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Customer-centric virtual reality applications adoption in the hospitality industry: quality-value-based adoption model

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Abstract

Purpose – The massive adoption of virtual reality (VR) applications has started since the COVID-19 pandemic, and until now, VR applications are still being used. However, there is limited research that analyses the consumer's perspective on the adoption of VR applications. Thus, this study discovers the adoption of VR applications in the hospitality sector by integrating the value-based adoption model (VAM) and VR quality.
Design/methodology/approach – The data were gathered through a survey of 500 respondents and evaluated through the structural equation model-partial least squares (SEM-PLS).
Findings – Employing SEM-PLS and importance-performance map analysis (IPMA), the findings revealed that VR quality and perceived value are essential determinants in the adoption of VR applications in the hospitality industry.
Practical implications – Practically, this study encourages the hospitality industry to create and develop high-quality VR application technology to benefit visitors. Through this study, hospitality marketing managers, governments and others concerned with the hospitality industry's future development can create effective ways to increase the adoption of VR applications in this industry.
Originality/value – This study offers novel perspectives into the theory and application of VR quality and VAM in the adoption of VR applications in the hospitality industry.

Keywords VR applications, VAM, VR quality, Behavioural intention, Hospitality industry
Paper type Research paper

1. Introduction

COVID-19 was declared an outbreak that poses a high public health risk which requires large-scale social restrictions to be implemented, including in tourism activities (Wibisono *et al.*, 2023). These restrictions have significantly impacted industries, including tourism and hospitality, where VR applications have emerged as a promising technological solution (Godovykh *et al.*, 2022; Griffin *et al.*, 2023). VR applications encompass programs or websites that utilise technologies such as VR headsets, 3D maps, graphics, videos, sounds, and aerial views to immerse users in virtual environments (Lee *et al.*, 2020). These applications are helpful technology because they can easily access information about the hotel room (Flavián *et al.*, 2021) and improve the user's experience of imagining the hotel situation before deciding to book (Lim *et al.*, 2024). By utilising VR applications, hotels can create immersive and interactive experiences, attract more guests, and provide personalised and customised services (Lee *et al.*, 2020). As the VR applications continue to advance, the global market of VR was valued at \$19.44bn in 2022 and is predicted to grow to \$165.91bn by 2030, up from \$25.11bn in 2023 (Fortune Business Insight, 2023). VR applications are expected to play an even more critical role in the future of the hospitality industry. However, there are limited studies on the adoption of VR applications in the hospitality sector (Flavián *et al.*, 2021; Lim *et al.*, 2024). With the global VR market projected to grow substantially, this study becomes crucial in filling the existing gap

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in understanding VR application adoption in the hospitality industry during these challenging times. Therefore, this study will add to the existing knowledge on hospitality marketing by providing a novel viewpoint on the use of VR applications in this industry.

In explaining VR applications adoption in the hospitality industry, this study demonstrates the adoption from a consumer's perspective in the value-based adoption model (VAM) (Kim *et al.*, 2007). The VAM is more concerned with technology adoption from a consumer's perspective based on Zeithaml's concept of perceived value (Zeithaml, 1988). This model evaluates the benefits and sacrifices before adopting or using technology (Kim *et al.*, 2007; Lau *et al.*, 2019). The VAM has been tested in various studies related to technology adoption, including service robots (Kang *et al.*, 2023), Robo-advisors (Hong *et al.*, 2023), augmented reality (Lau *et al.*, 2019), and VR (Vishwakarma *et al.*, 2020), which demonstrate the reliability of VAM in user-perceived value (value-based). However, VAM does not measure technology adoption from the technical aspects of technology; thus, previous studies have suggested assessing technology quality (Lau *et al.*, 2019; Vishwakarma *et al.*, 2020). To overcome the weaknesses of the VAM framework, this study evaluates VR quality as the main reason for adopting VR applications, confirmed by previous studies regarding VR quality (Godovykh *et al.*, 2022; Lee *et al.*, 2020). VR quality, which is able to present quality content, quality systems, and vivid visualisation, is the basis for VR adoption (Lee *et al.*, 2020). Considering the benefit of VR quality in discussing technical aspects of technology and VAM in evaluating technology adoption from a customer perspective, this study integrates VR quality and VAM into a single model. This integrated model can determine the adoption of VR applications from the viewpoint of consumers who consider value and from technology users who evaluate VR quality. This integration has not been utilised in prior studies related to VR adoption in the hospitality industry. Thus, this study may help to address the limitations identified in previous studies.

This study offers a comprehensive research model to explain VR application adoption in the hospitality industry and fill the identified gaps. Especially, this study: (1) assesses VR application adoption using VR quality and VAM and (2) explains the use of IPMA to find constructs with the highest level of importance for the target construct. Utilising IPMA in this study is to find out what constructs are most important in VR application adoption. This study examined the adoption of VR applications amongst Indonesian users for two main reasons. First, 360° tourist destinations have been developed by the Indonesian Ministry of Tourism which are incorporated into VR technologies, and the number continues to increase (Wibisono *et al.*, 2023). Second, in 2022, the occupancy rate of hotel rooms increased by 11.59% from 2021, with an occupancy percentage of 36.21% (Central Bureau of Statistics, 2023). This increase is supported by technological developments in tourism and hospitality (Lu *et al.*, 2022), including VR in Indonesia's tourism and hospitality industry (Idris *et al.*, 2021; Wibisono *et al.*, 2023). Owing to its benefits, the hospitality industry has opportunities to develop in the future through VR applications. Thus, it is important for evaluating the adoption of VR applications in the hospitality industry theoretically and practically.

2. Literature review

2.1 VR technology and VAM

The cost-benefit paradigm in behavioural decision theory serves as the basis for VAM, which states that the perceived value determines one's intention to adopt technology, evaluated by the cognition between the benefits ("getting" factor) and the sacrifice ("input" factor) (Kim *et al.*, 2007). Moreover, the readiness to adopt new technology evaluates individual differences between supporters and barriers (Parasuraman and Colby, 2015). VAM is based on perceived value, which is defined as "a consumer's overall judgement of the utility of a product (or service) based on perceptions of what is received and what is given" (Zeithaml, 1988). This model was developed from the technology acceptance model (TAM) (Davis, 1989). However, TAM struggles with new technology adoption and views users as “users” rather than “consumers”. Consumers differ from users in terms of value, which assesses benefits compared to costs and risks (Kim *et al.*, 2007). This difference lies in the primary constructs, attitude and value, in determining the adoption of new technology (Kim *et al.*, 2007, 2019). Over the past decade, it has been argued that positive attitudes toward new technology aren’t always crucial for predicting consumer intentions to use (Jackson *et al.*, 1997; Taylor and Todd, 1995). Compared to attitude, value may be a more significant determinant of intention to use (Chang and Wildt, 1994). Consumers analyse benefits and sacrifices to assess the value of all available alternatives (Zeithaml, 1988). Additionally, VAM incorporates benefits, sacrifices, and value into its analysis of consumer technology adoption, extending TAM’s framework (Kim *et al.*, 2007). Therefore, as an extension of TAM, VAM assesses benefits and sacrifices to evaluate value and, consequently, intentions for technology adoption.

