

DIGITAL BANKING TECHNOLOGY ADOPTION AMONG
ISLAMIC BANKS IN INDONESIA

BY

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ABSTRACT

Digital banking technology has enabled banks to provide digital banking services through internet banking and mobile banking, better known as digital banking. Driven by increased internet usage and the participation of the younger generation, digital banking has become a vital aspect of financial services for Indonesian banks, including Islamic banks. Furthermore, the impact of the COVID-19 pandemic has amplified the importance of banks' adoption of digital technology. However, the adoption of digital technology poses significant challenges, primarily due to a sizable investment, while Indonesian Islamic banks encounter a limited budget to invest in digital technology. Therefore, Islamic banks need to select a priority for services in digital banking. This study identified five objectives concerning digital banking adoption by Islamic banks in Indonesia: (i) to explore the current state of digital banking adoption among Islamic banks in Indonesia by analysing documents of Islamic banks; (ii) to explore the priority of the type of services in digital banking by Islamic banks in Indonesia from the bank perspective; (iii) to explore determinants in considering the priority of the type of services in digital banking by Islamic banks in Indonesia from the bank perspective; (iv) to examine bank-specific factors in determining the decision to adopt digital banking among banks offering Islamic banking services; (v) to examine market-specific factors in determining the decision adopting digital banking among banks offering Islamic banking services. This study adopted qualitative and quantitative methods, namely, document analysis to explore the current state of digital banking adoption, Analytic Network Process (ANP) to explore the priority of the types of services in digital banking, and Logistic Regression to examine determinants influencing digital banking adoption. The finding shows that Islamic banks in Indonesia have offered almost all the services in digital banking by using multi-channel, except for protection and investment services. The findings reveal that fund transfer and payment services emerge as the highest-priority services, while technology—specifically its security and associated risks—is identified as the most crucial criterion to be considered for digital banking services adoption by Islamic banks. Furthermore, all the bank-specific factors, along with market-specific factors, are found to significantly influence the adoption of digital banking among banks offering Islamic banking services, except for the labour cost. In particular, the COVID-19 pandemic has encouraged digital banking adoption by banks. Integration of multiple theories and inclusion of the Sharia aspect into the model have contributed to extending theories in the study of technology adoption. Considering the context and sample selection, this study is limited to digital technology adoption in the context of Islamic banking in Indonesia and does not consider the case of conventional banking. This study recommends that Islamic banks design a roadmap to implement the adoption of digital banking services based on the priority of service types offered by Islamic banks. For regulators, the findings contribute to policymakers for consideration in promoting digital banking development. Unlike other studies in digital banking, this study integrated multiple theories, applied mixed methods, and incorporated the Sharia aspect into the ANP model to prioritise digital banking services in Islamic banking from the bank's perspective, making it unique.

خلاصة البحث

أصبحت الخدمات المصرفية الرقمية جانبًا حيويًا من الخدمات المالية للمصارف الإندونيسية، بما في ذلك المصارف الإسلامية، مدفوعة بزيادة استخدام الإنترنت ومشاركة جيل الشباب. علاوة على ذلك، أدى تأثير جائحة (كوفيد-19) إلى تضخيم أهمية اعتماد المصارف للتكنولوجيا الرقمية. ومع ذلك، فإن اعتماد التكنولوجيا المصرفية الرقمية يطرح تحديات كبيرة، ويرجع ذلك في المقام الأول إلى الاستثمار الكبير، ففي حين تواجه المصارف الإسلامية الإندونيسية ميزانية محدودة عند اعتماد وتطوير التكنولوجيا الرقمية في الخدمات المصرفية، تحتاج المصارف الإسلامية إلى تحديد أولوية للخدمات المقدمة في الخدمات المصرفية الرقمية أثناء تقديمها للخدمات المالية. تحدد هذه الدراسة خمسة أهداف تتعلق باعتماد الخدمات المصرفية الرقمية من قبل المصارف الإسلامية في إندونيسيا، وهي: (1) استكشاف الوضع الحالي لاعتماد الخدمات المصرفية الرقمية بين المصارف الإسلامية في إندونيسيا، من خلال تحليل وثائق المصارف الإسلامية. (2) دراسة أولوية نوع الخدمات المقدمة في الخدمات المصرفية الرقمية التي تقدمها المصارف الإسلامية في إندونيسيا من منظور المصرف. (3) دراسة المحددات عند النظر في أولوية نوع الخدمات في الخدمات المصرفية الرقمية التي تقدمها المصارف الإسلامية في إندونيسيا من منظور المصرف. (4) دراسة العوامل الخاصة بالمصرف في تحديد قرار اعتماد الخدمات المصرفية الرقمية بين المصارف التي تقدم الخدمات المصرفية الإسلامية. (5) دراسة العوامل الخاصة بالسوق في تحديد قرار اعتماد الخدمات المصرفية الرقمية بين المصارف التي تقدم الخدمات المصرفية الإسلامية. تتبنى هذه الدراسة منهجًا نوعيًا وكميًا، بمشاركة (14) مشاركًا، من (8) مصارف إسلامية، و(3) هيئات تنظيمية مصرفية، و(3) أكاديميين. تم تطبيق عدة أساليب للتحليل لتحقيق أهداف الدراسة. أولاً، تم تطبيق تحليل الوثائق باستخدام التقرير السنوي للمصارف الإسلامية لاستكشاف الوضع الحالي لاعتماد الخدمات المصرفية الرقمية. ثانياً، تم استخدام أسلوب عملية الشبكة التحليلية (ANP) لاختيار أهم الخدمات في الصيرفة

الرقمية التي تقدمها المصارف الإسلامية، وأهم المعايير التي يجب مراعاتها في أولوية نوع الخدمات في الصيرفة الرقمية. في هذه الدراسة، تتضمن طريقة عملية الشبكة التحليلية مشاركين من الهيئات التنظيمية المصرفية، ومديري المصارف الإسلامية، والأكاديميين ذوي الصلة بالصيرفة والتمويل الإسلامي. أخيراً، تم تطبيق الانحدار اللوجستي للتحقيق في العوامل الخاصة بالمصرف، والعوامل الخاصة بالسوق التي تؤثر على اعتماد الخدمات المصرفية الرقمية بين المصارف التي تقدم خدمات مصرفية إسلامية باستخدام بيانات من عام (2010) إلى عام (2022). وقد أظهرت النتائج أن المصارف الإسلامية في إندونيسيا لم تقدم جميع الخدمات في الخدمات المصرفية الرقمية للعملاء. وقد اعتمدت معظم المصارف الإسلامية القنوات المتعددة لتقديم الخدمات المصرفية الرقمية. كما كشفت النتائج أن خدمات تحويل الأموال والدفع تبرز بوصفها الخدمات ذات الأولوية القصوى، في حين تم تحديد التكنولوجيا -على وجه التحديد أمنها والمخاطر المرتبطة بها- باعتبارها المعيار الأكثر أهمية الذي يجب مراعاته عند اعتماد الخدمات المصرفية الرقمية من قبل المصارف الإسلامية. علاوة على ذلك، وُجد أن العوامل الخاصة بالمصرف مثل حجم المصرف، والربحية، ونوع المصرف، وعمر المصرف، والملكية، إلى جانب العوامل الخاصة بالسوق، مثل تركيز السوق، واعتماد المنافسين، واعتماد العملاء، تؤثر بشكل كبير على اعتماد الخدمات المصرفية الرقمية بين المصارف التي تقدم الخدمات المصرفية الإسلامية. كما كشفت النتائج أيضاً أن جائحة (كوفيد-19) قد شجعت المصارف على تبني الخدمات المصرفية الرقمية. وقد أوصت هذه الدراسة المصارف الإسلامية بضرورة تبني الخدمات في مجال الصيرفة الرقمية، نظراً للأهمية النسبية لتلك الخدمات. كما أنه من المستحسن أن تقوم الجهة التنظيمية بتشجيع سياسة توحيد المصارف، والتي ينبغي إجراؤها بحذر من خلال النظر إلى حجم المصرف.

APPROVAL PAGE

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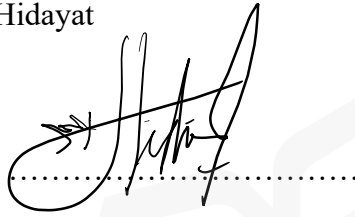
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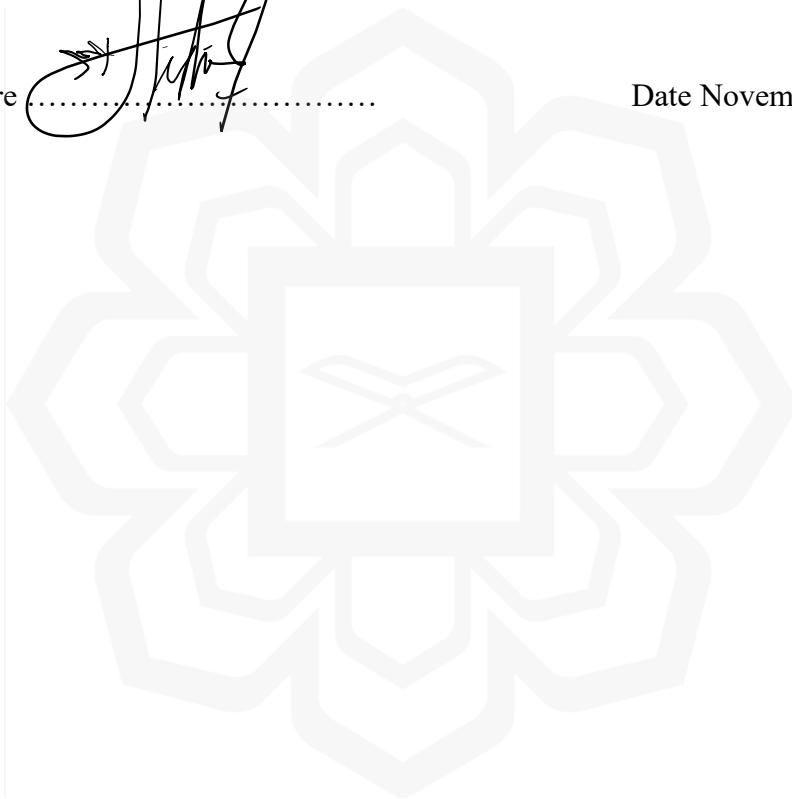
I hereby declare that this thesis is the result of my own investigations, except where otherwise stated. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at IIUM or other institutions.

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“Allah will raise those who believe among you and those who were given knowledge,
by many degrees. And Allah is All-Aware of what you do.”

(Surah Al-Mujadila, 58:11)



This thesis is dedicated to my beloved family:

My wife, my daughters, and my son.

Thank you for all the support I have received.

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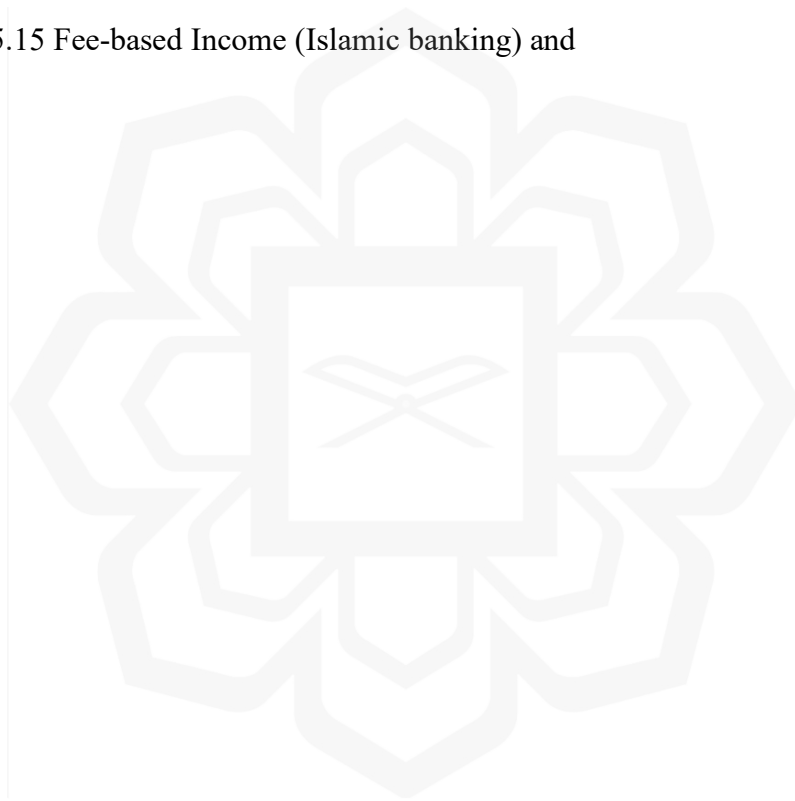
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LIST OF ABBREVIATIONS

2LL	2 Log Likelihood
AHP	Analytic Hierarchy Process
ANP	Analytic Network Process
ATM	Automated Teller Machine
BCBS	Basel Committee on Banking Supervision
BI	Bank Indonesia
BMI	Bank Muamalat Indonesia
BPRS	Bank Perkreditan Rakyat Syariah
BUS	Bank Umum Syariah
COVID	Coronavirus Disease
CR	Consistency Ratio
DBS	Digital Banking Adoption Share
DOI	The Diffusion of Innovation
HHI	Herfindahl-Hirschmann Index
IDR	Indonesia Rupiah
IFC	International Finance Corporation
IV	Instrumental Variable
KNKS	Komite Nasional Keuangan Syariah
LR	Likelihood Ratio Test
MMC	Multi-Market Contact
OJK	Otoritas Jasa Keuangan
PC	Personal Computer
POJK	Peraturan Otoritas Jasa Keuangan
PwC	PriceWaterhouseCoopers
QR	Quick Response
ROA	Return on Assets
ROI	Return on Investment
SMS	Short Message Services
SSB	Sharia Supervisory Board
UAE	United Arab Emirates
USD	US Dollar
UTAUT	The Unified Theory of Acceptance and Use of Technology
UUS	Unit Usaha Syariah
VIF	Variance Inflation Factor
WAP	Wireless Access Protocol
WOS	Web of Science

CHAPTER ONE

INTRODUCTION

1.1 OVERVIEW

Technological advancement has enabled innovations in financial services to take place. Van Horne (1985) revealed that innovations may take the form of a new product or a new process that may modify the existing innovations. The adoption of Automated Teller Machines (ATM) in the 1970s is an example of innovation in financial services. Afterwards, with the diffusion of the Internet to the people, digital technology has been adopted to enhance banking products and services through digital banking. Internet banking and mobile banking, which are categorised as digital banking, emerged to enable financial services progress in the 1990s and 2000s, respectively (Mullan et al., 2017; Thakor, 2020).

Internet banking and mobile banking represent the digital banking channel (Shaikh & Karjaluo, 2016; Garzaro et al., 2020). Customers access the bank's website to use internet banking services, whilst mobile banking is accessed through mobile devices. In the more advanced services, digital banking employs large-scale automation across front-end and back-end systems, advanced digital analytics connected to the banking ecosystem (Maiya, 2017), extensive use of technology (Lumpkin & Schich, 2020), and wholly or almost wholly banking business carried out through digital or electronic means (Bank Negara Malaysia, 2020).

With the booming internet technology, internet banking and mobile banking as a medium delivery channel have become more preferable to the customers compared to the physical banking model (Shah & Clarke, 2009; Liebana-Cabanillas et al., 2013). The benefits to the bank as well as to the customers have been the motive for banks to adopt internet banking and mobile banking as part of their products and services (Takeddine & Sun, 2015). Digital banking enables banks to provide financial transactions anytime and anywhere, which satisfy the customers' banking needs. It also enables banks to deliver banking services more conveniently, as well as to improve

customer experience relative to prior delivery channels such as physical branches or ATMs. By adopting digital banking, banks expect to obtain performance improvement, particularly financial performance. Digital banking adoption can create a competitive advantage for banks, retain the customer base and cut costs (Laukkanen, 2016). Banks may increase revenue from the additional fees charged to customers who use digital banking services.

Several conditions have been identified to pave the way to innovation in financial services. Technology has been identified as one of the conditions supporting innovation for financial services to take place (van Horne, 1985; Schindler, 2017). For instance, the usage of the internet has spread and increased rapidly. Internet users have reached 4.66 billion globally as of January 2021, which is equal to 59.5% of the global population (Datareportal, 2021). Globally, 92.6% or 4.32 billion internet users access the internet using mobile devices (Datareportal, 2021a). The compound annual growth rate (CAGR) of internet users achieved 7.01% from 2015 to 2024 globally (Datareportal, 2024).

