Assessing the Optimal Digital Banking Model for Service Users in Thailand: A Structural Equation Modelling Approach to Risk Analysis

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Abstracts: Purpose –This study investigates the factors that influence the adoption of internet banking in Thailand. It specifically examines the interplay between six dimensions of perceived risk (financial risk, performance risk, privacy risk, security risk, social risk, and time risk), attitude, and trust, and their impact on behavioral intentions to use internet banking. Design/methodology/approach –A multi-stage sampling process was used to obtain a representative sample of 505 respondents in Thailand. Structural Equation Modeling (SEM) was used to analyze the data.Findings –The research outcomes suggest that the adoption and usage of internet banking services are influenced by several key factors, namely perceived risk, attitude, and trust. These factors play a significant role in shaping individuals' decisions and behaviors when it comes to engaging with online banking platforms. The findings also show that attitude and trust mediate the relationship between perceived risk and behavioral intention. Practical implications of this study extend to two key groups: internet banking developers, who can leverage the insights from this research to design user-centric systems aligned with the needs and lifestyles of their target users, and CEOs, who can establish effective and operational strategies and regulations to provide a competitive advantage for their organizations. Originality/value –This study contributes to the existing literature on internet banking adoption by providing a comprehensive understanding of the factors that influence this behavior. It also provides insights for internet banking developers and CEOs on how to design and promote internet banking services in a way that minimizes perceived risk and maximizes attitude and trust.

Keywords: Internet banking, perceived risk, attitude, trust, behavioral intentions to use, SEM

1. INTRODUCTION

Digital banking is a convenient way for customers to conduct financial transactions at their own time and location using mobile devices such as personal digital assistants (PDAs). This advancement in mobile technology has revolutionized the banking sector, providing customers with more control over their finances [1](Dighe, 2018); [2] Karjaluoto, Püschel, Mazzon, & Hernandez, 2010).

Banks around the world have been investing heavily in mobile banking, with global spending on mobile banking technology exceeding $115 billion [3](Lin, 2013; [4]Ali Abdallah Alalwan et al., 2017), a trend largely driven, in part, by the continuous progress in mobile and telecommunications technology. This digital banking revolution has proven highly beneficial for both banks and their clientele. It allows banks to efficiently serve their clients across vast geographical areas, especially in regions with limited internet connectivity or fewer traditional branch establishments [5] (Wessels & Drennan, 2010). The global mobile user base has seen significant growth, which in turn is anticipated to result in a substantial expansion of the mobile banking systems market. This growth is expected to attract a larger client base and effectively cater to the requirements of both customers and banks [6] (Luna et al., 2018). According to a study conducted by Compete, it is projected that the global mobile banking user base will approach the significant milestone of 1 billion within a few years [1] (Dighe, 2018). The increasing adoption of mobile banking has the potential to revolutionize the banking industry by providing convenient and customer-focused financial services.

As previously discussed, perceived risk in internet banking is categorized into external risk and internal risk, both of which can inhibit customer acceptance of this banking method. External risk arises from factors outside the customers' control, including financial transaction protection, online frauds, online platform issues, data security, and concerns related to social status. For example, [7] Albashrawi and Motiwalla (2019) found that risks associated with performance, time, finance, and security, negatively influence consumer perceptions regarding web-based

banking services, with performance risk also affecting perceived usefulness. Additionally, the study also demonstrated that consumer confidence has a significant impact on the degree to which they perceive risk, which, in turn, has a direct and indirect influence on customers' behavioral intentions, primarily mediated by their performance expectancy. It is important to emphasize that in this context, the overarching concept of perceived risk involves a spectrum of risk types, including but not limited to performance risk, financial risk, time risk, psychological risk, social risk, physical risk, privacy risk, and an overall assessment of risk.

Several studies have highlighted the importance of addressing perceived risk in internet banking adoption. Choi and Choi (2017) [8] found that perceived risk, as a higher-order factor, has a negative impact on performance expectancy and behavioral intentions towards internet banking in the mobile payment industry. Cocosila and Trabelsi (2016) [9] also found that customers' perceptions of privacy have a significant impact on their attitudes and intentions towards internet banking in Jordan. Park et al. (2019) [10] observed that various dimensions of total risk, including economic, functional, security, time, privacy, service, and psychological risks, have a significant impact on customers' trust levels and subsequently affect their intentions and evaluations of online payment systems, particularly among young Chinese customers. These findings suggest that external risk factors can have a negative impact on customers' trust in internet banking, which can, in turn, lead to lower levels of perceived usefulness and behavioral intentions.

To enhance customer confidence and minimize perceived risk associated with internet banking, financial institutions should develop strategic approaches. The goal is to reduce customers' perception of risk and increase their trust, which will positively impact their future intentions to adopt internet banking. There are three main areas of focus in this research area:

The first area involves determining the correlation between various dimensions of perceived risk and customers' inclinations to use internet banking services in Thailand. Identifying these associations highlights the importance of implementing service quality strategies to improve the quality of internet banking services.

The second aspect focuses on exploring mediators, such as attitude and trust, that play an intermediary role between the dimensions of perceived risk and customers' intentions to use internet banking in Thailand. This study seeks to determine whether service quality enhancement strategies can be integrated into risk mitigation, thereby raising service quality standards, and fostering trust among internet banking users.

The third aspect involves proposing effective strategies to address perceived risk. These strategies are designed to encourage stronger behavioral intentions to adopt internet banking. By implementing these strategies, banks can create an environment that fosters trust and confidence in internet banking services.

2. LITERATURE REVIEW

This study focuses on the examination of perceived risk as a key factor in defining and predicting individuals' mindsets, trust, and behavioral intentions towards the adoption of digital banking. A proposed research model (see Figure 1) is presented to address this research question. The following sections will explore the different variables proposed in this research and their expected relationships with behavioral expectations regarding the adoption and retention of digital banking services.

2.1 Behavioural Intentions to Use

A substantial body of literature in the field of internet banking (IB) has explored numerous factors and formulated various theories (Zhou, 2013[11]; Yang et al., 2015[12]; Tam and Oliveira, 2016) [13]. The acceptance of IB has generated substantial interest in the past few years, as evidenced by the growing body of research on the topic (e.g. Shao, et al., 2019[14]; Oliveira et al., 2016) [13].

Extensive research has been conducted to examine and validate various crucial factors that influence the consumer's intent and utilization of IB. In a research conducted by Martins et al. (2014) [13], a sample of 249 bank clients in Portugal was examined to investigate the factors influencing their decision to adopt IB. The study found that expectations of performance, effort, and social pressure were significant factors in determining customers' inclination towards adopting IB. In a study conducted by Yang et al. (2015) [12], a significant correlation was discovered between the utilization of IB services and the intention to engage in related behaviors. According to an investigation conducted by Riffai et al. (2012)[14] in Oman, it was found that several factors, namely expectations of performance, effort, user-friendliness, and web design, played a significant role in influencing the intent to utilize IB services. Based on a study carried out by Albashrawi and Motiwalla (2019)[7], customers' perceptions regarding their competence and capability to utilize technological user interfaces had a substantial impact on their inclination to adopt different self-service platforms, like e-payments and e-commerce. Al-Somali et al. (2009) [15] in Saudi Arabia found that the perceived ease of use of IB significantly contributed to both the perceived value and consumer perceptions of this service.

