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Driving ICT Adoption among Real Estate Agents: An Extended Technology Acceptance Model

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Abstract

The practice of real estate agents and the extent to which Information and Communication Technology (ICT) is applied in Malaysia appears to be more specialised and diverse with the exploration of technology and innovation. Due to the increasing interest in using more innovative marketing and negotiation techniques, this study focuses on real estate agents' acceptance as well as the intention to use ICT in Malaysia according to the extended Technology Acceptance Model (TAM). In this study, a sample including 400 real estate agency practitioners was surveyed and analysed using Partial Least Squares-Structural Equation Modelling (PLS-SEM). The findings show that Perceived Usefulness (PU), Perceived Ease of Use (PEOU), as well as Trust (TRU) affect Behavioural Intention (BI). On the other hand, PU is affected by PEOU as well as Service Quality (SERQ). Meanwhile, PEOU is affected by Perceived Enjoyment (ENJ) as well as Innovativeness (INNO). These results indicate that ICT acceptance among real estate agents can be improved by providing them with high-quality service, fostering perceived enjoyment, building trust, and establishing innovative ICT solutions tailored to real estate agents' needs.

Keywords: Extended Technology Acceptance Model, ICT Adoption, Real Estate Agents

1. INTRODUCTION

Information and Communication Technology (ICT) is a broad term referring to all technologies used to communicate and share information (Babatunde & Ajayi, 2018). As stated by Adedamola et al. (2021), it is also possible to regard ICT as infrastructure and innovation that enables the collection, storage, analysis, and electronic communication of information. Undeniably, ICT is indispensable to the real estate industry. The emergence of ICT, such as the internet and social media, has significantly transformed how people work, communicate, and obtain information. ICT has also become critical today as people interface with technology and information systems in the digital era. ICT is important to real estate agents, which includes marketing (Lizam, 2019), dissemination of information to potential clients (Saiz, 2020), as well as assisting clients, specifically buyers, with regard to property transactions (Shaw, 2018; Gu & Zhu, 2021).

Additionally, the use of ICT for information gathering is faster, more accurate, and the cheapest way to sell products (Oyetunji et al., 2018). However, although ICT has the potential to offer benefits as aforementioned, many real estate agents are not yet willing to apply and employ these kinds of technologies (Mohd 2019; Bakar & Yaacob 2020). Real estate operators are, by large, less willing to

use ICT and, therefore, feel pressured to quickly adapt to these technologies in their business models (Baum et al., 2020; Asensio-Soto & Navarro-Astor, 2022). As a result, it will disrupt real estate agents who do not adopt this in their business model (Kohli & Melville, 2018). Likewise, ICT costs may be an issue of concern to real estate agents (Low et al., 2020). Another factor is the lack of accessibility and what customers think about the resources (Adegoke et al., 2020). The adoption of new digital and computer technologies is slowly increasing in the real estate sector, which is characterised by its limited capacity for innovation and its relatively slow uptake to adopt innovative technologies (Kassner et al., 2022). Additionally, it holds a relatively weak position in terms of transformation compared to other sectors (Roulac, 2019; Saiz, 2020; Asensio-Soto & Navarro-Astor, 2020). To address this issue, it is crucial to understand the factors influencing real estate agents' acceptance of ICT. This research aims to identify the factors affecting the acceptance of ICT among real estate agencies in Malaysia using the Technology Acceptance Model (TAM). In this study, ICT refers to a variety of ICT tools, applications, services, platforms, and devices used by real estate agents in practice (in this study, ICTs refer to cloud, drones, virtual reality, augmented reality, online real estate platforms, social media, the metaverse in real estate, and robotic process automation). The next section of the paper outlines the theoretical framework and the hypothesis's structural model. It is followed by the method of analysis and results. Finally, the discussion, conclusions, and implications for both theory and practice are presented.

2. LITERATURE REVIEW

2.1 Real Estate Agents in Practice

Real estate agents act as mediators in the property market, facilitating communication between buyers and sellers, and providing information to both parties. Real estate agents significantly impact the home-buying process and, ultimately, the final selling price of a house (Besbris, 2020; Besbris & Faber, 2017). As technology advances, it has a significant impact on the property market. Consequently, it has been highlighted that real estate agents will not be replaced by technology but by agents with technology. This statement suggests that technology can greatly benefit real estate agents by making it more convenient for them to update their sales and find clients (Adedamola et al., 2021). ICT tools, such as virtual reality, drones, and Artificial Intelligence (AI)-powered algorithms, have significantly changed how real estate transactions are conducted. However, they cannot entirely replace the expertise and personal touch provided by human agents. Moreover, despite technology serving as a tool that can streamline processes, provide data-driven insights, and improve efficiency, it lacks the nuanced understanding, negotiation skills, and emotional intelligence that real estate agents bring to the transaction process (Benites-Gambirazio, 2020). Real estate agents are required to conduct property transactions (Jud et al., 2002). According to the National Association of Realtors, 89% of sellers take advantage of a real estate agent to sell their homes, and 88% percent use one when buying (NAR, 2020). Online advertising is one of the most common platforms where individuals can promote apartments and search for appropriate accommodations. In addition, landlords may look for someone who specializes in a specific kind of property or neighbourhood to customize effective marketing and leasing strategies that are tailored to their needs.

2.2 Theoretical Foundation of the Current Study

This study also enhances the foundational theory of the (TAM), which was introduced by Davis and his colleagues in 1989, a paper published in the MIS Quarterly journal (Davis et al., 1989). According to Davis et al. (1989), TAM aims to explain the factors influencing computer acceptance by explaining user behaviour across a wide array of end-user computing technologies and user populations while remaining both practical and theoretically sound (Davis et al., 1989, p.985). In this study by Davis and colleagues, the TAM is designed as a general model to account for user behaviour across various computing technologies and populations. TAM has been widely employed in numerous studies as a research framework with external variables since it was developed, and its context is very extensive, including e-learning services, e-commerce systems, or social media platforms (Verkijika, 2020; Altay

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& Okumus, 2021; Chatterjee et al., 2021; Al-Sabaawi et al., 2021). TAM is based on Ajzen's Theory of Reasoned Action (TRA), which is a generic theory that predicts and explains various human behaviours in different domains (Ajzen & Fishbein, 1980). In the TRA/TPB, the basic concepts of attitude and behavioural intention, TAM argued and proposed that two specific beliefs, Perceived Ease of Use (PEOU) and Perceived Usefulness (PU), indirectly influence an individual's attitude toward accepting technology (Davis, 1989).