Similarly, Indonesia has undergone a positive growth in the usage of the internet, as illustrated in Figure 1.1. Internet users reached 190.92 million users in 2020, and the users are estimated to increase to 239 million users by 2026 (Statista, 2021b). According to Datareportal (2021b), internet users in Indonesia have reached 202.6 million users as of January 2021, which is equal to 73.7% of the total Indonesian population. 96.4% of users have been accessing the internet using mobile devices such as smartphones (Datareportal, 2021b). The growth (CAGR) of internet users in Indonesia was higher than the global growth of internet users (Figure 1.1). Indonesia's internet users grew 14.55% (CAGR) from 57.4 million users in 2015 to 195 million users in 2024 (Datareportal, 2024). High internet users have promoted the diffusion of the internet to the people and provoked financial innovation in financial services, utilising digital technology. The use of mobile internet has also facilitated the increase in e-commerce transactions, supported by the ownership of smartphones and mobile phones (ADB, 2020).

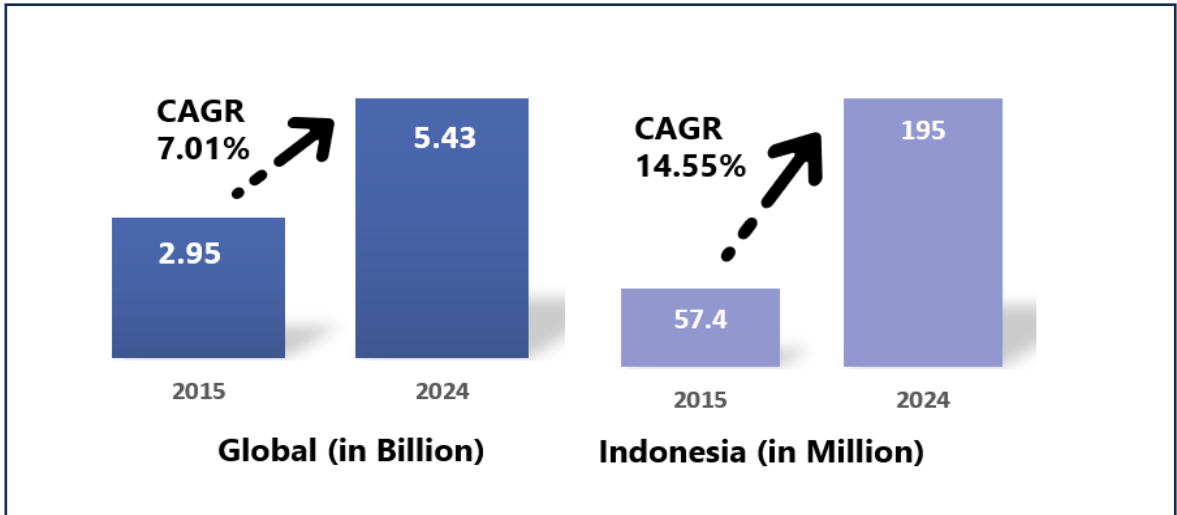


Figure 1.1 Number of Internet Users Worldwide and in Indonesia
(Source: Datareportal, 2024)

Schindler (2017) contended that demographics have contributed to the growth of innovation in the financial sector. The younger generation, generally represented by Gen Y and Gen Z in society, contributes to the spread of technological advancement as they tend to be more familiar with new technology. The younger generation is more familiar with the use of new technology, and they use the technology intensively. Consequently, they will demand more convenient financial services as they are familiar with innovative products and services. The younger generation has also been a substantial group of people in Indonesia. Statistics on Indonesian demographics have shown that the younger generation (Gen Y & Z) is the largest group of people in Indonesia, accounting for almost 60% of the demographics (Bank Indonesia, 2019). They are the dominant internet users in Indonesia, accounting for around 65% (APJII, 2024). The figure becomes higher when incorporating Post-Gen-Z into the group (Figure 1.2). Younger generation participation has played an important role in the diffusion of digital technology, particularly digital banking (Rahman et al., 2024).

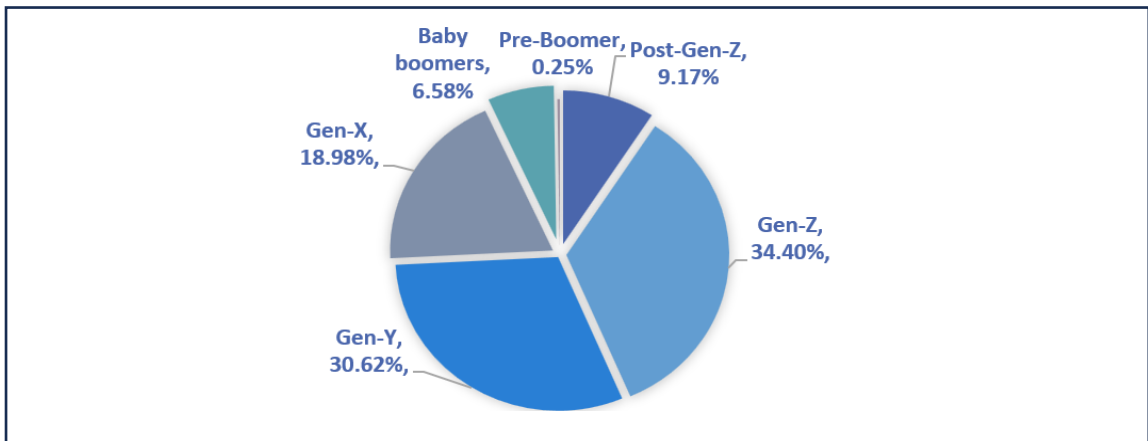


Figure 1.2 Demographic Distribution of Internet Users in Indonesia (2024)
(Source: APJII, 2024)

Furthermore, the COVID-19 outbreak has increased the awareness of technology as a way to overcome challenges in daily life activities (Dutta, 2020). It has also affected consumer behaviour transactions, including banking transactions (IFSB, 2020). In Indonesia, digital transactions during and post-COVID-19 were higher than before COVID-19, as illustrated in Figure 1.3. Before COVID-19, digital transaction users had achieved 3.512 million transactions. During and post-COVID-19, digital transactions reached 4.959 million transactions in 2020 and 7.772 million in 2021. The COVID-19 outbreak has changed consumer behaviour in transactions, prioritising cashless transactions and minimising physical contact by embracing digital financial services (IFSB,2020; Dutta, 2020; Mariani et al., 2021; Rahman et al., 2024).

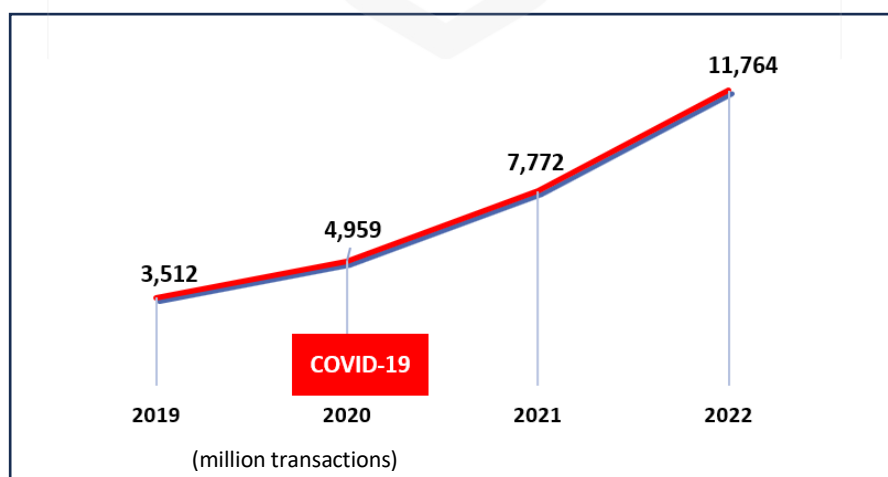


Figure 1.3 Digital transactions before, during, and after COVID-19
(Source: www.bi.go.id, the researcher's calculation)

The Indonesian banking sector, a dual banking system in which Islamic banking operates alongside conventional banking since the issuance of Banking Act No.7/1992, with the first Islamic bank established in 1992 (Kasri & Kassim, 2009; Ismal, 2011), has embraced digital banking. Digital technology in banking has an important role in Indonesian banking development. Indonesia Financial Services Authority / Otoritas Jasa Keuangan (OJK) has outlined accelerating digital transformation as the strategic direction of national banking for the period 2020-2025 to address the challenges of banking (OJK, 2021c). The Indonesian Islamic Banking Development Roadmap 2020-2025, designed by OJK, has promoted digitalisation in Islamic banking as the key factor for supporting Islamic banking development in Indonesia (OJK, 2021a).

According to the PricewaterhouseCoopers (PwC) Survey on digital banking in Indonesia (2018), 66% of respondents who represent Indonesian banks have embraced digital strategy as a business strategy and not merely as an information technology initiative. The survey indicated that the digital transformation journey has been started by large banks. It also revealed that smartphone mobile banking applications are preferable to Internet banking. Most of the respondents adopted a digital strategy aimed at enhancing customer experience, followed by revenue growth and cost reduction, respectively.

According to Wimboh Santoso, Chairman of the Board of Commissioners of the Indonesian Financial Services Authority, Islamic banking products have been underperforming compared to conventional banking products (Intan, 2021). In addition, the quality of information technology in Islamic banking has been in a sub-optimal state (OJK, 2023) and relatively poorer than conventional banking (Nurahman, 2022). Islamic banks are encouraged to create competitive products empowered by technology.

Islamic banking products and services should comply with the Sharia principle in all legal requirements and operational aspects (Laldin and Furqani, 2016), including digital banking services. Improvements in operating systems or software and upgrading the hardware are required to enable IT to support product development that aligns with the Sharia. For instance, general ledger entries or code for the balance sheet (Ahmed, 2011), IT modules aligned with Sharia contracts in recording, calculating and reporting (OJK, 2021a). Islamic banks are encouraged to select and develop technology that

enables them to support the products and services that align with the Sharia principle (OJK, 2021a).

The Diffusion of Innovation Theory revealed that compatibility with the norms or values may increase the rate of technology adoption (Sahin, 2006; Mullan et al., 2017). For Islamic banks, it is essential to comply with the Sharia, as violations of the Sharia will lead to a negative impact at the bank level and the Islamic banking industry (Ahmed, 2011). In addition, another theory, the Unified Theory of Acceptance and Use of Technology, identified that environmental pressure may promote the adoption of technology (Venkatesh et al., 2003; Raza et al., 2019). Islamic banks operate in a competitive environment which requires the products to fit the market in order to compete with other Islamic banks. Financial innovation has enabled banks to meet these interests efficiently. However, banks are more likely to efficiently adopt technology by considering the ease-of-use to fulfil their needs, as the Diffusion of Innovation Theory and UTAUT have been posited.

Furthermore, it is important to have a diversification of services offered through digital banking aimed at satisfying customer needs. Customers have various financial needs that the banks need to provide for. The service categories offered to the customers play an important role in customers' adoption decisions (Laukkanen, 2016). To fulfil customer needs through the provision of Islamic banking products and services, Islamic banks tend to replicate conventional products (Laldin & Furqani, 2016), as well as being criticised for merely changing terminology (Chaudhry et al., 2017). Islamic banks need to innovate their products and services to meet various Islamic transactions (Ismal, 2011). The development of financial technology could potentially help advance the Islamic banking industry (Indonesian Ministry of National Development Planning, 2019). In this regard, Islamic banks need to adopt and adapt to new technology in financial services to respond to environmental change and meet customers' needs and expectations.

Banks that have not adopted digital banking may encounter several challenges. One of them is the threat brought upon by fintech (financial technology). Currently, fintech can replicate various services being offered by the bank, which leads to the disaggregation of banking services such as lending, mutual funds, and remittance (Bank

Indonesia, 2019). The advantages of the bank will be reduced eventually, leading to the potential loss of market share. Not adopting digital banking may lead to customers switching to banks that provide digital banking services; hence, potentially reducing the profit for the banks that have yet to follow suit (He, 2015).

Despite the importance of digital banking adoption, Indonesian banking, including Islamic banking, has experienced issues with digital banking services adoption and development. A survey conducted by Bank Indonesia (2019) demonstrated that the adoption rate of digital banking is still relatively slow. The survey divided the digital transformation of banks into three quadrants: Quadrant I is the banks with IT developed (digital as a business in general), Quadrant II is the banks with digitalisation (digital as a business unit), and Quadrant III is the digital native bank. None of the banks surveyed was at digital level 2.0 (Quadrant III - digital native). Most of the banks surveyed were still at the IT development level (Quadrant I). Several banks with large assets have achieved digital level 1.0 (Quadrant II), whilst banks with small assets were still behind. This result was in line with PwC's survey on digital banking in Indonesia, which suggests that digital transformation has already begun in larger banks than in smaller banks.

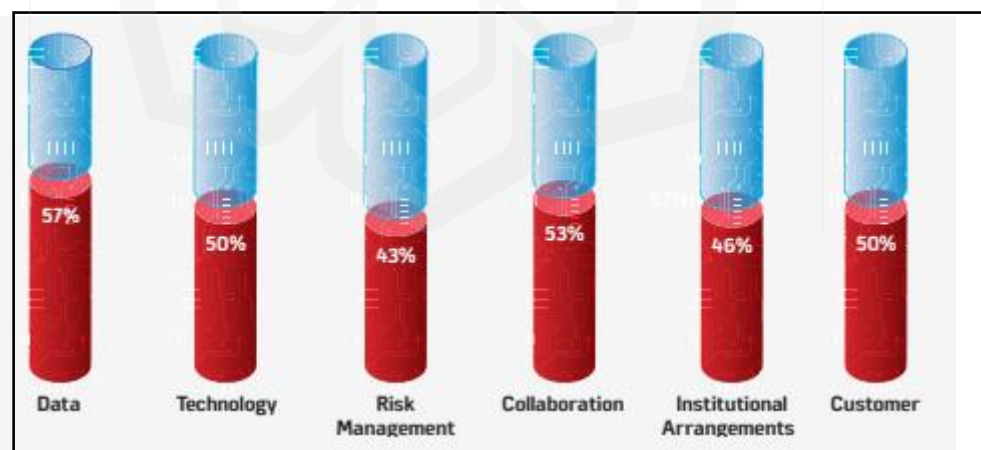


Figure 1.4 Digital maturity assessment for a bank
(Source: OJK, 2021b)

In addition, OJK's digital maturity assessment for banks (OJK, 2021b) has shown that banks in Indonesia have not reached the optimal level, as shown in Figure 1.4. Of the six dimensions of digital maturity for the bank, four dimensions comprising data, technology, collaboration and the customer had reached 50% or slightly less than 50% which suggests an adequate but not optimal level. Two dimensions comprising risk management and institutional arrangements were below 50% which suggests the level was less than optimal. These issues need to be addressed by Islamic banks in order to compete in the market.

1.2 PROBLEM STATEMENT

The bank requires resources, especially financial resources, to embrace and develop digital banking. The adoption of services is influenced by the availability of perceived control; for instance, the availability of resources enables the adoption, whilst the high cost of adopting the services may impact the low-level intention of adoption (Nysveen et al., 2005). The high cost of innovation has been identified as a barrier to financial innovation in Islamic banking (Chaudhry et al., 2020). A sizable investment is required to adopt and develop digital banking services (OJK, 2021b). However, Indonesian Islamic banking has experienced a budget constraint in terms of investing in digital banking (Adewale & Ismal, 2020), which has hindered Islamic banks from adopting and developing digital banking services. The Indonesian Financial Services Authority (OJK) had suggested that Islamic banks should prioritise the services delivered to the customer since they had a limited budget. Banks should concentrate on important services in digital banking, which can be considered as a high-value investment (OJK, 2021b).