This model has been widely implemented in numerous contexts, including online-to-offline (O2O) accommodation app services (Kim *et al.*, 2019), service robots (Kang *et al.*, 2023), augmented reality (AR) technology (Lau *et al.*, 2019), travel information on social media (Chung and Koo, 2015), and VR in tourist destinations (Vishwakarma *et al.*, 2020). In tourism, Chung and Koo (2015) proves that the intention to use travel information search is influenced by benefits (reliability of information, enjoyment), sacrifices (complexity, perceived effort), and perceived value. These three main determinants influence the intention to use VR applications in tourist destinations, where benefits are determined by enjoyment, usefulness, and immersion. In contrast, sacrifices are determined by perceived cost, complication, and risk factors (Vishwakarma *et al.*, 2020). On the adoption of AR technologies in hospitality and tourism, benefits (usefulness and enjoyment), sacrifice (technicality and captivating inputs), and perceived value are the determinants of adoption intention (Lau *et al.*, 2019). These studies contribute to VAM development by exploring how perceived benefits and sacrifices affect technology adoption across various dimensions and contexts.

VAM has been successfully integrated with various relevant constructs and theories, such as push-pull-mooring model (Kang *et al.*, 2023), expectation-confirmation model (Kim *et al.*, 2019), and uncertainty reduction theory (Hong *et al.*, 2023). This integration also provides a more comprehensive framework than the original VAM, allowing future studies to understand the complex phenomena behind the reasons for technology adoption. This study integrates VR quality into VAM to deepen understanding of technological aspects in users’ intentions for VR application use. A previous study has identified VR quality constructs consisting of content quality, system quality, and display quality (vividness) (Lee *et al.*, 2020). The information quality delivered by VR is referred to as content quality. This includes content accuracy, completeness, and presentation type (Jung *et al.*, 2015; Lee *et al.*, 2020). System quality refers to the technical level of communication, whilst information quality refers to the semantic class of communication (Jung *et al.*, 2015; Lee *et al.*, 2020). Vividness is the richness of environmental representations and how an environment communicates information to the senses (Lee *et al.*, 2020; Yim *et al.*, 2017). These three qualities have been applied in previous studies related to VR quality (Jung *et al.*, 2015; Lee *et al.*, 2020). VR quality will determine user expectations, which will determine future trips (Lee *et al.*, 2020). This study will enhance comprehension of VR quality and its adoption (see Figure 1).

2.2 VR quality and VAM

One of the constructs from the benefit dimension in VAM is enjoyment. Enjoyment refers to using a pleasurable technology to its users, regardless of the performance that can be produced (Kim *et al.*, 2007). Perceived enjoyment in using VR can be determined by the technology and visual quality (Mouatt *et al.*, 2020; Vishwakarma *et al.*, 2020). When someone uses VR with high optical quality, they feel happy because they have experienced being

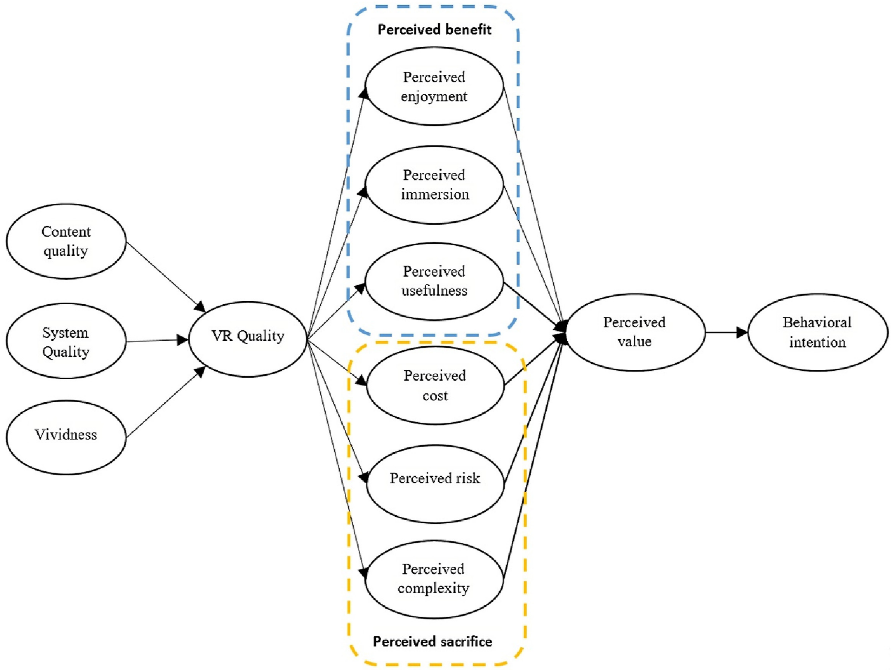

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Figure 1.
Research framework

present in the VR space and time (Griffin *et al.*, 2023). This suggests that users with a higher tendency to experience presence may derive more enjoyment from VR experiences. Another study has shown that high immersive quality can affect perceived enjoyment much higher than average immersive quality (Mouatt *et al.*, 2020). These indicate that VR quality affects perceived enjoyment. Therefore, the proposed hypothesis:

H1. VR quality significantly positive affects perceived enjoyment

Perceived immersion is the experience from users of being physically present in such non-physical environment (Lee and Kim, 2021; Lyu *et al.*, 2023). This perception is created because the user experiences images, sounds, or other stimuli in the VR world. Immersion is a distinctive characteristic of an exciting virtual environment (Shin, 2019). The key to improving immersion is the user's perception of quality, interaction with services, and the quality of the technology features that users perceive and interact with (Shin, 2019). High-quality VR applications that provide realistic sensory stimulation and seamless virtual environments and cater to individual tendencies to become involved enhance the sense of presence and immersion (Bae *et al.*, 2020; Yim *et al.*, 2017). Therefore, the hypothesis proposed:

H2. VR quality significantly positive affects perceived immersion

Usefulness is the total value users feel from using new technology and is one of the main factors determining technology adoption (Kim *et al.*, 2007). Users develop satisfaction and perceived usefulness when the perceived quality after using an accommodation application exceeds their expectations (Kim *et al.*, 2019). A previous study discovered that perceived usefulness is influenced by the system's quality (Du *et al.*, 2022). Another study found that the quality of features affects perceived usefulness in the context of mobile games (Mulyawan and Rafdinal, 2021). When VR experiences are of high quality, users are more likely to perceive they can provide valuable benefits. Based on these studies, the proposed hypothesis:

