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ICT Adoption Intention Among Household-owned Tourism Businesses in the Era of Digital Transformation

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Abstract

The adoption of information and communication technology (ICT) has become increasingly essential for household-owned tourism businesses as they adapt to the demands of the digital transformation era. To explore the factors influencing ICT adoption intentions, a structured survey was conducted among household-owned tourism businesses in the Northern mountains of Vietnam. The collected data was analysed using the Partial Least Squares Structural Equation Modeling (PLS-SEM) method. This study applies the Technology–Organisation–Environment (TOE) framework to identify the key determinants shaping ICT adoption intentions. The results indicate that several factors significantly impact the intention of household-owned tourism businesses to adopt ICT, including technological characteristics such as complexity, compatibility, and relative advantage, as well as organisational readiness, competitive pressure, and government support. Beyond identifying these influential factors, the study's theoretical contributions and practical implications are also discussed. The findings provide valuable insights for policymakers, business owners, and researchers, enhancing the understanding of ICT adoption intention in the tourism sector.

Keywords

ICT adoption, digital transformation, TOE framework, Vietnam

This article was originally published with an error. This version has been corrected/amended in the Corrigendum. Please see the Corrigendum (https://doi.org/10.3311/PPso.41286)!

1 Introduction

The rapid advancement of digital technologies is fundamentally transforming economic structures, governance mechanisms, and societal interactions worldwide. Digital transformation has become an essential strategy for businesses and governments striving to maintain competitiveness in an increasingly technology-driven environment. However, its adoption is largely shaped by external pressures rather than internal strategies. According to Mergel et al. (2019), over 80% of digital transformation efforts stem from external forces, with technological advancements accounting for 34% and competitive pressures – particularly from environmental enterprises – contributing 48.9%. These figures underscore the necessity for organisations to integrate digital solutions to remain adaptable to shifting market conditions. This trend is particularly evident in tourism, where digitalisation is reshaping business operations, customer engagement, and governance models (Pencarelli, 2020). The increasing use of digital tools, such as online booking platforms, AI-powered services, and data-driven marketing strategies, enables tourism enterprises to improve efficiency, service quality, and sustainability in a globally competitive market (Wang, 2020).

Tourism has long been a key economic driver, generating national revenue, creating employment opportunities, and improving local livelihoods. Beyond its direct financial contributions, tourism fosters cultural exchange, enhances regional connectivity, and attracts investment in infrastructure (Su et al., 2016). It also serves as a mechanism for poverty alleviation, benefiting marginalised populations such as ethnic minorities, the elderly, and rural communities with limited economic opportunities. However, tourism's fragmented structure – encompassing accommodation, transportation, food services, cultural attractions, and regulatory oversight – poses challenges in terms of both coordination and management. The integration of information and communication technology (ICT) is increasingly critical in addressing these complexities.

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Law et al. (2019) highlight that advancements in data analytics and predictive modelling have improved demand forecasting, enabling businesses to allocate resources efficiently and optimise pricing strategies. Digital platforms have also streamlined tourism management, enhanced personalised visitor experiences, and expanded market access for small enterprises, particularly those in rural areas (Ruhanen, 2012). Despite these benefits, disparities in digital infrastructure, financial resources, and digital literacy create barriers for underdeveloped regions, limiting their ability to fully leverage ICT (Adebanjo et al., 2016; Ahmad et al., 2014; Al-Weshah and Al-Zubi, 2012; Zaied, 2012). Addressing these gaps is essential to ensuring that digital transformation supports inclusive and sustainable tourism growth.

Numerous studies have examined the adoption of ICT in the tourism sector (El-Gohary, 2012; Ezzaouia and Bulchand-Gidumal, 2020; Lin, 2017; Matikiti et al., 2018; Ozturk and Hancer, 2014; Pizam et al., 2022; Sunny et al., 2019), highlighting its role in enhancing business efficiency, customer engagement, and market competitiveness. However, the majority of these studies focuses on formal tourism enterprises, such as hotels, travel agencies, and large-scale service providers, which have greater access to technological advancements and institutional support. In contrast, informal tourism businesses – particularly those in socio-economically disadvantaged areas – remain largely overlooked in the academic discourse, despite their significant contribution to local economies and community-based tourism development. Given these gaps in the literature, it is crucial to investigate how ICT adoption unfolds within informal tourism businesses (e.g., household owned businesses), where digital transformation is both an opportunity and a challenge. Understanding the specific barriers and drivers influencing ICT adoption intention in these contexts will provide valuable insights for policymakers, development agencies, and tourism stakeholders seeking to promote inclusive and sustainable digital transformation in the tourism sector.

Household-owned businesses play a crucial role in Vietnam's tourism sector, representing a significant component of the broader tourism ecosystem. These household-owned businesses, which are prevalent in various sectors such as hospitality, food services, entertainment and handicrafts, contribute substantially to local economies, cultural preservation, and community resilience. In the northern regions of Vietnam, each province has developed its own approach to community-based tourism (CBT), taking advantage of the unique natural landscapes and cultural identities of the area. This approach plays a crucial role in achieving sustainable development goals, particularly in reducing poverty and fostering community growth (Pasanchay and Schott, 2021). Furthermore, CBT aims to raise awareness among both tourists and locals about the importance of environmental conservation and sustainable practices (Pham and Khanh, 2021; Raftopoulos, 2020). In the CBT sector, local household-owned businesses are key players, offering tourists accommodations, cultural experiences, diverse agricultural products, scenic landscapes, and traditional culinary delights (Rosalina et al., 2021). As demand for higher-quality experiences increases, these businesses must invest in improved services and adopt new technologies, such as ICT, to better operate and market their offerings (Russell, 2000), especially the adoption of ICT in operating and marketing of household-owned businesses. However, the household-owned businesses in the Northern mountains of Vietnam have applied ICT in their tourism services only to a limited extent. Therefore, this study aims to investigate the intention to adopt ICT of household-owned tourism businesses in the Northern mountains of Vietnam.