Furthermore, the adoption of technology is influenced by the characteristics of the adopter (Dearing & Cox, 2018). Bank characteristics have been identified to have a relationship with digital banking adoption; for instance, the size of the bank has been identified to influence financial innovation such as Internet banking (Frame & White, 2004; Sullivan & Wang, 2020). Studies on financial innovation from the banks' perspectives are still scarce (Nejad, 2016). On the other hand, Indonesian Islamic banking has experienced a lack of research and development (Indonesian Ministry of

National Development Planning, 2019). Consequently, Islamic banks find it difficult to prioritise services in digital banking, identify characteristics of the bank that influence digital banking adoption, and clarify the bank's motivation in adopting digital banking.

In addition, Indonesian banking has experienced issues in terms of the relatively slow digital banking adoption. According to various rates of digital technology adoption among countries, as well as the adoption of financial innovation or technology in Islamic countries, Indonesia's rate is relatively slower compared to non-Islamic countries, a common challenge for many other Islamic countries (Iman, 2020). The digital transformation of Indonesian banking is at a relatively slower pace compared to financial technology development (Bank Indonesia, 2019). Islamic banking has challenges regarding optimising technology. In particular, the infrastructure should be updated continuously following technological advancements to support the digitalisation process of Islamic banking products and services (OJK, 2021a; BI, 2021). With regard to the level of digital maturity, Indonesian banks, including Islamic banks, have also not reached the optimal status (OJK, 2021b). The slower pace of adoption and sub-optimal digital technology development have made it challenging for Islamic banks to support innovation in their products and services. Islamic banks have not significantly differentiated the products and services they offer (Indonesian Ministry of National Development Planning, 2019; OJK, 2021a).

Based on the research background, this study has identified several issues concerning digital technology banking by Islamic banks as follows:

1. High cost of innovation
2. A limited budget to invest in digital banking technology
3. A lack of research and development in Islamic banking
4. Slower adoption of digital technology
5. Sub-optimal digital technology development

Prioritisation is needed to determine the most important type of services in digital banking and the most important factor in considering the prioritisation of digital banking services. In addition, it is crucial to determine the bank and market characteristics that affect digital banking adoption by Islamic banks. Therefore, it is essential to investigate the digital technology adoption of Islamic banks in Indonesia from the bank's perspective.

1.3 RESEARCH OBJECTIVES

This study aimed to investigate the adoption of digital banking services among Islamic banks by investigating the motivation of banks to adopt digital banking in a dual banking system with reference to Islamic banking that operates alongside conventional banking. It also aimed to explore the priority of digital banking services among Islamic banks. Specifically, the objectives of this study are as follows:

- i. To explore the current state of digital banking adoption among Islamic banks in Indonesia by analysing documents of Islamic banks.
- ii. To explore the priority of the type of services in digital banking by Islamic banks in Indonesia from the bank's perspective.
- iii. To explore determinants in considering the priority of the type of services in digital banking by Islamic banks in Indonesia from the bank's perspective.
- iv. To examine bank-specific factors in determining the decision to adopt digital banking services among banks offering Islamic banking services in Indonesia.
- v. To examine market-specific factors in determining the decision to adopt digital banking services among banks offering Islamic banking services in Indonesia.

1.4 RESEARCH QUESTIONS

To achieve the research objectives, several research questions were developed following the research objectives. This study was geared to answer research questions as follows:

- (RQ1) How is the current state of digital banking adoption among Islamic banks in Indonesia analysed through the documents of the Islamic banks?
- (RQ2) How are the types of services in digital banking by Islamic banks in Indonesia prioritised from the bank's perspective?
- (RQ3) What are the most important determinants in considering the priority of the type of services in digital banking by Islamic banks from the bank's perspective?
- (RQ 4) What are the bank-specific factors that determine the decision to adopt digital banking among the banks offering Islamic banking services in Indonesia?
- (RQ 5) What are the market-specific factors that determine the decision to adopt digital banking among the banks offering Islamic banking services in Indonesia?

1.5 SIGNIFICANCE OF THE STUDY

The diffusion of innovation theory posited that before adopting innovation or technology, a potential adopter encounters uncertainty regarding the outcome and whether the outcome is suited to what has been expected. This uncertainty is a potential risk to the potential adopter. To reduce the degree of uncertainty, the potential adopter will seek information regarding innovation or technology. For the adopter who has adopted innovation, information is needed to ensure the continuation of using the innovation.

This study on digital banking adoption could provide potential adopters with the knowledge and information regarding digital banking adoption to reduce the degree of uncertainty, as well as to ensure the continuation of using digital banking, since the study provides a literature review, theoretical framework and empirical evidence on digital banking adoption. Moreover, while other studies on digital banking concentrate on the conventional banking system, this study focused on the Islamic banking system since the different banking systems involve different markets and practices (Nejad, 2016).

The methodology of this study can offer new insight into digital banking adoption. The study opted for Indonesian Islamic banking as the sample of the study. Indonesia has the largest Muslim population in the world. This makes Indonesia a strong potential market for Islamic banking. Islamic banking in Indonesia is an industry that has grown tremendously. However, Indonesian Islamic banking has challenges regarding optimising information technology to support product development as well as business model development (OJK, 2021a). This study is critical to uncover the issues and challenges encountered by Islamic banks in Indonesia. The study implications of the study and recommendations would shed light on the related issues and challenges. Moreover, the method used in this study allows for connecting and obtaining feedback among the involved elements and on the criteria to prioritise in the selection of the relative importance of the services in digital banking, and the main criteria to be considered.

The study contributes to the literature by extending the literature on the adoption of digital banking, particularly Internet banking and mobile banking. Since the study is conducted by taking Islamic banking, it provides different perspectives on digital banking adoption using different banking system perspectives. The model provided in this study grants Islamic bank managers new insight into decision-making on the type of services in digital banking that are going to be adopted and the determinants considered for digital banking adoption. The findings would be useful to policymakers and regulators in formulating the policies that will support and encourage Islamic banks to adopt digital banking services.

1.6 SCOPE AND LIMITATION OF THE STUDY

This study concentrated on digital banking adoption in dual banking systems with reference to Islamic banks. The scope of this study can be viewed from four perspectives. Firstly, this study focused on digital banking adoption, consisting of Internet banking and mobile banking, considering these technologies utilise the Internet to deliver services. Secondly, digital banking adoption was approached mainly through the relative importance of the type of services in digital banking and the determinants in considering the priority of the type of services in digital banking. It was also approached through the determinants of digital banking adoption, covering bank-specific and market-specific factors. Thirdly, the context in which the study was conducted is the dual banking system in Indonesia. For Islamic banking, the products and services of Islamic banks must adhere to Islamic principles. Lastly, the primary data was collected through a survey, and the secondary data was acquired from the annual reports and financial reports of banks offering Islamic banking services.

Considering the context of the study in Indonesian Islamic banking, it was necessary to have modifications for application in other Islamic banking systems that operate in different countries due to the different characteristics of the countries. This study also had a certain period of observation to investigate determinant factors toward the adoption of digital banking. Different periods of observation were important due to the different characteristics or environmental conditions involved in the observation.

1.7 ORGANISATION OF THE STUDY

This study is organised into six chapters. The first chapter presents the main interests of the study. It discusses the overview, elaborates on the problem statement, and identifies the research objectives and research questions. In addition, it also presents the significance of the study, the scope and limitations of the study.

The second chapter elaborates on the landscape of digital banking by discussing its definition, advantages, service categories, channel development, the ways to adopt digital banking by banks, the risks related to digital banking, and potential development.

Moreover, the chapter also elaborates on the issues of digital banking adoption concerning Islamic banking. Since the study takes Indonesia as the sample, the chapter also highlights digital banking adoption in Indonesia.

The third chapter elaborates on the theoretical framework and empirical studies on digital banking adoption. On the theoretical framework, three theories or approaches are elaborated, namely the Diffusion of Innovation Theory, the Financial Innovation Approach, and the Unified Theory of Acceptance and Use of Technology (UTAUT). Furthermore, the chapter reviews the empirical studies on digital banking adoption by banks and digital banking adoption in Islamic banking. This chapter also identifies the research gaps in the literature.

The fourth chapter presents the research methodology used in this study. It discusses the research design and the conceptual framework for this study. Hypotheses development drawn from the conceptual framework is also elaborated. Since this study utilised primary data and secondary data, both data are discussed in this chapter, comprising the sample, data collection, and data analysis. Document analysis was utilised to uncover the current state of digital banking adoption by Islamic banks to answer the first research question. The Analytic Network Process (ANP) method answered research questions regarding the priority of the type of services in digital banking, and the logistic regression model answered research questions regarding determinants of digital banking adoption.

The fifth chapter discusses the study findings, which have been obtained from the results of document analysis, ANP method and logistic regression. The chapter is divided into three main sections. The first section provides the outline of the findings on the current state of digital banking adoption by Islamic banks. The second section presents the findings on the most important services in digital banking, along with the main criteria considered to select the most important types of services in digital banking by Islamic banks. The third section discusses the results of logistic regression to determine the bank-specifics and market specifics that affect digital banking adoption among banks offering Islamic banking services.

Lastly, the sixth chapter summarises the major findings of this study. The study has contributed to knowledge, managerial/practices and policy or regulation. The study has also provided recommendations to Islamic banking managers, policymakers and regulators to improve the adoption and development of digital banking, particularly for Islamic banks.



CHAPTER TWO

DIGITAL BANKING: CONCEPTS, ADOPTION, AND SERVICES

2.1 INTRODUCTION

Financial technology has been around in the banking industry since before the Automatic Teller Machine, as a self-service technology was applied in the 1990s. The telephone banking services in the 1980s, web-based applications with the emergence of the internet in the 1990s and mobile banking applications with the proliferation of mobile devices in the 2000s are several examples of the various self-service technologies in the banking sector (Hoehle et al., 2012). Out of all the self-service technologies offered through digital banking, Internet banking (web-based applications) and mobile banking have received tremendous attention (Schaechter, 2002; Levy, 2022). The advancement of technology has driven the growth of Internet users as well as mobile device users (Thakor, 2020).

The previous chapter has discussed the importance of digital technology in delivering banking services through digital banking. To understand the digital banking concept comprehensively, this chapter will discuss in detail the digital banking services, which are divided into several sections focusing on the type of delivered services and banks as adopters of digital banking services. The digital banking definition is elaborated in Section 2.2. The category of services offered through digital banking and the advantages of adopting digital banking are outlined in Section 2.3. and 2.4. respectively. The next section, 2.5, presents how bank adopts digital banking concerning the modes of adoption, the channel, the drivers and the inhibitors. How digital banking emerged, along with the risks, is elaborated on in Section 2.6. Regarding Islamic banking and Indonesian Islamic banking, Section 2.7 will cover the issues of digital banking in the context of Islamic banking. Lastly, this chapter also gauges the adoption of digital banking in Indonesia.

2.2 DIGITAL BANKING DEFINITION

Banking services offered in traditional banking, such as fund transfers and payments, are normally accessed by visiting the physical branches. Digital banking technology has enabled banks to transform traditional banking into digital banking, which delivers financial services via digital platforms, such as mobile applications and websites, in a secure, real-time, and convenient way (Rosnita, 2018; Indriasari et al, 2022; Temenos, n.d; Zenus Bank, n.d). Digital banking technology has allowed customers to access traditional banking services without visiting the physical branches. Furthermore, digital banking generally refers to delivering banking services to customers through digital channels, including internet banking and mobile banking (Garzaro et al., 2020; Chauhan et al., 2022). Similar to digital banking, electronic banking consists of Internet banking and mobile banking. However, electronic banking utilises electronic channels as a means of delivery to offer banking services (Schaechter, 2002), comprising automated teller machines (ATMs), touch dial-tone phones, Internet banking, and mobile banking (Hoehle et al., 2012). Shaikh and Karjaluo (2016) explained that virtual delivery channels, such as Internet banking and mobile banking, are superior in terms of eliminating location and time barriers compared to physical delivery channels, such as ATMs. Digital banking excludes ATMs and touch dial-tone phones, as it emphasises the use of data communication or internet connectivity to enable customers to access banking services. Despite having a similar category as digital banking, Internet banking and mobile banking have been identified as two separate digital banking channels considering the environment, technologies, and devices, for example, the location to access and the size of the device's display (Shaikh and Karjaluo, 2016).

Internet banking refers to the remote delivery channel using the Internet for banking services (Furst et al., 2002). Internet banking, more specifically, refers to the use of a bank's website to perform financial and non-financial services using a computer or Personal Computer (Laukkanen, 2007; Hoehle et al., 2012; Laukkanen, 2016; Levy, 2022; Chauhan et al., 2022). Customers can perform online transactions on their accounts (Berger, 2003; Sullivan & Wang, 2020) using the main channel of engagement for Internet banking, namely the web browser, to access computer-based websites (Levy, 2022). Such modes of transaction are why Internet banking is regarded as online banking (Hernandez-Murillo et al., 2010) or PC banking (Kolodinsky et al.,

2004). Shaikh and Karjaluo (2016) contended that Internet or net banking enables bank customers to access banking information to assist various financial and non-financial transactions using either a personal computer or laptop, anytime and anywhere.

On the other hand, mobile banking refers to a channel used by customers to interact with the bank using a mobile device (Barnes & Corbitt, 2003; Tiwari et al., 2006; Hoehle et al., 2012; Nicoletti, 2014). The customer may use mobile phones, handheld devices, or smartphones to access mobile banking services (Laukkanen, 2007; Laukkanen, 2016; Levy, 2022) using banking mobile phone applications (Levy, 2022). Mobile banking emphasises the use of data communication to access the services which make up phone banking. Voice dial-up and dial-up to services based on touch-tone phones are not considered part of mobile banking services (Barnes & Corbitt, 2003). Mobile banking enables customers to use multiple access modes to access services such as short message service (SMS), browser-based systems (WAP) and client applications or apps (Mullan et al., 2017). According to Shaikh and Karjaluo (2016), depending on the delivery channel and type of transaction, mobile banking enables bank customers to access banking information for facilitating various financial and non-financial transactions using a mobile telecommunication device, for instance, a cell phone, smartphone, or tablet.

Initially, mobile banking was introduced using a WAP-based system that enabled the banks to deliver services to customers remotely. Unlike Internet banking, which received a lot of attention from the bank and became widely adopting the service (Sullivan and Wang, 2020), at the introduction stage, mobile banking faced several challenges that inhibited the proliferation of the service to the customers. Mobile banking experienced a setback due to a lack of customer interest and undeveloped technologies (Tiwari et al., 2006). The adoption rate of mobile banking differs among the countries globally, whereby the adoption of mobile banking is higher in developing countries compared to developed countries (Mullan et al., 2017; Barnes & Corbitt, 2003). Mobile banking has a relative advantage compared to the previous channel that has existed. In developed countries where remote banking has matured, the relative advantage of mobile banking will only be a small extension to the existing channel. However, in developing countries where access to online banking has not been effective,

mobile banking offers great value by providing access to low-cost, remote banking (Barnes and Corbitt, 2003).

The medium to access the banking services or the devices is an important difference between Internet banking and mobile banking in terms of customer experience (Laukkanen, 2007; Shaikh and Karjaluo, 2016). Internet banking which is accessed through a personal computer (PC) and/or laptop (Shaikh & Karjaluo, 2016) has been perceived as easy to use by customers since the PC has a wider monitor and the flexibility of keyboard (Laukkanen, 2007) compared to the mobile banking accessed through mobile phones, smartphones, and tablets (Shaikh and Karjaluo, 2016) that have limited display and keyboard space (Laukkanen, 2007). Conversely, mobile banking has been perceived to be more flexible in terms of location compared to Internet banking, which requires a PC to access (Laukkanen, 2007). Other than devices, the usage of Internet banking and mobile banking has another major difference. The usage of mobile banking is possible by downloading the mobile application developed specifically for mobile devices, whilst Internet banking requires no specific application, and users communicate with the bank through a web browser (Shaikh & Karjaluo, 2016). The type of transaction provided by Internet banking is associated with mobile banking in the sense that both of the delivery channels provide financial transactions and non-financial transactions (Shaikh & Karjaluo, 2016). In this study, digital banking indicates the provision of banking services using digital platforms, namely, internet banking and mobile banking, in a secure, real-time, and convenient way.