The research on internet banking (IB) adoption in Jordan is limited, with only a few studies having been conducted (i.e., Al-Smadi, 2012 [16]; Al-Majali, 2011[17]; AbuShanab et al., 2010[18]). Although these studies have helped us understand important factors that influence IB adoption in Jordan, certain essential predictors like intrinsic motivation and habit have been overlooked [7](Albashrawi and Motiwalla, 2019; [10] Park et al., 2019). Additionally, the concept of perceived value, especially regarding aspects like price value, remains insufficiently explained in the context of Jordanian studies. This indicates a need to delve into the value customers associate with using IB, as it can significantly influence their intentions and behavior towards IB adoption [8](Choi and Choi, 2017; [10]Park et al., 2019). It is also important to study how intrinsic motivation affects both customers' perceived value of IB services and their perception of the usefulness of these services. Additionally, future research should explore the associations across all functional utilities, such as perceived worth and performance expectancy, and customer-perceived value in the context of IB. This would provide valuable information regarding the determinants that shape consumers' predisposition to adopt and use IB services.

2.2 Perceived Risk

The concept of risk perceptions in measuring the experience of using m-banking apps is not limited to a single construct but encompasses multiple aspects. The idea of consolidating various facets of risk into a higher-order construct was first proposed by Featherman and Pavlou in 2003[19]. Cox further categorized perceived risk into two main sets: performance risk and psychosocial risk, each comprising three and two sub-categories, respectively. Cunningham (1967) [20], on the other hand, identified six significant aspects of perceived risk, namely: performance, financial, opportunity, safety, social, and psychological risks. Featherman and Pavlou (2003) [19] also carried out a comprehensive investigation to analyze the impact of perceived risk on the adoption of e-services. The study focused specifically on privacy risk, which was operationalized as the potential data breach and the overall risk construct was derived from the work of Baganzi and Lau in 2017.

Featherman and Pavlou (2003) [19] defined financial risk as the fear or anxiety associated with potential monetary losses incurred during a transaction facilitated by a mobile banking (m-banking) application. This apprehension may also include the potential loss of financial information while using the app. One of the reasons behind this perception is that m-banking app transaction is purely virtual, unlike traditional bank transactions that provide physical vouchers (Namahoot and Laohavichien, 2018[20]; Park et al., 2019[10]). Consequently, if any issues arise during the funds transfer process, customers encounter difficulties in reporting and reclaiming their lost money. Hence, customers consider the risk of losing their funds through m-banking as relatively high.

Performance risk in an m-banking application refers to the possibility of incorrect results delivery [8](Choi and Choi, 2017). This can occur due to various factors such as connectivity, operating system, capacity of processors, the level of adaptability of the app to different mobile devices [21](Khalilzadeh et al., 2017). For instance, the m-banking app, may malfunction, leading to incomplete transactions (Featherman & Pavlou, 2003[19], Namahoot & Laohavichien, 2018[20]). As a result, the association between performance risk and m-banking app has been verified using the subsequent hypothesis.

Privacy risk in an m-banking context pertains to the potential threat that users' personal and sensitive information may be exposed, accessed, or mishandled in a way that infringes upon their privacy. This risk encompasses the possibility of unauthorized access to financial data, transaction details, personal identifiers, and other confidential information stored or transmitted through the mobile app. Unauthorized access by hackers can result in the misuse and exploitation of this information for fraudulent or malicious purposes, and thus, mitigating privacy risks is crucial to ensure the confidentiality, security, and privacy of users' financial and personal data in the digital banking environment (Featherman and Pavlou, 2003[19]; Khalilzadeh et al., 2017[21]; Namahoot and Laohavichien, 2018[20]). The utilization of the m-banking app is perceived by customers as a potential threat to their privacy. Therefore, to explore this connection, we examined the following hypothesis.

Psychological risk in the context of m-banking app usage refers to the potential concerns and anxieties that users may experience when engaging with the app due to factors related to their psychological well-being. Unsuccessful transactions through the app can lead to feelings of frustration, anxiety, or loss of self-esteem. Such experiences may even challenge the customer's self-image (Yang et al., 2015) [12]. Several studies have also found that older customers may be hesitant to use m-banking apps because of the perceived psychological risk involved. For example, older customers may be worried about making mistakes, being scammed, or losing their money. Additionally, they may not be comfortable using technology or may have difficulty learning how to use new apps (Namahoot and Laohavichien, 2018) [20]. Therefore, it is essential to conduct an evaluation of the psychological risk associated with the utilization of these applications. This necessity is substantiated by the subsequent hypothesis.

Security risk in an m-banking app represents the potential vulnerabilities and threats that can compromise the confidentiality, integrity, and availability of a user's financial and personal information when using the app. It involves various risks related to unauthorized access, data breaches, fraud, identity theft, and other security breaches that could harm the user's financial well-being and privacy. These security concerns can impact customer trust (Nilashi et al., 2015) [22] and the perceived quality of service offered by the bank (Khalilzadeh et al., 2017) [21], resulting in a loss of confidence in using the m-banking app in the future (Patel & Patel, 2018) [23]. These concerns related to security can have an influence on the trust that customers place in the m-banking app (Nilashi et al., 2015) [22], and can also affect how customers perceive the overall quality of service provided by the bank (Khalilzadeh et al., 2017) [21]. Consequently, this can result in a decreased confidence among users in using the m-banking app in the future, as demonstrated in the research conducted by Patel and Patel (2018) [23]. The following hypothesis explores how security risk affects the customer experience:

The concept of social risk pertains to the potential negative consequences that individuals may face in terms of their social standing as a result of utilizing m-banking applications. Customers who engage in m-banking express concerns about potential negative perceptions from their friends and family (Featherman and Pavlou, 2003) [19]. This apprehension stems from the possibility that the behavior associated with using m-banking applications may not be widely accepted by other members of society (Khalilzadeh et al., 2017) [21]. Hence, it is imperative to ascertain the presence of any correlation between consumer experience and social risk.

Time risk refers to the potential challenges, uncertainties, or inconveniences users may have about the amount of time required to complete transactions or access services within the app. It involves concerns such as delays in processing transactions, slow app performance, or difficulties in quickly accessing necessary information or services when needed (Featherman and Pavlou, 2003) [19]. Additionally, learning how to use the app effectively can also consume valuable time. Moreover, application developers regularly release updates for the app, which require syncing with the mobile device to enhance services [8] (Choi and Choi, 2017). Moreover, reinstallation and utilization of the app can lead to time loss due to potential downtime, authentication requirements, learning curve, transaction delays, and user frustration, impeding efficient access to banking services. Therefore, the goal of the following hypothesis is to analyze how time risk affects user experience.

2.3 Trust

Trust has been a subject of various definitions in research. Moorman et al. (1993) [24] define trust as the desire to place trust in a person for the purpose of engaging in business. Morgan and Hunt (1994) [25] offer a similar perspective, explaining trust as the presence of belief in the dependability and honesty of a business partner involved in a trade. Based on the research conducted by Deutsch in 1960, trust can be defined as a concept that encompasses two fundamental elements: confidence in one's ability and confidence in one's intention.