The structure of this paper is as follows: the next section presents an explanation of the theoretical framework and hypotheses development. The subsequent section details the research methodology, outlining data collection procedures, sample characteristics, and analytical techniques. This is followed by the results and discussions. Finally, the paper concludes with key insights, limitations, and suggestions for future studies.

2 Theoretical framework and hypothesis formulation

2.1 Theoretical framework

A wide range of theoretical frameworks has been employed to analyse the adoption of new technologies, each offering distinct perspectives on the factors influencing technology acceptance and use. Among the most widely recognised models are the Theory of Reasoned Action (Ajzen and Fishbein, 1975), the Theory of Planned Behaviour (Ajzen, 1991), the Technology Acceptance Model (Davis et al., 1989), and the Unified Theory of Acceptance and Use of Technology (Venkatesh et al., 2003). These frameworks primarily focus on individual decision-making processes, emphasising psychological and behavioural factors such as perceived usefulness, ease of use, attitudes, and subjective norms. However, rational choice models have been criticised for their technologically deterministic and techno-centric outlook, which

often assumes that technology itself drives adoption rather than considering the broader organisational and environmental contexts in which adoption decisions occur (Chittipaka et al., 2023). Such limitations make them less suitable for studying technology adoption in complex, dynamic, and resource-constrained settings, particularly among small enterprises and informal businesses.

To address these shortcomings, this study employs the TOE framework (DePietro et al., 1990), which provides a more comprehensive approach by integrating technological, organisational, and environmental factors that influence decisions to adopt innovations. Unlike user-centred models, the TOE framework acknowledges that technology adoption is shaped by both internal business characteristics – such as firm size, resources, and managerial capabilities – and external environmental pressures, including market competition, regulatory requirements, and infrastructural constraints. This holistic perspective is particularly relevant for analysing ICT adoption among household-owned tourism businesses, where adoption is not solely determined by individual perceptions but also by institutional support, financial limitations, and the digital ecosystem in which businesses operate. By applying the TOE framework, this study aims to generate deeper insights into the multifaceted drivers and barriers influencing digital transformation in the tourism sector, particularly in developing regions where informal businesses play a crucial economic role. Table 1 provides a detailed overview of the specific Technology–Organisation–Environment dimensions utilised in this study.

2.2 Hypotheses development

2.2.1 Technological context

Complexity plays a critical role in shaping the adoption of new technologies, particularly in small-scale businesses with limited technical expertise. According to Rogers (1995), innovations perceived as difficult to understand and use are less likely to be adopted. This is especially relevant for household-owned tourism businesses, where digital literacy varies and ICT adoption may require significant learning efforts. When technologies appear complex, businesses may hesitate to integrate them due to concerns about usability, system compatibility, and disruption to existing operations (Yeoh and Koronios, 2010). In many cases, the perceived complexity of ICT solutions stems from integration challenges. Berman et al. (2012) and Davis (1989) emphasise that ease of use is crucial in increasing adoption rates, as overly complicated systems deter users. Furthermore, the absence of supporting infrastructure and technical enablers can prolong adoption (Dwivedi et al., 2019). In rural areas, where digital connectivity and ICT support services may be limited, these challenges become more pronounced. Businesses struggling with slow internet connections or lacking access to training resources may find ICT adoption too complex to pursue, leading to delays or outright rejection of digital solutions. Thus, while complexity is an important factor in adoption decisions, it differs from other innovation characteristics as it tends to reduce the likelihood of adoption. Based on this rationale, the study suggests the following hypothesis: H1. Complexity has a negative impact on the adoption of ICT.

Rogers (1983) defines compatibility as the extent to which an innovation aligns with established norms, previous practices, and the evolving requirements of potential users. This concept plays a crucial role in technology adoption, as individuals and organisations are more likely to embrace innovations that seamlessly integrate into their existing workflows and systems (Ifinedo, 2011; Owusu et al., 2017). In particular, businesses that perceive an innovation as compatible with their current strategies and infrastructure may view its implementation as less disruptive and more beneficial. Moreover, compatibility not only enhances ease of adoption but also strengthens long-term sustainability by ensuring that new systems do not conflict with established processes (Lai et al., 2014; Ozturk et al., 2012; Wang et al., 2010; Zhu et al., 2006). Organisations that integrate new technologies without significant modifications to their existing structures are more likely to experience improved efficiency and performance. Several studies reinforce this perspective, showing a positive correlation between compatibility and the widespread adoption of IT innovations across various industries (Damanpour and Schneider, 2009; Meuter et al., 2005; Vasi, 2006). In this regard, the study established the following hypothesis: H2. Compatibility has a positive impact on the adoption of ICT.

Innovation adoption is often driven by its perceived efficiency compared to existing systems, as highlighted by Rogers (1995). This efficiency is typically evaluated based on various factors, including improvements in social standing, financial returns, and additional benefits such as cost reductions, time efficiency, and enhanced decision-making capabilities. Prior research has consistently demonstrated that the speed at which an innovation is adopted is closely tied to the advantages it offers. The greater the perceived benefits, the more likely individuals or organisations are to integrate

Table 1 TOE model and the dimensions

Perspective	Factors	Studies
Technological	Complexity	Chatterjee et al. (2021), Mndzebele (2013), Ozturk et al. (2012), Pizam et al. (2022), Wang et al. (2016).
	Compatibility	Ifinedo (2011), Mallat and Tuunainen, (2008), Mndzebele (2013), Wang et al. (2010).
	Relative advantage	Al-Qirim (2007), Dembla et al. (2007), Ifinedo (2011), Mallat and Tuunainen (2008), Mndzebele (2013), Stockdale and Standing (2006), Yadegaridehkordi et al. (2020).
Organisational	Top management support	Chiu et al. (2017), Low et al. (2011), Mohamad et al. (2022), Park and Kim (2019), Pateli et al. (2020), Wang and Wang (2016), Yang et al. (2015), Yong (2023).
	Organisational readiness	Oliveira et al. (2014), Oliveira and Martins (2010), Pizam et al. (2022), Yang et al. (2015), Yong (2023).
Environmental	Competitive pressure	Chiu et al. (2017), Chong and Lim (2022), Cruz-Jesus et al. (2019), Molla and Licker (2005), Marchena Sekli and De La Vega (2021), Maroufkhani et al. (2020), Youssef et al. (2022)
	Government support	Chang and Cheung (2001), El-Gohary (2009), Grandon and Pearson (2004), Kuan and Chau (2001), Looi (2004). Simpson and Docherty (2004), Tsao et al. (2004)