H3. VR quality significantly positive affects perceived usefulness

Perceived cost is a monetary element that resembles the intuitively perceived direct cost of purchasing a product or service (Kim *et al.*, 2007). Higher costs imply higher-quality products and services (Ahn and Kwon, 2020). In using VR applications the cost is a problem that becomes an obstacle in using VR applications, and perceived value is considered an economic cost that consumers must bear to use VR technology (such as Internet data and devices) (Vishwakarma *et al.*, 2020). People use VR applications if the quality of VR applications is higher than the cost. When users perceive high quality in VR applications, they are more likely to perceive the cost as reasonable. Therefore, to determine the relationship between VR quality and perceived cost, the following hypothesis is generated:

H4. VR quality significantly negative affects perceived cost

Perceived risk is a "consumer's perception of the uncertainty and adverse consequences of buying a service" (Dowling and Staelin, 1994). VR users will feel that VR will benefit if risks such as insecurity and discomfort in its use can be minimised (Wibisono *et al.*, 2023). The quality of VR tourism experiences creates an environment that transcends time and space, avoiding economic costs and risks (Zhang *et al.*, 2022). However, it stated hurt risk, indicating that product quality cannot guarantee a reduction in performance risk (Said and Mustaking, 2020). Therefore, the VR quality can affect how users perceive the risk associated with using VR applications. Thus, the proposed hypothesis:

H5. VR quality significantly negative affects perceived risk

Perceived complexity is defined as "the degree to which an innovation is perceived as relatively difficult to understand and use" (Rogers, 1995). Regarding technical quality, users have the highest expectations for reliability, connectivity, response time, and ease of use (Kim *et al.*, 2007). Less complexity may positively affect quality, meaning higher perceived quality will decrease complexity (Creusen *et al.*, 2010; Lavidas *et al.*, 2022). The slightest visual complexity of the virtual world is sufficient to promote moderate quality (Creusen *et al.*, 2010). High-quality VR applications with realistic graphics, immersive interactions, and intuitive controls can enhance the sense of presence, which will reduce complexity for users. Thus, the proposed hypothesis:

H6. VR quality significantly negative affects perceived complexity

2.3 VAM

The VAM concept is based on perceived value and provides an overall evaluation of a product or service that consumers can accept (Lee *et al.*, 2020). VAM uses benefits and sacrifices to assess perceived value in adoption intentions; VAM's point of view depends on consumers maximising the value of benefits. Perceived enjoyment is a benefit that affects perceived value in adopting mobile Internet and information technology (Kim *et al.*, 2007). A previous study found that the enjoyment users feel in AI-based intelligent products is one of the factors that influences perceived value in the VAM framework (Sohn and Kwon, 2020). Another study verified that perceived enjoyment in VR significantly affects perceived value and satisfaction (Kim *et al.*, 2019). Users experience high enjoyment from VR applications in exploring a hotel, which increases their perceived value. Thus:

H7. Perceived enjoyment significantly positive affects perceived value

Immersion is a type of awareness in the eye of the beholder that represents the degree of a user's cognitive, emotional, and sensory connection to products and contents (Shin, 2019). It is often associated with VR, where users can feel a sense of presence and involvement in the virtual world (Lee and Kim, 2021). Perceived value also refers to the perceived benefits or worth that an individual derives from a particular product or experience (Seneviratne *et al.*, 2017). The existing studies support the claim that perceived immersion positively affects perceived value. Immersions experienced directly by VR users will determine perceived value and intentions to use VR (Lee *et al.*, 2020). Immersive AR experiences can increase the value of using them (Shin, 2019). When individuals feel fully immersed in a virtual environment, they are more likely to recognise the experience as valuable. Thus, perceived immersion has significantly impacted perceived value in VR applications.

H8. Perceived immersion significantly positive affects perceived value

Perceived usefulness is "the extent to which a person believes technology can improve job performance" (Davis, 1989). The results of previous studies prove that perceived usefulness positively influences perceived value of technology in various fields, such as wearable devices (Seneviratne *et al.*, 2017), artificial intelligence-based intelligent products (Sohn and Kwon, 2020), and accommodation applications (Kim *et al.*, 2019). The perceived usefulness of an application influences the perceived value, satisfaction, and emotional benefits intended by the user (Kim *et al.*, 2019). According to various existing studies, when users perceive VR applications as applicable, they are more likely to recognise them as valuable. This is because perceived usefulness directly affects the perceived value. Thus, the proposed hypothesis:

H9. Perceived usefulness significantly positive affects perceived value

The relationship of perceived cost and perceived value has been extensively studied in consumer behaviour related to technology (Liu *et al.*, 2015; Singh and Sinha, 2020). Perceived cost is the direct cost experienced by consumers when purchasing a product or service (Kim *et al.*, 2007). Cost is the most prominent factor hindering application use (Kim *et al.*, 2019). This is confirmed by previous studies showing that perceived cost negatively affects perceived value (Liu *et al.*, 2015; Sohn and Kwon, 2020). This study also indicates that the cost sacrifice of technology hurts users' perceived value. If the perceived cost of VR applications is high, users may have higher expectations for the experiences that VR applications can provide. If these expectations are met or exceeded, users are likely to sense a higher value in the VR applications.

H10. Perceived cost significantly negative affects perceived value

Perceived physical risk describes the possibility of a product physically harming consumers and others near it (Kerviler *et al.*, 2016). A previous study indicates that the perceived risk associated with the physical dangers in VR usage has a detrimental effect on the perceived value of VR experiences (Vishwakarma *et al.*, 2020). Travellers' desire to reduce risks, costs, and time has driven the rise of VR tourism, providing added value (Zhang *et al.*, 2022). Another risk is stress related to the risk of information leakage when using VR, significantly reducing perceived value (Kim *et al.*, 2019). These findings underscore the close relationship between perceived risks associated with VR and the tangible risks inherent in its usage. When perceived risks outweigh benefits, consumers perceive lower value in VR applications.