Before people can be persuaded to adopt a new technology, they need to have some knowledge and awareness of it. However, knowledge and awareness alone are not enough. People also need to believe that the technology is reliable and trustworthy, and that the people behind the technology are reliable and trustworthy (Rogers and Shoemaker, 1971) [25]. Trust becomes particularly important in situations involving risk and uncertainty, as highlighted by Mayer et al., (1995) [26], and given the virtual nature of the online environment, it becomes susceptible to various types of risks. As uncertainty is highly anticipated in life, trust emerges as a vital component (Zhou, 2013[11]; Gao and Waechter, 2017[27]). In the context of internet banking, where face-to-face interaction between clients and bankers is non-existent, the reliance on internet-based delivery further underscores the significance of trust (Yap and Sweeney, 2007) [28].

Trust is a fundamental factor in shaping customers' attitudes and inclination towards online banking. Customers who trust their bank are more likely to use its online services. This trust can be built through traditional banking channels, such as in-branch visits, as well as through online security measures and customer-friendly policies.

Several studies have highlighted the importance of trust in online banking. For example, Flavian et al. (2006) [20] found that customers' trust in their bank has a significant impact on their intention to use online banking. Woldie et al. (2008) [29] and Park et al. (2019) [10] also emphasized the importance of trust and security in boosting customers' confidence in online banking. Zhu et al. (2017) [30] identified the lack of security as a primary barrier to online banking adoption. Gao and Waechter (2017) [27] further confirmed that trust plays a paramount role in influencing customers' usage of online banking.

To overcome trust issues in online banking, banks should identify and analyze relevant factors impacting clients' trust (Yap et al., 201) [28] and subsequently develop well-defined online banking strategies that can effectively build trust and confidence among their customer base, ultimately leading to increased customer loyalty and satisfaction ([31] Popoola and Arshad, 2015; [10] Park et al., 2019; [32] Moga et al., 2012). Banks should also cultivate strong customer relationships to foster trust in online banking (Nel and Heyns, 2017) [33].

Previous studies have acknowledged the significance of trust in shaping customers' attitudes and inclination towards the adoption of mobile banking technology (Zhou, 2013[11]; Gao and Waechter, 2017[27]; Nel and Heyns, 2017) [33]. The connection between the unique nature of electronic banking services, which is marked by a significant level of uncertainty, and the high degree of risk of financial services has been identified as possible contributing variables (Hanafizadeh et al., 2014) [34].

2.4 Hypotheses Formulation and Framework Proposal

As described by Featherman and Pavlou (2003)[19], perceived risk in an IB app refers to the subjective sense of uncertainty and concern that users might have about potential negative outcomes or vulnerabilities associated with using the app for financial transactions. Numerous studies have focused on issues related to perceived risk [7](Albashrawi and Motiwalla, 2019; [10] Park et al., 2019) and recognized them as critical negative factors affecting consumer intentions and adoption of IB (Nel and Heyns, 2017)[33]. Online banking is a complex and uncertain environment, with many factors that can influence customer trust. These factors include the intangibility of the service, the heterogeneity of the customer base, and the ambiguity of the online environment. Additionally, the lack of human interaction in online banking can make it difficult for customers to build trust with their bank ([19]Featherman and Pavlou, 2003 [7]Albashrawi and Motiwalla, 2019; [10] Park et al., 2019). Therefore, this study hypothesizes that:

Hypothesis 1: **Perceived risk significantly influences individuals' attitudes towards digital banking adoption.**

Hypothesis 2: **Perceived risk significantly influences individuals' trust towards digital banking adoption.**

Several studies have been conducted to examine the factors that influence the perception of risks in mobile banking and online shopping. Notable studies by Albashrawi and Motiwalla (2019) [7] and Park et al. (2019) [10] have shown that these factors can hinder the growth of the mobile payment industry, as highlighted by Choi and Choi (2017) [8]. Perceived risks have been shown to have a negative impact on consumer acceptance of mobile payment and trust in this payment method. Yang et al. (2015) [12] found that perceived risks reduce consumer acceptance, while Park et al. (2019) [10] found that they also reduce consumer trust. These findings highlight the importance of addressing and mitigating perceived risks to promote consumer acceptance and trust in mobile payment systems.

Studies have also shown that factors such as perceived usefulness, favorable attitude, and service quality have a positive impact on consumer inclination towards mobile payment adoption. For example, de Luna et al. (2018) [6] found that perceived usefulness is a significant factor in influencing consumer adoption, while Park et al. (2019) [10] highlighted the importance of a favorable attitude. Additionally, Liébana-Cabanillas et al. (2019) [35] emphasized the role of service quality in shaping consumer inclination towards adopting mobile payment methods. These findings suggest that factors such as perceived usefulness, favorable attitude, and service quality play a crucial role in influencing consumer behavior towards mobile payment adoption. Mobile payment has also been shown to have a positive impact on consumers' perception of in-store prices, leading to a higher willingness to pay. Falk et al. (2016) [36] found that this is likely due to the convenience and perceived value of mobile payment methods.

Security, trust, and risk have been identified as key factors influencing mobile payment adoption. Oliveira et al. (2016) [13] and Shao et al. (2019) [14] found that security is a crucial factor, while Zhou (2013) [11] and Gao and Waechter (2017)[27] found that trust is also important. Cocosila and Trabelsi (2016) [9] found that perceived risk also plays a role in adoption. These factors collectively contribute to the understanding of the complexities surrounding mobile payment adoption and provide valuable insights for businesses operating in this domain.

While the literature has extensively highlighted the importance of perceived risks, further research is required to gain a deeper understanding of consumers' attitudes towards these risks and their relationship with various consumer segments. Recent studies by Liébana-Cabanillas et al. (2019)[35] and Park et al. (2019) [10] have shed light on this topic and provide valuable insights for future research in this area.

Hypothesis 2: **Perceived risk directly influences consumers' trust in using internet banking.**

According to Albashrawi and Motiwalla (2019) [7] and Park et al. (2019) [10] , customers' lack of confidence in banks' ability to manage risks, such as performance, financial, time, or personal risks, is a major barrier to internet banking adoption. Instances of hackers affecting banking operations or technical problems leading to system failures have the potential to adversely impact customer confidence in using banking services. Therefore, it is crucial for banks to implement security measures, such as providing a security code, to enhance customer trust and promote the growth of internet banking [8](Choi and Choi, 2017).

To minimize the psychological risk that prevents customers from using internet banking, banks should devise strategies and focus on shared values between customers and the institution. When banks take steps to reduce customers' perceived risks, customers are more likely to view their services favorably and adopt online banking. In fact, research has shown that minimizing or eliminating perceived risks can lead to a significant increase in customers' willingness to use online banking [10] (Park et al., 2019; [7]Albashrawi and Motiwalla, 2019). However, it is important to note that different people have different risk tolerances. Some people may be more comfortable with online banking than others, even if the perceived risks are the same. This is why it is important for banks to offer a variety of security features and options to meet the needs of all their customers (Bussakorn and Dieter, 2005)[37].