the new technology into their operations (Ifinedo, 2011). For example, research on Business Intelligence (BI) systems has highlighted their capacity to simplify business processes, support data-driven decision-making, and boost overall operational efficiency. Organisations adopting BI tools often experience increased profitability, better resource allocation, and a competitive edge in the market. The widespread recognition of these advantages has led to BI systems being regarded as a transformative innovation in the field of information systems (Malladi and Krishnan, 2013; Oliveira et al., 2014). Given these findings, it is evident that perceived benefits play a crucial role in determining the adoption of technology within businesses. When decision-makers recognise tangible gains, such as higher revenue potential, reduced inefficiencies, and improved strategic planning, they are more inclined to invest in ICT technologies. Therefore, based on this understanding, the following hypothesis has been proposed: H3. Relative advantage has a positive impact on the adoption of ICT.

2.2.2 Organisational context

Extensive research has established that support from top management is a crucial factor in the successful adoption and implementation of new technologies, particularly those requiring sustained commitment and strategic leadership (Premkumar and Ramamurthy, 1995). Emerging technologies often involve substantial investments, organisational restructuring, and long-term integration efforts, making leadership endorsement essential to overcoming resistance and ensuring smooth implementation (Jeyaraj et al., 2006). When senior leadership actively advocates for a new technology, it fosters a culture of innovation, encourages employee engagement, and enhances confidence in the transition process (Grover and Goslar, 1993). Furthermore, top management plays a pivotal role in securing financial resources, allocating necessary infrastructure, and facilitating cross-departmental collaboration to mitigate challenges associated with digital transformation (Law and Ngai, 2007). Research into technology adoption utilising the TOE framework has consistently demonstrated that top management support plays a crucial role in shaping an organisation's decision to integrate innovative technologies (Abed, 2020; Pizam et al., 2022; Wang et al., 2010). Given the pivotal role of leadership in driving digital adoption, it is reasonable to anticipate that businesses with higher levels of top management support will exhibit greater willingness to embrace ICT. Taking these points into consideration, the following hypothesis has been articulated: H4. Top management support has a positive impact on the adoption of ICT.

Organisational readiness is a crucial determinant in the adoption of new technologies, as it reflects a business's capability to integrate innovations effectively. This readiness encompasses both financial and technological resources, ensuring that an organisation has the necessary infrastructure and expertise to support new systems. As emphasised by Ifinedo (2011), businesses with a higher level of ICT knowledge and competence are more inclined to embrace technological advancements. Similarly, Iacovou et al. (1995) suggest that the preparedness of an organisation plays a pivotal role in its decision to adopt

innovations, as firms must assess their ability to invest in and implement new solutions. Financial readiness refers to an organisation's capacity to allocate sufficient funds for technology adoption, including the costs of procurement, training, and ongoing maintenance. Without adequate financial support, businesses may struggle to integrate innovations effectively. On the other hand, technological readiness signifies the extent of an organisation's technical expertise and existing infrastructure, which can determine the ease with which new systems are implemented. Several studies have established a strong link between organisational readiness and technology adoption, indicating that well-prepared businesses are more likely to transition successfully (Qatawneh, 2024; Tsai et al., 2010; Yang et al., 2015). Based on these considerations, the following hypothesis has been formulated: H5. Organisational readiness has a positive impact on the adoption of ICT.

2.2.3 Environmental context

Competitive pressure has been widely recognised as a key driver of innovation adoption and diffusion, influencing how businesses respond to evolving market dynamics (Lin and Lin, 2008; Lippert and Govindarajulu, 2006). This pressure arises from the need to remain competitive within an industry, compelling companies to adopt emerging technologies to sustain or enhance their market position (Low et al., 2011; Sears et al., 2008). Essentially, competitive pressure encompasses both external forces from industry rivals and internal motivations to achieve a strategic edge, prompting firms to explore and implement new technological solutions (Shi and Yan, 2016). Embracing such innovations can play a crucial role in shaping competitive strategies, forecasting the potential impact of technology adoption, and strengthening relationships with key stakeholders (Allen and Iano, 2019). Yigitcanlar (2009) highlights that highly competitive and fast-paced business environments significantly influence decision-making processes related to technology adoption, particularly in industries where rapid adaptation is necessary to maintain market relevance. In the context of off-site construction, Mao et al. (2015) investigated how competitive forces, especially market demand, could act as both a barrier and a catalyst for technology adoption. They found that in prefabrication, insufficient market demand and intense competition posed challenges for manufacturers and stakeholders, potentially hindering widespread adoption. However, in sectors where competition drives innovation, businesses may be more inclined to adopt technologies, such as tourism, to differentiate themselves, optimise efficiency, and meet standards. Given the substantial influence of competitive pressure on technology adoption, the following hypothesis is proposed: H6. Competitive pressure has a positive impact on the adoption of ICT.

Government support is a crucial factor in the adoption and implementation of ICT (Doh and Kim, 2014; Ifinedo, 2011; Makame et al., 2014; Wong et al., 2020), helping businesses overcome financial and technical barriers. Numerous studies have emphasised the role of government intervention in facilitating technology adoption. For instance, Doh and Kim (2014) highlighted that financial support from the government significantly aids enterprises in adopting new innovations, while Alam and Noor (2009) found that the Malaysian government actively provides financial assistance to encourage ICT adoption. Beyond financial incentives, technological infrastructure is essential for enabling businesses to integrate ICT into their operations. Makame et al. (2014) demonstrated that national policy initiatives in Tanzania have been instrumental in building online trust and enhancing technological infrastructure, thereby supporting ICT adoption. Furthermore, in developing countries, government agencies can foster ICT adoption by establishing innovation hubs that enable enterprises to connect, communicate, and collaborate with technology providers and other stakeholders (Vrgovic et al., 2012). Thus, in the context of tourism-related households, governments can accelerate ICT adoption by combining financial assistance with infrastructure development and capacity-building initiatives. Given these insights, the following hypothesis has been proposed: H7. Government support has a positive impact on the adoption of ICT.