H11. Perceived risk significantly negative affects perceived value

Rogers (1995) explains the complexity perceived by technology users indicates how difficult it is for them to understand and utilise IT innovations. Overly complex technological innovations hinder technology adoption (Rogers, 1995). Perceived complexity plays a role in influencing perceived value in VR experiences. A more complex technology will create a negative value because the complexity will cause stress (Chung and Koo, 2015). Another study shows that the higher perceived complexity will make the technology increasingly useless for its users and reduce its value (Lavidas *et al.*, 2022). Related to AR technology, a previous study showed that technical aspect such as the complexity experienced by users affects the perception of using AR, leading to reduced perceived value (Lau *et al.*, 2019). When users perceive VR applications as complex, it can negatively impact their overall perception of the value they derive from VR applications. Therefore, the hypothesis proposed:

H12. Perceived complexity significantly negative affects perceived value

2.4 Perceived value and behavioural intention

Perceived value is the benefits and sacrifices consumers feel, assessed from the entire experience of using a product or service from a consumer's perspective (Zeithaml, 1988). In VAM, "perceived value results from an overall evaluation of the relative perceived benefits and sacrifices associated with the offering" (Kim *et al.*, 2007). Previous studies have shown the importance of perceived value in technology adoption and discovered that it was a reliable predictor of behavioural intention (Jiang *et al.*, 2022; Liu *et al.*, 2015). In the context of applications, a previous study has shown that perceived value is the primary extrinsic motivator determining behavioural intention to use accommodation applications (Kim *et al.*, 2019). Because VR applications are high-tech products, this study hypothesises that consumers' high-value perceptions of VR applications will increase behavioural intention to use VR applications.

H13. Perceived value significantly positive affects behavioural intention

3. Method

3.1 Sampling

This study uses purposive sampling data collection techniques. The reason is because this non-probability sampling approach selects samples based on similar characteristics and perspectives about the phenomenon. Several criteria were set in selecting sample: (1) the respondents regularly used VR applications; (2) the respondents have used VR applications at least once in the past month. To gather the appropriate sample, we surveyed VR online community members who commonly use VR applications, with the first question asking whether the user had previously experienced VR content. Those who have never used VR applications in hospitality were not invited to join the survey. Data were collected through surveys distributed online using Google Forms. Questionnaires were distributed online to VR users in several regions in Indonesia through various VR online communities on social media such as Instagram, Facebook, and Discord. Data were gathered over three weeks in April 2023. A total of 678 responses were received, only 500 responses could be used for further analysis.

In Indonesia, the user penetration in Indonesia rise from 21.8% in 2023 to 34.6% in 2027 respectively (Statista, 2023). This number could be the basis of calculating the sample size using statistical power. Previously, the detailed information of VR users number in the hospitality industry is unavailable. Thus, the sample size was determined using G*Power based on statistical power. This study sample had a statistical power value of 0.95, surpassing the cut-off value (0.8) (Carranza *et al.*, 2020; Hair *et al.*, 2022). Consequently, the sample size meets the acceptable criteria.

The demographics results show that the respondents are female (51.2%) compared to male (48.8%), which offers a reasonably balanced ratio. The majority of respondents ranged in age from 18 to 23 years old (78.4%), followed by 24–29 years old (13.6%) and over 30 years old (8%), representing the respondents in this study as the young generations. More than half of the respondents (72.6%) were students, followed by entrepreneurs (9.4%), professionals (2.8%), civil servants (1%), and others (14.2%). Because the respondents are young generations, the majority of their monthly income is less than IDR 5,000,000 (93.2%). Respondents reported that they use VR applications every month. Thus, it can be concluded that this study's respondents are young and highly interested in VR applications.

3.2 Research instruments and measurements

The questionnaire comprises three sections: the first assesses respondents' familiarity and usage frequency of VR applications, the second presents research construct items rated on a 5-point Likert scale, and the third collects demographic information. Three dimensions of VR quality (content quality, system quality, and vividness) are measured by eleven items (Jung *et al.*, 2015; Lee *et al.*, 2020; Yim *et al.*, 2017) which analyses the quality of VR application technology that visualises hotels in VR applications. Furthermore, in the VAM, perceived benefit is measured with three dimensions consisting of perceived enjoyment with five items (Chung and Koo, 2015; Lau *et al.*, 2019; Sohn and Kwon, 2020), perceived immersion using four items (Bae *et al.*, 2020; Vishwakarma *et al.*, 2020), and perceived usefulness with four items (Kim *et al.*, 2007, 2019; Lau *et al.*, 2019). Perceived sacrifice is also measured with three dimensions consisting of perceived cost with three items (Kim *et al.*, 2007, 2019), a perceived risk with three items (Stone and Gronhaug, 1993; Vishwakarma *et al.*, 2020), and perceived complexity with three items (Chung and Koo, 2015; Davis, 1989). In measuring perceived value, we modified the previous measurement items (Chung and Koo, 2015; Kim *et al.*, 2007) to fit the VR applications in the hospitality context. Finally, the behavioural intention to use VR applications is assessed using three items (Lau *et al.*, 2019; Sohn and Kwon, 2020), which were adjusted to the context of VR applications in the hospitality industry. All indicators are shown in Table A1. The questionnaire was pre-tested with 30 respondents to ensure validity and reliability, and no significant changes were made.

3.3 Data analysis

The data analysis technique is PLS-SEM. It performs statistical analysis, simultaneously testing every relationship between constructs in the conceptual model (Hair *et al.*, 2022). A two-step data analysis approach was employed: the first stage assessed the measurement model, whilst the second stage examined the relationships between constructs in the structural model (Hair *et al.*, 2022). Furthermore, IPMA was evaluated to identify each independent construct's performance and determine which construct highly impacts the dependent construct (Hair *et al.*, 2022). IPMA helps identify improvement areas, prioritise actions, and support strategic decision-making. IPMA provides valuable insights for organisations to allocate resources effectively and improve overall performance (Ringle and Sarstedt, 2016).

4. Results

4.1 Measurement model

The measurement model evaluates this study's constructs for validity and reliability, including both convergent and discriminant validity (Hair *et al.*, 2022). Convergent validity evaluates the outer loading and AVE. The outer loading on all indicators in this study has a cut-off value above 0.708, which indicates that the indicators are reflective indicators of the research construct (Hair *et al.*, 2022). The AVE value above 0.50 indicates that the construct can describe 50% of the items that reflect the construct (Hair *et al.*, 2022). Furthermore, construct reliability was measured using CR and Cronbach's alpha. If the CR and Cronbach's alpha cut-off values are greater than 0.70, the construct is considered reliable (Hair *et al.*, 2022). The CR and Cronbach's alpha values exceeded 0.60 (≥0.865) and 0.7 (≥0.773), indicating the reliability of all constructs. Thus, all of the indicators and constructs used are valid and reliable (see Table A2).

Measurement model assessment to evaluate discriminant validity using the heterotrait-monotrait (HTMT) ratio. HTMT approximates the correlation between two constructs if measured reflectively (Hair *et al.*, 2022). If the HTMT value is > 0.90, it shows that the discriminant validity of the construct is weak, which means that the indicators in the construct do not perfectly reflect the construct (Hair *et al.*, 2022). Table A3 shows the HTMT results for each construct. HTMT values are supposed to be below 0.90 for conceptually similar constructs, indicating the satisfactory discriminant validity of this study's measurement model.

