use new technology (Jarrar et al., 2020). According to Parasuraman (2000), innovativeness in the context of TRI is a person's proclivity to be a technological pioneer and thought leader. The more innovative a person is, the more likely he is to adopt and positively believe in a technology (Parasuraman, 2000; Parasuraman & Colby, 2015). In a past study discussing mobile applications in the tourism context, innovativeness showed a significant and positive impact on perceived usefulness (Jarrar et al., 2020). The similarities found in other previous literature related to other technologies, adding that innovativeness can also predict perceived ease of use (Rafdinal & Senalasari, 2021; Warden et al., 2022). According on the above description, the following hypotheses:

H3: Innovativeness has a significant and positive effect on perceived usefulness
H4: Innovativeness has a significant and positive effect on perceived ease of use

Discomfort with technology is a state in which a person feels pressurized by technology and has a sense of being useless over it (Parasuraman, 2000). Previous research has revealed that discomfort has a negative impact on perceived usefulness and perceived ease of use in industries other than tourism (Lin & Chang, 2011; Martens et al., 2017; Walczuch et al., 2007). However, a study showed that no effect of discomfort on both perceived usefulness and perceived ease of use (Yang et al., 2022). They argued that the level of consumer discomfort with VR tourism technology is low, or if there is any, still in the range of their tolerance, which makes it not affect the consumers' process in adopting VR tourism technology (Yang et al., 2022). These inconsistent results, especially since studies related to VR tourism technology that focus on discomfort are still scarce, make further investigation compulsory to be done. This current research believes that when one feels discomfort with technology, he will assume that the technology is overly sophisticated and not designed for everyone (Rafdinal & Senalasari, 2021), which then results in such a negative relationship. The following are the proposed hypotheses:

H5: Discomfort has a significant and negative effect on perceived usefulness
H6: Discomfort has a significant and negative effect on perceived ease of use

Insecurity is defined as a lack of trust in technology as a result of scepticism about the technology's capability to work effectively and the potential ramifications it in the future (Parasuraman & Colby, 2015). Both discomfort and insecurity are barriers of technology readiness, and a high score in both dimensions usually means a refusal to adopt the technology (Lai & Lee, 2020; Parasuraman, 2000). As one feels more insecure about using technology, this will make the notion that technology is a complex tool, which will reduce the perception of the ease of using technology (Lin & Chang, 2011). Walczuch et al. (2007) stated that generally, those who are extremely insecurity and discomfort tend to have lower perceived use of technology compared to those whose insecurity and discomfort levels are low. Thus, the finding above helps to develop the hypotheses:

H7: Insecurity has a significant and negative effect on perceived usefulness
H8: Insecurity has a significant and negative effect on perceived ease of use

Perceived usefulness and perceived ease of use. Perceived usefulness is the degree to which a person believes that using a particular technology will improve their work performance, whereas perceived ease of use is the degree to which one believes that utilizing a certain technology will make their life easier (Davis, 1989). The perceived usefulness and perceived ease of use of technology have been found to have a positive effect on a person's attitude toward utilizing technology and intention to use the technology (Humbani & Wiese, 2019; Rafdinal & Senalasari, 2021; Yang & Lin, 2019). However, in the tourism sector, many past studies are found to apply the non-original concept of TAM; They tended to investigate the direct influence of perceived usefulness and perceived ease of use on behavior intention rather than using attitude as the moderating variable. However, in smartphone apps for tourism information search and online tourism booking systems, the original TAM constructs were used, and both perceived usefulness and perceived ease of use could predict people's attitude towards using the technology or system (Chen & Li, 2020; Lin et al., 2020). When a person is confident that a particular technology can improve his job performance, he will have a more positive attitude towards using the technology (Lin et al., 2020). Similarly, the effect will also occur if he considers technology as easy to use and requires little effort to operate (Chen & Li, 2020). The developed hypotheses are as follows.

H9: Perceived usefulness has a significant and positive effect on attitude
H10: Perceived ease of use has a significant and positive effect on attitude

Attitude. In general, attitude is defined as a consistent and long-lasting condition of readiness to respond (Chakravarti, 1997). Attitude is an individual's continuous assessment of preference for a thing or idea and is a form of emotional feeling (Davis, 1989; Wibisono et al., 2022). In TAM, attitude is believed that attitude directly influences usage intention (Davis, 1989). The positive effect between attitude and usage intention has been studied in various industries for different technologies (Chen & Li, 2020; Humbani & Wiese, 2019; Lin et al., 2020). Hence, it is important to observe the relationship between one's attitude towards VR tourism and his intention to use the VR tourism technology. The following hypothesis is proposed:

H11: Attitude towards using the VR tourism has a significant and positive effect on VR tourism usage intention.