2.3 TYPE OF SERVICES IN DIGITAL BANKING

The type of services offered to the customers is important to the adoption decisions (Nysveen et al., 2005). Diversifying the services is crucial for the bank to create competitive advantages in the market, retain the customer base, and cut costs (Laukkanen, 2016). Different perspectives have been applied to categorise services delivered through digital banking services. Certain basic threshold levels of usefulness need to be embodied in the mobile services to develop a positive attitude and intention to use the services (Nysveen et al., 2005). In line with the basic threshold levels, Furst et al. (2002) distinguished the type of services in Internet banking according to the

importance of the services, namely, *basic services* and *premium services*. According to Furst et al. (2002), basic services comprise three services, namely, balance inquiry, fund transfer and bill payments. Premium services comprise basic services with the addition of at least three of the following services:

1. Credit application
2. New account set-up
3. Brokerage
4. Cash management
5. Fiduciary
6. Bill presentment
7. Insurance

Tiwari et al. (2006) classified the services of mobile banking based on the relation of services to accounting, brokerage and information as follows:

1. *Mobile accounting* emphasises the transaction revolving around the bank account, and the essentials are related to operating the account, such as money transfers and bill payments, and administering the account, such as access administration, account sets, cards, and chequebook administration.
2. *Mobile brokerage* related to transaction-based revolving around the securities account, and the essential part is related to bank activity that operates the securities account, such as purchasing or selling financial instruments and administers the securities account, such as administration of access and booking orders.
3. *Informational* relates to the non-transaction-based and characterised by informational nature, services comprise the bank accounts and securities accounts. The information regarding the bank accounts includes balance and

transaction inquiry, alerts and status on account activity, branch location and ATM locations, whilst the securities account of the customer covers the information of the market that is relevant to the customers, such as bank and market interest rate, exchange rate, product, and information offers.

The type of services delivered through Internet banking appears seemingly similar to mobile banking (Laukkanen, 2016). Without distinguishing channels used to deliver internet and mobile banking services, Shah and Clarke (2009) revealed that banks may deliver several services such as account access, balance transfer, bill payment, bill presentment, mortgage/credit card/miscellaneous lending, business banking services, customer service and administration, cross-selling, personalised content and tools, account aggregation and electronic fund transfer (Shah and Clarke, 2009). In the same vein as Shah and Clarke (2009), based on *the nature of transactions*, Shaikh and Karjaluo (2016) divided services in digital banking into two broad categories, namely *financial transactions* and *non-financial transactions*. Services related to financial transactions involve monetary terms such as fund transfers, cash withdrawals, utility bill payments, and donations, while non-financial transactions include instance balance inquiries, mini bank statements, sending chequebook requests and finding ATM locations. Regarding the type of transaction, as previously explained in the definition section, there is a similar type of transaction provided in Internet banking and mobile banking, where both digital banking channels provide financial and non-financial transactions.

Previous literature on digital banking services did not include the financial needs of the customer to determine the classification of digital banking services, though customers have been identified to have particular financial needs along their life stage (Kamakura et al., 1991). Pearce et al. (2021) divided the customer life stage into student, young professional or first job, starting a family, mid-life and retiree. For each life stage of a customer, particular financial needs emerge following the particular situation they face. For example, when customers start a family, they begin to think of owning a home or protection for risk, and when the customers are in mid-life and are already knowledgeable about future revenue/income, they start to consider investments. Banking products or services are designed to satisfy the financial needs of the customers.

Table 2.1 presents each banking product/service potentially to serve financial needs along the life stage.

Table 2.1 Financial Products Based On Life Stage

Life Stage	Product Focus	Product Category
Student	Checking accounts Credit cards Students loans	Deposit accounts Loans (account)
Young professional	Auto loans Lines of credit Savings accounts	Deposit accounts Loans (account)
Starting a family	Joint bank accounts Mortgages Child education account	Deposit accounts Loans (account) Saving plan
Mid-life	Investment accounts Retirement planning Tax advisory services	Investments Pension plan Advisory
Retiree	High-yield savings Reverse mortgages Estate planning	Deposit accounts Loans (account) Advisory

Source: Pearce et al. (2021) with the researcher's modification.

According to the services provided through Internet banking and mobile banking, the Indonesian Financial Services Authority (OJK/Otoritas Jasa Keuangan) identifies four services in digital banking (OJK, n.d.), as follows:

1. Fund transfer;
2. Bank information concerning bank account (balance and transaction inquiry) and exchange rate;
3. Bill payments such as credit card, telephone, cell phone (post-paid), electricity, and insurance;
4. Purchases such as top-up prepaid cell phones, aeroplane tickets, and buying securities.

Additionally, the advancement of technology has enabled banks to provide more services through digital banking by building a Super-App. Services that may be provided using a Super-App covering (Jhaveri et al., 2024) :

1. Payment solutions (Transfers and payments).
2. Savings and lending services
3. Investment services
4. Insurance
5. Financial planning and expense management

The type of services in digital banking can be defined following financial needs and financial products based on Harrison (1994), Ahmed (2011) and Yumna and Marta (2021), with some modifications suited to the services that are provided by digital banking. Harrison (1994), by adapting Kamakura's financial needs hierarchy (Kamakura et al., 1991), outlined financial products related to financial needs can be categorised into: foundation products (savings accounts, cheque accounts and loans such as credit cards and mortgages), risk management and cash reserves (life assurance, endowments, pension plan and time deposit), growth to offset inflation (stocks and shares, unit trusts and personal equity plan) and risk and tax protection assets (government bonds). The essential product consists of products related to saving accounts and checking accounts (Ahmed, 2011), and products for transaction purposes (Yumna & Marta, 2021). In terms of digital banking services, the essential product is separated into *transfer and payment* services for transaction purposes and *account opening* for saving accounts and checking accounts. Extension to account opening services for the saving and checking accounts, loan/financing application, particularly for basic needs such as a mortgage, is categorised under this type of service.

According to Ahmed (2011) and Yumna and Marta (2021), complementary product emphasises the security purpose, namely insurance, pension plans, time deposits and endowments. In digital banking services, the complementary product can be divided into facilitating security/protection or precautionary purposes, such as

insurance, pension plans and time deposits, and the services to facilitate social purposes, such as endowments. The embellishment product is identified to fulfil investment purposes such as financial instruments (stocks and obligations) and leisure or luxury purposes. In the digital banking services context, the services are separated as services to fulfil the investment purpose by providing brokerage or buying/selling securities and services to fulfil the need for leisure as well as luxury, such as arranging for travelling. The need for leisure and travelling is an example of customers' needs that are beyond financial services and is categorised as beyond banking services (Mariani et al., 2021). The various services that could be provided under digital banking can be classified as follows:

1. Fund Transfer and Payment

Fund transfers and bill payments are services in digital banking provided to satisfy the financial transactions of the customer, which are mostly related to the savings and current accounts. Saving and checking accounts are banking products which are addressed to fulfil the basic needs of customers' financial needs (Ahmed, 2011; Yumna, 2019) and are assumed to satisfy transaction purposes (Yumna & Marta, 2021). Fund transfer is a service provided to transfer funds between accounts (Tiwari et al., 2006; Shah & Clarke, 2009). The service allows customers to transfer funds between the owner's accounts within the bank and to other banks and cross-border payments/international remittances (Crowe et al., 2015). Bill payment allows customers to pay any designated bill based on instructions automatically or manually each month (Shah and Clarke, 2009), for instance, phone, electricity, credit card, and so on. Technology has enabled digital banking to provide ticket purchases such as buses, trains or aeroplanes; to pay online shopping payments and taxes (Malhotra & Singh, 2010); direct debit, commercial payment, and remote payments concerning paying for goods at the store (Nicoletti, 2017). Services for transaction purposes lead to easier management of daily or periodic financial transactions for customers.

2. Opening accounts (savings/deposits and loans)

The advances in technology, such as financial technology, have enabled the banks to develop various services for the banking sector, including opening accounts (with digital signatures) (Nicoletti, 2014). Thakor (2020) has identified digital transformation in banking affecting the intermediation function in bank activities concerning deposits and credit/loans. Customers can apply for a new account online, whether a deposit account or apply for a loan online (Shah & Clarke, 2009; Malhotra & Singh, 2010) and monitor the status of loan applications (Nicoletti, 2017). Customers may apply for a deposit account or a loan application by accessing digital banking conveniently. The customer has previously been required to visit the branch office to open an account for a deposit, as well as for a loan application. The benefit of digital banking has enabled banks to process account openings without requiring customer presence in the office. Banks may offer customers to subscribe for new deposit accounts (Furst et al., 2002) or to apply online for a mortgage, personal loans, credit card, car loan or buy now pay later (Furst et al., 2002; Mariani et al., 2021; Jhaveri et al., 2024). Since these services are related to savings and checking accounts, the services are assumed to fulfil the basic financial needs of customers (Ahmed, 2011) and to satisfy transaction purposes (Yumna & Marta, 2021).

3. Security/protection

Complementary or security is geared to satisfy additional needs beyond essential or basic needs, such as cash reserve, risk management or precautionary purposes. Examples of banking products to fulfil security needs are insurance, savings plans, education savings, pension plans, and time deposits (Ahmed, 2011; Yumna, 2019; Yumna & Marta, 2021). Digital banking facilitates the fulfilment the security or precautionary purposes by offering services concerning insurance, pension plans, and plan saving, for example, purchasing insurance policies online (Shah & Clarke, 2009) and managing insurance policies (Nicoletti, 2017), for instance, life insurance, health insurance and general insurance (Jhaveri et al., 2024).

4. Social

Banks are important for endowment services, since such services fulfil the complementary financial needs of customers (Ahmed, 2011). Digital banking allows customers to pay for charity or donations online (Malhotra & Singh, 2010; Nicoletti, 2014).

5. Investment

When the customer is knowledgeable enough to think about future income, a bank can offer financial products for investment (Deloitte, 2020). Financial products for investment are geared to satisfy ameliorable products such as offsetting inflation and protecting against risk and taxes (Ahmed, 2011). Financial products that satisfy investment purposes include shares, bonds, mutual funds, and unit links (Yumna & Marta, 2021). Bank offers brokerage services to buy and sell financial instruments for investments such as stock trading using online channels (Furst et al., 2002; Malhotra & Singh, 2010; Nicoletti, 2017; Jhaveri et al., 2024).

6. Beyond banking

Beyond banking services, which refers to services outside the financial services, is a new territory to be explored in digital banking (Mariani et al., 2021). Beyond banking is offered to satisfy the customer's needs for ameliorable products, lifestyle, leisure, or conspicuous consumption (Ahmed, 2011). It also aims towards the self-actualisation of customers (Yumna, 2019). Examples of beyond banking services are personal financial management that assists the customer in managing customer cash flow, spending better such as discounts, financial planning, expense management, and rewards with retailers and entertainment/media, and accessing lifestyle services such as food, education, sports, transportation and mobility, comprehensive booking services, and leisure (Mariani et al., 2021; Jhaveri et al., 2024).

2.4 ADVANTAGES OF DIGITAL BANKING

2.4.1 The Advantages for The Bank

Banks expect to gain numerous benefits from adopting Internet banking as well as mobile banking. Cost reduction is one of the benefits resulting from digital banking adoption, for example, reducing operational costs (Rahi et al., 2019). Digital banking is expected to reduce costs by decreasing the operational cost due to the elimination of branches that affect decreasing expenses related to labour cost, premises and fixed assets costs since the branch needs the buildings and personnel to support with (DeYoung et al., 2007; Shah & Clarke, 2009) and the bank enables to substitute the bank personnel handling the transaction with the automated process (Tiwari et al., 2006). It is also aimed at reducing the cost per transaction once a critical mass of customers is achieved by shifting transactions to the digital channel (Shah & Clarke, 2009; Tiwari et al., 2006). Implementing Internet banking enables banks to standardise their services, which may lead to allocating resources among the channels. Whilst the low-value-added transactions, such as fund transfer, bill payment, and opening accounts, are moved to the online channels, the banks are able to allocate resources to specialised services that have a high-value-added, such as wealth management, lending business, and investment banking, to the branch (Sullivan & Wang, 2020). It allows banks to exploit the economies of scale and scope (Tiwari et al., 2006). However, getting customers to move from the traditional channel to the online channels, to concurrently reduce operational costs, is still an issue for many banks (Hoehle et al., 2012).

Customers are demanding greater choices and more convenient services, and the banks need to meet these customer needs (Schindler, 2017). Customer centricity encourages banks to pay more attention to customer experiences as well as customer satisfaction. Offering digital banking services means that the bank offers greater choices to the customers to meet their needs conveniently. For the bank, the wider choices to offer to the customers have enabled the bank to perform cross-selling financial products by recommending and advertising the products and services that are suitable for the customers (Hoehle et al., 2012). Internet banking has allowed the bank to deliver convenience to the customer, allowing customers to access the services remotely while removing numerous inconveniences (Sullivan & Wang, 2020).

The bank can diversify value creation activities, such as offering premium services, as long as the value delivered to the customers is higher than the cost charged to the customers (Shah & Clarke, 2009; Tiwari et al., 2006), which can become another revenue stream for the bank. Another advantage is the flexibility to expand their network. Traditionally, banks expand their reach geographically by opening new physical branches, which demand set-up and maintenance costs. Digital banking allows banks to reach the customer base in other areas/regions without opening a physical branch, reducing the potential costs involved (Shah & Clarke, 2009).

2.4.2 The Advantages for The Customer

Banks employing digital banking services aim to increase customer satisfaction. Digital banking services allow the customer to access banking services regardless of time and location, 24 hours 7 days a week, throughout the year (Shah & Clarke, 2009; Tiwari et al., 2006; Rahi et al., 2019). Customers perceived the usage of Internet banking and mobile banking as delivering efficiency to the customer in the sense of using the service whenever wanted, and no need to leave the home or office, allowing the customer to take immediate action, which saves time (Laukkanen, 2007).

Digital banking benefits the customer in terms of providing a decision support system that can help them make financial decisions in real-time, conveniently (Hoehle et al., 2012). The technology can assist the bank in understanding the needs of customers more deeply, specifically and designing a tailor-made product and services that fulfil their needs (Shah & Clarke, 2009; Hoehle et al., 2012).

Another advantage of digital banking for the banks is retaining existing customers, which leads to an improved position of the banks competitively (Rahi et al., 2019). Customers do not need to move to the competitor to find a bank offering digital banking services. By doing so, banks can retain existing customers from moving away from competitors such as other banks and fintech firms. Digital banking also enables customers to gather, make decisions, upload relevant information, make transactions, search for new financial products and services, promotions and so on, without too much human interaction and subsequently increase the utility towards banking services

(Thaker et al., 2022) and increase the customer experience in using banking services and customer engagement with the bank.

2.5 ADOPTION OF DIGITAL BANKING

2.5.1 The Modes of Adoption

Digital banking was offered to consumers as a complement to the traditional bank activities that require physical banking activities, such as branch offices. The banks combined the traditional banking activities delivered through branch offices with digital banking channels called “click and mortar” or “click and brick” banks (Schaechter, 2002). Some banks employed transactional websites in addition to their physical offices and ATMs, enabling customers to conduct transactions online, such as accessing accounts, transferring funds and applying for loans, whilst others set up a website to provide information regarding the banks and the services without providing the transaction ability for the customers (Berger, 2003). Only a bank-employed transactional website can be regarded as a “click and mortar” bank.

Others offered digital banking channels without relying more on the physical branch, and offering only through digital banking channels. These banks were usually called “internet-only banks” or “virtual banks” (Schaechter, 2002). These banks offered transactions online through the website and access to the ATM without building a physical branch open to the public (Berger, 2003). Several ways to establish internet-only banks include independent banks that obtain a license from the regulator, existing banks that create a virtual bank as a member of a holding bank, or existing banks that convert their form completely into a virtual bank (Schaechter, 2002).

Studies on the relative performance of Internet banking have revealed several findings. Firstly, large banks offering transactional Internet services relatively outperform those that do not offer transactional sites. Secondly, small banks show no statistical difference in profitability between those offering Internet transactions and those that do not. Thirdly, young banks (less than three years of experience) in particular showed a relatively poor performance (Berger, 2003). These studies

collectively suggested that the discontinuation of internet-only banks and units was most likely due to poor performance.

Within the literature, the cost is the crucial deciding factor in adopting Internet banking, incurred from high initial set-up costs as well as redundancy costs incurred from legacy (existing) systems (Bradley & Stewart, 2002). Adopting Internet banking requires a fixed cost charge to the bank. However, it potentially decreases the marginal cost of operation where large banks have the advantage to adopt the technology rather than smaller banks and with the changes of the environment, such as consumers willing to pay for the services, average bank productivity and cost-saving from Internet banking, the adoption diffuses to the smaller banks (Sullivan & Wang, 2020). As shown in Figure 2.1, the number of in-state banks with deposits over USD 300 million that adopted transactional Internet banking had reached 90.5%, while the in-state banks with a deposit under USD 25 million had only 10.5% transactional Internet banking adoption (Sullivan & Wang, 2020).