VR quality construct, as second-order formative construct, reflect first-order dimensions. Content validity was evaluated at individual and construct levels. The VIF values for VR quality are 1.769 and 2.392 (see Table A4). Even though a VIF value is slightly higher than 2.00, this value is still lower than the cut-off value of 5 (Hair *et al.*, 2022), indicating that multicollinearity amongst first-order constructs is not a problem. The next test was assessing the level of significance and relevance of the VR quality dimensions. Findings indicated that each dimension surpassed the critical T-value of 1.96 and exhibited significance levels below 0.05. The results showed that these qualities are dimensions of VR quality.

4.2 Structure model

Evaluate collinearity before analysing structural relationships to ensure unbiased regression findings by using variance inflation factor (VIF). The VIF value should be less than 3 (Hair *et al.*, 2022). Since the VIF value was less than the specified threshold (1.000–2.150), no collinearity problem was found in this study (See Table 1). Furthermore, the criteria for evaluating the structural model are the coefficient of determination (R^2), effect size (f^2), cross-validated redundancy (Q^2), and the path coefficient (Hair *et al.*, 2022). Regarding the value of R^2, perceived value predicted behavioural intention (28.8%). All the benefit and sacrifice constructs predicted perceived value (36.8%). Amongst the VR Quality constructs, perceived enjoyment showed the most significant explanatory power (53.3%). Next, in evaluating Q^2, the exogenous construct shows its predictive relevance to the endogenous construct if the Q^2 value is more significant than zero (Hair *et al.*, 2022). The Q^2 values obtained ranged from 0.004 to 0.530, indicating that endogenous constructs have good predictive power over endogenous constructs. The effect size (f^2) is one of the supporting criteria for determining whether an independent construct strongly

Hypotheses	β	T - values	VIF	p - values	Supported
H1. VR quality → Perceived enjoyment	0.730	25.649	1.000	0.000	Yes
H2. VR quality → Perceived Immersion	0.667	18.774	1.000	0.000	Yes
H3. VR quality → Perceived usefulness	0.653	17.454	1.000	0.000	Yes
H4. VR quality → Perceived cost	−0.078	1.491	1.000	0.068	No
H5. VR quality → Perceived risk	−0.140	3.003	1.000	0.001	Yes
H6. VR quality → Perceived complexity	−0.242	4.709	1.000	0.000	Yes
H7. Perceived enjoyment → Perceived value	0.301	5.466	2.150	0.000	Yes
H8. Perceived immersion → Perceived value	0.132	2.133	2.012	0.016	Yes
H9. Perceived usefulness → Perceived value	0.240	4.013	2.112	0.000	Yes
H10. Perceived cost → Perceived value	−0.059	1.138	1.609	0.128	No
H11. Perceived risk → Perceived value	0.074	1.588	1.736	0.056	No
H12. Perceived complexity → Perceived value	−0.075	1.533	1.912	0.063	No
H13. Perceived value → Behavioural intention	0.538	12.292	1.000	0.000	Yes

Source(s): Table created by authors

Table 1.
Hypotheses results

influences the dependent construct. The f^2 value categories are small (0.02–0.15), medium (0.15–0.35), and large (>0.35) (Hair *et al.*, 2022). The results indicate large effect sizes for VR quality's influence on perceived enjoyment (1.130), perceived immersion (0.827), and perceived usefulness (0.740), as well as for perceived value's impact on behavioural intention (0.430). Meanwhile, for other influences, the effect size is in the small category.

4.3 Path coefficients

Next, analyse path coefficients via bootstrapping with 95% confidence, employing 10,000 subsamples, ensuring t-values exceed 1.96 (Hair *et al.*, 2022). The nine hypotheses were accepted with a significance p-value <0.05 and t-value >1.96. Meanwhile, four hypotheses were rejected (H4, H10, H11, and H12). Then, for the accepted hypotheses, VR quality significantly positive affects perceived enjoyment ($\beta = 0.730$), perceived immersion ($\beta = 0.667$), and perceived usefulness ($\beta = 0.653$), which supports H1 to H3. Then, VR quality significantly negative affects perceived risk ($\beta = -0.140$) and perceived complexity ($\beta = -0.242$) which supports H5 and H6. Perceived value was found to have a significant impact on all benefit constructs, namely perceived enjoyment ($\beta = 0.301$), perceived immersion ($\beta = 0.132$), and perceived usefulness ($\beta = 0.240$) which supports H7 to H8. Lastly, perceived value significantly affects behavioural intention ($\beta = 0.538$), which supports H13.

4.4 IPMA

IPMA was used to evaluate constructs with a high level of importance and performance at an average to low level (Hair *et al.*, 2022). Table 2 presents importance and performance values for the target constructs of perceived value and behavioural intention. VR quality ranks highest in importance (0.477), closely followed by perceived enjoyment (0.301) as shown in Figure 3. Meanwhile, the performance of the two constructs is average. Therefore, prioritising VR quality and enjoyment is crucial for enhancing perceived value, given their significant importance despite average performance. For behavioural intention as the target construct (Figure 4), perceived value (0.538) and VR quality (0.257) were the most important constructs, indicating their essential role due to their high importance and performance.

5. Discussion and implications

5.1 Conclusions

The integration of VR quality and VAM constructs presents a robust framework for predicting VR application adoption within the hospitality industry (Figure 2), building upon existing literature and addressing research gaps. Quality aspects such as content quality, system quality, and vividness significantly influence users' perceived benefits, underlining

Constructs	Perceived value Important	Perceived value Performance	Behavioural intention Important	Behavioural intention Performance
VR quality	0.477	76.002	0.257	76.002
Perceived enjoyment	0.301	79.210	0.162	79.210
Perceived immersion	0.132	73.712	0.071	73.712
Perceived usefulness	0.240	79.165	0.129	79.165
Perceived cost	−0.059	47.073	−0.032	47.073
Perceived risk	0.074	47.948	0.040	47.948
Perceived complexity	−0.075	34.873	−0.040	34.873
Perceived value	–	–	0.538	73.059