TRI acts as a basic theory for adopting the VR tourism technology, considering people readiness is something that it tries to measure, and it directly influences on TAM (H1-H8).

Then, TAM will predict the adoption of the VR tourism technology (H9-H11). Figure 1 presents the conceptual framework as a summary of the literature review and formulation of hypotheses.

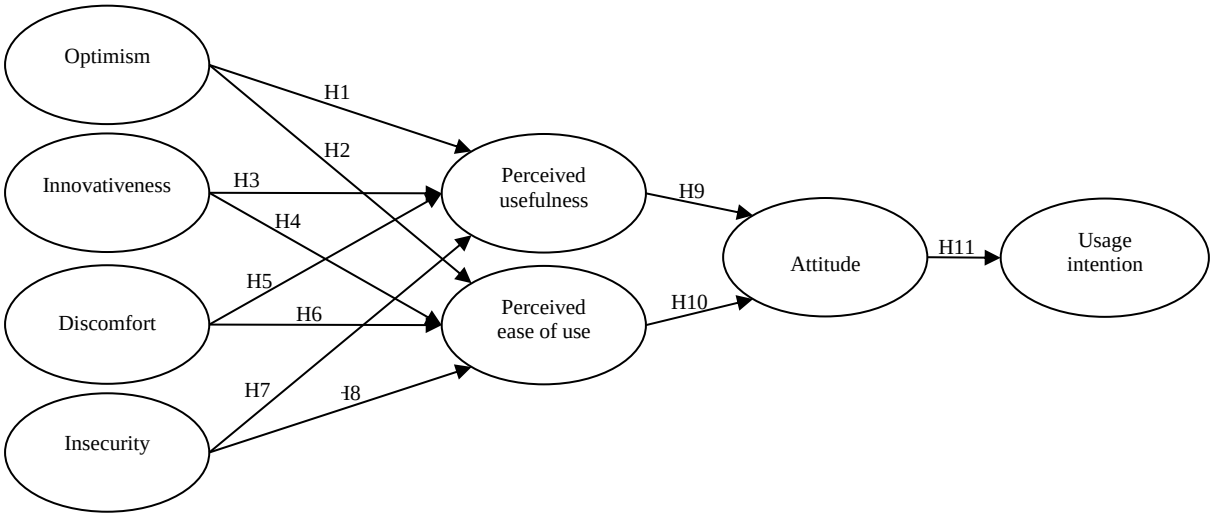

Figure 1. The Conceptual Framework

Methods

Research instruments and measurements

The current study's constructs were all adapted from previous studies. The technology readiness acceptance model (TRAM) is built on the two major theories: TRI and TAM, hence, the constructs used were based on those theories. The TRI consists of four constructs: optimism was measured with five indicators, innovativeness with four indicators, discomfort with two indicators, and insecurity with three indicators (Kim et al., 2020; Parasuraman & Colby, 2015; Rafdinal & Senalasari, 2021). To examine technology readiness of VR tourism technology adoption uses all the indicators aforementioned. Then, perceived usefulness and perceived ease of use which are the constructs of TAM, have three and four indicators respectively (Davis, 1989; Özekici & Küçükergin, 2022). Three indicators were used to measure the attitudes of VR tourism technology users, with few modifications made to fit the context of VR tourism technology during the new normal era (Lin et al., 2007; Rafdinal & Senalasari, 2021). Furthermore, the usage intention VR tourism technology was gauged by three indicators (Özekici & Küçükergin, 2022; Yang et al., 2022). A Likert scale with five levels, from 1 to 5, was used to score each construct item (strongly disagree to strongly agree). An applied pre-test aims to ensure that the 30 correspondents clearly understood the questions before conducting the survey. The result becomes the recommendation to revise the question wordings.

Sampling and data collection

Purposive sampling was utilized in this study to meet the objectives supporting the study focus: Adoption of VR tourism technology. To examine each indicator in the TRAM constructs, an online self-administered questionnaire was distributed. The data collection process was from April to June 2022. The distributed controlled question aimed to ensure that all the respondents have used the VR tourism technology of tourist destinations at least once. From 461 responses returned, 456 samples were qualified to be further processed. The partial least squares structural equation model (PLS-SEM) requires a minimum number of samples. G*Power is used in this study to calculate sample size based on statistical power. This sample's value was 0.93, which

was higher than the minimum threshold of 0.8 (Carranza et al., 2020; Hair et al., 2019). Thus, the total sample size of 456 respondents is acceptable.