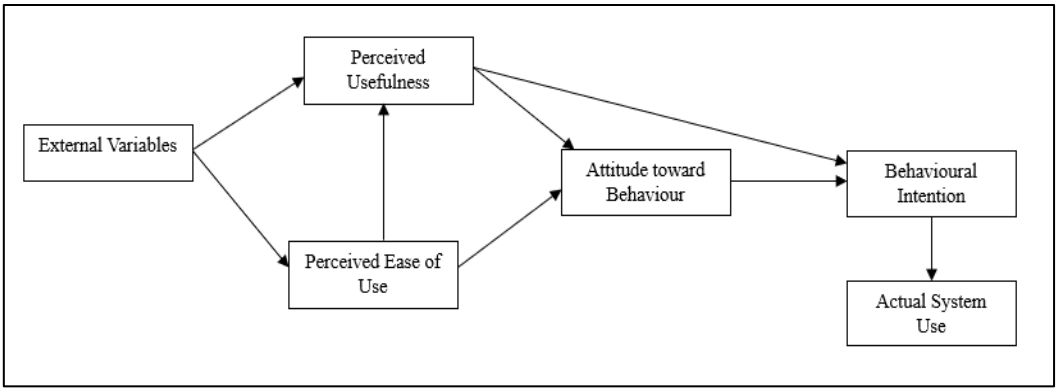

Figure 1: First version of the Technology Acceptance Model (TAM)
Source: Davis et al., 1989

Initially, the development of TAM is determined by six constructs (see Figure1, Table 1): PU, PEOU, Behavioural Intention (BI), attitude towards using the technology, and actual use of the technology. Figure 1 illustrates that the actual system use is directly influenced by BI, which is impacted by both Attitudes Toward Behaviour (ATT) and PU. Meanwhile, ATT is directly influenced by PEOU and PU alike. The TAM mainly relies on two variables, PEOU and PU, to assess an individual's beliefs and attitude toward accepting computer technology (Davis et al., 1989). Additionally, PEOU directly impacts PU, while external variables affect both PEOU and PU.

Table 1: The Determinants of Initial TAM

Determinant	Definition
External Variables	External factors that might affect PU and PEOU include system characteristics, user characteristics, tasks, social influence, user habits, and the direct or indirect impact of the user's cognitive beliefs (Fishbein and Ajzen, 1975; Davis et al., 1989).
Perceived Usefulness	The extent to which a person believes that using a specific system will improve their job performance (Davis, 1989).
Perceived Ease of Use	The extent to which a person believes that using a specific system will be effortless (Davis, 1989).
Attitude toward behaviour	The extent to which an individual views performing a behaviour as positive or negative (Fishbein & Ajzen, 1975).
Behavioural intention	An individual's intention or plan to behave in a certain manner, with no guarantee of actually doing so (Fishbein & Ajzen, 1975).
Actual System Use	The final stage is where individuals utilize the technology (Davis, 1989).

In their final model, Davis et al. (1989) removed the ATT construct because it weakly mediated the effect between PU and BI. Additionally, PU had a strong direct influence on BI. Moreover, ATT failed to mediate the relationship between PEOU and BI. Figure 2 shows the revised version of the original TAM.

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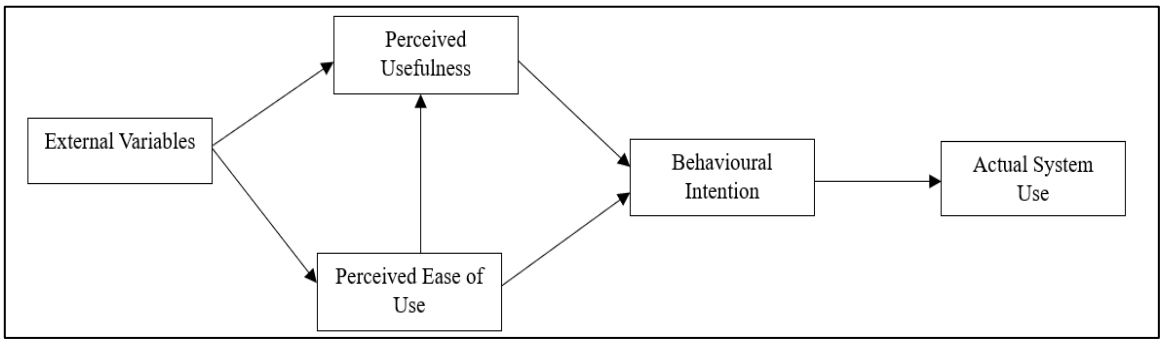

Figure 2: Revised Technology Acceptance Model (TAM)
Source: Davis et al., 1989

3. RESEARCH CONCEPTUAL MODEL AND HYPOTHESES

This study incorporates eight variables to explain the use of ICT by real estate agents. The anticipated relationships among these variables are illustrated in Figure 3.

PU is a central construct in the TAM (Davis, 1989). PU is defined as the extent to which an individual believes that using the technology in question will enhance their performance (Davis, 1986). Additionally, PU is assumed to directly influence the BI's acceptance and use of the technology (Davis, 1989). Numerous studies on technology acceptance in the real estate sector (Taherdoost, 2018; Sepasgozar et al., 2019; Guhr et al., 2020; Park & Park, 2021; Al-Husamiyah & Al-Bashayreh, 2021; Ullah et al., 2021) supported the same result. Therefore, this study proposed the following hypotheses:

H1*:* Perceived Usefulness (PU) has a direct positive influence on real estate agents' Behavioral Intention (BI) of Information and Communication Technology (ICT)

PEOU is defined as the degree to which an individual believes that using the technology under investigation will not demand significant effort (Davis, 1986). In this study, PEOU pertains to how easy real estate agents find using ICT. According to the TAM (Davis, 1989), real estate agents perceive ICT as user-friendly, so they are more likely to adopt the technology. Using the TAM, Al-Husamiyah and Al-Bashayreh (2022) stated that their study explores factors influencing users' acceptance of smart home services. They identified a positive relationship between PEOU and PU in users' intentions to use these services. Similarly, Chatterjee et al. (2021) found that in the context of adopting social media marketing for sustainable business growth, PEOU impacts PU.

On the other hand, a study by Park and Park (2020) on factors of the TAM for Construction IT also revealed the positive significance of the PEOU effect on BI's use of the IT system. At the same time, Altay and Okumus (2021) confirmed a direct relationship between PEOU and BI in examining citizens' acceptance of trip-planning apps in Turkey. Therefore, this study proposed the following hypotheses:

H2*:* Perceived Ease of Use (PEOU) has a direct positive influence on real estate agents' Perceived Usefulness (PU) of Information and Communication Technology (ICT).

H3*:* Perceived Ease of Use (PEOU) has a direct positive influence on real estate agents' behavioural Intention (BI) of Information and Communication Technology (ICT).