Hypothesis 3: **Attitude directly influences behavioural intentions in digital banking adoption.**

According to Zhou (2013) [11], trust is the customers' collective understanding and belief that a product or service is reliable and dependable. This encompasses various aspects such as customer objections, attributes, and the ultimate benefits that the customers associate with a particular commodity. Trust is a fundamental concept in both societal and individual contexts, hinging on the crucial element of honesty between parties (Amijaya, Herman, & Sulhaini, 2021)[38]. Gao and Waechter. (2017)[27] posited that trust plays a crucial role both prior to and subsequent to transactions. Zhou (2013) [11] conducted a study that revealed trust as a significant driver of online purchasing behavior and usage, with its foundation primarily influenced by integrity factors. According to a study by Farivar et al. (2017)[39], trust is identified as a significant psychological state that has an impact on an individual's personal nature. This influence is observed in the individual's motivation to adopt and utilize new technologies. As a result, this study hypothesizes that:

The concept of consumer trust in mobile banking refers to a multifaceted construct comprising various cognitive and affective components, namely ethics, compassion, and ability. These components collectively contribute to the development of a consumer's propensity to place reliance on mobile banking platforms for conducting financial transactions. This perspective is supported by the findings of Gao and Waechter (2017)[27], who have explored the factors influencing consumer trust in mobile banking. The existing body of literature has consistently highlighted the pivotal role of trust in influencing client perceptions and intentions towards mobile banking (Hanafizadeh, et al., 2014)[34]. This finding has been corroborated by multiple studies, which have underscored the significant implications of trust on customer intentions (Amijaya, Herman, & Sulhaini, 2021[38]; Gao and Waechter, 2017[27]). In the realm of mobile banking, trust has emerged as a prominent factor influencing its usage, as substantiated by Zhou's (2013) [11] research. Moreover, the acceptance of mobile banking among Iranian consumers has been found to be driven by perceived credibility and trust, as evidenced by the studies conducted by Hanafizadeh et al. (2014)[34] and Gao and Waechter (2017)[27].

The theory proposed in this study suggests that trust may indirectly affect business intelligence (BI) by increasing the significance of relative advantage. Relative advantage refers to the perceived benefits of using mobile banking over other banking channels. When customers trust their bank and believe that mobile banking is the best option for them, they are more likely to use BI to improve their business performance. Therefore, this study proposes the following hypothesis:

Hypothesis 4: **Trust directly affects behavioural intentions in digital banking adoption.**

Despite previous empirical studies failing to find evidence that perceived risk, trust, and service quality mediate the relationship between service quality and behavioral intentions to use internet banking in Thailand, this study aims to investigate the potential indirect influence of service quality and behavioral intentions on internet banking utilization. Specifically, this study explores the mediating role of perceived risk and trust (H5 and H6).

Hypothesis 5: **Perceived risk indirectly influences behavioral intentions in the adoption of digital banking through attitude as a mediator.**

Hypothesis 6: **Perceived risk indirectly influences behavioral intentions in the adoption of digital banking through trust as a mediator.**

Drawing on theoretical frameworks and empirical evidence, this research paper proposes a set of hypotheses to evaluate the factors that influence individuals' behavioral intentions to use internet banking services. It also develops a comprehensive model (Figure 1) to illustrate the relationships between these factors. The study focuses on evaluating various factors that significantly impact business performance, including service quality, perceived risk, and trust. Perceived risk and trust are considered intervening variables in this study. The primary data collection method was a questionnaire-based survey conducted in Thailand in 2016. A comprehensive analysis using structural equation modeling (SEM) was conducted on a sample of 500 valid questionnaires. The study aimed to gain insights into how internet banking can improve the overall image of a bank by investigating the impact of

perceived risk and trust on individuals' behavioral intentions to use internet banking services. It also sought to address security concerns and identify potential future challenges.
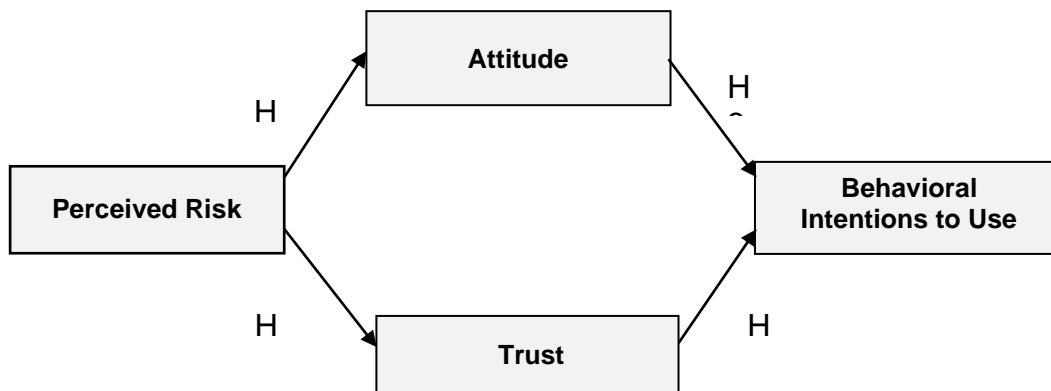

Figure 1. The Research Framework

3. METHODOLOGY

3.1 Data Collection, Sampling, and Population

Due to the extensive size of the population and limited data available to researchers regarding the total number of individuals, researchers utilized WG Cochran's formula (Cochran, 1953)[40] for sample size determination, which resulted in a minimum of 385 participants.

To select participants, this study used a multi-stage sampling approach. First, the researchers collected comprehensive data from all 14 major banks in Thailand that offer internet banking services. They then used cluster sampling to group the banks into three categories based on size: large, medium, and small, as defined by the Bank of Thailand in 2015.

Next, the researchers used a simple random sampling technique, called the lottery method (Koul, 1984)[41], to select half of the banks from each of the three size categories. As a result, the remaining sample sizes were as follows: 2 banks from the large category, 2 banks from the medium category, and 3 banks from the small category.

In the third stage of the research process, researchers used quota sampling to ensure that the sample groups were representative of the population. They aimed to have a minimum of 400 respondents, with 50% (200) from large banks, 35% (140) from medium banks, and 15% (60) from small banks (Battaglia and Michael, 2008)[42].

The data collection process involved the utilization of online questionnaires, which were administered to respondents who were selected based on three specific inclusion criteria: (1) respondents must be Thai nationals who hold savings account in any Thai commercial banks; (2) must be a registered online banking user; and (3) must have experience in utilizing internet banking. The research employed a snowball sampling technique, wherein participants were systematically chosen based on recommendations received from their social network, including friends and acquaintances.

The distribution of online questionnaires was conducted through the utilization of e-mail and social media (Couto *et al.*, 2013)[43]. The process began by selecting the initial respondent using a simple random sampling technique. The initial respondents subsequently provided recommendations for additional participants or distributed online questionnaires to individuals who possessed previous involvement with online banking services. The online questionnaires were specifically designed to collect data from participants, taking into account their gender, age, education level, occupation, and income. This approach was implemented to ensure a thorough examination of internet banking services offered by each bank, that includes a wide range of demographic characteristics. The study's sample size was found to be adequate in meeting the research objectives.