The result of the respondent's demographics shows an almost equal ratio between male (41%) and female (59%). Based on age, the group of the younger generation with ages 25-34 years (48%) and 17-24 years (47%) are the majority of VR tourism users. In line with age, based on educational background, the highest number of respondents are at the undergraduate or diploma (54%) and high-school level (44%) graduates. All respondents have experienced VR tourism in 2022. Therefore, based on the respondents' demographics, it can be said that respondents were generally young and educated, in line with the previous study related to VR tourism (Schiopu et al., 2021).

Data analysis

The PLS-SEM functions as a fitting analysis technique to explore the relationship between every variable in the conceptual model, simultaneously (Hair et al., 2019). Additionally, this method is appropriate for overcoming abnormal data distribution. This study used the PLS-SEM method by employing SmartPLS 3.2.7 software. In the evaluation process, a two-step process was implemented, namely the measurement model and the structural model (Hair et al., 2019). First, The measurement was used to assess the validity and reliability of the constructs while the structural model was measured by evaluating the value of R^2, f^2, Q^2, and path coefficients (Hair et al., 2019). The next stage, The Important-Performance Map Analysis (IPMA) method is used to determine the importance of each independent construct to the target construct (Ringle & Sarstedt, 2016). In this study, the target constructs of attitude and usage intention were analyzed to find out which constructs were most important to the two constructs.

Results

Measurement model

The first stage was to assess the constructs in the conceptual model for reliability and validity. For this purpose, the first step is to evaluate internal consistency reliability and convergent validity with outer loading, ρA, composite reliability (CR), and average variance extracted (AVE). In evaluating reliability, we prefer using ρA to using the Cronbach's alpha (α) because ρA has more precise measurement which usually lies between the α and CR (Hair et al., 2019). The α is conventional and less precise to measure reliability due to un-weighted items. The value of the loading factor, ρA, CR, and AVE must meet the minimum criteria of 0.708, 0.7, 0.7, and 0.5 respectively (Hair et al., 2019). In addition, all constructs meet the requirement of convergent validity and reliability (see Table 1). This shows the reliability of the constructs and the convergent construct is able to explain the variance of the items.

Next, the Fornell-Larcker criterion was used in this study to measure discriminant validity. The square root of each AVE construct value must not be higher than the correlation with the other latent constructs (Fornell & Larcker, 1981). The discriminant validity results show that the AVE constructs have accepted value. To measure discriminant validity, the heterotrait-monotrait (HTMT) ratio was also calculated. This analysis assesses the ratio of heterotrait to monotrait correlations; an acceptable score is less than 0.90 (Henseler et al., 2015). The results indicate that the value of discriminant validity is accepted (see Table 2). Based on this explanation, the constructs in this study indicates validity and reliability.

Table 1. Evaluation of internal consistency reliability and convergent validity

Constructs or Items	Loading	ρA	CR	AVE
Optimism		0.867	0.900	0.642
VR tourism technology provides free mobility	0.808			
VR tourism technology is comfortable to use .	0.799			
The most advanced VR tourism technology is preferred when available	0.779			
VR tourism technology makes it more efficient to travel	0.812			
VR tourism technology provides freedom and mobility	0.808			
Innovativeness		0.787	0.861	0.608
Other people have asked my opinion regarding VR tourism technology	0.761			
Be the first to own/use VR tourism technology	0.763			
Update on the latest VR tourism technology	0.819			
Fewer problems in using VR tourism technology compared to others	0.774			
Discomfort		0.765	0.845	0.733
VR tourism technology is not designed for use by ordinary people	0.780			
Feel embarrassed when facing problems in using VR tourism technology	0.925			
Insecurity		0.852	0.910	0.770
VR tourism technology reduces the quality of human relations because it minimizes direct interaction	0.884			
I'm afraid that information I've given permission to be accessible online is being abused	0.863			
Double check that the system does not generate errors	0.886			
Perceived usefulness		0.872	0.921	0.796
VR tourism technology makes traveling easier	0.897			
VR tourism technology is useful in the travel process	0.892			
VR tourism technology saves me time	0.886			
Perceived ease of use		0.922	0.939	0.755
VR tourism technology is easy to learn	0.877			
It's easy to become an expert in using VR tourism technology	0.866			
VR tourism technology is easy to use	0.891			
VR tourism technology is flexible in usage	0.879			
Interaction with VR tourism technology is clear and easy to understand	0.830			
Attitude		0.914	0.938	0.791
After the COVID-19 pandemic, using VR tourist technology is a good choice.	0.885			
My opinion about VR tourism technology is positive	0.896			
VR tourism technology will be useful after the COVID-19 pandemic	0.911			
After the COVID-19 pandemic, VR tourism technology could be interesting.	0.865			
Usage intention		0.908	0.858	0.670
I chose to use VR tourism technology before traveling directly to the post pandemic COVID-19	0.711			
After the COVID-19 pandemic, I plan to continue using VR tourism technology	0.851			
When the chance presents, I intend to use VR tourism technology	0.883			