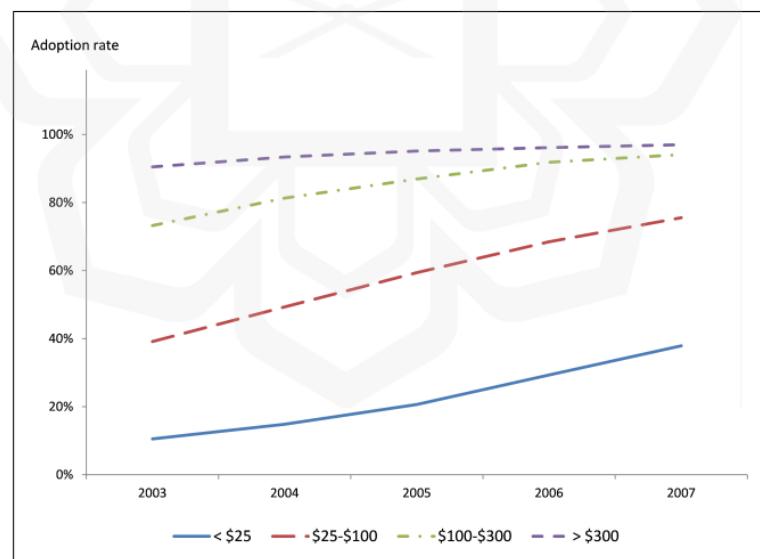


Figure 2.1 Internet Banking Adoption by Bank Size Group in the United States of America (Deposits in USD Millions)
(Source: Sullivan & Wang, 2020)

Figure 2.1. also suggests that bank size is substantial enough to diffuse Internet banking within the banking industry. Consequently, different bank sizes apply Internet banking with different strategies. Large banks tend to build their own system, and small banks prefer to choose the outsourcing strategy (Berger, 2003). One of the most important strategic questions that the banks should answer is whether they should utilise in-house or contract with a third party (outsourcing) in their technology system; *ceteris paribus*, the one with the least cost would be the one to be chosen (Sinkey, 1998). Outsourcing is primarily encouraged since banks are not able to have expertise in technical high-technology in this high-cost environment. For instance, small banks are inclined to outsource scale-sensitive products to a long-term bank or non-bank provider (Sinkey, 1998). In the case of mobile banking, partnership formation has become an important driver to support successful adoption by banks (Mullan et al., 2017).

The rise of fintech encouraged banks to adopt the technology to the benefit of fintech. Basel Committee on Banking Supervision (BCBS, 2018) gauges several alternative scenarios to adopt the fintech which is the acquisition of the system on behalf of the bank itself (“better bank”), conversion or establishment of a new bank fully “built-for-digital” bank without having branch network for the transaction (“neo-bank”), partnership with the fintech companies where the bank manages the customer relationship whilst the fintech providing the technology (“distributed bank”), partnership with the fintech companies where the fintech is responsible to engage customer relationship whilst the bank deal with the system as back-office (“relegated bank”) and it is possible to have the combination in adopting the fintech (BCBS, 2018).

With regard to the services, digital banking comprises various types of services which can be delivered through Internet banking and mobile banking, as outlined in the previous section. Digital banking services are generally adopted gradually toward the digital ecosystem (PwC, 2024). Initially, it is designed to achieve a single-purpose application equipped with various services. Along with the growth of business, other services are integrated into the application. Afterwards, an integrated digital ecosystem is built to serve the customer by enhancing the customer experience, covering financial and non-financial services or beyond banking services.

Banks can have many applications for providing digital banking services. However, it is not financially viable for banks to have many standalone applications (PwC, 2024). With technological advances, Super-Apps have emerged to improve customer experience by delivering seamless, integrated and personalised digital banking services, regardless of whether the bank uses Internet banking and/or mobile banking. Super-App offers multiple diversified services accessed by mobile devices or web browsers (Prud'homme et al., 2023). It refers to a platform or an application enabling banks to consolidate various products and services in a single application that provides customers with a one-stop-shop experience compared to a standalone application focusing on products or services (Jhaveri et al., 2024). It is designed to build the digital ecosystem and tailor offerings to the customer using customer data (Perri, 2022).

Super-App combines services into a single application in a way that will bring value to the customers, such as speed, performance and maintenance: the sum/whole must be worth more than the sum of its parts. By combining financial interests such as payments, lending investments, personal finance management, and wealth management services with lifestyle interests such as accommodation, ridesharing, entertainment and marketplace, customers are offered the capability to control their finances as well as unify customer experiences. Super-App brings a lifestyle angle to financial services (Pearce et al., 2022).

A platform or an application is categorised as a Super-App when the application meets these criteria: multi-service (cross multiple services within the industry), a single app for all services (integrating access to a broad range of services/experiences into a single point of entry), consistent customer experience (facilitating transactions across different services, intuitive design, seamless navigation, quick load times, and personalised interaction), data sharing across experience (sharing data across services or third party services), community affinity and loyalty programme, and data insights (analysing customer data to gain insight into user behaviour, preferences, and trends) (Pearce et al., 2022; Jhaveri, et al., 2024). A bank may go through three stages towards becoming a Super-App (Pearce et al., 2022):

1. Traditional App

The bank begins with one primary function or a single purpose by offering some services.

2. Expanded offerings

The bank acquires new functionality, which may represent new competitors, new value-adds or new markets by acquiring more services considering the growth of the customer base.

3. Customer catch-all

Integrating customer data to expand the services will increase the customer experience and attract third parties to collaborate. In this stage, digital banking may be connected to the digital ecosystem to improve customer experience.

2.5.2 Channel Development

The emergence of digital banking channels has provided alternative channels for the bank to provide its services. Before the introduction of digital banking channels, the bank relied on the physical branch as a traditional banking channel to deliver services. Digital banking channels encourage the bank to utilise ATMs, phones or the internet to deliver the services side by side with the traditional banking channel, leading to a multi-channel strategy in the banking industry.

Alternative delivery channels in the banking industry fall into two major categories: physical and virtual (Shaikh & Karjaluo, 2016). In the digital banking channel context, ATMs and Point of Sale (POS) are categorised as physical delivery channels where the customer accesses the services using a variety of cards (payment, debit, or credit cards) while internet and mobile banking are grouped as a virtual delivery channel since customers have the flexibility to access the services conveniently without visiting banking branch or ATM (Shaikh & Karjaluo, 2016).

Focusing on the virtual delivery channel that uses internet connectivity as a medium to deliver banking services, banks may opt to employ Internet banking and mobile banking as an extension of the existing traditional channel. Using Barnes' strategic model for mobile banking, the bank may follow the path to implement Channel Extension as a multi-channel strategy development, considering the PC penetration and mobile penetration as illustrated in Figure 2.2 (Scornavacca & Hoehle, 2007). For the banks with high PC penetration, it is better to move on to online banking first to channel extension (1-2-4), while the bank with high mobile penetration would be more advantageous by developing mobile banking first before online banking (1-3-4).

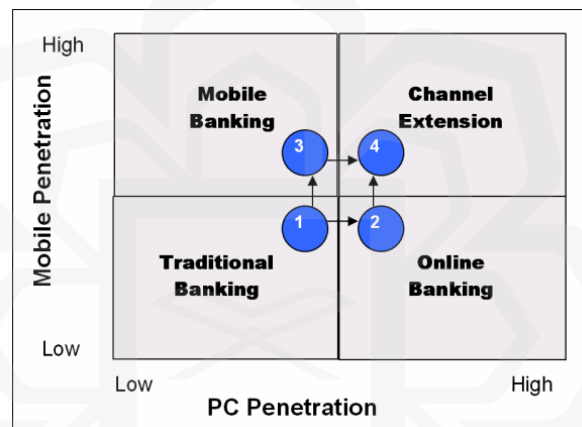


Figure 2.2 Barnes' Strategic Model of Mobile Banking
 Source: (Scornavacca & Hoehle, 2007)

The United States experienced the widespread adoption of digital banking (Sullivan & Wang, 2020; Berger, 2003). Scornavacca and Hoehle (2007), as cited from Scornavacca and Barnes (2004), found that the banks in Germany initially developed multi-channel from traditional banking to online banking, supported by the PC penetration rate and which is similar to New Zealand. Japan, on the other hand, took the other path by adopting mobile banking that followed traditional banking.

The use of a singular virtual or physical becoming channel refers to a single-channel approach. In contrast, for banks using two or more synchronised channels, it relates to a multi-channel approach. In addition, the use of multiple channels integrated into a seamless, overall, and simultaneous channel delivering services is called

omnichannel management, which is expected to dominate the development of distribution management in the future (Verhoef et al., 2015; Menrad, 2020). Multichannel typically combines physical channels and online channels (Verhoef, 2021). Research has shown that customers may take different roles between mobile devices and fixed devices (i.e. personal computers) (Verhoef, 2021). The rise of digital banking has shifted the distribution channel from a multichannel to an omnichannel approach, which coordinates and integrates multiple channels to deliver a seamless and consistent experience across all channels, whether users use an ATM, a PC, or a mobile device (Hamouda, 2019). Omnichannel has been suggested as ideal, specifically for the banking industry (Komulainen & Makkonen, 2018). It is assumed that customers conduct the same banking tasks across all channels, allowing them to switch seamlessly from one channel to another while performing the necessary services (Hamouda, 2019; Komulainen & Makkonen, 2018). Using the omnichannel approach, customers enjoy the same experience across the channels (consistency), whether they use Internet banking or mobile banking while performing the transaction. Therefore, banks should manage the integration quality of omnichannel since it would lead to customers' perceived value and increase customer satisfaction (Hamouda, 2019). Customers would experience the same banking task with a seamless experience, whether using Internet banking or mobile banking, which has made both of them unified in the services. As for digital-only channels, banks may choose to be fully digital companies characterised by branchless, superior customer experience, adopting advanced technology (for example, through big data, AI, and cloud), and adopting one of digital channels (internet banking or mobile banking) or adopting both digital channels (internet banking and mobile banking) since each channel has its role and advantages (Schaechter, 2002; Berger, 2003; Choi et al., 2020; Verhoef, 2021).

2.5.3 The Drivers and Inhibitors

The adoption rate of digital banking has differed across banks. While large banks tend to adopt Internet banking compared to smaller banks, young banks are more likely to adopt Internet banking (Furst et al., 2002). The decision to adopt digital banking involves several factors that are characterised as drivers leading to positive adoption of digital banking and inhibitors leading to negative adoption.

In the case of Internet banking, Bradley and Stewart (2002) identified external factors considered as the most important factors encouraging the bank to adopt the technology, such as the number of other retail banks adopting the technology, competitive forces, consumer demand and technological availability. Internal factors are considered the most important factors inhibiting the banks from adopting the technology, such as a lack of ability to deal with customers, resistance to change, attitudes within the bank toward the innovation, availability of resources, and the existing legacy system. Costs remain the crucial factor inhibiting the adoption of Internet banking, particularly in the absence of returns evident and insufficient consumer demand. Mullan et al. (2017) found that key drivers encouraging the adoption of mobile banking refer to the penetration of mobile phones globally, pressure incurred from the competition, risk, and partnership formation, whilst the key barriers refer to the shortcomings of customer demand as well as evidence of Return on Investment (ROI). The partnership formation suggested a crucial factor that needs to be considered to support the successful adoption of mobile banking. The factors contributing to the drivers and inhibitors in the adoption of digital banking are the customer or consumer, competition, technology in terms of external and costs, dealt with return on investment, the culture within the banks and the existing legacy system are some factors related to internal issues for the banks.

Technological advancement or technological shocks stimulate innovation by providing from the supply side (van Horne, 1985; Tufano, 2003). Several advancements in digital technology may enhance digital banking services, as follows:

1. Big Data Analytics

Data is fundamental for banks to understand the customer preferences, customer behaviour, and customer expectations (Choi et al, 2020). Customer demographics, customer transactions, and product usage are available in the bank database. However, the data is useful if the bank has advanced analytics to process the data into insights and valuable information (McKinsey, 2019). Big Data Analytics are the technology that can enable banks to process data into valuable insights and information, such as the appropriate products for a customer, the target customer for certain products, and product offerings based on customer behaviour. A bank may exploit Big Data Analytics for

decision making, for example, a credit scoring to approve or not approve a credit application.

2. Artificial Intelligence (AI)

Human intelligence is involved in various tasks performed by employees. As a software algorithm, AI has the capability to perform various tasks involving human intelligence, for instance, visual perception, decision making and speech recognition (PwC, 2018). Machine learning is a field that constitutes Artificial Intelligence to perform its tasks. AI has the capability to recognise patterns, regression, analysis and prediction, which can be used to support human tasks, risk management, customer segmentation and prediction. In the banking activities, AI can be implemented for customer services, fraud detection, personalised offering and product, fraud detection, Know Your Customer (KYC), automation process, and document processing (OJK, 2025).

3. Blockchain

Blockchain has the capability to record and confirm transactions with reliability and anonymity (PwC, 2018). The record kept through blockchain is unique. Once the data is recorded, it can be shared with many parties without the possibility of altering the recorded data. A bank may exploit blockchain to enhance Accounting Information Systems (AIS), digital payments, smart contracts, and identification for Know Your Customer (KYC), fraud prevention and cybersecurity (Al-Dmour et al., 2024).

4. Cloud technology

Adoption of digital technology requires a great investment, which can be an obstacle for banks to adopt it. Cloud technology, which provides new functionalities equipped with artificial intelligence and machine learning, may become a valuable solution for banks with limited investment (Choie et al., 2020). Cloud assists banks in innovating more easily and quickly. It also

offers scalability and reliability for banks to update with the latest technology.

2.6 RISKS CONCERNING DIGITAL BANKING

There are many enormous benefits of the services provided using digital banking services, as discussed in the previous section. Embracing Internet banking or mobile banking has brought a variety of risks that banks should assess (BCBS, 2003; Pennathur, 2001). The risks are not novel to the basic type of banking risks that have been identified. Rather, they are modified to the risks that have existed before (BCBS, 2003). In addition, there is a possibility that embracing digital banking would lead to increasing the magnitude of risk of the bank (Pennathur, 2001). Operational risk, reputational risk, and legal risk are basic risks that have been identified due to digital banking adoption. Several specific problems may overlap across categories in the sense that the problems may categorise more than one type of risk (BCBS,1998).

2.6.1 Operational Risk

Operational risk refers to the risk that is generated from the potential for loss due to significant deficiencies in system reliability or integrity, mainly addressed to a security risk, customer misuse and inadequately designed or implemented technology (BCBS, 1998). Security issues arising from internal and external networks are mainly some sort of operational risk caused by banks involved in digital banking services. A bank employee internally may have access to the system and then conduct an unauthorised usage or misuse such as manipulating data to increase the account balance, while externally bank systems are potentially hacked from the external network, for instance, the threat of virus intruding to the bank network, account information, as well as confidential information that is stolen and used as a ransom (Pennathur, 2001). Employing systems that are not well designed or implemented potentially exposes the bank to the risk of an interruption or slowdown, and relying on external sources to provide the systems exposes to operational risk due to the possibility of inadequate expertise meeting the bank's expectations or may fail to update the technology (BCBS,

1998). Customer misuse, intentionally and inadvertently, along with inadequately educating customers about security precautions and the absence of measures to verify transactions, would increase the magnitude of operational risk (BCBS, 1998). Digital banking involving the advance of technology to deliver convenient, personalised and seamless banking services to the customer has raised questions about how the bank addresses risks such as consumer protection, cybersecurity and data protection (Choi et al., 2020).

2.6.2 Reputational Risk

Reputational risk refers to the risk of significant negative public opinion that results in a critical loss of funding or customers (BCBS, 1998). Considerable ambiguity concerning laws or rules regulating the banking environment can cause uncertainty about regulations related to the bank, for example, the possibility of uncertainty regarding legal rights (Pennathur, 2001). Issues with customer privacy and disclosure may also increase the legal risk (Pennathur, 2001).