3.2 Variable Measurement

Since this study aimed to answer research questions and test hypotheses, a survey was the best method. The main data collection tool was a structured questionnaire, which was adapted from the following research instruments to ensure relevance and validity:

- Perceived Risk scale (6 variables, 20 items): Adapted from Featherman and Pavlou (2003) [19], Albashrawi and Motiwalla (2019) [7], and Park et al. (2019) [10]

- Attitude measurement (4 items): Adapted from Han and Baek (2004)[44], Rod et al. (2009)[14], and Nimako et al. (2013)[45]

- Trust scale (3 variables, 9 items): Adapted from Zhou (2013) [11] and Amijaya, Herman, and Sulhaini (2021)[38]

- Behavioural Intentions to Use (3 items): Derived from the studies conducted by Rogers (2010)[25] and Nel and Heyns (2017)[33]

Participants were asked to indicate their responses to each statement by marking the 5-point Likert scale, where 1 represents "Strongly Disagree" and 5 represents "Strongly Agree."

3.3 Measurement Validation

To ensure the reliability and validity of the research instrument, a preliminary test was conducted before administering the main survey. The initial evaluation involved a representative sample of 30 individuals who possessed previous knowledge on leveraging internet banking services in Thailand. They were subsequently requested to provide feedback on the various aspects of the instrument, including its structure, word choice, formatting, language used, and the phrasing of the rating scales. Their feedback was then used and analyzed using IBM SPSS version 20 to confirm the reliability and validity of the research measurements. A reliability test was performed on a total of 54 items included in the questionnaire. The results of this test revealed a Cronbach's alpha coefficient of 0.903, which exceeds the suggested threshold value of 0.7. This indicates a high level of internal consistency and reliability of the questionnaire items (Hair et al., 2010) [46].

4. DATA ANALYSIS AND RESULTS

This study used a variety of statistical methods to analyze the data, including frequency and descriptive statistics (averages, percentages, variances, and tests for normality to assess unidimensionality), confirmatory factor analysis (CFA), convergent validity (average variance extracted, AVE), discriminant validity, and structural equation modeling (SEM). These methods were utilized to assess the reliability and validity of the data collected, as well as to examine the relationships between the variables under investigation. The use of SEM as a confirmatory method has been widely recognized as a valuable approach for assessing and enhancing theoretical models (Anderson & Gerbing, 1988)[47].

4.1 Characteristics of the Respondents

A demographic analysis of the 505 respondents showed that the majority were women (57%), aged 31-35 (37.00%), with undergraduate degrees (52.30%), employed as government servants (28.50%), and earning monthly incomes above 20,000 Baht (48.7%). About 36.60% of the respondents had 1-3 years of experience using internet banking.

4.2 Test for Normality

A three-stage approach was used to develop the measurement model. In the first stage, we checked to make sure that the data was normally distributed. This is important because many statistical tests assume that the data is normally distributed. We used skewness and kurtosis values to assess normality. All the model items had skewness and kurtosis values within the acceptable range of -2.0 to 2.0 and -7.0 to 7.0, respectively.

In the second stage, we assessed the internal consistency of the scales and the reliability of the constructs using Cronbach's alpha. Cronbach's alpha is a measure of reliability that is commonly used in social science research. It should be above the common threshold of 0.70. After refining the questionnaire and conducting a reliability test on the 51 items, the Cronbach's alphas for the four constructs, were SQ: 0.926, PCR: 0.902, TRUST: 0.849, and BI: 0.880.

However, the Cronbach's alpha for the observed variable of social risk was below 0.7, so we removed items PS1 and PS2 from the analysis model. The results of these analyses are presented in Table 1.

Table 1. Construct Reliability Findings

Constructs	Observed Variables	Cronbach's Alpha (α)	
Perceived Risk		**0.902**	
	Financial risk (PF5, PF6)	0.831	
	Psychological risk (PY7, PY8, PY9)	0.712	
	Performance risk (PP10, PP11, PP12)		
	Privacy risk (PR14, PR15, PR16)	0.782	
	Time risk (PT17, PT18, PT19, PT20)		0.806
			0.804
Attitude	ATT1, ATT2, ATT3 and ATT4	**0.880**	
Trust		**0.849**	
	Competence (TA1, TA2, TA3)	0.868	
	Benevolence (TB4, TB5, TB6)	0.852	
	Integrity (TI7, TI8, TI9)	0.205	
Behavioural Intentions to Use	BI1, BI2, and BI3	**0.880**	

To assess the reliability of the measurement model, the standardized regression weights of each individual item were analyzed. Items with standardized factor loadings below 0.6 were removed, as recommended by Hair et al. (2010)[46]. Eleven items did not meet this criterion and were therefore excluded: PF4, SP13, SP10, SR5, SR7, ST2, PP13, PT18, SE20, SE21, and SE22. Composite reliability and AVE were calculated using completely standardized solutions in the CFA results (Hult et al., 2004)[48].

4.3 Convergent Validity

The analysis of standardized loadings and validity (Table 2) demonstrates that all observed values (factor loadings, CR and AVE) meet the predetermined criteria. This suggests that the convergent validity of the research findings is satisfactory based on the available data.

The assessment of convergent validity in this present inquiry was conducted using three criteria, namely factor loadings, CR, and AVE, as suggested by Fornell and Larcker (1981)[49]. Factor loadings measure how strongly the items on a scale are related to a latent variable. CR assesses the consistency of results by measuring the extent to which items are free from random error. AVE gauges the proportion of variance explained by the latent variable relative to random measurement error. All three of these criteria should exceed certain thresholds to indicate satisfactory convergent validity. Specifically, factor loadings should be above 0.6 (Suh and Han, 2003)[50], CR values should be above 0.7 (Hair et al., 2010)[46], and AVE values should be above 0.5 (Fornell and Larcker, 1981)[49]. All observed values (factor loadings, CR, and AVE) in Table 2 meet the predetermined criteria. The examination of standardized loadings and validity, as presented in Table 2, reveals that all observed values (factor loadings, CR, and AVE) satisfy the predetermined criteria. The available data indicates that the convergent validity of the research findings is deemed satisfactory.

4.4 Discriminant Validity

To assess whether the constructs were distinct, we calculated the square root of AVE for each construct. Then, we compared this value to the correlations between the variables and other constructs to determine their distinctiveness from one another (Fornell and Larcker, 1981)[49].

Table 2. Assessment of Standardized Loadings and Validity

Model and Constructs	Standardized Loadings Variability	CR	AVE	Discriminant Validity			
				1	2	3	4
Attitude	0.056 – 0.72	0.787	0.480	0.693			
Perceived risk	0.54 – 0.95	0.927	0.723	-0.611	0.850		
Trust	0.56 – 0.91	0.933	0.823	0.689	-0.640	0.907	
Behavioral intentions to use	0.76 – 0.93	0.886	0.723	0.430	-0.545	0.644	0.850

Based on the results, the square root of the AVE values is significantly higher than the correlation values (as shown in Table 2). This outcome further supports the existence of robust discriminant validity of the constructs included in this investigation.