Note(s): CR = composite reliability; AVE = average variance extracted

Table 2. Discriminant validity results

		1	2	3	4	5	6	7	8
Fornell-Larcker criterion	1. Optimism	*0.801*							
	2. Innovativeness	0.576	*0.780*						
	3. Discomfort	0.207	0.216	*0.856*					
	4. Insecurity	0.264	0.263	0.260	*0.878*				
	5. Perceived usefulness	0.553	0.500	0.148	0.331	*0.892*			
	6. Perceived ease of use	0.487	0.480	0.107	0.267	0.597	*0.869*		
	7. Attitude	0.563	0.445	0.152	0.388	0.688	0.685	*0.889*	
	8. Usage intention	0.441	0.376	0.185	0.096	0.391	0.429	0.483	*0.818*
Heterotrait-monotrait ratio	1. Optimism								
	2. Innovativeness	0.695							
	3. Discomfort	0.263	0.303						
	4. Insecurity	0.295	0.319	0.342					
	5. Perceived usefulness	0.631	0.603	0.190	0.384				
	6. Perceived ease of use	0.541	0.561	0.128	0.298	0.664			
	7. Attitude	0.628	0.525	0.181	0.442	0.772	0.745		
	8. Usage intention	0.534	0.477	0.320	0.139	0.431	0.467	0.502	

Structural model

Collinearity must be evaluated before evaluating the structural model to ensure that the regression result is not biased (Hair et al., 2019). To test the collinearity, it is ideal for the

variation inflation factor (VIF) under 3, and as shown in Table 2, no co-linearity issue was found. The structural model then is accountable.

The quality of the model in this study requires advance-checked before testing the hypotheses. The path coefficients were evaluated using the Bootstrapping procedure with 5,000 subsamples (Chin et al., 2008). The criteria to be evaluated are coefficient of determination (R^2), cross-validated redundancy (Q^2), effect size (f^2), and path coefficients (Hair et al., 2019). The R^2 value of 0.75 is considered substantial, 0.50 is moderate, and 0.25 is weak (Hair et al., 2019). R^2 usage intention is 0.234, R^2 attitude is 0.591, R^2 perceived usefulness is 0.382, and R^2 perceived ease of use is 0.311 (see Table 3). It shows that each mentioned constructs has been affected by exogenous constructs with small to moderate criteria. In evaluating the predictive accuracy using Q^2. The Q^2 values at 0, 0.25 and 0.50 explain the small, medium, and enormous predictive relevance of the path model (Hair et al., 2019). The results indicate that all constructs have an acceptable predictive of relevance. Finally, the f^2 was tested to assess the effect size of each path model with the criteria: 0.02 is categorized as low, 0.15 as medium, and 0.35 as high. The results of the f^2 test show that exogenous constructs have effect sizes on low and medium criteria for endogenous constructs.

Table 3. The results of structural model and hypotheses testing

Relationships	β	*T* value	VIF	R^2	R^2 Adjusted	Q^2	f^2
OPM -> PUS	0.370	6.706**	1.535	0.382	0.376	0.296	0.144
OPM -> PEU	0.300	4.558**	1.535	0.311	0.305	0.225	0.085
INN -> PUS	0.247	4.778**	1.538				0.064
INN -> PEU	0.284	5.009**	1.539				0.076
DIC -> PUS	-0.028	0.760	1.107				0.001
DIC -> PEU	-0.049	1.007	1.107				0.003
INR -> PUS	0.176	4.218**	1.144				0.044
INR -> PEU	0.126	2.627*	1.144				0.020
PUS -> ATT	0.434	9.433**	1.555	0.591	0.589	0.449	0.296
PEU -> ATT	0.426	8.899**	1.555				0.285
ATT -> UIN	0.483	11.075**	1.000	0.234	0.232	0.136	0.305

Note(s): *n* = 5,000 subsample; ***p* value < 0.01, **p* value < 0.05 (one-tailed test); OPM = optimism; INN = innovativeness; DIC = discomfort; INR = insecurity; PUS = perceived usefulness; PEU = perceived ease of use; ATT = attitude; UIG = usage intention.