Source(s): Table created by authors

Table 2. IPMA of perceived value and behavioural intention

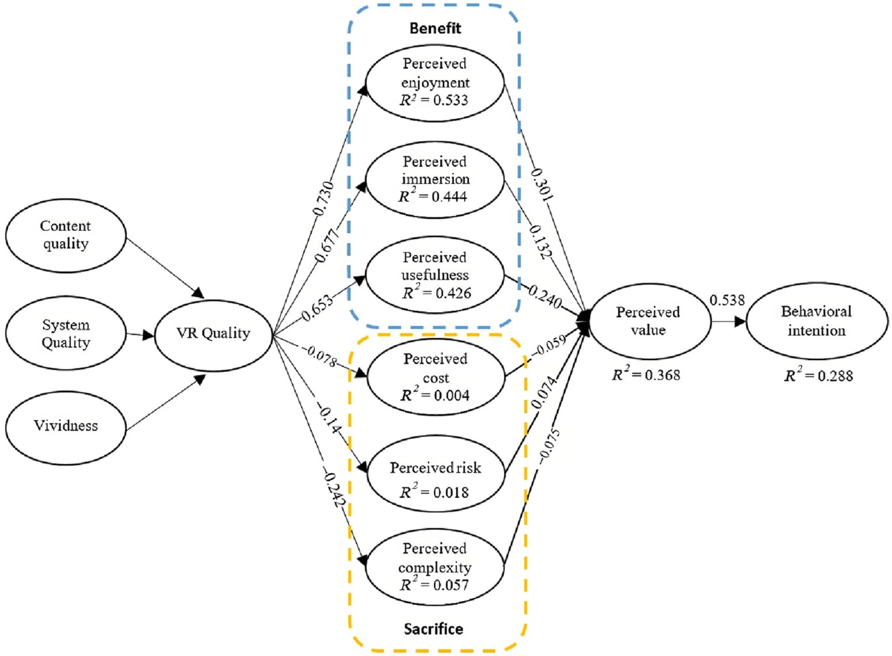


Figure 2.
Result model

Source(s): Figure created by authors

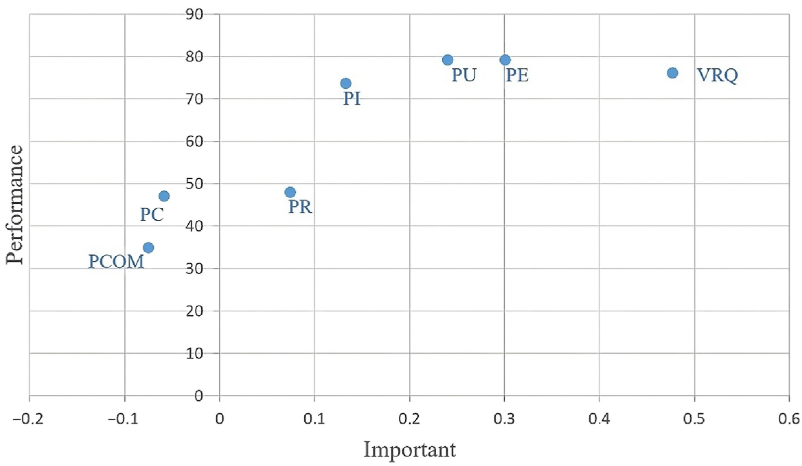
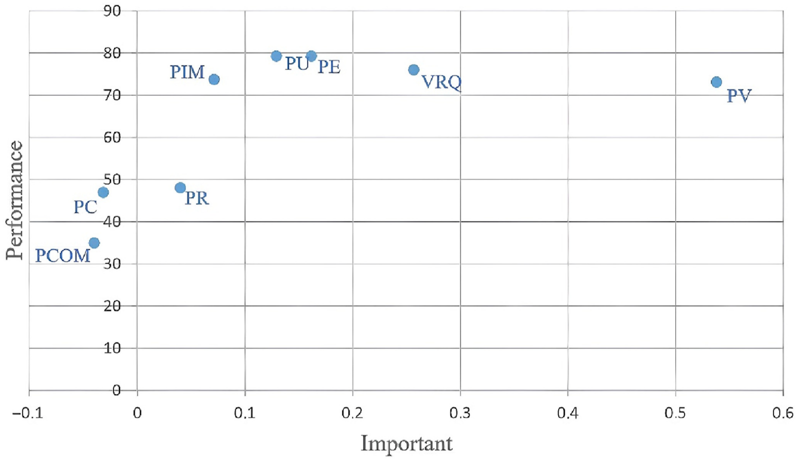


Figure 3.
Target construct "perceived value."

Source(s): Figure created by authors

the importance of technical aspects in shaping VR adoption (Godovykh *et al.*, 2022; Lee *et al.*, 2020). However, the impact of VR quality on perceived costs varies amongst generations, notably observed in Generation Z (Gen Z), where traditional barriers like cost are less influential. This underscores the need to consider generational dynamics in understanding the relationship between VR quality and perceived sacrifice. Furthermore, perceived benefits,



Source(s): Figure created by authors

Figure 4. Target construct "behavioural intention."

particularly perceived enjoyment, play a central role in determining perceived value, emphasising the immersive nature of VR experiences. Interestingly, perceived sacrifice dimensions do not significantly affect perceived value, especially amongst Gen Z users, who exhibit fewer barriers to technology adoption (Cilliers, 2017). Ultimately, perceived value significantly influences behavioural intentions to use VR applications, aligning with broader findings in technology adoption literature (Kim *et al.*, 2019; Lau *et al.*, 2019; Sohn and Kwon, 2020), this improves our comprehension of VR application adoption dynamics in the hospitality industry and underscores the critical role of perceived value in shaping user behaviour.

5.2 Theoretical implications

The study confirms that combining VR quality and VAM into a single framework can predict the adoption of VR applications. This model strengthens previous literature regarding the use of VR in the hospitality and tourism industries (Lee *et al.*, 2020; Mouatt *et al.*, 2020; Vishwakarma *et al.*, 2020). This integrated model enhances the practicality and explanatory power of two previous models in hospitality environments. The measurement of content quality, system quality, and vividness as VR quality constructs are specifically designed to measure specific attributes of VR (Lee *et al.*, 2020), whilst VAM is to assess users' perceptions of value from the "consumer's perspective" (Kim *et al.*, 2007, 2019; Lau *et al.*, 2019). This proven integrated model provides a more thorough analysis of users' intentions to adopt VR applications. This model contributes to a deeper understanding of VR application adoption and addresses the lack of VR applications research in the hospitality industry. Therefore, this study contributes to completing the identified gaps and proving a theoretical framework (quality-value-based adoption model) for assessing technology adoption in the context of VR applications in the hospitality industry.