4.5 Measurement Model Assessment

During the second phase of the study, a broad set of 39 items was employed to assess the effectiveness and efficiency of the CFA framework. The adequacy of the SEM was contingent upon its capacity to accurately reproduce the observed covariance matrix of the indicator variables. The evaluation of model fit encompassed the analysis of multiple indices, which were classified into four distinct categories as proposed by Hair et al. (2010)[46]: (1) Chi-square measures, which comprise of degree of freedom (df), associated probability, and chi-square statistics; (2) Absolute fit measurements, which consist of Root Mean Square Residual (RMR), Root Mean Square Error of Approximation (RMSEA), and Goodness-of-Fit Index (GFI); (3) Parsimony fit measures, which include Parsimony Normed Fit Index (PNFI) and adjusted Goodness-of-Fit index (AGFI); and (4) Incremental fit measures, which include Normed Fit Index (NFI) and the Comparative Fit Index (CFI).

Iacobucci (2010)[51] noted that the chi-square (χ2) statistic is the only inferential statistic among the SEM fit indices, while the others are descriptive. This means that the chi-square test can be used to test the null hypothesis that the model fits the data perfectly, while the other indices provide guidance on how well the model fits the data.

The data in Table 3 and Figure 3 show that the measurement model demonstrated satisfactory fit (χ^2 = 1061.81, df = 360, p-value > 0.05). This is supported by the other fit indices, which are all within acceptable ranges (RMSEA = 0.062, RMR = 0.045, CFI = 0.919, IFI = 0.920, TLI = 0.909, AGFI = 0.846, and PNFI = 0.722).

4.6 Test of Hypotheses and Structural Model Analysis

Table 3. Evaluation of Model Fit Using Fit Indices

Fit indices	Fit Criteria	Measurement Model
Chi Square (χ2)		1139.72
Degrees of freedom		362
P-value (probability)	≥ 0.5	0.000
CMIN (χ2)/DF	< 3.00	3.000
RMSEA (Root Mean Square Error of Approximation)	≤ 0.05	0.050
RMR (Root Mean Square Residual)	≤ 0.05	0.048
CFI (Comparative Fit Index)	≥ 0.9	0.911
TLI	≥ 0.8	0.900
IFI	≥ 0.9	0.911
AGFI (Adjusted Goodness-of-Fit Index)	≥ 0.8	0.838
PNFI (Parsimonious Normed Fit Index)	≥ 0.5	0.720

The final analysis of the study revealed a significant relationship between the three variables and behavioral intentions to use internet banking, with an R-squared value of 0.428. This indicates that the three hypotheses, H1, H2, and H4, explained 44.8% of the variance in behavioral intentions. All three hypotheses were strongly supported by the findings, with beta coefficients of -0.656 (p ≤ 0.00), 0.682 (p ≤ 0.00), and 0.627 (p ≤ 0.00), respectively. However, Hypothesis H3 (β = 0.056, p ≤ 0.346) was rejected, as it did not show a significant relationship between the two variables (Table 4, Figure 2).
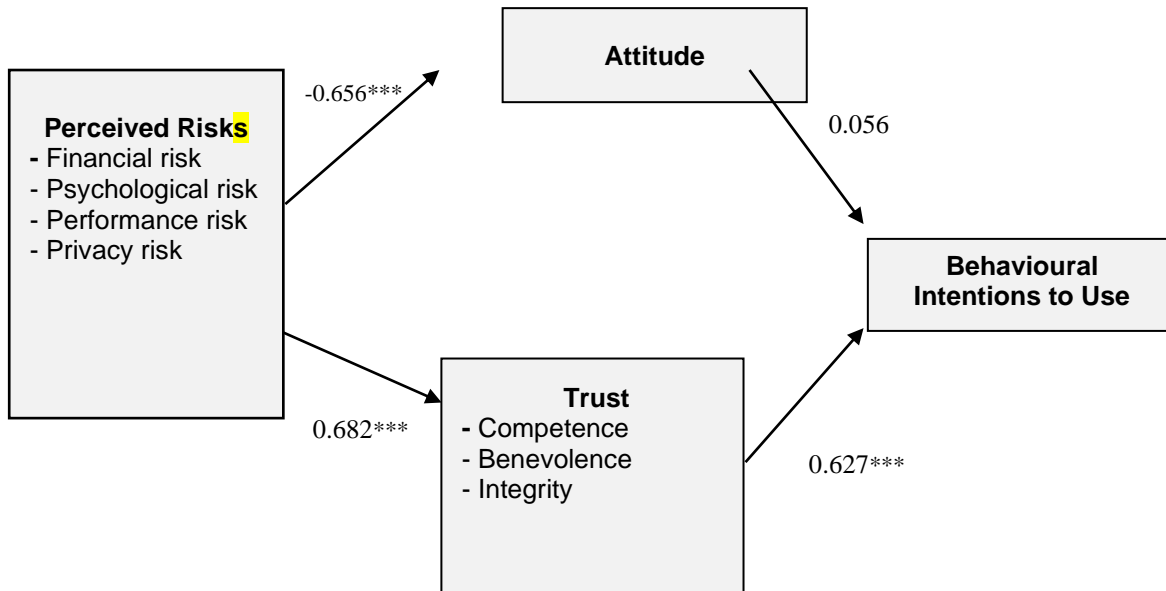
Figure 2. Summary of Structural Model Outcomes
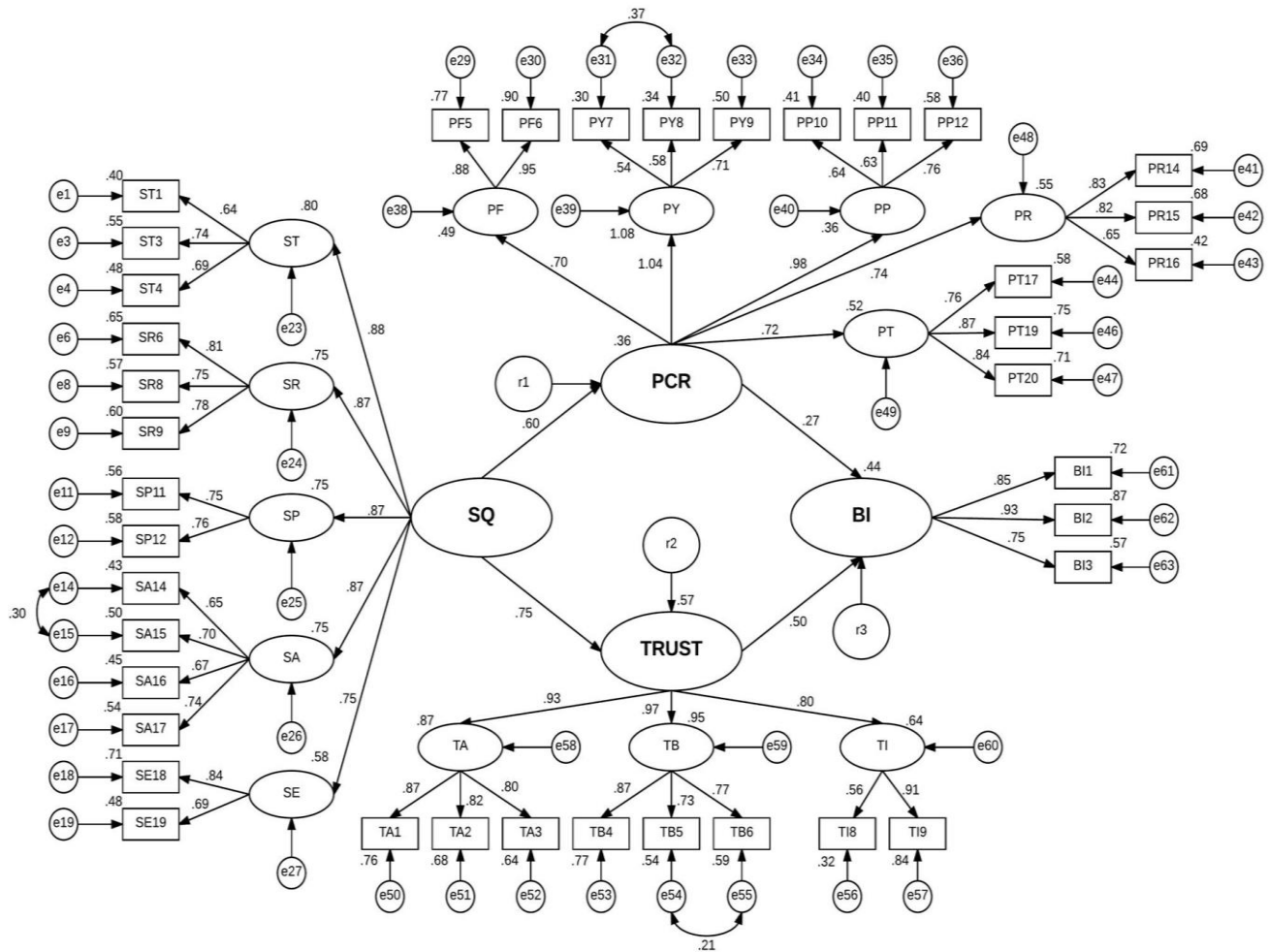
Figure 3. Structural Model Analysis Findings