BI is defined as an individual's intent or purpose to engage in a particular behaviour (Fishbein & Ajzen, 1975). TRA-based technology-acceptance theories, such as the Theory of Planned Behavior (TPB), the TAM, the TAM2, the model of PEOU determinants, and the TAM3, BI is the primary predictor of Acceptance (ACC) and indicates the person's willingness to use the technology (Fishbein & Ajzen, 1975; Ajzen, 1985; Davis et al. 1989; Venkatesh & Davis, 2000; Venkatesh, 2000; Venkatesh

& Bala, 2008). Dieck and Jung (2015), Ullah et al. (2019), Park and Park (2020), and Al-Husamiyah and Al-Bashayreh (2021) found that within the context of technology in the real estate sector, the relationship between BI and ACC is the most significant in their model. Thus, the current study proposed a series of hypotheses as follows:

H4*:* Behavioural Intention (BI) has a direct positive influence on real estate agents' Acceptance (ACC) of Information and Communication Technology (ICT).

Perception of external control or Facilitating Conditions (FC) is defined by Venkatesh and Bala (2008) as consumers' perceptions of the resources and support available to perform a behaviour. Previous studies have found a significant relationship between FC and BI in using technology (Taherdoost, 2018; Adegoke et al., 2020). Thus, the following hypothesis was proposed for this study:

H5*:* Facilitating Conditions (FC) have a direct positive influence on real estate agents' Behavioural Intention (BI) of Information and Communication Technology (ICT).

Innovativeness (INNO) is a personality trait that reflects the willingness of individuals to try new things, especially new technologies (Hu et al., 2019). Individuals with high levels of INNO often tend to be early adopters of new technologies, eager to learn about and experiment with them. They are more open to new technologies and enjoy the experience of learning them (Wang et al., 2019). Their readiness to learn, comprehend, and utilize new technologies gives them a higher adoption rate. Besides, innovative people are considered to be open-minded with respect to any new idea and innovation in general (Cao & Shao, 2021). This has been supported by the previous study that INNO is a significant factor influencing PEOU's intention to use technology (Hong et al., 2019). Thus, the following hypothesis was proposed for this study:

H6: Innovativeness (INNO) has a direct positive influence on real estate agents' Perceived Ease of Use (PEOU) of Information and Communication Technology (ICT).

Trust (TRU) is the willingness to depend on them, believing that they are trustworthy (Akram et al., 2021). According to Aldossari and Sidorawa (2018), TRU is one of the most essential factors in establishing successful customer relationships, particularly under conditions with a high level of uncertainty and the possibility of opportunistic behaviour from the consumer's point of view. A prior study (Hu et al., 2019) found that users' TRU significantly impacts their BI to use technological services. This implies that the more TRU users have in technology, the more likely they are to adopt and use it. Thus, the following hypothesis was proposed for this study:

H7*:* Trust (TRU) has a direct positive influence on real estate agents' Behavioural Intention (BI) of Information and Communication Technology (ICT).

Perceived Enjoyment (ENJ), or hedonic motivation, is the degree to which people find using technology enjoyable, even though there are no practical benefits (Venkatesh & Bala 2008). A study conducted by Do et al. (2020) and Park and Park (2020) found that when users interact seamlessly with technology, they experience enjoyment, enter a flow state, and become so engrossed in the activity that they lose track of time and become fully absorbed at the moment. They discovered that PEOU and PU significantly predictor users using the ICT. Hence, the following hypothesis is proposed:

H8*:* Perceived Enjoyment (ENJ) has a direct positive influence on real estate agents' Perceived Usefulness (PU) of Information and Communication Technology (ICT).

H9*:* Perceived Enjoyment (ENJ) has a direct positive influence on real estate agents' Perceived Ease of Use (PEOU) of Information and Communication Technology (ICT).

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Service Quality (SERQ) is a method by which service providers can provide excellent and exemplary service to customers to differentiate themselves from competitors. It is noted that client satisfaction and SERQ are closely related (Kaur & Solomon, 2021; Do et al., 2020). When clients have a positive experience with the SERQ provided by sellers, their overall satisfaction with the SERQ is likely to increase (Low et al., 2020). A previous study (Ullah et al., 2021; Sepasgozar et al., 2019) revealed that SERQ is positively significant to PU and PEOU''s use of ICT. Therefore, this study proposed the following hypotheses:

H10: Service Quality (SERQ) has a direct positive influence on real estate agents' Perceived Usefulness (PU) of Information and Communication Technology (ICT).

H11*:* Service Quality (SERQ) has a direct positive influence on real estate agents' Perceived Ease of Use (PEOU) of Information and Communication Technology (ICT).

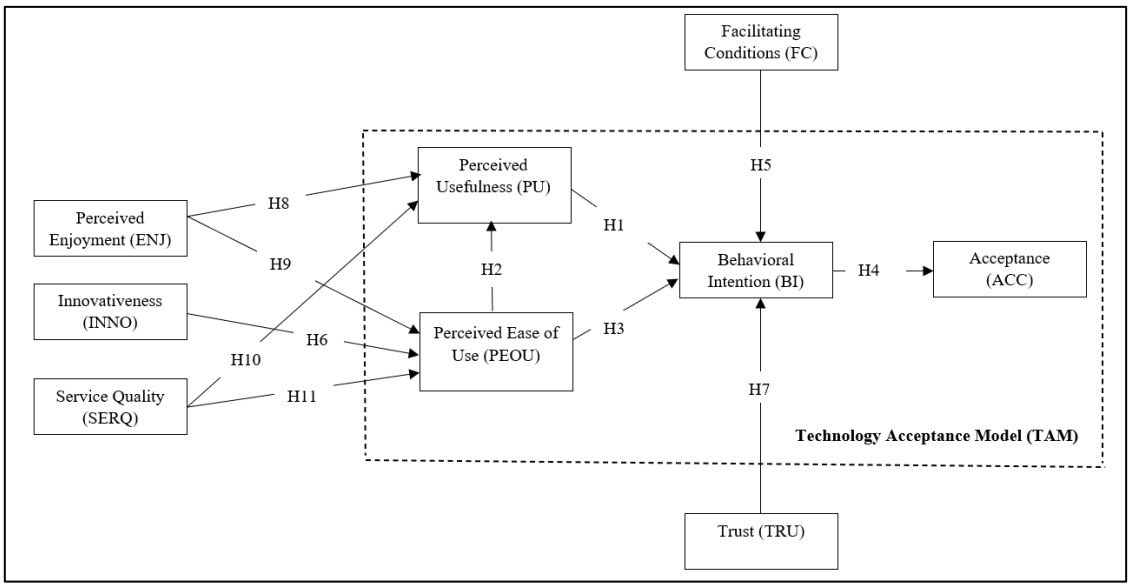

Figure 3: Research Conceptual Model & Hypotheses

4. RESEARCH METHODOLOGY

4.1 Data Collection and Sampling

The study aimed to identify factors influencing the acceptance of ICT among real estate agents. Therefore, the respondents of this study are those practising real estate in the Klang Valley and legally registered with the Board of Valuers, Appraisers, Estate Agents, and Property Managers (BOVAEP) Malaysia. This includes real estate negotiators, estate agents, probationary valuers, estate agents, and registered valuers. In Malaysia, the responsibilities of real estate agents are also performed by valuers, probationary valuers, probationary estate agents, and real estate negotiators. The questionnaire comprises two parts: demographic questions and scale items for the model's variables. All items use a 5-point Likert scale (1: strongly disagree to 5: strongly agree). Data was gathered through random sampling using an online self-administered questionnaire via Survey Monkey and hard copy versions. This method involved the researcher travelling to real estate agencies in the 14 major cities of the Klang Valley (Gombak, Selayang, Setapak, Shah Alam, Klang, Petaling Jaya, Subang Jaya, Damansara, Puchong, Kuala Lumpur City Center, Mont Kiara, Ampang, Bangsar, and Putrajaya), ensuring direct interaction with respondents and accurate delivery of the questionnaires. In face-to-face data collection, respondents were questioned about factors influencing their acceptance and use of ICTs. The questionnaires were shared with respondents via a QR code and sent through WhatsApp, and hardcopy