Table 3 shows the findings of testing hypotheses by using one-tailed test. It is used when the coefficient in the hypothesis is believed to have a negative or positive sign. Optimism has a positive and significant effect on perceived usefulness (β = 0.370, $p < 0.001$) and perceived ease of use (β = 0.300, $p < 0.001$); indicating H1 and H2 are accepted. Innovativeness shows a positive and significant impact on perceived usefulness (β = 0.247, $p < 0.001$) and perceived ease of use (β = 0.284, $p < 0.001$) therefore, H3 and H4 are accepted. However, discomfort is ineffectual on both perceived usefulness (β = -0.028, $p > 0.05$) and perceived ease of use (β = -0.049, $p > 0.05$), H5 and H6 are rejected. The last construct of TRI, insecurity, has a positive effect on both perceived usefulness (β = 0.176, $p < 0.001$) and perceived ease of use (β = 0.126, $p < 0.05$), H7 and H8 are accepted. Perceived usefulness (β = 0.432, $p < 0.001$) and perceived ease of use (β = 0.426, $p < 0.001$) have a positive effect on attitude toward using VR tourism technology. Therefore, H9 and H10 are accepted. Lastly, H11 is accepted because attitude shows a positive and significant effect on usage intention (β = 0.483, $p < 0.001$).

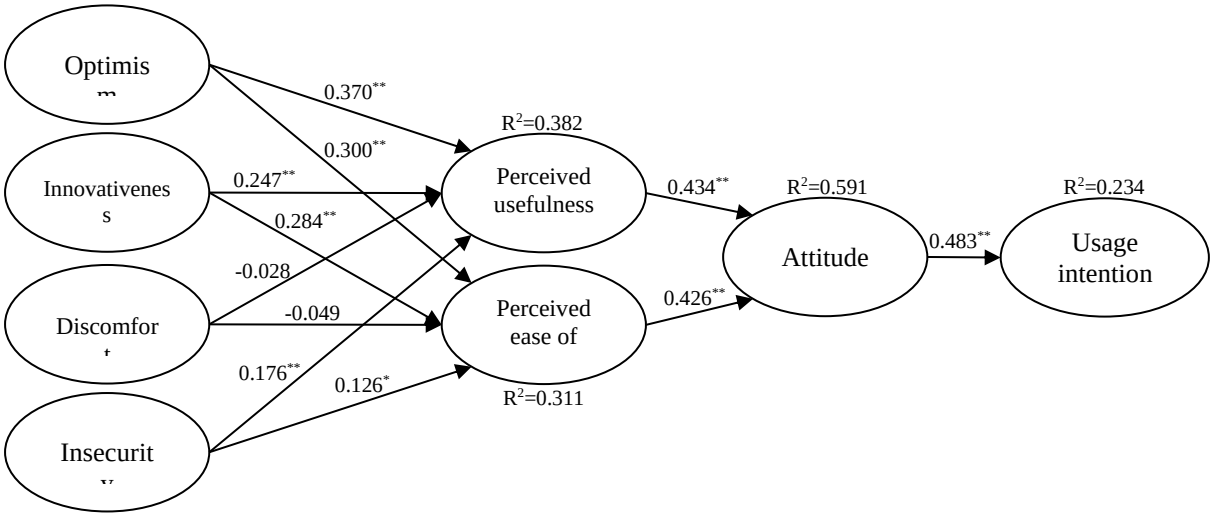

Figure 2. Result model

Importance performance map analysis

IPMA is applied to recognize constructs with high importance and average or low performance (Ringle & Sarstedt, 2016), so that they can increase or improve the construct. Table 4 presents the IPMA test results for the target constructs of attitude and usage intention. The first IPMA for the attitude construct target (Figure 3). The TRI constructs have a lower importance value than the TAM constructs with respective values of 0.288, 0.228, -0.033, 0.130. The highest importance is the perceived usefulness construct, which is 0.434, which is close from the other TAM constructs, namely the perceived ease of use of 0.425. Meanwhile, from all TRI and TAM constructs share less different values from the performance value. Thus, to increase attitude, the priorities are perceived usefulness and perceived ease of use because these constructs have the highest import value and average performance. Therefore, focus on the TRI constructs; optimism and innovativeness have the highest importance value of the other two in. Therefore, in improving the attitude It is essential to concentrate the community's optimism and innovativeness in relation to VR tourism technology.