The conceptual framework illustrating the key variables and hypothesized relationships in this study is presented in Fig. 1.

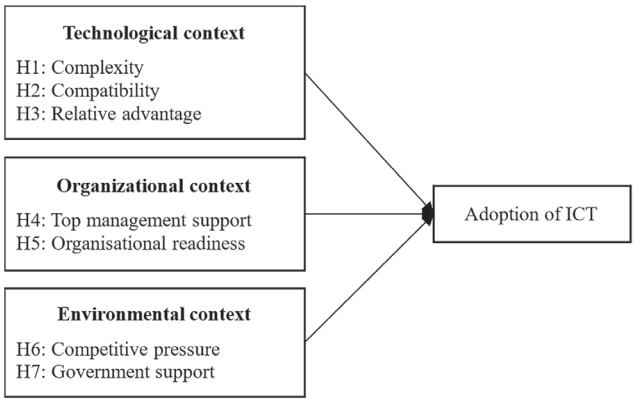

Fig. 1 Conceptual framework

3 Methodology

This study examines the adoption of ICT among tourism household-owned businesses in Hoa Binh province, Vietnam. Hoa Binh province is one of the representative tourism destinations belong to the Northern mountains of Vietnam with a significant development of community-based tourism. To achieve this objective, a structured questionnaire was developed to collect primary data from business owners. Given the prevalence of informal tourism businesses in this region, direct engagement through face-to-face interviews was essential for ensuring accurate responses, clarifying ambiguities, and improving response rates. Data collection took place between January 2024 and August 2024, targeting household-owned tourism businesses in key tourist destinations where digital transformation is increasingly relevant. The study focused on businesses engaged in tourism-related activities such as accommodation services, local tour operations, handicraft production, and food services. Since these businesses are often dispersed and less formally registered, the research team collaborated with local community leaders and tourism associations to facilitate access to respondents. Face-to-face interviews were conducted with 218 business owners across selected areas, ensuring representation from various tourism service providers. The criteria for selecting tourism household-owned businesses were:

1. willingness to participate in the survey,
2. business scale, and,
3. types of operating tourism services. The questionnaire, developed in Vietnamese to accommodate respondents' linguistic preferences, underwent pre-testing with 15 business owners to refine its clarity and relevance. Trained enumerators visited each household business, explained the study's purpose, and conducted structured interviews while recording responses. In total, 200 valid responses were obtained after excluding incomplete or ineligible cases, resulting in a final response rate of 91.7%. To gauge respondents' perspectives, a 5-point Likert-type scale was employed, ranging from 1 ("strongly disagree") to 5 ("strongly agree"). This scale facilitated the precise assessment of variables influencing ICT adoption among household-owned tourism businesses, particularly in resource-constrained environments where digital transformation remains a challenge. The specific 24 items used to measure these variables are presented in Table 2.

The study surveyed 200 tourism household-owned tourism businesses to examine patterns of ICT adoption. The demographic and technological characteristics of the respondents are presented in Table 3. Among the participants, 57.0% were male (114 individuals) and 43.0% were female (86 individuals), indicating a relatively balanced gender distribution. In terms of age, the majority of respondents were middle-aged adults (36–55 years old), accounting for 51.0% of the sample. Meanwhile, 26.0% were young adults (18–35 years old), and 13.0% were seniors (above 55 years old). Regarding educational background, 54.0% of respondents had a high school education or less, while 42.0% held a Bachelor's degree or diploma, and a smaller proportion, 4.0%, had completed postgraduate studies.

In terms of technology adoption (Table 3), ICT infrastructure and connectivity were well-established among the respondents. A significant majority (91.5%) reported access to Wi-Fi, and 77% utilised 4G or 5G mobile networks, indicating a high level of digital connectivity. Regarding communication and interaction tools, Zalo (VNG Online Company Limited, 2025) was the most widely used platform, adopted by 87% of respondents, followed by Messenger (48.5%) (Meta Platforms, 2025a), while email was notably less popular, with only 13% using it. Concerning online presence and promotional strategies, 56% of the respondents utilised social networking platforms such as Facebook (Meta Platforms, 2025b), TikTok (TikTok Pte. Ltd., 2025), or YouTube (Google LLC, 2025) to promote their tourism services. However, a much smaller proportion (3.5%) reported having a business website, suggesting limited engagement with formal online branding. The use of online booking and travel platforms was also relatively low, with only 6.5% of respondents using Traveloka (PT Trinusa Travelindo, 2025) and 5% using Agoda (Agoda Company Pte. Ltd., 2025). In the realm of digital financial tools, all respondents (100%) reported using mobile banking applications, reflecting the extensive integration of digital banking into daily financial transactions. However, only 5.5% used e-wallets, pointing to a relatively low adoption of this specific digital payment method. Overall, while the findings underscore a high level of connectivity and the frequent use of communication tools, they also highlight a more limited adoption of advanced digital tools, such as formal websites, e-wallets, and online travel platforms.

The study utilised Partial Least Squares Structural Equation Modelling (PLS-SEM) to analyse the collected data, as this method is particularly well-suited for research involving complex relationships among latent variables.