The indirect effects of perceived risk on BI through attitude and trust were comparable. To assess the difference in the indirect effects, a bootstrapped sampling distribution was generated with 2000 replications. In Amos 21, a user-defined estimate can be used to test the difference in indirect effects. The findings of the study support hypotheses H5 and H6, indicating that attitude and trust mediate the relationship between perceived risk and BI. The indirect effect of perceived risk on BI through attitude and trust ($\beta = 0.509$, $p \leq 0.000$) was significantly greater than the indirect effect of perceived risk on BI through attitude alone ($\beta = -0.043$, $p \leq 0.00$).

Table 4. Summary of Effects and Hypotheses Testing Results

Hypotheses	Result	Standardized Estimates
H1: Perceived risk directly influences attitude and behavioral intentions towards internet banking adoption.	Supported	-0.656***
H2: Perceived risk directly influences trust on behavioral intentions in internet banking adoption.		0.682***
H3: Attitude directly influences behavioral intentions in internet banking adoption.		
H4: Trust directly influences behavioral intentions in internet banking adoption.	Supported	
H5: Perceived risk indirectly affects behavioral intentions to utilize internet banking services as facilitated by attitude.		**0.056**
	Not Supported	
H6: Perceived risk indirectly affects behavioral intentions to utilize internet banking as mediated by trust.		0.627***
	Supported	-0.043***

	Supported
	0.509***
	Supported

5. Discussion

The data analysis has revealed a few significant findings, and their interpretations and implications are discussed as follows:

First, perceived risks are strong predictors of people's intentions to adopt internet banking in Thailand, based on their attitude and trust. The first and second hypotheses were supported, indicating that perceived risk has a strong negative effect on people's attitude towards internet banking (β = -0.656, p ≤ 0.000), and a significant positive effect on their trust in adopting online services (β = 0.682, p ≤ 0.00). This highlights the importance for banks to focus on improving performance, as it can effectively reduce perceived risk and increase trust, thereby influencing customers' behavioral intentions to adopt online banking. Financial risk and performance risk emerge as key factors influencing business outcomes, emphasizing the need for banks to prioritize these risks as integral components of their strategic approach [7](Albashrawi and Motiwalla, 2019; Park et al., 2019) [10].

This study has identified five key types of perceived risk that significantly impacted behavioral intentions in the adoption of online banking in Thailand. These risks were categorized as financial, psychological, performance, time, and privacy risks. For instance, customers expressed concerns about system failures, errors, and performance issues related to internet banking utilization (performance and psychological risks), potential financial losses during transactions (financial risk), privacy breaches and data theft (privacy risk), and time-consuming processes (time risk). To encourage customer engagement, businesses must address the perceived concerns related to these risks. By implementing efficient systems that mitigate these concerns, businesses can expect an increase in customer utilization of web-based banking services.

This research has successfully identified the possible role of higher-order dimensions in effectively reducing perceived risk and consequently establishing credibility in online banking adoption. These dimensions are ranked as follows: financial, performance, psychological, privacy, and time risks. Among these, the "financial risk" dimension holds the utmost significance for internet banking in Thailand, with a substantial loading factor of 0.88 (Figure 2). This emphasizes the significance of integrating additional security features beyond standard banking services, including privacy measures, protection against financial frauds, relevant loss prevention information, location-based bank details, transaction accuracy reminders, and more. The performance risk, privacy risk, and psychological risk dimensions also play a crucial role, as they hold the same significant factor loading of 0.87. To address performance risk, internet banking systems should ensure accurate and complete transaction processing, as well as maintain consistency. Privacy risk, and psychological risk are equally important, necessitating secure transactions and prompt service that align with consumers' ease-of-use and convenience. However, it is worth noting that these dimensions based on the results of the study differ from those reported by Albashrawi and Motiwalla (2019) [7] and Park et al. (2019) [10], where customers' perceived risks expectations were ranked in the following order: performance risk, privacy risk, and psychological risk (highest expectations), followed by time risk (which did not contribute to building trust). These differences may underscore the significance of cultural and regional variations in consumer preferences and expectations in internet banking.

Secondly, perceived risk is a key factor in influencing individuals' behavioral intentions towards utilizing internet banking services. This implies that customers' inclination towards utilizing internet banking services is directly influenced by their perception of declining risk. In other words, when people feel that there is less risk involved in internet banking, they are more likely to use the services. These findings align with previous studies conducted by Albashrawi and Motiwalla (2019) [7] and Park et al. (2019) [10].

This study highlights the importance of reducing psychological risk for internet banking users. Banks should educate customers about how easy the internet banking system is to use, which can help to reduce anxiety. By

making sure that the system is easy to access and use, users will gain confidence in real-time financial transactions, leading to continued use and positive word-of-mouth recommendations.

However, a study by Cocosila and Trabelsi (2016)[9] found different results, both in the order and number of perceived risk factors. Cocosila and Trabelsi (2016)[9] identified three out of the six perceived risk factors as significant influencers of behavioral intentions towards internet banking in Portugal. These risk factors, ranked in the following order, were performance risk, financial risk, time risk, and privacy risk.