Next, IPMA for the target construct of usage intention (Figure 4). Similar to the previous results, perceived usefulness (0.210) and perceived ease of use (0.206) have a higher importance value than the TRI constructs (0.139, 0.110, -0.016, 0.063). Thus, optimism aspects related to perceived usefulness and perceived ease of use is important because they have high importance and average performance. However, compared to other constructs, attitude has a higher importance value (0.483) and lower performance (71.467) than perceived usefulness (72.227). This indicates that attitude must be prioritized because it is the most important and good performance.

Table 4. Importance-performance analysis of attitude and usage intention

Constructs	Attitude		Usage Intention	
	Important	Performance		Important
Optimism	0.288	64.460	Optimism	0.288
Innovativeness	0.228	54.972	Innovativeness	0.228
Discomfort	-0.033	51.874	Discomfort	-0.033
Insecurity	0.130	69.788	Insecurity	0.130
Perceived usefulness	0.434	72.227	Perceived usefulness	0.434
Perceived ease of use	0.426	67.806	Perceived ease of use	0.426

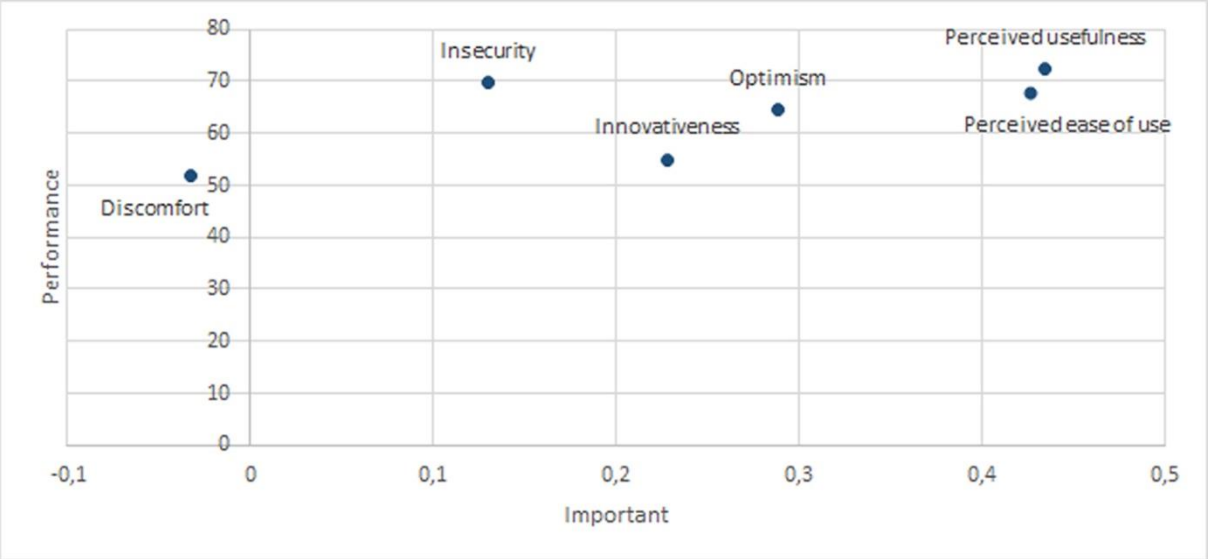

Figure 3. IPMA of target construct "attitude"