Table 2 Model constructs and measurement items

Constructs		Items	Sources
Complexity	CPL1	Learning how to operate ICT applications would be difficult.	Pizam et al. (2022)
	CPL2	ICT applications are too complex to implement.	
	CPL3	Integrating ICT applications in our current work practices are very difficult.	
Compatibility	COM1	ICT adoption is compatible with our ICT infrastructure	Pizam et al. (2022)
	COM2	ICT adoption is consistent with our beliefs and values	
	COM3	ICT adoption is compatible with our business processes and operations	
Relative advantage	REL1	ICT adoption can allow us to increase the market share.	Pizam et al. (2022)
	REL2	ICT adoption can allow us to improve customer service.	
	REL3	ICT adoption can increase the profitability.	
Top management support	TMS1	The owners are likely to invest ICT applications	Pizam et al. (2022)
	TMS2	The owners are likely to be interested in adopting ICT in order to gain competitive advantage.	
	TMS3	The owners are likely to take risk in the adoption of ICT applications	
Organisational readiness	ORG1	We know how to use ICT for business support.	Qatawneh (2024)
	ORG2	We possess the necessary technical, managerial, and other skills needed to implement ICT.	
	ORG3	We have sufficient financial, technological, and other resources needed to implement ICT.	
Competitive pressure	COPR1	We operate in a very competitive environment	Ezzaouia and Bulchand-Gidumal, (2020); Jia et al. (2017); Sitawati et al. (2015)
	COPR2	We have to adopt ICT in order to stay ahead of our competitors	
	COPR3	We need to differentiate from our competitors	
Government support	SUP1	There is financial support from the government regarding the use of ICT.	Ezzaouia and Bulchand-Gidumal (2020)
	SUP2	Government offers national programs to encourage the use of ICT in tourism.	
	SUP3	Government ensures ICT infrastructure availability.	
Adoption of ICT	INT1	I think that using ICT for our business is positive	Ezzaouia and Bulchand-Gidumal (2020); Ramayah et al. (2016); Tarhini et al. (2017)
	INT2	I intend to increase the use of ICT for our business	
	INT3	I intend to increase budget for ICT in the next 12 months	

PLS-SEM is widely recognised for its ability to model intricate interactions, making it a preferred choice for studies that explore multifaceted constructs (Hair et al., 2011). Unlike traditional covariance-based SEM, which requires large sample sizes and normally distributed data, PLS-SEM is more flexible in handling smaller samples and non-normal data distributions (Qatawneh, 2024). This characteristic makes it an appropriate analytical tool for this study, which is based on a sample of 200 respondents. Another advantage of PLS-SEM is its ability to incorporate both reflective and formative measurement models, allowing for a more comprehensive examination of the constructs under investigation. This feature enhances the robustness of hypothesis testing by ensuring that different types of measurement structures are properly accounted for (Qatawneh, 2024). In the context of this study, where the adoption of ICT is being analysed, using a method that accommodates various measurement models strengthens the reliability and validity of the findings. The data analysis and hypothesis testing were conducted using SmartPLS (SmartPLS GmbH, 2025), a specialised software program designed for PLS-SEM applications. This software enables researchers to estimate multiple relationships simultaneously, making it particularly useful for studies that investigate complex systems. Furthermore, PLS-SEM accounts for measurement errors, which helps improve the accuracy of the results and provides deeper insights into the relationships between variables. Given the intricate nature of financial performance and technology adoption, employing PLS-SEM ensures a more nuanced understanding of the factors influencing ICT adoption.

4 Results

4.1 Assessment of the measurement model

Convergent validity and reliability were assessed using factor loadings, Cronbach's alpha (α), composite reliability

Table 3 Characteristics of the respondents

Characteristics	Frequency	Percentage
Sex		
Male	114	57.0
Female	86	43.0
Age		
18 – 35 years (young adults)	52	26.0
36 – 55 years (middle-aged adults)	102	51.0
> 55 years (seniors)	26	13.0
Education		
High school or less	108	54.0
Bachelor/Diploma	84	42.0
Postgraduate	8	4.0
Technology application		
ICT infrastructure/connectivity		
Wi-fi	183	91.5
4G/5G networks	154	77.0
Communication and interaction tools		
Email	26	13.0
Messenger	97	48.5
Zalo	174	87.0
Online presence and promotion		
Website	7	3.5
Social networking (e.g., YouTube, TikTok, Facebook)	112	56.0
Online booking and travel platforms		
Agoda	10	5.0
Traveloka	13	6.5
Online payment applications		
E-Wallets	11	5.5
Mobile Banking Apps	200	100

(CR), and average variance extracted (AVE). These measures ensure that the constructs are both internally consistent and that their indicators effectively represent the underlying concepts. Convergent validity was examined through factor loadings and AVE (Table 4). All factor loadings exceed the recommended threshold of 0.70 (Hair et al., 2016), demonstrating that each observed variable contributes significantly to its respective construct. The factor loadings range from 0.817 (ORG1) to 0.933 (REL2), indicating strong associations between items and their constructs. Additionally, the AVE values for all constructs surpass the acceptable threshold of 0.50, confirming that the latent variables explain a sufficient proportion of variance in their indicators (Bagozzi and Yi, 1988; Henseler et al., 2009). The AVE values range from 0.766 (Compatibility) to 0.792 (Relative advantage), suggesting that each construct captures a high proportion of the variance in its measurement items. These findings provide strong support for the convergent validity of the measurement model. Reliability was evaluated using Cronbach's alpha and composite reliability (CR). Cronbach's alpha values for all constructs are above the 0.70 threshold (Tenenhaus et al., 2005), indicating a high level of internal consistency. The values range from 0.847 (Compatibility) to 0.869 (Relative advantage), suggesting that the measurement items are highly correlated and consistently measure their respective constructs. Similarly, CR values exceed the recommended threshold of 0.70, further confirming the reliability of the constructs (Hair et al., 2011; Hair et al., 2016). The lowest CR value is 0.907 (Compatibility), while the highest is 0.919 (Relative advantage), highlighting the robustness of the constructs in terms of internal consistency and reliability.