Regarding the effect of VR quality on VAM, the impact of VR quality on perceived benefits (enjoyment, immersion, and usefulness) is entirely accepted. The higher the quality of VR, the higher its benefits, which validates previous findings (Bae *et al.*, 2020; Mouatt *et al.*, 2020; Vishwakarma *et al.*, 2020). Content quality, system quality, and vividness must be present in VR because they determine the user's enjoyment, usefulness, and immersion (Bae *et al.*, 2020; Du *et al.*, 2022; Mouatt *et al.*, 2020; Yim *et al.*, 2017). The quality of VR applications is highly related to technical aspects, highlighting their importance in shaping VR adoption in the hospitality industry. These results the significance of addressing technical issues, especially the benefits of using VR applications to enhance VR application quality and positively influence perceived benefits. Recognising the critical impact of VR technical quality on adoption contributes to the existing literature (Lee *et al.*, 2020; Wibisono *et al.*, 2023), providing valuable insights into the factors driving VR adoption in the hospitality industry. Therefore, this study extends to a more nuanced understanding of the relationship between VR quality and users' perceived benefits, with implications for practitioners and researchers who seek to increase the adoption of VR applications by improving the quality of VR applications that benefit its users.

The quality of VR applications in terms of user sacrifices, the findings show that VR quality significantly affects perceived risk and complexity, thus validating the results of previous studies (Creusen *et al.*, 2010; Said and Mustaking, 2020). This proves that as the quality of VR improves, users perceive less risk and complexity. However, the influence of VR quality on sacrifice is not entirely accepted. In particular, VR quality does not significantly affect users' perceived costs. This result occurred because most of the respondents were Gen Z. Most were aged 17–23. Gen Z's adoption of VR applications is facilitated by their extensive internet usage, possession of smartphones, and willingness to pay more products they can use as long as the products are beneficial (Francis and Hoefel, 2018). Whilst high VR quality does not significantly affect perceived costs for this demographic, highlighting their unique preferences. Factors like internet data costs are not barriers; they prioritise product benefits, emphasising the need to consider generational dynamics in understanding VR quality's impact on perceived sacrifice. This study introduces a nuanced perspective by revealing that the influence of VR quality on sacrifice is generation-specific, particularly amongst Gen Z users. These findings contribute to the literature on the effect of VR quality and perceived sacrifice, revealing that the level of user generation determines this effect.

In VAM, users evaluate benefits and sacrifices, with benefits carrying a greater effect on perceived value than sacrifices. Perceived enjoyment, immersion, and usefulness positively and significantly influenced perceived value. These findings support the previous studies regarding the perceived benefits of technology on perceived value (Lau *et al.*, 2019; Lee *et al.*, 2020; Seneviratne *et al.*, 2017). Amongst the dimensions of perceived benefits, perceived enjoyment was the main predictor of perceived value. VR is a fun activity because users can feel they are in that place without needing to visit it directly and enjoy using it (Vishwakarma *et al.*, 2020). This underscores how users find VR enjoyable due to its immersive nature, enabling a sense of presence in a virtual environment without physical presence, highlighting the centrality of perceived enjoyment (Lee *et al.*, 2020; Lee and Kim, 2021). These insights deepen our theoretical understanding of VAM in the context of VR application adoption, emphasising the pivotal role of perceived enjoyment, thereby enhancing the significance of benefits, especially in shaping users' perceived value of VR applications.

Another interesting finding is that none of the dimensions of perceived sacrifice significantly affected perceived value. This is due to differences in the characteristics of the respondents. In this study, most respondents aged 17–23 years old belonged to Gen Z. Gen Z is the first generation to have access to technology from an early age (Cilliers, 2017); sacrifices such as cost, risk, and complexity are not fully felt by Gen. Z. These user characteristics are the characteristics of "explorers" who use technology and do not experience many obstacles in using technology (Rafdinal and Senalasari, 2021). These results prove that VR user characteristics determine VR adoption in the hospitality industry. Additionally, these findings contribute to expanding the literature that reveals that perceived sacrifice has no significant effect on perceived value in the VR applications context in the hospitality industry.

Finally, the study discovered that perceived value has a positive and significant influence on behavioural intention to use VR applications. This result aligns with prior studies which show the effect of value on behavioural intention of various types of technology such as accommodation app services (Kim *et al.*, 2019), intelligent products powered by AI (Sohn and Kwon, 2020), and AR in tourism (Lau *et al.*, 2019). Consistent results are also shown in the findings of this study in the context of VR applications. This consistency across studies underscores the impact of perceived value on users' intentions to use VR applications. By establishing and strengthening this relationship, this study contributes to the theoretical landscape of technology adoption and hospitality marketing literature, highlighting the pivotal role of perceived value in shaping behavioural intentions towards VR applications.

5.3 Managerial implication

This study empirically supports VR service providers and hospitality industry marketers to create VR applications based on the results of the IPMA. Of all the constructs, perceived value has the highest level of importance. Thus, to boost intentions to use VR applications, supporting items related to perceived value need to be maximised. Therefore, practitioners can increase the adoption of VR applications by maximising benefits and minimising sacrifices (Lau *et al.*, 2019). Regarding the benefits perspective, VR application developers and marketers in the hospitality industry should emphasise VR benefits via digital campaigns, spotlighting enjoyment, immersion, and usefulness through social media. Hotel managers must also provide VR applications on hotel and tourist destination websites, online advertising, and at industry events. Furthermore, incentive programs like exclusive hotel offers and discounts are integrated into VR applications to boost perceived value and encourage users to use VR applications more actively. Regarding the sacrifice perspective, practitioners in the hospitality industry need to minimise the sacrifices of VR application users. Even though sacrifices do not significantly affect perceived value, VR application developers and marketers also need to reduce their perception of cost, risk, and complexity (Vishwakarma *et al.*, 2020) by providing VR applications that protect data, are comfortable to use, are easy to use, and reduce the sacrifices of using VR applications.

Improving VR quality is crucial for enhancing perceived value and intention to use VR applications, emphasising its significance in technical aspects. In all dimensions of VR quality, vividness is highly important. Therefore, VR service providers must create vivid VR applications measured by clear, high-quality, sharp and well-defined displays that make users feel real feelings in using VR and the benefits of it (Lee *et al.*, 2020; Yim *et al.*, 2017). In addition, two other qualities cannot be ignored because they also determine the quality of VR applications. Regarding content quality, VR service providers must create detailed visual content in VR applications and provide clear information. In terms of system quality, service providers should create features that are user-friendly easy to use, and have usage guidelines. With these VR qualities, users feel the value of these benefits when using VR applications. Thus, the hospitality industry can increase its adoption of VR applications as a profitable promotional medium. For this reason, VR service providers must meet these qualities to VR users and collaborate with experts in VR application development. This will produce a high-quality application and meet user perceptions.

Finally, the challenge of VR adoption in developing countries requires the support of several stakeholders (the government, VR service providers, network operators, hotel companies, and marketers) to create an enabling environment for widespread VR application use across all regions. First, the government invests in digital infrastructure and high-speed internet connectivity to ensure seamless hotel VR experiences. Second, VR service providers develop customised VR solutions for the hotel industry, offer affordable packages to a wide range of hotels, and provide technical support to hotel staff to ensure they can effectively maintain VR applications. Third, hotel companies must allocate a budget for VR technology and establish a feedback loop with guests to improve VR application quality based on their preferences.