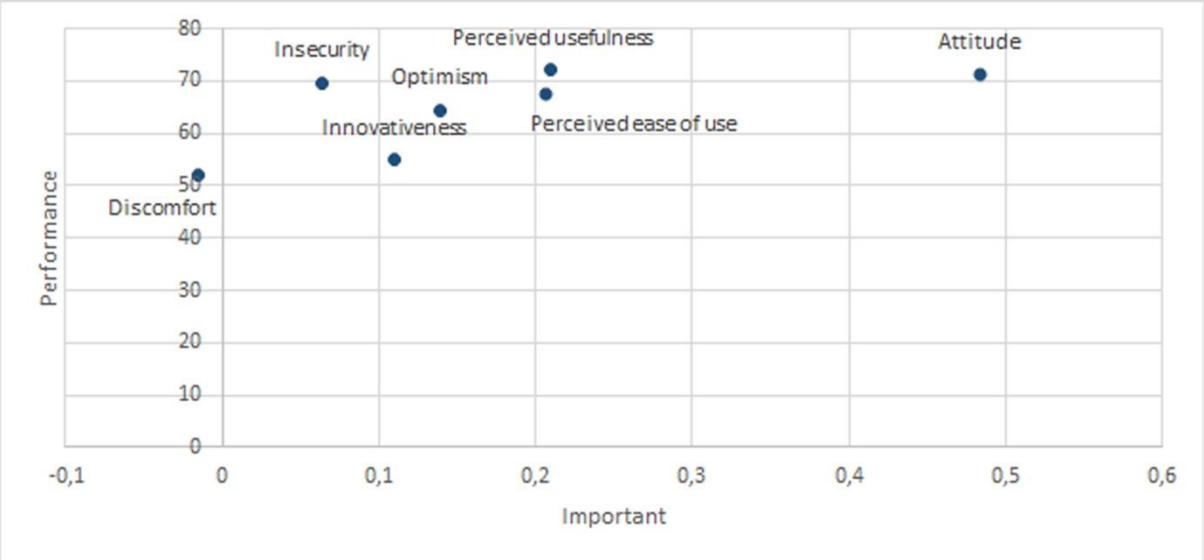

Figure 4. IPMA of target construct "usage intention"

Discussion

First, this study proposes VR tourism technology adoption model in the new normal era by combining TRI and TAM. This integration model has proven successful in predicting VR tourism technology adoption, strengthening the previous study (Lai & Lee, 2020; Lin et al., 2007; Yang et al., 2022). The integrated model can predict technology adoption better and strengthen the explanatory power of both TRI and TAM compared to when they are single-applied. While TAM is system-specific, TRI is more individual-specific (Lin et al., 2007). In a marketing context, the integrated model improves the explanatory and applicability strength of the preceding two models (Lin et al., 2007; Rafdinal & Senalasari, 2021). Although studies on the integration of TRI and TAM have been conducted, this integrated model has been evaluated and proven to describe the usage intention of VR tourism technology. The results also contribute to a more focused understanding of people's technology acceptance behavior after the post COVID-19 pandemic.

In this TRI model, the impacts of technology readiness constructs on TAM constructs are not fully accepted. According to the findings, optimism and innovativeness have a positive

impact on perceived usefulness and perceived ease of use. The more optimist and innovative they are, the more they will regard new technology as useful and easy to use, validating past findings (Lin et al., 2007; Rafdinal & Senalasari, 2021; Yang et al., 2022). In the VR tourism technology context, people who are optimist and innovative about VR technology will find ways to use VR technology that also experience the ease of use and usefulness of VR tourism technology. In contrast to these results, another TRI construct is discomfort is ineffectual on perceived usefulness and perceived ease of use. These results are supported with previous studies (Rafdinal & Senalasari, 2021; Yang et al., 2022). In developing countries VR technology is still relatively new, the operation of something new can cause discomfort for most people and they will feel confused to use it (Walczuch et al., 2007). Until they reach a certain level of comfort, they will experience the advantages of VR tourism technology less. These results provide new understanding that comfort has no affect to perceived usefulness and perceived ease of use because the use of VR tourism technology in the post COVID-19 pandemic remains a new and ongoing phenomenon. It also has an impact on increasing the level of discomfort.

Insecurity has a positive effect on perceived usefulness and perceived ease of use. This finding is contrary to previous studies which showed that insecurity negatively affected perceived usefulness and perceived ease of use (Humbani & Wiese, 2019; Martens et al., 2017). This shows that the impact of insecurity will differ depending on the type of technology and the particular time. The application of VR tourism technology during the COVID-19 pandemic has changed the way people view technology. People are used to (or forced to) master certain technologies to survive a pandemic, including VR technology in travel. People introduces this new habit during the new normal. The current type of VR technology user is "hesitant-sceptic", they are less worried about new technology's insecurity, but they need more motivation to adopt new technologies continuously (Humbani & Wiese, 2019), especially in the post-pandemic COVID-19. These findings have contributed to and expanded the TRI literature regarding the adoption of VR tourism technology revealing that the effect of insecurity on the usefulness and ease of use of VR tourism technology will be determined by individual characteristics.