The assessment of discriminant validity ensures that the constructs in the model are adequately distinct from one another, which was measured using the Fornell-Larcker criterion and the Heterotrait-Monotrait (HTMT) ratio. Ensuring discriminant validity is essential in structural equation modelling, as it confirms that each construct represents a unique concept and does not excessively overlap with others (Hair et al., 2016). The principle behind the Fornell-Larcker criterion is that a construct should have more variance with its indicators than with other constructs in the model. This is verified by comparing the square root of the Average Variance Extracted (AVE) (bold diagonal) to the correlations between constructs (below the diagonal) (Hair et al., 2012). The results in Table 5 show that each construct's AVE square root (values on the diagonal in bold) is greater than its correlation with any other construct (values below the diagonal), demonstrating strong discriminant validity. This ensures that the measured variables capture the distinct aspects of each latent construct rather than significantly overlapping with others. The HTMT ratio is another approach used to evaluate discriminant validity by measuring the degree of similarity between constructs. It compares the average correlations between different constructs to the average correlations within the same construct (above the diagonal). Typically, an HTMT value (above the diagonal) below 0.90 is considered acceptable, while a more conservative threshold of 0.85 may be used in stricter analyses (Henseler et al., 2015). In this study, the highest HTMT value observed is 0.688 (between Competitive pressure and Government support), which remains within the

Table 4 Results summary for measurement models

Constructs	Items	Factor loadings	α	CR	AVE
Complexity	CPL1	0.875	0.862	0.915	0.783
	CPL2	0.901			
	CPL3	0.878			
Compatibility	COM1	0.897	0.847	0.907	0.766
	COM2	0.889			
	COM3	0.838			
Relative advantage	REL1	0.886	0.869	0.919	0.792
	REL2	0.933			
	REL3	0.849			
Top management support	TMS1	0.854	0.852	0.910	0.772
	TMS2	0.888			
	TMS3	0.894			
Organisational readiness	ORG1	0.817	0.851	0.909	0.769
	ORG2	0.888			
	ORG3	0.922			
Competitive pressure	COPR1	0.865	0.849	0.908	0.767
	COPR2	0.908			
	COPR3	0.854			
Government support	SUP1	0.883	0.864	0.917	0.786
	SUP2	0.910			
	SUP3	0.866			
Intention to adoption ICT	INT1	0.853	0.855	0.912	0.776
	INT2	0.904			
	INT3	0.885			

Note: α = Cronbach's alpha, CR = Composite reliability, AVE = Average Variance Extracted

Table 5 Fornell-Larcker criterion and HTMT ratio analysis for checking discriminant validity

Constructs	1	2	3	4	5	6	7	8
Compatibility (1)	**0.875**	0.332	0.598	0.448	0.656	0.591	0.687	0.497
Competitive pressure (2)	0.285	**0.876**	0.440	0.688	0.428	0.247	0.294	0.342
Complexity (3)	0.510	0.380	**0.885**	0.385	0.398	0.458	0.669	0.372
Government support (4)	0.388	0.601	0.334	**0.887**	0.561	0.442	0.446	0.412
Intention to adoption ICT (5)	0.560	0.370	0.344	0.484	**0.881**	0.587	0.665	0.488
Organisational readiness (6)	0.513	0.229	0.404	0.391	0.512	**0.877**	0.547	0.656
Relative advantage (7)	0.595	0.258	0.582	0.390	0.579	0.484	**0.890**	0.472
Top management support (8)	0.423	0.290	0.314	0.354	0.418	0.568	0.410	**0.879**

acceptable range. This confirms that the constructs are sufficiently distinct from one another.

4.2 Assessment of the structural model

The Standardised Root Mean Square Residual (SRMR) was used to determine the overall quality of the structural model. The results indicated that the SRMR value was 0.061, which falls well below the commonly accepted threshold of 0.08, signifying a strong model fit (Hair and Alamer, 2022). Beyond assessing model fit, the study also evaluated the predictive capability of the structural model by analysing the R-square (R^2) value, which measures the proportion of variance explained by the independent variables. The results revealed that the R^2 value for ICT adoption intention among tourism household-owned businesses was 0.503, meaning that 50.3% of the variance in ICT adoption intention could be attributed to the factors identified in the study. These results,

highlight the substantial explanatory power of the model in capturing the dynamics of ICT adoption intention. The structural model was evaluated using the bootstrapping method to assess path coefficients (Hair et al., 2011). The results in Table 6 and Fig. 2 indicate that most hypotheses (H1, H2, H3, H5, H6, and H7) were supported, while H4 was not statistically significant. Specifically, compatibility (β = 0.236, t = 2.606, p = 0.009), relative advantage (β = 0.334, t = 3.502, p = 0.001), organisational readiness (β = 0.185, t = 2.155, p = 0.032), competitive pressure (β = 0.134, t = 2.131, p = 0.034), and government support (β = 0.150, t = 2.308, p = 0.021) all had significant positive effects on ICT adoption intention. Complexity (β = –0.157, t = 2.046, p = 0.041) had a significant negative impact, suggesting that businesses perceive ICT adoption as more challenging when technological complexity is high. In contrast, top management support (β = 0.033, t = 0.484, p = 0.628) was not statistically significant, indicating that leadership endorsement alone may not be a decisive factor in ICT adoption within tourism household-owned businesses.

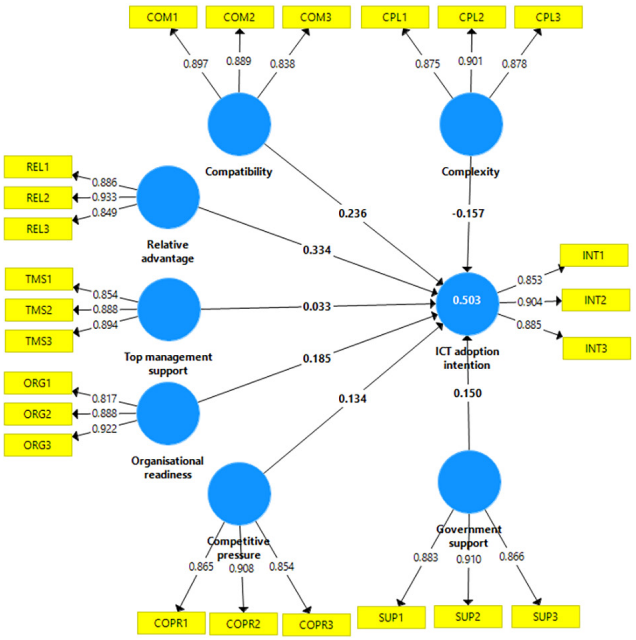

Fig. 2 Estimated causal relationships in the structural model

5 Discussion

From a technological perspective, complexity presents a major obstacle to ICT adoption among tourism households. When digital systems are perceived as difficult to understand, implement, or integrate into existing operations, adoption rates decline. This challenge is particularly evident in rural areas of Vietnam, where digital literacy and technical expertise are often limited. Moreover, unstable internet connectivity and restricted access to technical support further compound these difficulties. Small, family-run tourism households are especially affected, as they typically lack formal ICT training, making it harder to engage with digital solutions that require specialised knowledge or significant learning efforts. These findings contrast with previous studies (Chatterjee et al., 2021; Maroufkhani et al., 2023; Mndzebele, 2013; Ozturk et al., 2012; Pizam et al., 2022; Wang et al., 2016; Qatawneh, 2024). However, given the informal nature of these businesses and their resource constraints, complexity becomes an even greater challenge in this context.