2.6.3 Legal Risk

Legal risk arises from the violation of or non-conformance with laws, rules, regulations or prescribed practices, or when the legal rights and obligations of parties are not well established in a transaction that has been agreed upon (BCBS, 1998). Problems with operational risk and legal risk will further lead to the emergence of reputation risk for the bank (Pennathur, 2001). In addition, the bank can be exposed to reputation risk due to customers who are dissatisfied with using online services, security breaches or fraudulent acts (Pennathur, 2001).

2.6.4 Other Risks

The presence of digital banking services would exacerbate the degree of risks that have been recognised by banks, such as credit risk, liquidity risk, interest rate risk, and so forth (Pennathur, 2001). He et al. (2020) investigated the effect of online channel

adoption by Chinese banks and found that the effect of banks applying online channels raised credit risk due to suffering from switching to hard-information-based lending. In addition, the increased credit risk after adopting the online channel is more likely to lead to a higher solvency risk due to the insignificant reduction of the capital buffer. However, He et al. (2020) found no evidence of the effects of the online channel on bank liquidity.

2.7 ISSUES RELATED TO ISLAMIC BANKING

2.7.1 Sharia Compliance

Islamic banking is a system of banking or banking activity that complies with the Sharia principle (Cihak & Hesse, 2008; Abedifar et al., 2013) and Islamic economics (Cihak and Hesse, 2008). In particular, the Sharia principle (Islamic law) prohibits payment or receipt of *Riba* that is similar to usury, interest, or excess to be returned on money lending, instead Islamic banking applies to profit and loss arrangements that profit or loss would be shared in the pre-agreed proportion, debt-like based financing in the form of purchase and resale, and lease-based financing in the form of purchase and rent (Cihak & Hesse, 2008; Abedifar et al., 2013).

Unlike conventional banks, Islamic banks must ensure the services comply with Sharia principles by satisfying all Islamic legal requirements and without violating any of the conditions defined by the Islamic system (Laldin & Furqani, 2016). As a part of the Islamic economy, the overall goal of Islamic finance is to realise maqasid Sharia that is achieved at the transaction level by fulfilling legal requirements through satisfying the contractual and compliance with the principles of Islamic law in the documentation, process and operation (Ahmed, 2011). Therefore, violating the Islamic legal requirements as well as conditions defined by the Islamic system makes the services non-sharia-compliant.

Sharia compliance in financial services is central to the integrity and credibility of Islamic financial services (Muryanto, 2023). Sharia compliance applied in financial technology is not different from Islamic finance traditionally (Laldin and Furqani, 2019).

Digital banking services, which are similar to financial technology, should meet Islamic principles as follows :

1. The basic rule is that financial technology/services in business transactions (*mu'amalah*) are considered permissible and are generally encouraged, except where there is a clear text that prohibits them or conflicts with the fixed rules of Sharia. It is welcomed so long as it brings real benefit to human beings and removes hardship in financial transactions (Laldin and Furqani, 2019; Ichsan et al., 2024).
2. The presence of services is to achieve the objectives of Sharia (*maqasid al-Sharia*), that is, to realise the benefits (*maslahah*) and avoid the harm or difficulties in the transactions (Laldin and Furqani, 2019; Ichsan et al., 2024).
3. The fintech/services are free from the prohibited elements in transactions such as interest (*riba*), gambling, uncertainty (*gharar*), harms, cheating/fraud, and the transactions must be transparent, with no hidden costs and irresponsible finance (Bello et al, 2017; Laldin and Furqani, 2019; Muryanto, 2023; Ichsan et al, 2024). It should comply with Islamic ethics such as transparency, fairness and justice. The fintech/services should follow the rules of the contract (*'aqd*) under the Sharia by complying with the pillars (*rukun*) and conditions in the contract (Laldin and Furqani, 2019).
4. Shared services between Islamic and conventional banking should be developed to enforce the purpose of the transactions as envisaged by the Sharia while similar services between conventional and Islamic banking, such as the transfer of money, can both use the same system and method of transfer (Laldin and Furqani, 2019).
5. The fintech/application should be supervised by the Sharia Boards to ensure that the application does not violate the Islamic principle (Laldin and Furqani, 2019; Ichsan et al., 2024).

Furthermore, Islamic banking has been criticised for only changing the terminology from the conventional bank (Chaudhry et al., 2020). Instead of coming up with a unique product elaborated on Islamic principles, Islamic scholars and practitioners have employed the replication of conventional financial products and structures into an Islamic form (Laldin & Furqani, 2016). There are at least three general steps that must be followed regarding the replication of conventional products and structures: removing the prohibited elements in the conventional products and structures, applying Islamic principles and appropriate Sharia contracts to the transaction and enhancing the product and structure based on Sharia principles (Laldin & Furqani, 2016). Islamic banks have done so by assuming that financial intermediaries in the conventional perspective are similar to the Islamic perspective in the function and objectives, namely channelling from the savers to borrowers, and the difference emerges from the paradigm to perform the universal functions of a bank and mechanism to solve the problem in practice usually in term of contracts (Laldin & Furqani, 2016).

Ahmed (2011) categorised three types of Islamic banking products in response to the fulfilment of legal requirements of Islamic law: pseudo-Islamic products, Sharia-compliant products and Sharia-based products. A pseudo-Islamic product is identified as an Islamic banking product that fulfils the legal form but not the substance or the social needs, whereas a Sharia-compliant product satisfies the legal form and the substance but fails to meet the social needs. Ideally, a Sharia-based product, which is acknowledged as an Islamic banking product that will not only fulfil the legal form and substance of Sharia but also satisfy the social needs of all the segments, including the poor and small and micro-enterprises. The Sharia Supervisory Board (SSB) is responsible for ensuring that Islamic banking products comply with Islamic principles and values before being launched to the market. In addition, SSB has a critical role in minimising the usage of pseudo-Islamic products.

2.7.2 Product Development and Customer Financial Needs

Concerning Islamic banking, Ahmed (2011), as cited by Yumna (2019), revealed two main issues related to product management in Islamic banking, which are perceived as replication or modification from conventional banking, namely Sharia compliance

issues and the inability to meet customer needs. In this regard, Islamic banks need to consider designing digital banking services perceived as unique or different from conventional banks and comply with the Sharia principle. It is expected that Islamic banks should offer unique services delivered through digital banking channels that differentiate them from conventional banks.

Thus, services in digital banking for Islamic banks are required to be aligned with the Islamic principles. Account opening services only serve opening accounts related to Islamic banking deposits and financing, which are based on Islamic principles, among others, *mudharabah*, *murabahah*, or *musharakah*. Islamic banks may offer to subscribe to and pay for Islamic insurance policies or *takaful*. In particular, donation services for customer support to increase religious social funds, such as *zakat* and *waqf* in Islamic social finance, which are necessary to be accommodated in digital banking, since *zakat* is a Muslim obligation for those who have met the requirements, and both funds have a social impact on the community. Moreover, financial instruments facilitated for selling and buying should adhere to the Sharia, for example, Islamic stocks/shares and Sukuk. For Islamic banking, going beyond banking has the potential to satisfy the customer needs concerning the Islamic tenets. Contents or tools to manage performing *hajj*, *umrah* travelling, or facilitating worship, such as a time prayer (*azan*) schedule or *qiblah* direction, are some services that increase the customer experience using digital banking concerning the application of Islamic tenets. Performing *hajj* and *umrah*, travelling, and religious social funds have been identified to fulfil the self-actualisation of the customer (Yumna, 2019) or religious purpose (Yumna and Marta, 2021). Beyond banking services have more potential to be elaborated for increasing the customer experience. Above all, the most important is Sharia compliance, as it is the main consideration for the consumer to select a financial product (Yumna, 2019). Table 2.2 summarises the classification of digital banking services in relation to Islamic banking, following the categories of services in digital banking.

Table 2.2 Digital Banking Services Classification Related to Islamic Finance

No	Offered Services	Related Islamic Financial Products
1.	Transaction Fund transfer Payments and purchases	
2	Account opening Deposit accounts (savings/checking) Loan account (loan application)	Saving accounts, checking accounts Financing such as mortgage, personal finance (based on Islamic principles such as mudharabah, musharakah, murabahah, etc.)
3	Security/Protection Insurance Pension Plans Time Deposits	Islamic insurance/takaful, Islamic pension funds
4	Social Endowment Donation	Sadaqah, Zakat, Waqf
5	Investment/Brokerage: Stocks Mutual funds Bonds	Islamic stocks, Sukuk Mutual funds
6	Beyond banking Travelling for leisure Conspicuous consumption Personal finance management / Wealth management	Application/tools for assisting hajj, umrah, and qiblat direction or time prayer (adzan) schedule.

Source: The researcher's modification based on Ahmed (2011), Yumna and Marta (2021), Dinar Standard and Elipses (2021)

2.7.3 Internal Dynamics

Internal dynamics have been a critical issue in the product development of Islamic banking. Ahmed (2011) pointed out that internal dynamics may occur in the bank since product development involves various departments, including the Sharia department and the Sharia Supervisory Board (SSB). Frictions can happen in determining which products are going to be delivered to the customers. Chaudhry et al. (2020) have asserted the issue of compatibility between the Product Development Department and

the Sharia Department or the Product Development Department and the Sharia Supervisory Board.

Internal dynamics may also occur due to trade-offs between the economic and Sharia aspects. The objective of the bank, including Islamic banks, is to create products for the customer that are efficient, in terms of delivery and development, and generate a high expected return to the bank; however, if the trade-off exists, then the Sharia requirements should prevail since too much concern for the profitability may sacrifice particular Sharia requirements (Ahmed, 2011). The Board of Directors' role is critical to facilitate the trade-off suited to the vision and mission of the Islamic bank, while the SSB should ensure the products comply with the Sharia principle (Ahmed, 2011).

2.8 INDONESIAN ISLAMIC BANKING

2.8.1 Brief History of Islamic Banking in Indonesia

The establishment of the first Indonesian Islamic bank, namely Bank Muamalat Indonesia, in 1992 (Abduh & Omar, 2012; Kasri & Kassim, 2009) marked the cornerstone of the development of Islamic banking in Indonesia. The establishment of the Islamic bank was initially pioneered with the measures of Ulama and academicians that absorbed the aspiration of considerable Muslims in Indonesia demanding an Islamic bank, whilst the concept of an Islamic bank was not familiar in those days (Kasri & Kassim, 2009). The issuance of Banking Act No.7/1992 paved the way to establish the first Indonesia Islamic Bank since there was no possibility of establishing Islamic banking based on the previous Banking Act although the Banking Act No.7/1992 did not mention "Islamic Bank" or "Sharia Bank" terms and Bank Muamalat Indonesia was known as "profit and loss sharing bank" (Kasri & Kassim, 2009).

After the crises of 1997-1998 that affected people's lives in Indonesia multidimensionally (Abduh & Omar, 2012), four big banks in Indonesia were merged into one commercial bank, namely Bank Mandiri, in 1999. Bank Mandiri bought a bank to convert into an Islamic Bank, namely Bank Syariah Mandiri. It became the second Islamic bank in Indonesia (Abduh & Omar, 2012). Before the consolidation, Banking Act No.10/1998 was issued to amend the Banking Act No.7/1992 which, under this

banking act, a commercial bank in Indonesia was allowed to operate based on the Islamic (Sharia) principle and a conventional bank that was operated under interest rate principle also were allowed to establish sharia branch office (Kasri & Kassim, 2009). The Banking Act No.7/1992 and Banking Act No.10/1998 enabled Indonesia to have a dual banking system that allows Islamic banks, along with conventional banks (Ismal, 2011).

Furthermore, Bank Indonesia, as the central bank in Indonesia, launched the “Blueprint of Islamic Banking Development in Indonesia” in 2002 as a strategy to develop Islamic banking in Indonesia. It described the phases of developing Islamic banking and its parameters (Abduh & Omar, 2012), as well as aimed to achieve 5% of the market share of Islamic banking over the total banking industry (Kasri & Kassim, 2002). To provide the legal basis for the further development of Islamic banking, the Islamic Banking Act No.21/2008 was issued (Kasri & Kassim, 2009), which led to many conventional banks converting (spin-off) their Islamic windows to full-fledged Islamic banks (Abduh & Omar, 2012).

The establishment of Otoritas Jasa Keuangan (OJK) in 2012 has transferred the supervision of the banks to OJK, including Islamic banks, which were previously supervised by Bank Indonesia. OJK has launched several initiatives to foster the development of Islamic banking in Indonesia, such as the Roadmap of Islamic Banking Development 2015-2019 and the Roadmap of Islamic Banking Development 2020-2025. Further, Bank Indonesia continued its role in the development of Islamic banking and finance as well as the Islamic economy by launching the Islamic Economy and Finance Development Blueprint in 2017.

Indonesian Ministry of National Development Planning has also contributed to the development of Islamic finance including Islamic banking by launching two blueprints as a strategy to foster the growth of Islamic banking and finance as well as the Islamic economy, that is Master Plan Arsitektur Keuangan Syariah Indonesia in 2015 (Indonesian Ministry of National Development Planning, 2019) and Master Plan Arsitektur Ekonomi dan Keuangan Syariah Indonesia in 2018 which also incorporate the Master Plan Arsitektur Keuangan Syariah Indonesia (Indonesian Ministry of National Development Planning, 2019) respectively.

Komite Nasional Keuangan Syariah (KNKS) was established in November 2016 to accelerate, enlarge and advance the development of Islamic finance to support national economic development. In addition, KNKS was also directed to strengthen coordination, synchronisation, and synergy across the authority, ministry/institution and other stakeholders in Islamic finance. Afterwards, KNKS was converted into Komite Nasional Ekonomi dan Keuangan Syariah (KNEKS) in 2020 by enlarging its function to capture the Islamic economy in Indonesia.

Thus, the application of Islamic banking in Indonesia has a strong legal aspect (Ismal, 2011). Government regulation and consumer demand have fostered Islamic banking growth (Abduh & Omar, 2012). The collaboration of many stakeholders, such as Ulama, Islamic scholars (academicians), the government, banking regulators, and the parliament, also contributed to Islamic banking growth (Kasri & Kassim, 2009; Ismal, 2011).

Currently, there are three categories of Islamic banks in Indonesia: Sharia Commercial Bank, Sharia Business Unit of a Conventional Bank, and Rural Islamic Bank. According to the Islamic Banking Act No. 21/2008, an Islamic bank refers to a bank which operates based on Islamic (Sharia) principles and by category, it consists of Sharia Commercial Bank or “Bank Umum Syariah” (BUS) and Rural Islamic Bank or “Bank Pembiayaan Rakyat Syariah” (BPRS). The difference between BUS and BPRS is that Sharia Commercial Bank is involved in the payment system, whilst Islamic Rural Bank is not allowed to be involved in the payment system. In addition, since a conventional bank is allowed to open a Sharia branch office, conventional banks should have a Sharia Business Unit or “Unit Usaha Syariah” (UUS). It refers to the working unit in the head office of a Conventional Bank to act as a head office for all the offices, branches or units that operate based on Islamic (Sharia) principles. UUS is also known as the Islamic window (Abduh & Omar, 2012).

Table 2.3 Performance of Islamic Banking

	2015	2016	2017	2018	2019	2020	2021	2022
Asset	296,262	356,504	424,181	477,327	524,564	593,948	676,735	782,100
Deposit	231,175	279,335	334,888	371,828	416,558	465,977	536,993	606,063
Financing	212,996	248,007	285,695	320,193	355,182	383,944	409,878	491,489
ROA	0.84%	0.94%	1.17%	1.59%	1.83%	1.54%	1.69%	1.90%
Total Banks	34	34	34	34	34	34	33	33
• IB	12	13	13	14	14	14	12	13
• CB	22	21	21	20	20	20	21	20

Notes: IB = Islamic Banks; CB = Conventional Banks that own Islamic Business Unit; Asset, Deposit, and Financing in IDR billion.

Source: Sharia Banking Statistics December 2022 (OJK, 2022).