surveys were available for those who preferred them. Finally, the study had a total sample size of 400 respondents, and the questionnaire collection process lasted four months.

4.2 Data Analysis

The hypothetical relationships were then evaluated in the following phase of the investigation. Moreover, it is important to note that the proposed model was assessed using Partial Least Squares-Structural Equation Modelling (PLS-SEM). This measurement instrument is used as it can predict and identify critical constructs and test an extension of the existing structural theories (Hair et al., 2017). Thus, SEM was used as a measuring instrument in this study.

5. RESULT

5.1 Measurement Model

The measurement model, or outer model, describes the relationship between constructs and their indicators (Hair et al., 2014). Essentially, it explains how constructs are measured using indicators (Hair et al., 2021). Researchers Henseler et al. (2015) and Hair et al. (2017) have offered guidelines for evaluating and reporting the measurement model, covering aspects such as indicator reliability, construct reliability, convergent validity, and discriminant validity.

The first step begins with indicator reliability to measure the outer loadings. High outer loadings mean that the indicators of a construct have a large degree of similarity (Hair et al., 2017). It is suggested that indicators' reliability is ensured when each indicator's outer loading exceeds 0.7. Utilizing the PLS algorithm with 5,000 iterations, the results are shown in Table 2. The outer loading for each indicator ranges from 0.759 to 0.922. However, the outer loading value for PEOU1 is below 0.7, leading to its exclusion from the model. This indicates that all indicators on this scale are consistent with each other, except for PEOU1.

Table 2: Results of Measurement Model Assessment

Construct	Indicators	Outer loadings > 0.7	Cronbach's alpha > 0.7	Composite reliability > 0.7	Average variance extracted > 0.5
FC	FC1	0.835	0.791	0.877	0.705
	FC2	0.850			
	FC3	0.833			
INNO	INNO1	0.812	0.900	0.926	0.715
	INNO2	0.888			
	INNO3	0.847			
	INNO4	0.817			
	INNO5	0.861			
TRU	TRU1	0.881	0.863	0.916	0.785
	TRU2	0.884			
	TRU3	0.893			
ENJ	ENJ1	0.862	0.889	0.918	0.693
	ENJ2	0.870			
	ENJ3	0.862			
	ENJ4	0.806			
	ENJ5	0.757			
SERQ	SERQ1	0.787	0.899	0.922	0.664
	SERQ2	0.832			
	SERQ3	0.844			

	SERQ4	0.837			
	SERQ5	0.832			
	SERQ6	0.755			
PU	PU1	0.840	0.920	0.940	0.758
	PU2	0.895			
	PU3	0.888			
	PU4	0.873			
	PU5	0.856			
PEOU	PEOU1	0.693	0.862	0.906	0.707
	PEOU2	0.831			
	PEOU3	0.855			
	PEOU4	0.845			
	PEOU5	0.831			
BI	BI1	0.868	0.905	0.933	0.777
	BI2	0.902			
	BI3	0.877			
	BI4	0.880			
ACC	ACC1	0.897	0.892	0.933	0.822
	ACC2	0.922			
	ACC3	0.900			

Next is a measurement of construct reliability. Reliability pertains to the internal consistency of indicators and their ability to produce consistent results under the same conditions (Field, 2013). In social science research, reliability is typically assessed using internal consistency measured by Cronbach's alpha (Cronbach, 1951). It has been shown that values between 0.7 and 0.9 are considered acceptable (Hair et al., 2017). In this study, Cronbach's alpha coefficient values range from 0.791 to 0.920, and composite reliability values range from 0.878 to 0.933. These findings demonstrate the high reliability of the constructs.

The next measurement is convergent validity. It describes the positive correlation of an indicator with other indicators within the same construct (Sekaran & Bougie, 2016). Convergent validity is established when the outer loadings of each indicator are established when the outer loadings of each indicator were greater than 0.7, and the Average Variance Extracted (AVE) for constructs is 0.5 or above (Hair et al., 2016; Sarstedt et al., 2017). As such, the AVE values are over 0.5, which signifies construct convergent reliability in the effect of current research. The following measurement is discriminant validity. Discriminant validity ensures that a construct is distinct from other constructs in the model and accurately captures the intended variable (Hair et al., 2014). This means that each construct should correlate more strongly with its own indicators than with those of other constructs (Hair, 2017). Discriminant validity can be assessed using the following methods: 1. cross-loadings, 2. Fornell-Larcker criterion, and 3. Hetereotrait-Monotrait (HTMT) ratio. However, due to recent criticism of the limitations of the cross-loading approach and the Fornell-Larcker criterion in reliably assessing discriminant validity, Henseler et al. (2015) proposed the HTMT ratio as an alternative. The HTMT ratio estimates the correlation of a construct with other constructs, which should be less than one (Henseler et al., 2016). A correlation closer to one indicates a lack of discriminant validity. The results of this study, shown in Table 3, indicate that the HTMT values range from 0.554 to 0.863, demonstrating the discriminant validity of the constructs.

Table 3: Results of HTMT Discriminant Validity

	ACC	BI	ENJ	FC	INNO	PEOU	PU	SERQ	TRU
ACC									
BI	0.788								
ENJ	0.554	0.560							
FC	0.599	0.575	0.747						
INNO	0.626	0.608	0.656	0.670					
PEOU	0.589	0.615	0.670	0.692	0.704				
PU	0.734	0.809	0.597	0.595	0.669	0.579			
SERQ	0.675	0.761	0.660	0.615	0.709	0.573	0.791		
TRU	0.660	0.648	0.641	0.684	0.720	0.579	0.722	0.803	

5.2 Structural Model

According to Hair et al. (2017), when using PLS-SEM, the primary evaluation criterion for the structural model is the R^2 value, measured alongside the significance level of the path coefficients. Typically, R^2 values are classified as follows: 0.75 is substantial, 0.50 is moderate, and 0.25 is weak. The results of this study, shown in Table 4, indicate that R^2 for all the endogenous constructs is 0.50 and above. Thus, this indicates that the model explanatory power is moderate in value.