In the TAM constructs, the perceived usefulness and perceived ease of use of VR tourism technology are crucial elements in influencing attitudes toward its adoption. This finding is supported with previous studies that shows the more a person believes a technology or system as useful and ease to use, the more positive their attitude toward using the technology and continuing the system's improvement (Schiopu et al., 2021). The findings also show that attitude significantly affects on VR tourism technology usage intention, which supports previous findings (Chen & Li, 2020; Humbani & Wiese, 2019; Lin et al., 2020). Since the COVID-19 pandemic, people have implemented social distancing and traveling prohibition. Thus, the opportunity to carry out tourism activities virtually increases during the pandemic. Even after the COVID-19 pandemic, people who feel the usefulness and ease of use of VR tourism will continue to use it. Perceived usefulness and perceived ease of use are closely related to the technical side that must exist in a technology (Yang et al., 2022). Therefore, it is explainable that as long as the VR tourism technology is useful and easy-to-use, people continuously use it after the pandemic. This study enriches the existing technology and tourism literature by highlighting the importance of perceived usefulness and perceived ease of use in the adoption of VR tourism technology in the post COVID-19 pandemic.

Managerial implication

This study provides empirical evidence for VR tourism technology developers to create VR tourism technology based on user insights using IPMA. Perceived usefulness and perceived ease of use have a high degree of importance on attitude and usage intention compared to the

TRI constructs. This proves that building high-quality VR technology is essential to increase consumer attitudes towards adopting the technology. Unlike traditional tourism that allows tourists to experience the attractions in real life, VR tourism tries to create that experience for consumers as closely as possible. Therefore, to encourage VR tourism technology, the developers need to ensure that their technology is user-friendly, making it easy to use and useful. For this purpose, the developers require understanding which feature will promote benefits and eases VR tourism technology better, then focus on building and improving that feature(s). Features such as high-quality images and videos in VR tourism technology will give the feeling of visiting a tourist destination as real as possible. In addition, VR technology needs a regular update in accordance with the wishes of the user at a time. Thus, the users will continue to experience the usefulness and ease of use of VR tourism technology. Furthermore, Technological superiority, along with the right marketing plan, may boost the adoption of VR tourism technology and function to attract more users.

Insecurity influences perceived usefulness and perceived ease of use positively. In VR tourism technology, actually security issues are not a major concern because VR technology has minimal risk. This is what makes insecurity not have a significant effect on perceived usefulness and perceived ease of use. However, discomfort has significantly affects on perceived usefulness and perceived ease of use. This shows that the more people feel discomfort in using VR tourism technology, the more they will not feel the usefulness and convenience of VR tourism technology. One solution is to demonstrate how to use VR tourism technology and show features that satisfy user needs. This is possible by sharing videos on social media platforms such as Tiktok, Instagram, and YouTube, etc. Types of social media platforms that have a high social presence can be a medium for delivering credible information by displaying professional content (Chung et al., 2015). Tourism marketers can use social media that distributes content to promote the advantages of VR tourism technology so that the feeling of discomfort will decrease and the audience will get used to using it.

In addition, marketing managers, local governments and other parties who have the same concern for increasing the number of tourists must also ensure that they promote VR tourism technology to the right customers, using the right touch-points, through the right platforms. Social media is one of the most effective platforms for promoting the advantages of VR tourism technology, especially in today's digital era. Virtual tourism also contributes to sustainable marketing which needs attention from various parties in the tourism industry.

This study has broadened our understanding of the adoption of VR tourism technology by integrating TRI and TAM. But, some limitations are existed. First, the R square value for usage intention is not high enough. Some other constructs also influence the usage intention of VR tourism technology in the post COVID-19 pandemic. Other technological adoption frameworks can be used in future studies to describe the usage intention of VR tourism technology. Second, some collected samples come from developing countries, namely Indonesia. Therefore, it is necessary to be careful when applying the findings of this study abroad because it is relatable to the technological readiness in society varied in each country. Future research can differentiate in analyzing the adoption of VR tourism technology in other countries. The results will differ in countries with different levels of technology readiness. Third, VR tourism technology has many types, ranging from mobile applications, websites, to large-scale VR devices in amusement parks. Because this study does not consider the type of VR device used. Further studies could focus on specific types of VR devices. This will have more specific and practical implications for VR tourism technology developers.

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