Table 2.3. highlights the performance of Indonesian Islamic banking during the period 2015 to 2022. Total assets, total deposits, and total financing of Islamic banking are inclined to increase. In fact, in the challenging time when COVID-19 began in 2020, Islamic banking has maintained its performance positively, which was indicated by the increase in assets, deposits and financing. Profitability, which is indicated by ROA, is inclined to increase except for the year 2020 due to the COVID-19 pandemic. The number of banks offering Islamic banking products and services remained stagnant until 2020. The corporate action which merged three Islamic banks into the largest Islamic bank in 2021 has resulted in the number of banks declining to 12 Islamic banks, and the number of banks offering Islamic banking products and services has declined to 33 banks. The additional number of Islamic banks has been caused by the conversion of conventional banks that own Islamic business units into Islamic banks in 2016, 2018, and 2022, respectively, and an additional conventional bank licensed to have an Islamic business unit in 2021. The additional number of Islamic banks has been caused by the conversion of conventional banks/Islamic business units into Islamic banks. As of December 2022, 33 banks offering Islamic banking products and services consist of 13 Islamic banks and 20 conventional banks that own Sharia business units, as presented in Appendix I. In addition, Islamic banking assets have achieved IDR 782,100 billion, which is equal to 6,88% share of Indonesia's banking assets (excluding rural banks and Islamic rural banks).

2.8.2 Digital Banking Adoption in Indonesia

Digital banking in Indonesia was pioneered by the adoption of Internet banking in the 1990s. Bank Indonesia stated that the first adoption of Internet banking in Indonesia was performed by a private commercial bank in the middle of 1999 (Bank Indonesia, 2002), while Iman (2011) found that Bank Papan Sejahtera claimed to be the first bank offering Internet banking services in 1997.

At the beginning of the 2000s, mobile banking began to be offered to customers. Panin Bank and BCA Bank claimed to launch access to banking services through mobile devices in 2000 (Iman, 2011; IFC, 2017). Afterwards, Danamon Bank offered mobile banking services since 2004 (IFC, 2017). However, the banks offered mobile banking services using STK and SMS-based services.

For Islamic banking, it is not clear which was the first Islamic bank to embrace digital banking. However, in 2009, Bank Syariah Mandiri offered Internet banking to customers along with GPRS-based mobile banking (Utama, 2009). In the same year, Bank Muamalat Indonesia (BMI) conducted a soft launch of its mobile banking services using a Java-based system in the first half of 2009 (IFC, 2017). BMI's mobile banking was upgraded in 2016 so that its mobile banking application can be downloaded on the Google Play Store, Apple Store, Blackberry World, and Microsoft Store (Bank Muamalat Indonesia, 2016). Before adopting internet-based mobile banking, BSM and BMI initially adopted internet banking.

Apart from that, BRI Syariah has taken a different approach to adopt digital banking. In 2012, BRI Syariah launched and claimed its mobile banking application was the first mobile banking that could be downloaded through four online markets, namely Blackberry App World, Android Google Play, Apple App Store and Nokia Store (Gunawan, 2012). BRI Syariah later launched Internet banking services in 2014 (Sulistyawati, 2014).

Islamic banks have utilised the advances of technology, which have enabled them to offer banking services without having or with limited branch offices, i.e. as digital banks. In 2021, Bank Aladin Syariah, previously known as Bank Net Syariah

Indonesia, adopted digital banking by converting the mode of banking business from a traditional bank that relies more on branch offices to a digital bank (Putra & Gunawan, 2021). By doing so, Bank Aladin Syariah can be regarded as the first digital Islamic bank in Indonesia.

The progress of digital technology in the Indonesian banking industry has been supported by Government initiatives and policies. In 2015, OJK issued OJK Regulation (POJK) No. 24/POJK.03/2015 regarding the Products and Activities of Islamic Bank and Sharia/Islamic Business Unit, which regulates the products and activities of Islamic banking. Regarding digital banking, Islamic banks are required to obtain a license prior to offering internet banking and mobile banking to the customer, and a small Islamic bank is prohibited from offering internet banking to the customer unless the internet banking services are performed in collaboration with other banks. Through this regulation, the Sharia Business Unit is allowed to use the license obtained by a conventional bank, which is its parent, to offer internet banking and mobile banking.

In line with the POJK No. 24/POJK.03/2015, Sharia Business Unit (Islamic Windows) has an advantage in adopting digital banking compared to Islamic banks (full-fledged Islamic banks), in which Sharia Business Unit has an opportunity to collaborate with a conventional bank, which is its parent, in adopting and developing digital banking. For instance, CIMB Niaga has employed the Dual Banking Leverage Model (DBLM) to develop an Islamic banking business since 2015, which has enabled CIMB Niaga Syariah, a Sharia Business Unit of CIMB Niaga, to utilise the infrastructure of CIMB Niaga, including offering Internet banking and mobile banking (Apriyani, 2016).

In December 2016, OJK issued POJK No. 39/POJK.03/2016 regarding Implementation of Risk Management on the Usage of Information Technology by Commercial Bank. Through this regulation, the bank should implement risk management adequately on the Information Technology, including electronic banking services as well as digital banking services. A bank which intends to implement electronic banking services or digital banking services should adhere to the POJK regarding the Implementation of Digital Banking Services. The regulation is also applied to Islamic banks.

Responding to the advancement of digital technology, OJK issued POJK No. 12/POJK.03/2018 regarding the Implementation of Digital Banking Services by Commercial banks to regulate digital financial services performed by the bank, including Islamic banks. Digital banking in this regulation refers to the advanced services offered by electronic banking, for example, online account opening. The regulation outlines the procedure for implementing digital banking services and the criteria for banks to be allowed to adopt digital banking services. Banks must implement risk management and prudential principles accordingly before and during the delivery of digital banking services.

Several initiatives have been issued by OJK to support digital transformation in the banking industry. In February 2021, OJK issued the Roadmap of Islamic Banking Development 2020-2025. One of the directions of Islamic banking development is to strengthen Islamic banking identity, and one of the initiatives is to accelerate digitalisation in Islamic banking, since the lack of digitalisation has been an issue to be addressed in Islamic banking. The policy outlines the strategy to accelerate digitalisation in Islamic banking as follows:

1. Encouraging Islamic banks to provide adequate infrastructure of information and technology through the OJK regulation concerning banking synergy between Islamic banks and their corresponding parent bank.
2. A policy to support Islamic banks adopting the latest technology should be provided by OJK. By doing so, Islamic banks are expected to have the capacity to maintain competitiveness in the post-pandemic era, such as online account opening.
3. Islamic banks have different characteristic products and services from conventional banks due to Islamic principles (Sharia). Therefore, OJK encourages Islamic banks to develop Information Technology that complies with Islamic principles, such as Sharia-based contracts.

In July 2021, OJK issued POJK No. 13/POJK.03/2021 regarding the Implementation of Commercial Bank Products. In this regulation, digital banking

services are categorised as advanced banking products using information and technology. OJK introduced procedures to issue banking products to encourage innovation in the financial sector. In October 2021, OJK issued a Blueprint for Digital Transformation in Banking containing the policy design of OJK to boost the acceleration of digital transformation in the Indonesian banking sector by balancing between digital banking innovation and prudential principles to sustain banking performance in prudent, safe and sound conditions.

The Blueprint for Digital Transformation in Banking provides the OJK's policy to accelerate digital transformation in the Indonesian banking industry, including Indonesian Islamic banking. The policy identifies five elements as the main focus of the digital transformation policy that will encourage banks to innovate financial products and services by concentrating on customer expectations and experience, as follows:

1. Data

Data has become a new kind of wealth, and data exchange is predicted to take place more frequently in the future. A bank is expected to be a secure data repository. Data protection, data transfer and data governance in banking are crucial issues to be addressed by the banks.

2. Technology

Technological innovation has made technology change rapidly. Consequently, particular technology, especially today's technology, potentially becomes obsolete quickly. Therefore, technology should be implemented properly by considering IT governance, IT architecture and the adoption of the latest information technology.

3. Risk Management

Adopting new technology, especially digital technology, carries risks to the bank, such as cyber-attacks that may harm the information system and technology of the bank and steal the company's and customers' data. The bank is required to implement Information and Technology Risk Management to

anticipate and mitigate the potential risk associated with the adoption of digital technology. Cybersecurity is one of the issues that needs to be addressed. Banks also need to consider the risks arising from outsourcing.

4. Collaboration

The bank is required to collaborate with other entities to build a digital ecosystem that will support the bank in enhancing and innovating its products and services. Sharing platforms and collaboration with non-bank financial institutions and fintech companies are some examples of collaboration that banks have the capability to perform.

5. Institutional Arrangement

Digital transformation should be followed by the bank's initiatives to support the transformation concerning financing and investment, leadership, organisational design, digital culture and digital talent. When adopting digital technology, banks consider financing and investment to support the provision of infrastructure, providing digital leadership along with digital culture and digital talent, and designing the organisational structure to be more dynamic to support product and service innovations.

The five key elements in the Blueprint of Digital Transformation are geared towards providing innovative products and services to the customer at all levels of society. Banks should focus on the customer-centric orientation by considering customer engagement, customer experience, customer insight and customer trust and perception.

The regulation to establish a digital bank in Islamic banking was issued in August 2022 under POJK No. 16/POJK.03/2022. An Islamic digital bank may be established by obtaining a new bank license as a new digital bank or by transforming the current Islamic bank into a digital bank. Considering the advancement of digital technology along with the changing customer expectations, OJK issued POJK No. 21/2023 regarding Digital Banking Services, which outlines the procedure for the banks,

including Islamic banks, to issue digital banking services, whether the services are issued by the bank itself or by the bank collaborating with other parties. Furthermore, the regulation emphasises the importance of implementing risk management on information technology by the bank and to maintain and protect securely the personal data of customers. In the same year, OJK issued the Roadmap for the Development and Strengthening of Indonesian Islamic Banking 2023-2027, which asserted the importance of digital banking in the Islamic banking industry. Indonesian Islamic banking is encouraged to accelerate digitalisation to support product and service development so that Islamic banks are able to offer competitive products and services. The acceleration of digitalisation is also geared toward strengthening Information Technology resilience. OJK established the acceleration of digitalisation in Islamic banking as one of the five pillars for developing and strengthening Indonesia's Islamic banking industry.

Along with the advantages of digital banking, it also carries risks that should be mitigated accordingly by the bank. For instance, in June 2001, a fake domain or a fake website, which was almost similar to BCA's website, was found deceiving BCA's customers (BI, 2002). Although POJK No. 39/POJK.03/2016, regarding Risk Management in Information Technology, has demanded that banks implement risk management adequately. Indonesian Islamic banking has been exposed to cyber risk. For instance, the most recent cyber risk was experienced by Indonesia's largest Islamic bank, which resulted from the merger of three Islamic banks in 2021. Two years after the merger, in 2023, the bank was allegedly attacked by hackers with the Lockbit 3.0 ransomware, which affected customer convenience in performing digital banking services (Lestari, 2023).

2.9 CHAPTER SUMMARY

In this chapter, the landscape of digital banking elaborates on the definition of digital banking, Internet banking and mobile banking. Digital banking is simply defined as banking services delivered through digital banking channels. In this study, digital banking refers to Internet banking and mobile banking, as these technologies utilise the Internet for delivering services and are regarded as a virtual delivery channel. The main

advantage of digital banking for the bank is the ability to reduce costs and improve customer experience, while the advantage for the customer is anytime and anywhere access to banking services. Based on financial needs, types of digital banking services can be categorised as transfer and payment, account opening, social, protection, investment, and beyond banking. To adopt digital banking, the traditional bank may adopt Internet banking or mobile banking first, depending on the market encountered by the bank. By adopting digital banking, potential risk arises, primarily, the risk concerning operational risk. For Islamic banks, Sharia compliance is the main issue in financial innovation in Islamic banking. Satisfying customer needs and internal dynamics are other issues that need to be addressed.



CHAPTER THREE

THEORETICAL FRAMEWORK AND EMPIRICAL LITERATURE REVIEW

3.1 INTRODUCTION

The previous chapter has elaborated on the concept of digital banking from various perspectives: definition, types of services, the advantages, the risks, and issues related to Islamic banking. Furthermore, digital banking adoption in Indonesia has been discussed in the previous chapter. In terms of technology adoption, digital banking has been studied from various perspectives, such as the underlying theories used to study it, the perspective of adopters, and the model used to study the phenomenon. These perspectives have brought heterogeneity to the study on technology diffusion in the financial sector, with its characteristics or uniqueness to the literature.

This chapter elaborates on the underlying theories used to study technology adoption, particularly in the banking sector. By doing so, the theoretical framework for this study was constructed as the foundation of the study to achieve the objectives of the study. The conceptual framework also plays a role as the foundation for developing hypotheses in this study.

3.2 THEORETICAL FRAMEWORK

3.2.1 Diffusion of Innovation Theory

The diffusion of innovation theory attempts to explain the process of adopting innovation, and it has been used since 1960 (Hernandez and Mazzon, 2007). It is regarded as one of the most popular models to explain the adoption of innovation (Sahin, 2006; Pushcel et al., 2010), proposed by Rogers' seminal text in the first edition of his book entitled *Diffusion of Innovation* in 1962 (Nutley et al., 2002), as well as later editions in 2003 (Sahin, 2006). This theory has been widely used in the adoption of

innovation in the industrial and service sectors as well as the public sector (Nutley et al., 2002).

Rogers (2003) described diffusion as the process of communicating an innovation over time to the members of a given social system through a certain channel (Sahin, 2006; Al-Jabri & Sohail, 2012). Diffusion also gauges the process in which adoption of and spread of innovation occur widely in the population (Frame & White, 2004; Sullivan and Wang, 2020). The main element of innovation is the perception of adopters or potential adopters to envisage the innovation as new (Brown, 1992; Dearing & Cox, 2018). Rogers utilised the term “innovation” similar to “technology”, though Rogers contended that technology is designed to decrease the uncertainty toward achieving the intended outcome (Sahin, 2006). According to Rogers, the diffusion process generates acceptance or penetration of a new idea, behaviour or physical innovation (Al-Jabri & Sohail, 2012), and when the process generates a decision not to adopt an innovation, it leads to rejection (Sahin, 2006). Assessing the diffusion can be attributed to individuals, organisational context, as well as larger contexts such as cities or states (Dearing & Cox, 2018). The set of variables that explain the diffusion or lack of diffusion of an innovation encompasses the attributes of innovation, the characteristics of adopters, including potential adopters, and the larger social and political context (Dearing & Cox, 2018).

Based on the Diffusion of Innovation Theory, Rogers (2003) explained four elements of the diffusion of innovation. Firstly, *the innovation* is perceived to be new. An innovation that has been previously invented is still called an innovation if it is perceived as new. The important obstacle to adopting innovation is the consequences resulting in uncertainty that can be reduced by communicating the advantages and disadvantages. Secondly, *communication channels* are the means utilised by one another to deliver a message from the source to the receiver so that mutual understanding is achieved. Thirdly, *the time dimension*. It is an important aspect since the process of innovation-diffusion, the category of the adopter, and the rate of adoption involve a time dimension. Lastly, *the social system* is where the diffusion of innovation takes place. A social system consists of a set of interrelated units that work together to solve a problem to achieve a similar goal. The nature of the social system influences innovativeness, which is used to make categorisations of adopters. Regarding diffusion,

Dearing and Cox (2018) contended that, despite the importance of time of adoption as a variable under-researched, subsequent implementation of diffusion is more meaningful in the organisational context.

The mechanism in deciding to adopt or reject the innovation involves psychological and sociological aspects, intending to reduce the uncertainty regarding the consequences or outcome. Dearing and Cox (2018) argued that the process initiated by people learning about innovation should result in important consequences for the people. Uncertainty of the consequences encourages seeking information about attributes of innovation to further warrant the exploration. This activity may be considered a psychological aspect of behaviour. If the information leads to promising results and has consequences for the person, a secondary search involving information from opinion leaders such as trusted, expert or accessible others to reduce the uncertainty is conducted and considered as social reinforcement. The information is evaluated for judgment on the adoption.

A more specific innovation-decision process based on Rogers' Diffusion of Innovation Theory was further elaborated on by Sahin (2006), revealing that the decision to adopt or reject involves five stages as follows:

1. Knowledge (Cognitive) stage

The individual learns about the existence of innovation to is motivated to search for more information on innovation. Information concerning how to use and function the innovation is also sought.

2. Persuasion (Affective) stage

Information that has been collected in the previous stage may induce the attitude, whether it is positive or negative. The individual's opinion is influenced by the uncertainty toward the outcome since the innovation brings newness that may lead to uncertainty of the outcome. Social reinforcement also plays a role in the formation of opinions with the close peer subjective that reduces uncertainty and is more credible than others.