Table 4: Result of Model's Exploratory Power (R^2)

Endogenous	R-square	R-square adjusted
ACC	0.5	0.5
BI	0.6	0.6
PEOU	0.5	0.5
PU	0.6	0.6

The analysis continues with f^2 analysis. It measures whether the excluded independent variable significantly impacts the dependent variable. The predicted variable has a significant structural impact if the f^2 values are 0.02, 0.15, and 0.35, corresponding to small, medium, and large effects, respectively (Cohen, 1988). Table 5 summarizes the f^2 results, showing an acceptable effect size that supports the hypotheses. However, a detailed discussion regarding the significance of the relationships between the studied variables will be presented later in Table 7.

Table 5: Results of Effect Sizes (f^2)

	Effect Size	
Relationship	**f-square**	**Magnitude**
Behavioural Intention → Acceptance	1.008	large
Perceived Enjoyment → Perceived Ease of Use	0.153	medium
Perceived Enjoyment → Perceived Usefulness	0.014	small
Facilitating Conditions → Behavioural Intention	0.047	small
Facilitating Conditions → Perceived Usefulness	0.01	small
Innovativeness → Perceived Ease of Use	0.115	small
Perceived Ease of Use → Behavioural Intention	0.066	small
Perceived Ease of Use → Perceived Usefulness	0.026	small
Perceived Usefulness → Behavioural Intention	0.413	large
Service Quality → Perceived Ease of Use	0.002	small
Service Quality → Perceived Usefulness	0.418	large
Trust → Behavioural Intention	0.022	small

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Additionally, the model's Predictive Relevance (Q^2) was evaluated using the blindfolding procedure. Q^2 measures the model's ability to accurately predict data not included in its development, also known as out-of-sample prediction (Hair et al., 2017). Correspondingly, Hair et al. (2019) categorised Q^2 values as small if they fall between 0.1 and 0.249, medium between 0.25 and 0.499, and large if 0.50 or higher. The results of this study, shown in Table 6, reveal that most endogenous constructs in this structural model exhibited acceptable predictive accuracy at $Q^2 = 0.476$ (medium) for PEOU, $Q^2 = 0.487$ (medium) for BI, and $Q^2 = 0.394$ (medium) for ACC. Meanwhile, PU indicates higher acceptable predictive accuracy at $Q^2 = 0.548$ (higher). Thus, these results suggest that the predicted relationships between the independent variable, mediators, and the dependent variable were accurate and relevant.

Table 6: Results of Q^2 Predict

Endogenous	Q^2predict	RMSE	MAE
ACC	0.394	0.785	0.634
BI	0.487	0.725	0.555
PEOU	0.476	0.731	0.52
PU	0.548	0.677	0.515

Figure 4 illustrates the path coefficients and significance levels. PLS-SEM employs bootstrapping to obtain standard errors for hypothesis testing by repeatedly sampling with replacement from the original sample to create bootstrap samples. For this analysis, bootstrapping was performed with 5,000 subsamples, as recommended by (Hair et al., 2011). As a result, all tested hypotheses were positive and significant, except for FC →BI (β = 0.093 t = 1.918, p = 0.055), ENJ → PU (β = 0.073 t = 1.371, p = 0.171), SERQ → PEOU (β = 0.042, t = 0.810, p = 0.418). The analysis results are summarised in Table 7.

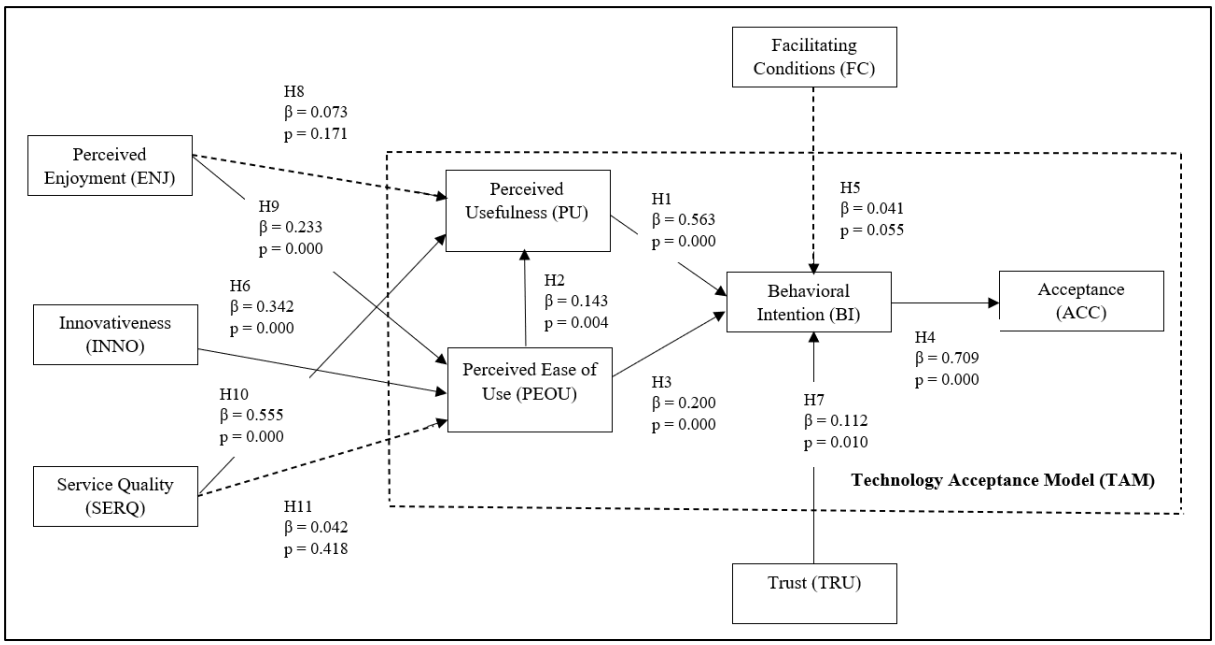

Figure 4: Path coefficients of the model

Table 7 in this study reveals the results of the hypothesis examining the relationships between various constructs in the study. The analysis assessed the statistical significance of the hypothesis paths using coefficients, t-values, and p-values. Out of the eleven hypotheses tested, eight were supported, and three hypotheses were rejected.