Fourth, marketers must proactively create awareness about the benefits of VR applications and encourage their use. Some valuable efforts to proactively attract VR users include special discounts when ordering through VR applications, friend referrals, social media communication, developers' encouragement, and guidance for first-time users (Wibisono *et al.*, 2023). Additionally, marketing strategies such as promotional notifications and smartphone price discounts can increase VR adoption in the hospitality industry.

5.4 Limitations and future research

Although the results offer valuable insights, some limitations should be recognised. The R square value for behavioural intention is unsatisfactory, indicating numerous other predictors. Whilst this study focused on VR quality and VAM, various research models can address VR adoption in hospitality. Hence, future studies should explore alternative models for assessing VR adoption. Second, VR applications lack immersive experiences without VR devices. Respondents' experiences vary as not all use both simultaneously. Future studies may employ fully immersive VR devices to investigate VR's impact on hotel visitor behaviour. Third, longitudinal analysis is needed because VR applications develop rapidly over time. Future research could focus on longitudinal studies to show how acceptance of VR applications changes over time. Fourth, the 5-point Likert scale limits response variation in this research. Future studies should consider using a 7-point Likert scale for enhanced statistical accuracy, parameter estimation, and diverse responses. Finally, this study focused on VR users in developing countries like Indonesia, suggesting varying results based on technological adoption levels. Future studies could be extended to other countries with different levels of adoption readiness.

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(The Appendix follows overleaf)

Appendix

Latent variables		Indicators	Sources
Content quality	CQ1	Visual overview	Jung *et al.* (2015), Lee *et al.* (2020), Yim *et al.* (2017)
	CQ2	Information contents	
	CQ3	Assist in planning hotel selection	
System quality	SQ1	Easy to use	
	SQ2	User-friendly interface	
	SQ3	Interactive	
	SQ4	Relevant information	
Vividness	VI1	Clear	
	VI2	High-quality	
	VI3	Sharp	
	V14	Well-defined	
Perceived enjoyment	PE1	Enjoy selecting hotels	Chung and Koo (2015), Lau *et al.* (2019), Sohn and Kwon (2020)
	PE2	looking for information with fun	
	PE3	Enjoy using VR	
	PE4	Enjoy experiencing real visuals	
	PE5	VR is not boring	
Perceived immersion	PI1	Unaware of what was happening around me	Bae *et al.* (2020), Vishwakarma *et al.* (2020)
	PI2	Feel disconnected from the outside VR	
	PI3	Feel in that place	
	PI4	Feel in another world	
Perceived usefulness	PU1	Choose a room	Kim *et al.* (2007, 2019), Lau *et al.* (2019)
	PU2	Reservation	
	PU3	Better information	
	PU4	Effectiveness	
Perceived cost	PC1	High internet data	Kim *et al.* (2007, 2019)
	PC2	high cost of supported devices	
	PC3	Financial barriers	
Perceived risk	PR1	Eyestrain	Stone and Gronhaug (1993), Vishwakarma *et al.* (2020)
	PR2	Uncomfortable	
	PR3	Potential physical risk	
Perceived complexity	PCOM1	Difficult	Chung and Koo (2015), Davis (1989)
	PCOM2	Complicated	
	PCOM3	Frustrated	
Perceived value	PV1	Higher benefits than sacrifices	Chung and Koo (2015), Kim *et al.* (2007)
	PV2	Worth in hotel selection	
	PV3	Overall, VR delivers better value	
Behavioural intention	BI1	Plan to use VR for hotel selection	Lau *et al.* (2019), Sohn and Kwon (2020)
	BI2	Intent to use VR for hotel selection	
	BI3	will use VR in choosing hotels shortly	

Source(s): Table created by authors

Table A1.
Measurement scale

Latent variable	Indicator	Loadings	Cronbach's alpha	CR	AVE
Content quality	CQ1	0.859	0.814	0.889	0.728
	CQ2	0.858			
	CQ3	0.844			
System quality	SQ1	0.816	0.850	0.889	0.690
	SQ2	0.860			
	SQ3	0.826			
	SQ4	0.819			
Vividness	VI1	0.837	0.911	0.937	0.789
	VI2	0.900			
	VI3	0.911			
	V14	0.904			
Perceived enjoyment	PE1	0.748	0.893	0.922	0.706
	PE2	0.858			
	PE3	0.878			
	PE4	0.898			
	PE5	0.891			
Perceived immersion	PI1	0.798	0.799	0.868	0.623
	PI2	0.710			
	PI3	0.815			
	PI4	0.841			
Perceived usefulness	PU1	0.861	0.874	0.913	0.726
	PU2	0.798			
	PU3	0.866			
	PU4	0.879			
Perceived cost	PC1	0.716	0.825	0.880	0.714
	PC2	0.911			
	PC3	0.939			
Perceived risk	PR1	0.758	0.873	0.914	0.782
	PR2	0.936			
	PR3	0.946			
Perceived complexity	PCOM1	0.907	0.903	0.939	0.837
	PCOM2	0.923			
	PCOM3	0.906			
Perceived value	PV1	0.796	0.818	0.892	0.734
	PV2	0.889			
	PV3	0.882			
Behavioural intention	BI1	0.723	0.773	0.865	0.684
	BI2	0.889			
	BI3	0.859			

Note(s): CR = composite reliability; AVE = average variance extracted
Source(s): Table created by authors

Table A2.
Measurement model

Table A3. Heterotrait-Monotrait (HTMT)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) Content quality											
(2) System quality	0.81										
(3) Vividness	0.595	0.738									
(4) Perceived enjoyment	0.741	0.712	0.696								
(5) Perceived immersion	0.61	0.712	0.695	0.746							
(6) Perceived usefulness	0.666	0.622	0.651	0.747	0.753						
(7) Perceived cost	0.084	0.068	0.059	0.084	0.067	0.066					
(8) Perceived risk	0.128	0.112	0.124	0.104	0.148	0.152	0.61				
(9) Perceived complexity	0.213	0.227	0.257	0.238	0.188	0.221	0.635	0.681			
(10) Perceived value	0.489	0.472	0.54	0.638	0.585	0.623	0.1	0.093	0.223		
(11) Behavioural intention	0.511	0.445	0.466	0.594	0.664	0.618	0.126	0.129	0.182	0.665	

Source(s): Table created by authors

Table A4. Content validity of the formative measurement construct

Higher order relationships	Weights	*T* value	*p* value	VIF
Content quality → VR quality	0.373	31.099	0.000	1.879
System quality → VR quality	0.385	34.055	0.000	2.392
Vividness → VR quality	0.402	31.276	0.000	1.769

Source(s): Table created by authors

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