Third, trust plays a pivotal role in shaping customers' attitudes and perceptions towards online banking, affecting their decision to use such platforms. Customers with higher degree of confidence and trust are more inclined to use various services. Our research in Thailand has shown that three key components are essential for building trust in internet banking: benevolence, the belief that the bank has good intentions and cares about the customer's well-being; competence, the belief that the bank has the skills and knowledge to provide reliable services; and integrity, the belief that the bank is honest and fair. For example, Thai users highly value the following factors when assessing the trustworthiness of internet banking: accountability of online financial transactions, accuracy and promptness of the internet banking system, reputation, competence, and integrity of the bank in managing financial entities, completeness of financial information, and the bank's ability to keep user information confidential (Zhou, 2013) [11].

Our study's findings differed from Zhou (2013) [11] research. They examined three trust-building components (Calculative, Predictive, and Identification) to predict trust levels in relation to individuals' intentions in internet banking adoption in China. Despite similar research results, there were distinctions in the components used. One instance is their use of the Calculative factor in measuring potential dishonesty and opportunistic actions, which aligns with our concept of Integrity. The Predictive factor in their study evaluated the effectiveness of internet banking processes, staff knowledge, and capability to manage online services, similar to our concept of competence. Our understanding of identification is related to feeling treated well and fairly by banks, which is the same as the concept of benevolence in our study.

5.1 The Mediating Functions of Attitude and Trust

This current investigation found that trust is a more significant factor in predicting people's intentions to use internet banking than their attitude towards it ($\beta = 0.509$, $p \leq 0.00$ and $\beta = -0.043$, $p \leq 0.00$, respectively). When considering factors that indirectly influence perceived risk and behavioral intentions, trust emerges as the most significant variable. This suggests that if individuals foster trust and perceive lesser risks in adopting online banking services, they are more likely to use it.

To capitalize on this insight, banks can devise strategies that prioritize service quality, fostering trust and minimizing risks for consumers. The three attributes of trust, namely, benevolence, competence, and integrity, should also be considered in developing their banking strategies. For example, to enhance user experience and ensure account security, banks should implement a robust notification system integrated with account access. This system will promptly alert users of any account activity, detecting unauthorized actions or potential breaches in real-time. Users will also be notified during their legitimate transactions, distinguishing them from fraudulent attempts. Such a proactive approach mitigates risks, builds customer trust, and fosters a secure banking environment. Allowing users to access their transaction history conveniently enhances satisfaction and engagement. The system should offer seamless assistance and support round the clock to meet users' needs with comfort and assurance.

Although trust has a stronger mediating influence than perceived risks, it is important to acknowledge that perceived risks still has a positive function in internet banking adoption. Our study highlights the significance of all five risk dimensions – psychological, performance, financial, privacy, and time – as influential factors in user behavior and decision-making. To ensure customer satisfaction, financial institutions must have a reliable banking system that minimizes transaction failures. The ideal service should be comprehensive, meeting diverse user needs and providing a seamless one-stop experience.

5.2 Implications for Theory

Our findings show that people in Thailand who are part of the late majority are more concerned about the possibility of unreasonable charges from internet banking, which is a type of perceived risk. We used six dimensions of perceived risk in internet banking adoption to model potential factors that may influence customer satisfaction and behavioral intentions in Thailand: financial risk, social risk, psychological risk, performance risk, privacy risk, and time risk.

Previous studies on behavioral intentions in internet banking adoption, such as the research by Chang, W-L. et al. (2023)[52], have not given much attention to mediating variables like perceived risk and trust. However, our findings show that attitude and trust can indeed act as mediating variables, significantly improving the model's ability to predict behavioral intentions for internet banking.

By combining perceived risk, attitude, and trust models, our study achieved a predictive capability of 72.80% for behavioral intentions towards internet banking in Thailand. In comparison to other studies of behavioral intentions in the context of internet banking, our research demonstrated stronger predictive accuracy than Chang, W-L. et al. (2023)[52], who used TAM with self-efficacy as an additional variable and focused on users in Taiwan, China, and Japan. Their model explained 62.78%, 62.84%, and 59.43% of intentions in Taiwan, China, and Japan, respectively, using variables such as risk, internet experience, and facilitating conditions.

5.3 Implications for Practice

Minimizing perceived risk can positively influence attitude and trust among the users, ultimately impacting their behavioral intentions towards using internet banking services.

Early adopters in Thailand are particularly concerned about financial risk, performance losses, and privacy risks. These findings align with previous research, which has shown that early adopters prioritize these risks [9](Cocosila and Trabelsi, 2016; Wang et al., 2019)[53]. Mobile payment usage trends in China show a similar pattern: higher usage is associated with loss and performance concerns, while lower usage is associated with privacy concerns. These insights are significant because they draw from data across three different countries in the same region, which allows for comparative analysis. This analysis can offer valuable guidance to mobile payment operators entering these markets, as well as to policy makers and researchers focusing on the developed Asia Pacific region. The findings of this study can also help mobile operators in Thailand to diversify their approaches to cater to varying customer demands and maintain competitiveness. To effectively address the needs of clients, banks should consider the following strategies:

1. Strengthen security measures by enforcing password reset procedures and stringent identity verification. Prevent data theft by requiring identity documents for manual password reset. Implement an advertising policy to educate users on identity theft prevention and establish a financial support system for anti-corruption efforts. Comply with information technology laws to enhance information security services, reducing perceived risks associated with internet banking.

2. Offer customization features, allowing users to modify colors and create personalized themes for their on-screen appearance. Implement voice transaction support and provide clear instructions to assist users, ensuring ease-of-use and a seamless banking experience.

3. Develop a fast and convenient online banking platform tailored to users' lifestyles and needs. Promote internet banking through media publicity and special promotions, such as fee reductions. Offer attractive incentives like free money transfers, bill payments, and gifts to encourage users to adopt the service. Familiarity with internet banking will save users time and money, and consequently increasing their confidence and trust in the service.

Conclusion

This study investigated the relationship between perceived risk, attitude, trust, and behavioral intentions to use internet banking in Thailand. The results showed that perceived risk is directly related to attitude and trust, and that it indirectly influences behavioral intentions to use internet banking through attitude and trust as mediating factors. The impact of perceived risk and trust on individuals' behavioral intentions in internet banking adoption was statistically significant ($p < 0.001$).

These findings have important implications for the understanding of perceived risk and its impact on internet banking adoption. The study highlights the importance of understanding how attitude and trust mediate the relationship between perceived risk and behavioral intentions. It also provides valuable insights into the key perceived risk factors that influence users' intentions to adopt internet banking. This information can be used by the banking industry to develop effective policies and strategies for improving and developing internet banking services.

Future research should consider using the model developed in this study to analyze the generalizability of the findings to people who do not currently use internet banking or to those who are dormant users. It is also recommended to conduct additional research to identify the various factors that may influence people who do not use internet banking services. Additionally, it would be interesting to compare the characteristics and behaviors of internet banking users across different income brackets.

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