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Table 7: Path coefficients

H#	Paths	Coefficients (β)	t-value	p-value	Decision
H1	PU → BI	0.563	12.308	0.000	Supported
H2	PEOU → PU	0.143	2.913	0.004	Supported
H3	PEOU → BI	0.200	5.109	0.000	Supported
H4	BI → ACC	0.709	19.356	0.000	Supported
H5	FC →BI	0.041	1.918	0.055	Reject
H6	INNO → PEOU	0.342	6.769	0.000	Supported
H7	TRU → BI	0.112	2.581	0.010	Supported
H8	ENJ → PU	0.073	1.371	0.171	Reject
H9	ENJ → PEOU	0.233	3.679	0.000	Supported
H10	SERQ → PU	0.555	12.419	0.000	Supported
H11	SERQ → PEOU	0.042	0.810	0.418	Reject

6. DISCUSSION

PU had a significant effect on BI's use of ICT, which supported (H1). When real estate agents perceive ICT as useful, they are more likely to have a strong BI to use it since they anticipate that using such technology will lead to positive outcomes in their work. This includes better client management, more effective marketing, easier access to property listings, and overall better sales performance. The numerous studies supporting these findings have shown that PU positively influences BI and was validated by Taherdoost (2018), Sepasgozar et al. (2019), Guhr et al. (2020), Park and Park (2021), Al-Husamiyah and Al-Bashayreh (2021), and Ullah et al. (2021).

This study also supported the hypothesis that PEOU significantly impacts PU (H2). If an ICT tool is easy to learn and use, real estate agents are more likely to perceive it as beneficial since they can quickly integrate it into their daily work routines. With easy-to-use ICT tools, real estate agents can spend less time grappling with technology and more time on core activities like client interaction, property viewing, and closing deals. This shift in focus directly enhances their PU of the technology. Moreover, the influence of PEOU on PU was in line with the previous study by Al-Husamiyaha and Al-Bashayreha (2021) and Chatterjee et al. (2021).

This study also confirms the positive relationship between PEOU and BI (H3). When real estate agents find technology easy to use (high PEOU), they are more likely to explore its features and functionalities without hesitation. This experimentation allows them to discover how the ICT tool can effectively be utilised within their work context. The more they experiment and find practical applications, the stronger their intention becomes to use the tool regularly (BI increases). Correspondingly, the result of this study supports the hypotheses from the previous study by Ullah et al. (2021). The authors explore the user perceptions of real estate online platforms, and they discovered that PEOU affects the BI of the user when using real estate online platforms.

The results also support the strong and positive relationship between BI and ACC (H4). This indicates that when real estate agents have a strong intention to use ICT, they will likely take the necessary steps to learn, adapt, and integrate these technologies into their work routines. Furthermore, when real estate agents with strong BI use ICT, they can influence their peers through demonstration and positive word-of-mouth. This social influence can further drive collective acceptance in their professional community. The findings of this study are consistent with previous research by Ullah et al. (2019), Park and Park (2020), and Al-Husamiyah and Al-Bashayreh (2021), who determined that the relationship between BI and ACC is the strongest in their models.

There is a positive relationship between INNO and PEOU (H6). INNO refers to a person's willingness to try new things and their ability to adapt to change. A highly innovative real estate agent

is much more willing to explore new tools and software. They are less likely to feel overwhelmed by new features of ICT. Even when faced with a complex ICT tool, innovative real estate agents are less likely to give up or be deterred. Their eagerness to learn empowers them to navigate the complexities of using ICT tools and eventually utilize them easily. The findings of this study were in line with those of Hong et al. (2019), who found that INNO has a significant impact on the PEOU of ICT.

The finding supports the positive relationship between TRU and BI (H7), which states that real estate agents who trust the ICT tools would perceive it can help them improve their work, generate more leads, close more deals, and ultimately achieve their goals. This aligned with Taherdoost (2018) and Hu et al. (2019), who indicated that TRU among users positively relates to their BI in adopting the technology. Therefore, the more trust real estates have in ICT, the more likely real estate agents will adopt and use it.

This study also confirms the positive relationship between ENJ and PEOU (H9). When real estate agents enjoy using a particular tool, it no longer feels like an extra or forced addition to their work. Instead, it becomes something real estate agents naturally reach for and utilise as part of their daily routine, making their work more efficient and enjoyable. A study by Adegoke and Oladokun (2020) also discovered that ENJ significantly affects PEOU.

The findings also reveal a positive relationship between SERQ and PU (H10). Real estate agents will integrate and depend on ICT tools in their daily operations if they perceive them as useful and believe ICT enhances productivity and efficiency. High-quality service of ICT tools directly influences how useful real estate agents perceive the tool as beneficial to their work. This finding was supported by previous studies (Sepasgozar et al., 2019; Ullah et al., 2021), which discovered that SERQ significantly influences PU in ICT usage.

In contrast, three hypotheses were rejected. The relationship between FC and BI was rejected (H5). This result contradicts previous research that found a positive relationship between FC and BI (Adegoke & Oladukun, 2020; Taherdoost, 2018). Real estate agents are often commission-driven and prioritise finding tools that demonstrably help them close deals, even if limited organisational support is available. They might be more willing to explore and learn how to use a new tool independently if they believe it will significantly improve their efficiency and earning potential. The results indicate that real estate agents' intention to use ICT tools is primarily driven by their perceived usefulness in generating income, rather than the facilitating conditions provided. This discrepancy shows that facilitating conditions do not influence real estate agents' ICT adoption behaviour due to their strong focus on individual performance and financial gains.

The findings also depict a negative significance between ENJ and PU (H8). The findings show that real estate agents will prioritise the perceived usefulness of an ICT tool over its enjoyment factor especially when it directly impacts their potential income. If a tool is not enjoyable to use, real estate agents will adopt and use it if they believe it will help them be more productive and successful in closing deals. Thus, this result contradicts the positive relationship between ENJ and PU found in a study (Do et al., 2020; Park & Park, 2020). The differences in the result in the context of real estate agents highlight how the potential for financial gains can override the importance of enjoyment in ICT adoption.

In this study, the findings of SERQ and PEOU (H11) were not supported. SERQ refers to the overall quality of service real estate agents perceive they receive with the ICT tool they use, while PEOU focuses on the user-friendliness of the technology itself. Although the ICT tools have improved service quality, real estate agents do not perceive them to be user-friendly, negatively affecting PEOU. In other words, even if the service quality of the ICT is excellent, if the tool itself is difficult to use or navigate, real estate agents might not perceive it as easy to use. Consequently, this result contradicts the positive relationship between SERQ and PEOU shown in previous studies (Ullah et al., 2021; Sepasgozar et al., 2019).

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7. CONCLUSION

These findings hold significant implications for both theory and practice. For theory, the study provides empirical support for the TAM and extends the model by incorporating five new constructs. For practice, the study suggests several strategies can be employed to bridge the gap and encourage greater ICT acceptance among real estate agents. Firstly, the government can play a role by implementing policies that incentivise ICT adoption in the real estate sector. This could include tax exemptions for real estate agencies that invest in technology, particularly to enhance productivity or service quality, as well as a list of approved technologies ICT that qualify for the tax benefits. The government also can provide grants for training programs, with a focus on technologies that align with industry best practices.