Compatibility significantly influences ICT adoption, as tourism households are more likely to embrace digital technologies when they align with existing operational practices, business values, and available ICT infrastructure. Many of these households rely on traditional, informal management systems, so digital tools that seamlessly integrate – such as mobile booking applications, social media marketing, and digital payment platforms – are more readily accepted. In contrast, technologies that require significant operational changes or demand skills beyond the household's capacity may be seen as impractical, limiting adoption. These findings

Table 6 Results of the path model

Hypotheses	Path coefficient	Std. Dev.	t-value	p-value
H1: Complexity → ICT adoption intention	–0.157*	0.077	2.046	0.041
H2: Compatibility → ICT adoption intention	0.236**	0.090	2.606	0.009
H3: Relative advantage → ICT adoption intention	0.334***	0.095	3.502	0.001
H4: Top management support → ICT adoption intention	0.033ns	0.069	0.484	0.628
H5: Organisational readiness → ICT adoption intention	0.185*	0.086	2.155	0.032
H6: Competitive pressure → ICT adoption intention	0.134*	0.063	2.131	0.034
H7: Government support → ICT adoption intention	0.150*	0.065	2.308	0.021

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, ns $p > 0.05$

align with prior research (Chiu et al., 2017; Ifinedo, 2011; Mallat and Tuunainen, 2008; Mndzebele, 2013; Qatawneh, 2024).

The perceived relative advantage of ICT plays a crucial role in adoption decisions. Households are more inclined to adopt digital solutions when they see tangible benefits, such as expanded market reach, improved customer service, and enhanced profitability. Digital tools like online booking platforms, social media marketing, and electronic payment systems enable tourism households to attract a broader customer base and optimise operations. In Vietnam's mountainous regions, where traditional marketing channels and financial services are limited, ICT adoption bridges this gap by connecting businesses to larger markets and improving service quality. Demonstrating these advantages is key, as households are more likely to adopt ICT when they see direct improvements in business performance. These findings align with prior research (Al-Qirim, 2007; Dembla et al., 2007; Ifinedo, 2011; Pizam et al., 2022; Stockdale and Standing, 2006; Yadegaridehkordi et al., 2020).

From an organisational standpoint, top management support does not significantly impact ICT adoption among tourism households. This contradicts previous studies (Chiu et al., 2017; Low et al., 2011; Mohamad et al., 2022; Pizam et al., 2022; Wang and Wang, 2016; Yang et al., 2015). Unlike formal enterprises, where managerial endorsement drives technology adoption, household businesses often operate through informal, family-based decision-making structures. Consequently, ICT adoption is influenced more by practical needs, perceived benefits, and external pressures – such as customer demand or government incentives – rather than managerial encouragement. Moreover, financial and technical constraints pose significant barriers, meaning managerial support alone is insufficient without the necessary resources and digital expertise.

Conversely, organisational readiness plays a critical role in ICT adoption. Households with stable financial resources, ICT infrastructure, and digital skills are more likely to integrate ICT into their operations. While financial limitations and low digital literacy remain challenges, households that are better prepared technologically and managerially can more effectively implement digital solutions such as online booking systems, digital marketing, and cashless payments. Enhancing organisational readiness through financial support, improved digital infrastructure, and workforce training can significantly boost ICT adoption. These findings echo prior research (Oliveira et al., 2014; Oliveira and Martins, 2010; Pizam et al., 2022; Yang et al., 2015).

From an environmental perspective, competitive pressure serves as a strong driver of ICT adoption. Tourism households operating in highly competitive markets are more likely to adopt digital tools to maintain or improve their market position. In rural tourism settings, where traditional marketing and customer outreach methods are limited, digital solutions – such as social media promotion, online booking platforms, and electronic payment systems – offer a competitive edge. As ICT adoption becomes more widespread, businesses that fail to embrace digital transformation risk losing customers to competitors offering more convenient and digitally accessible services. This underscores the role of external market forces in shaping ICT adoption trends and highlights the necessity of digital transformation to sustain competitiveness. These findings are consistent with previous research (Chiu et al., 2017; Chong and Lim, 2022; Cruz-Jesus et al., 2019; Maroufkhani et al., 2020; Pizam et al., 2022).

Finally, government support is a crucial enabler of ICT adoption. Policies, financial incentives, and infrastructure help tourism households overcome barriers to digital transformation. In rural areas, where financial constraints and inadequate infrastructure hinder ICT adoption, targeted interventions – such as technology investment subsidies, national digital literacy programmes, and improved internet connectivity – can significantly reduce adoption barriers. Additionally, government-backed promotional campaigns and hands-on training programmes encourage households to utilise digital tools like online booking platforms, social media marketing, and digital payment systems. By creating a supportive environment, government intervention ensures that even small, resource-limited tourism enterprises can integrate digital solutions and benefit from the opportunities of the digital economy. These findings align with earlier research (Chang and Cheung, 2001; El-Gohary, 2009; Tsao et al., 2004).

This study also adds to the theoretical knowledge of ICT adoption intention by utilising and broadening the TOE framework in the context of tourism businesses owned by households. While previous research has largely focused on ICT adoption intention in formal business sectors, this study addresses a significant gap by examining adoption factors among small-scale tourism households. By doing so, it offers new insights into how technological, organisational, and environmental factors shape ICT adoption intention in an informal and resource – constrained business setting. The findings validate the applicability of the

TOE model in this unique context, emphasising the importance of compatibility, relative advantage, and government support in influencing adoption decisions.

From a technological standpoint, the study highlights the importance of factors like compatibility and relative advantage in influencing ICT adoption. The findings highlight that while ICT technologies may vary in complexity, tourism households prioritise technologies that seamlessly integrate with their existing operations and provide clear business benefits, such as improved market access and operational efficiency. This reinforces the theoretical perspective that compatibility and perceived benefits are crucial determinants of ICT adoption in resource-constrained, informal business settings. Consequently, fostering ICT adoption in tourism households requires the promotion of accessible and user-friendly digital tools, as well as initiatives that demonstrate the tangible advantages of ICT integration in tourism-related activities.

Organisational factors play a crucial role in shaping ICT adoption among tourism households. This study extends the theoretical understanding of ICT adoption by emphasising organisational readiness – particularly in terms of financial resources, digital skills, and ICT infrastructure – as key determinants within the TOE framework. Unlike formal businesses sectors with dedicated ICT departments, tourism households operate with limited technical expertise and financial capacity, making their readiness a critical factor in adoption decisions. The findings reinforce the theoretical perspective that businesses with stronger financial preparedness and basic digital literacy are more likely to integrate ICT solutions effectively. This contributes to the broader discourse on how resource availability influences technology adoption in informal business environments. Furthermore, the study highlights the significance of ICT infrastructure as a foundational element, suggesting that tourism households with access to reliable digital tools and connectivity have a higher propensity to adopt ICT. By integrating these insights, the research enhances the TOE framework's applicability to small-scale tourism enterprises, offering a nuanced perspective on the role of organisational readiness in technology adoption.

The study broadens the understanding of environmental factors by emphasising the role of government support and competitive pressure as external influences on ICT adoption among tourism households. The findings highlight that government support – through training programmes, financial assistance, and digital tourism policies – serves as a crucial driver of ICT adoption, reinforcing the theoretical perspective that institutional interventions play a key role in reducing technological and financial barriers. In contrast, the study challenges the assumption that competitive pressure is a strong determinant of ICT adoption in all business settings. Unlike formal enterprises that face intense digital competition, tourism households – particularly in rural areas – rely more on traditional marketing and niche markets, reducing the immediate impact of competitive dynamics on their ICT adoption decisions.

6 Conclusions and recommendations

This study explores the factors influencing ICT adoption intention among tourism household-owned businesses in the Northern mountains of Vietnam using the TOE framework. The findings reveal that technological, organisational, and environmental factors play a crucial role, with compatibility, relative advantage, organisational readiness, and government support driving digital transformation. From a practical perspective, the study emphasises the need for targeted policies and support mechanisms to promote ICT adoption among tourism households. Enhancing digital literacy and providing financial assistance can accelerate adoption, while government interventions – such as improved digital infrastructure and training programmes – are vital for facilitating the transition. A collaborative effort involving technology providers, industry stakeholders, and policymakers is essential to fostering an enabling environment for digital transformation in tourism development.

The results of this study offer various practical insights for enhancing ICT adoption among tourism households in rural Vietnam. From a technological perspective, the complexity of ICT systems remains a significant barrier to adoption. Tourism households, often constrained by limited digital literacy and inadequate technical support, may find complex digital solutions difficult to implement. Therefore, technology providers should prioritise the development of user-friendly, mobile-based applications that require minimal technical expertise. Additionally, multilingual interfaces tailored to local contexts can enhance accessibility. To address infrastructure limitations, offline-friendly digital tools and localised technical support services should be promoted, ensuring that businesses can integrate ICT seamlessly into their operations despite connectivity challenges.

From an organisational perspective, enhancing the readiness of tourism households is crucial for ICT

adoption. Businesses with sufficient financial resources, digital infrastructure, and technical skills are more likely to integrate ICT into their operations. To support adoption, financial initiatives such as micro-loans and grants should be introduced to help small tourism enterprises invest in digital tools. Additionally, digital literacy training programmes specifically designed for rural entrepreneurs can build their confidence and ability to use ICT effectively. Industry stakeholders, including tourism associations and business support organisations, should facilitate capacity-building initiatives that equip tourism households with practical digital skills. By fostering an environment where tourism households have access to both financial and technical resources, the likelihood of successful ICT adoption and long-term digital engagement can be significantly improved.

In terms of environmental factors, competitive pressure is a key driver of ICT adoption intention. Tourism businesses in rural areas are increasingly competing with digitally advanced enterprises, making it essential to leverage ICT for market relevance. Industry stakeholders should highlight the competitive advantages of ICT, such as expanding customer reach through social media marketing, improving service efficiency via online booking systems, and facilitating seamless transactions with digital payment solutions. Government agencies and tourism associations can support this transition by showcasing digital success stories, organising workshops on digital marketing strategies, and fostering peer-learning networks among tourism entrepreneurs. Demonstrating tangible business benefits can motivate more tourism households to integrate digital tools into their operations, helping them remain competitive in an evolving market.

Government support plays a vital role in enabling ICT adoption by addressing systemic challenges beyond individual business capabilities. Expanding digital infrastructure in rural areas, particularly through investments in reliable internet connectivity, is essential for supporting digital transformation. Additionally, structured training programmes and advisory services should be implemented at a broader policy level to provide ongoing technical assistance and reduce barriers to ICT integration. Rather than direct financial support to individual businesses, government interventions should focus on creating an enabling environment through public-private partnerships that facilitate collaboration between technology providers, local authorities, and tourism operators. By implementing targeted policy measures and institutional support, the government can accelerate the digital transformation of tourism households, ultimately fostering sustainable economic growth in rural areas.

Although this study makes valuable contributions, it has some limitations that suggest directions for future research. First, the cross-sectional design of the data restricts the ability to track changes in ICT adoption over time. Longitudinal studies could offer deeper insights into the evolving digital behaviours of tourism business households. Second, while the study conducts in Vietnam, comparative studies across different regions or countries could enhance understanding of contextual influences on ICT adoption. Third, future research could incorporate qualitative approaches to explore underlying motivations and barriers that may not be fully captured in quantitative models. Finally, considering the rapid evolution of digital technologies, future studies could examine emerging trends such as artificial intelligence, blockchain, and smart tourism applications to assess their potential impact on tourism household businesses.

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