Secondly, the professional organisation can establish standards and certifications for estate agents to be considered digitally competent. This could include proficiency in using basic computer skills, familiarity with certain real estate software, and understanding how to use digital marketing and social media to reach potential clients and promote properties effectively. Setting such standards not only gives real estate agents a clear goal to work towards but also assures clients that certified real estate agents possess the necessary digital skills. The professional organisation could further support this initiative by conducting workshops and training sessions to educate real estate agents on the latest technologies, which will make them more comfortable using new tools.

Additionally, real estate agencies can invest in ICT tools that cater specifically to the needs of real estate agents to do their jobs better. Companies can also offer extensive training and support to ensure that real estate agents are comfortable and confident using these tools.

One limitation of the study is that the sample of this study only covers real estate agents in Klang Valley, Malaysia. Although this study allows for a detailed examination of the real estate market in this particular area, the findings may not apply to other regions or countries with different real estate markets and technology landscapes. Further comparative studies can be made to identify patterns and differences in ICT usage in the real estate sector across various cultural and economic contexts. Additionally, this can lead to a deeper understanding of the factors that facilitate or hinder technology adoption in this field. It can also help develop strategies to facilitate effective and efficient ICT usage in the real estate sector globally.

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The authors state that there are no conflicts of interest.

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REFERENCES

1. Adedamola, W. A., Oyedeji, J. O., & Faturoti, T. F. (2021). Assessment of ICT Usage in Estate Surveying and Valuation Practice in Nigeria. *International Journal of Property Science*, *11*(1), 71–85.

2. Adegoke, A. S., Oladokun, T. T., Ayodele, T. O., Agbato, S. E., Jinadu, A. D., & Olaleye, S. O. (2021). Analyzing the criteria for measuring the determinants of virtual reality technology adoption in real estate agency practice in Lagos: a DEMATEL method. *Property Management*, *40*(3). https://doi.org/10.1108/pm-05-2021-0035

3. Ajzen, I., & Fishbein, M. (1980). *Understanding Attitudes and Predicting Social Behavior*. Prentice-Hall.

4. Al-Husamiyah, A., & Al-Bashayreh, M. (2022). A comprehensive acceptance model for smart home services. *International Journal of Data and Network Science*, *6*(1), 45–58. https://doi.org/10.5267/j.ijdns.2021.10.005

5. Al-Sabaawi, M. Y. M., Dahlan, H. M., Shehzad, H. M. F., & Alshaher, A. A. (2021). A model of influencing factors of online social networks for informal learning in research institutes. *Social Network Analysis and Mining*, *11*(1). https://doi.org/10.1007/s13278-021-00773-9

6. Altay, B. C., & Okumuş, A. (2021). User adoption of integrated mobility technologies: The case of multimodal trip-planning apps in Turkey. *Research in Transportation Business & Management*, 100706. https://doi.org/10.1016/j.rtbm.2021.100706

7. Asensio-Soto, J. C., & Navarro-Astor, E. (2022). Proptech: A qualitative analysis of online real estate brokerage agencies in Spain. *Intangible Capital*, *18*(3), 489. https://doi.org/10.3926/ic.2090

8. Babatunde, T. O., & Ajayi, C. A. (2018). The impact of information and communication technology on real estate agency in Lagos Metropolis, Nigeria. *Property Management*, *36*(2), 173–185. https://doi.org/10.1108/pm-10-2016-0057

9. Bakar, N. A. A., & Yaacob, A. (2020). The Role of Service Digitalisation in Realty Business during Pandemic from the Perspective of Real Estate Agency in Klang Valley, Malaysia. *International Journal of Real Estate Studies*, *14*(S1), 9–16. https://intrest.utm.my/index.php/intrest/article/view/59/25

10. Baum, A. E., & Hartzell, D. (2020). *Real estate investment: strategies, structures, decisions*. Wiley.

11. Benites-Gambirazio, E. (2020). Working as a real estate agent. Bringing the clients in line with the market. *Journal of Cultural Economy*, *13*(2), 153–168. https://doi.org/10.1080/17530350.2019.1697954

12. Besbris, M. (2021). *Upsold: real estate agents, prices, and neighborhood inequality*. The University of Chicago Press.

13. Besbris, M., & Faber, J. W. (2017). Investigating the Relationship Between Real Estate Agents, Segregation, and House Prices: Steering and Upselling in New York State. *Sociological Forum*, *32*(4), 850–873. https://doi.org/10.1111/socf.12378

14. Chatterjee, S., Chaudhuri, R., Sakka, G., Grandhi, B., Galati, A., Siachou, E., & Vrontis, D. (2021). Adoption of Social Media Marketing for Sustainable Business Growth of SMEs in Emerging Economies: The Moderating Role of Leadership Support. *Sustainability*, *13*(21), 12134. https://doi.org/10.3390/su132112134

15. Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Lawrence Erlbaum Associates.

16. Cronbach, L. J. (1951). Coefficient Alpha and the Internal Structure of Tests. *Psychometrika*, *16*(3), 297–334. https://link.springer.com/article/10.1007/bf02310555

17. Davis, F. D. (1986). A technology acceptance model for empirically testing new end-user information systems: theory and results. *Mit.edu*. http://hdl.handle.net/1721.1/15192

18. Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User Acceptance of Computer Technology: a Comparison of Two Theoretical Models. *Management Science*, *35*(8), 982–1003. https://doi.org/10.1287/mnsc.35.8.982

19. Do, H.-N., Shih, W., & Ha, Q.-A. (2020). Effects of mobile augmented reality apps on impulse buying behavior: An investigation in the tourism field. *Heliyon*, *6*(8), e04667. https://doi.org/10.1016/j.heliyon.2020.e04667

20. Dunning, R., Levy, D., Watkins, C., & Young, G. (2018). Technological change and estate agents'' practices in the changing nature of housing transactions. *Housing Studies*, *34*(5), 849–867. https://doi.org/10.1080/02673037.2018.1487041

21. Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention, and behavior: An introduction to theory and research*. Addison-Wesley Pub. Co.

22. Gu, G., & Zhu, F. (2020). Trust and Disintermediation: Evidence from an Online Freelance Marketplace. *Management Science*, *67*(2), 794–807. https://doi.org/10.1287/mnsc.2020.3583

23. Guhr, N., Werth, O., Blacha, P. P. H., & Breitner, M. H. (2020). Privacy concerns in the smart home context. *SN Applied Sciences*, *2*(2). https://doi.org/10.1007/s42452-020-2025-8

24. Hair, J. F., Sarstedt, M., Hopkins, L., & Kuppelwieser, V. G. (2014). Partial least squares structural equation modeling (PLS-SEM). *European Business Review*, *26*(2), 106–121. https://doi.org/10.1108/ebr-10-2013-0128

25. Hair, J. F. (2017). *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)* (2nd ed.). Sage.

26. Hair, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M., Danks, N. P., & Ray, S. (2021). *Partial least squares structural equation modeling (PLS-SEM) using R: a workbook*. Springer.

27. Hair, J. F., Ringle, C. M., & Sarstedt, M. (2011). PLS-SEM: Indeed a Silver Bullet. *Journal of Marketing Theory and Practice*, *19*(2), 139–152. https://doi.org/10.2753/MTP1069-6679190202

28. Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European Business Review*, *31*(1), 2–24. https://doi.org/10.1108/EBR-11-2018-0203

29. Henseler, J., Hubona, G., & Ray, P. A. (2016). Using PLS path modeling in new technology research: updated guidelines. *Industrial Management & Data Systems*, *116*(1), 2–20. https://doi.org/10.1108/imds-09-2015-0382

30. Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, *43*(1), 115–135. https://doi.org/10.1007/s11747-014-0403-8

31. Hong, X., Zhang, M., & Liu, Q. (2021). Preschool Teachers'' Technology Acceptance During the COVID-19: An Adapted Technology Acceptance Model. *Frontiers in Psychology*, *12*. https://doi.org/10.3389/fpsyg.2021.691492

32. Hu, Z., Ding, S., Li, S., Chen, L., & Yang, S. (2019). Adoption Intention of Fintech Services for Bank Users: An Empirical Examination with an Extended Technology Acceptance Model. *Symmetry*, *11*(3), 340. https://doi.org/10.3390/sym11030340

33. Icek Ajzen. (1985). *From intentions to actions: a theory of planned behavior* (pp. 11–39). S.N.

34. Jud, G., Winkler, D., & Sirmans, S. (2002). The Impact of Information Technology on Real Estate Licensee Income. *Journal of Real Estate Practice and Education*, *5*(1), 1–16. https://doi.org/10.1080/10835547.2002.12091580

35. Kassner, A. J., Cajias, M., & Zhu, B. (2022). The PropTech investors'' dilemma – What are the key success factors that secure survival? *Journal of Property Investment & Finance*. https://doi.org/10.1108/jpif-01-2022-0007

36. Kaur, T., & Solomon, P. (2021). A study on automated property management in commercial real estate: a case of India. *Property Management*, *ahead-of-print*(ahead-of-print). https://doi.org/10.1108/pm-05-2021-0031

37. Kohli, R., & Melville, N. P. (2018). Digital innovation: A review and synthesis. *Information Systems Journal*, *29*(1), 200–223. https://doi.org/10.1111/isj.12193

38. Lizam, M. (2019). Digital Technology And The Real Estate Industry. *Sinergi: Jurnal Ilmiah Ilmu Manajemen*, *9*(2). https://doi.org/10.25139/sng.v9i2.1811

39. Low, S., Ullah, F., Shirowzhan, S., Sepasgozar, S. M. E., & Lin Lee, C. (2020a). Smart Digital Marketing Capabilities for Sustainable Property Development: A Case of Malaysia. *Sustainability*, *12*(13), 5402.

40. Low, S., Ullah, F., Shirowzhan, S., Sepasgozar, S. M. E., & Lin Lee, C. (2020b). Smart Digital Marketing Capabilities for Sustainable Property Development: A Case of Malaysia. *Sustainability*, *12*(13), 5402.

41. Mohd, L. (2019). Digital Technology And The Real Estate Industry. *Sinergi: Jurnal Ilmiah Ilmu Manajemen*, *9*(2), 42–46. https://doi.org/10.25139/sng.v9i2.1811

42. National Association of Realtors (2020). Profile of Home Buyers and Sellers Report. https://www.gaar.com/images/uploads/2020_NAR_Consumer_Profile.pdf

43. Oyetunji, A. K., Ojo, B., & Oyetunji, B. O. (2018). Factors Influencing the Deployment of ICT in Nigerian Real Estate Practice. *Journal of African Real Estate Research*, *3*(1), 1–20. https://doi.org/10.15641/jarer.v1i1.561

44. Park, E. S., & Park, M. S. (2020). Factors of the Technology Acceptance Model for Construction IT. *Applied Sciences*, *10*(22), 8299. MDPI. https://doi.org/10.3390/app10228299

45. Roulac, S. (2019). The Industrial Revolution Remembers. *Journal of Property Investment & Finance*, *37*(4), 380–397. https://doi.org/10.1108/jpif-02-2019-0023

46. Saiz, A. (2020). Bricks, mortar, and proptech. *Journal of Property Investment & Finance*, *ahead-of-print*(ahead-of-print). https://doi.org/10.1108/jpif-10-2019-0139

47. Sarstedt, M., Ringle, C. M., & Hair, J. F. (2017). Partial Least Squares Structural Equation Modeling. *Handbook of Market Research*, 1–40. https://doi.org/10.1007/978-3-319-05542-8_15-1

48. Sepasgozar, S. M. E., Hawken, S., Sargolzaei, S., & Foroozanfa, M. (2019). Implementing citizen centric technology in developing smart cities: A model for predicting the acceptance of urban technologies. *Technological Forecasting and Social Change*, *142*, 105–116. https://doi.org/10.1016/j.techfore.2018.09.012

49. Shaw, J. (2018). Platform Real Estate: theory and practice of new urban real estate markets. *Urban Geography*, *41*(8), 1–28. https://doi.org/10.1080/02723638.2018.1524653

50. Sing, T. F., & Zou, Y. (2021). Economic Values of Property Technology (PropTech) in Housing Markets. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3772412

51. Taherdoost, H. (2018). A review of technology acceptance and adoption models and theories. *Procedia Manufacturing*, *22*, 960–967. https://doi.org/10.1016/j.promfg.2018.03.137

52. Ullah, F., Sepasgozar, S. M. E., Jamaluddin Thaheem, M., Cynthia Wang, C., & Imran, M. (2021). It''s all about perceptions: A DEMATEL approach to exploring user perceptions of real estate online platforms. *Ain Shams Engineering Journal*. https://doi.org/10.1016/j.asej.2021.04.023

53. Venkatesh, V. (2000). Determinants of Perceived Ease of Use: Integrating Control, Intrinsic Motivation, and Emotion into the Technology Acceptance Model. *Information Systems Research*, *11*(4), 342–365. https://doi.org/10.1287/isre.11.4.342.11872

54. Venkatesh, V., & Bala, H. (2008). Technology Acceptance Model 3 and a Research Agenda on Interventions. *Decision Sciences*, *39*(2), 273–315. https://doi.org/10.1111/j.1540-5915.2008.00192.x

55. Verkijika, S. F. (2020). An effective response model for understanding the acceptance of mobile payment systems. *Electronic Commerce Research and Applications*, *39*, 100905. https://doi.org/10.1016/j.elerap.2019.100905

56. Yang, A. J.-F., Huang, Y.-C., & Chen, Y. J. (2017). The importance of customer participation for high-contact services: evidence from a real estate agency. *Total Quality Management & Business Excellence*, *30*(7-8), 831–847. https