3. Decision stage

An individual arrives at a position to decide whether the individual would adopt or reject the innovation. Active rejection occurs when the rejection is decided after a trial has been conducted or innovation has been adopted (*discontinuance*), whilst passive rejection refers to not considering or thinking of adopting at all.

4. Implementation stage

Implementation is considered putting into practice. The degree of uncertainty is still influenced by implementation; thus, technical assistance may reduce the degree of uncertainty.

5. Confirmation stage

It is common to seek support for the decision that has been made. For the adopter, it will lead to the confirmation of whether to continue to adopt or discontinue the adoption. Discontinuance can replace the adoption with better innovation (*replacement discontinuance*) or discontinue due to dissatisfaction with the adoption. The rejection can turn into an adopter (*later adoption*).

The innovation-diffusion process, as illustrated in Figure 3.1, is considered to be a process to reduce the uncertainty concerning the adoption of innovation.

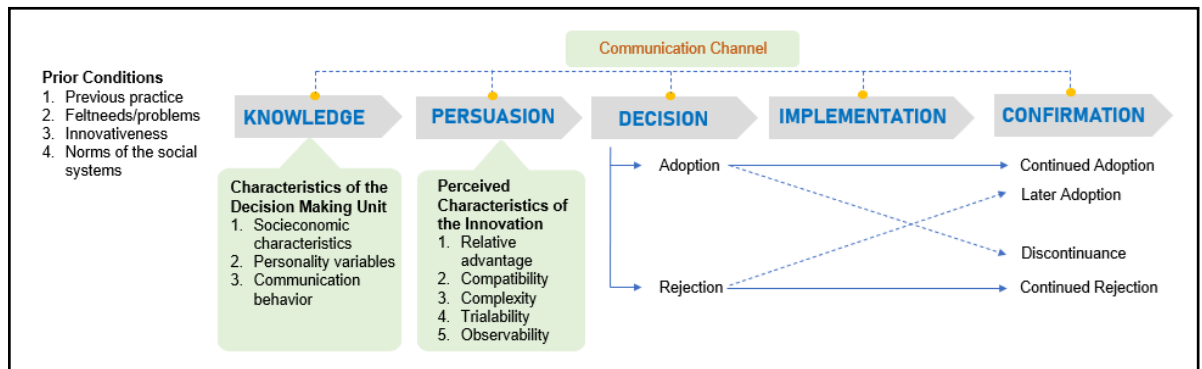


Figure 3.1 Innovation Decision Process (Sahin, 2016)

Rogers (2003) proposed the attributes of innovation that predict the rate of adoption of innovation (Sahin, 2006; Mullan et al., 2017), which consist of five attributes, namely relative advantage, compatibility, complexity, trialability and observability (Kolodinsky et al., 2004; Hernandez & Mazzon, 2007; Puschel et al., 2010) as follows:

1. Relative advantage is the degree to which the innovation is perceived to be different from and better than its substitutes (Kolodinsky et al., 2004) or superior to all other options (Puschel et al., 2010). Moore and Benbasat (1991) argued that relative advantage is related to providing more benefits to its predecessor (Al-Jabri & Sohail, 2012). Rogers (2003) contended that relative advantage brings about enhancement in efficiency, economic benefits, and status (Al-Jabri & Sohail, 2012).
2. Compatibility is the extent to which the innovation is perceived as consistent and compatible with the needs, values, beliefs, experiences, and habits of potential adopters (Kolodinsky et al., 2004; Puschel et al., 2010) as well as fit with the way to achieve the same goals (Dearing & Cox, 2018).
3. Complexity is the extent to which the innovation is perceived as difficult to understand and use (Puschel et al., 2010).
4. Trialability is the extent to which the innovation can be used as a trial before its actual adoption (Puschel et al., 2010) or is reversible to manage (Dearing

& Cox, 2018). Rogers (2003) argues that providing a partial trial would speed up the adoption process (Sahin, 2006).

5. Observability is the extent to which the innovation, particularly its benefits, can be observed or described and can be seen by the potential adopters (Puschel et al., 2010; Dearing & Cox, 2018)

The attributes of innovation apply to the adoption of innovation by the individual (consumer) as well as to the organisational context (Mullan et al., 2017).

Rogers (2003) defined innovativeness as the “degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than other members of a system” (Sahin, 2006) and, given the degree of the innovativeness, adopters can be differentiated into five categories namely innovators, early adopters, early majority, late majority and laggards respectively according to the timing of adoption. Table 3.1 presents the characteristics of adopter categories.

Table 3.1 Adopter Categories Based on Rogers (2003)

No	Adopter	Characteristics
1	Innovators	<ol style="list-style-type: none"> 1) Excitement over novelty and feeling unconstrained by social norms. 2) Willingness to experience new ideas, to cope with unsuccessful and unprofitable innovations, as well as a certain level of uncertainty.
2	Early adopters	<ol style="list-style-type: none"> 1) A measured appraisal that an innovation’s advantages outweigh its disadvantages. 2) More likely to hold leadership roles in the social system. 3) Their subjective evaluations reach other members of the networks. 4) Their leadership in adopting innovation decreases the degree of uncertainty regarding innovation.
3	Early Majority	<ol style="list-style-type: none"> 1) Adoption innovation is mainly motivated by the presence of social pressure. 2) Do not have a leadership role. 3) Adopting innovation deliberately, and neither the first nor the last to adopt the innovation.

No	Adopter	Characteristics
4	Late majority	<ol style="list-style-type: none"> 1) Adoption innovation is mainly motivated by the presence of economic necessity and social pressure. 2) Waiting until most of their peers adopt the innovation. 3) Sceptical about the innovation and the outcome.
5	Laggards	<ol style="list-style-type: none"> 1) Less susceptible to social pressure and feel free to take the time. 2) Have a traditional view. 3) More sceptical about the innovation and the outcome than the late majority. 4) They want to ensure the innovation works well before adopting it since they have limited resources and lack awareness-knowledge.

Sources: (Sahin, 2006; Dearing & Cox, 2018)

Following Rogers' empirical studies on diffusion (2003), Dearing and Cox (2018) illustrated the distribution of adopters following the normal distribution as illustrated in Figure 3.2, with the pattern of diffusion beginning from the periphery, that is, innovators, following the outside-inside-outward progression of diffusion.

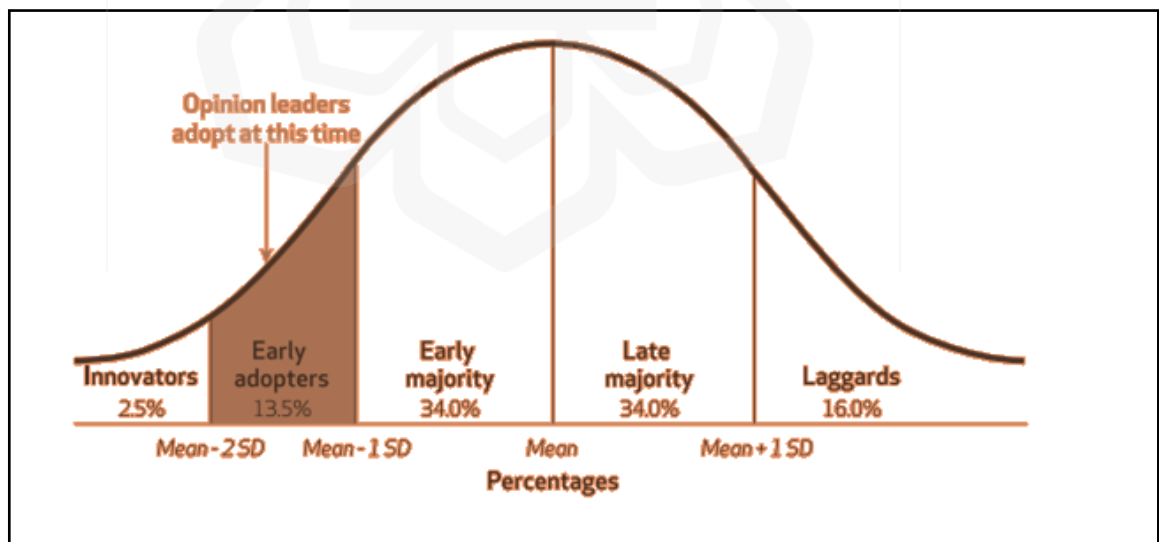


Figure 3.2 Distribution of Adopters Unit (Dearing & Cox, 2018)

Redrafting the distribution adopter categories in the form of cumulative adopters generates the S-shaped diffusion curve as illustrated in Figure 3.3, and from the view of marketing strategy, the curve is similar to the growth phase of the product life cycle (Brown, 1992).

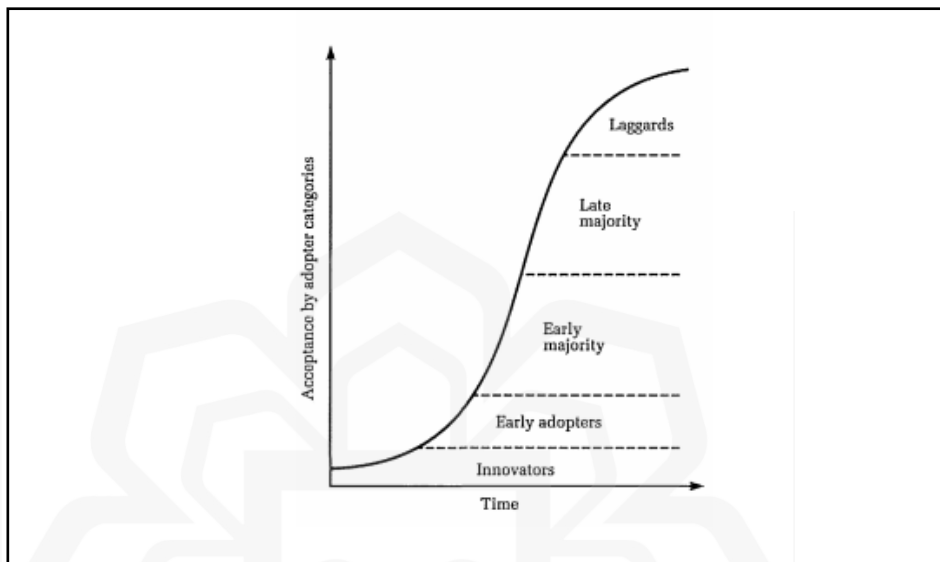


Figure 3.3 S-Shaped of Adopters Distribution (Brown, 1992)

Rogers' Diffusion of Innovation theory emphasises the communication of information, where the adoption of innovation by agents occurs when the agents have communicated with others who have already adopted it (Sullivan & Wang, 2020). Individual or organisational adopters are able to influence the rate of adoption in the social system, particularly in the case of voluntary adoption. When an influential member in a social system adopts the innovation and communicates the decision to the other members who follow to do so, then the rate of adoption is accelerated and the state of the social system changes whilst the state of the social system remains the same when the rejection by the influential member occurs (Dearing & Cox, 2018). Sullivan and Wang (2020) believed that in Rogers' Diffusion of Innovation, incomplete information is similar to contagion, "word of mouth," and more like internal diffusion. However, Sullivan and Wang (2020) proposed another approach, which may be called external diffusion, assuming that agents may have complete information regarding the

innovation and the adoption of innovation based on heterogeneous willingness to pay for the innovation, such as price reduction or quality improvement.

3.2.2 The Unified Theory of Acceptance and Use of Technology

Another theory that is often used to explain the use of technology is the Unified Theory of Acceptance and Use of Technology (UTAUT). The theory posits three determinants affecting the intention to use technology, namely, performance expectancy, effort expectancy and social influence (Venkatesh et al., 2003). The intention to use technology, along with the facilitating condition, directly determines the usage behaviour of technology (Venkatesh et al., 2003). The intention to use the technology is important to determine the usage behaviour since the real behaviour can be observed via intentions to use technology (Thaker et al., 2022). Therefore, UTAUT identified four main constructs as follows:

1. *Performance expectancy* refers to how to gain job performance (Venkatesh et al., 2003). It means how to use technology will improve user performance (Raza et al., 2019) or the benefit of performing specific activities, for example, being efficient and more productive (Thaker et al., 2022). In the digital banking context, it is the belief of banks that adopting digital banking will improve the performance of the bank.
2. *Effort expectancy* is related to the ease of using the system (Venkatesh et al., 2003). It tells how easy it is for the user to operate the technology, and the ease of technology increases the adoption rate of technology (Raza et al., 2019). The easiness may be indicated by the simple, effortless, user-friendly and less-interaction human dependency (Thaker et al., 2022). In the digital banking context, it tells how easy it is for the bank to operate the digital banking technology in delivering the services to the customer.
3. *Social influence* is a perception of the importance others believe in using the new system (Venkatesh et al., 2003). Social influence concerns the social pressure exerted on the user to adopt the technology (Rahi et al., 2019). As

for the bank, social influence may take the form of pressure to adopt digital banking technology due to competitor adoption, competitive pressure or consumer demand.

4. *Facilitating conditions* refer to the existence of organisational and technical infrastructure to support the use of the system (Venkatesh et al., 2003). Facilitating condition, which were drawn from perceived behaviour control, indicates that the system availability is required for the user to use the technology (Rahi et al., 2019). The user needs support to use the technology, for example, guidance in skills to use, facility descriptions, and security (Thaker et al., 2022). In the context of digital banking, to adopt the technology, the bank needs infrastructure supporting the usage of digital banking.

Afterwards, the extension of UTAUT confirmed the important role of hedonic motivation, price value and habits in influencing technology use (Venkatesh et al., 2012). Details of the UTAUT extension are as follows:

1. *Hedonic motivation* is defined as a feeling or emotion that appears during the usage of technology, for example, enjoyment or pleasure (Venkatesh et al., 2012; Thaker et al., 2022). In the digital banking context, from the bank's perspective, it tells the employee's feelings or emotions to operate the digital banking technology.
2. *Price value* is defined as the trade-off between the benefit and monetary cost attached to the usage of the technology (Venkatesh et al., 2012). The bank needs a sizable investment to adopt digital banking technology, staff costs to operate the technology and operational costs to maintain the technology. If the benefits exceed the monetary cost, there will be a positive impact towards the intention to use the technology (Thaker et al., 2022).
3. *Habit* refers to repeated action based on the individual's knowledge and experiences, for example, prior and automatic behaviour (Venkatesh et al.,

2012). Habit has been identified to be positively influencing the adoption of technology.

3.2.3 Financial Innovation Approach

Financial innovation is important for the financial system. The primary function of the financial system is to allocate and deploy economic resources, both spatially and across time, in an uncertain environment (Merton, 1992). More specifically, Frame and White (2010) contended that a payment system with a medium of exchange, the transfer of resources from savers to borrowers, the gathering of savings for pure time transformation, and the reduction of risk through insurance and diversification are several functions covered by the financial system. Financial innovation is deemed as one of the bedrocks of the financial system, and it is the lifeblood of an efficient and responsive capital market (van Horne, 1985). It is the engine driving the financial system toward its goal of improving the performance of the real economy (Merton, 1992). Improvements in the financial sector that are brought about by financial innovation will have a positive impact directly throughout an economy and indirectly impact more savings, investment and better investment decisions in productive ways (Frame & White, 2004).

To be regarded as a financial innovation, an idea should move the market more efficiently or more completely (van Horne, 1985). It can make the market more efficient in an operational sense by reducing the cost of financial intermediation to the consumer of financial intermediation through lowering the difference between the ultimate savers' receipt and the ultimate borrowers' pay, as well as reducing the inconvenience costs (van Horne, 1985). In addition, lowering transaction costs and reducing agency costs arising from information asymmetries are other ways of cost reduction (Merton, 1992). Financial innovation can be directed to market completeness (van Horne, 1985) by meeting investor or issuer demands to complete the market (Merton, 1992). Increased liquidity is another driving force behind the emergence of innovation (Merton, 1992). However, realising a profit and/or reducing risk is the primary motive for the arising of financial innovation that stems from the opportunities generated from the inefficiencies or incompleteness in the financial market (van Horne, 1985).

Given the function of the financial system and driving forces of financial innovation, financial innovation is defined as something new aimed at reducing costs, reducing risks, or providing improved products/services/instruments that better satisfy financial system participants' demands (Frame & White, 2010). Substantial financial innovation was regarded as novel but not entirely new (Merton, 1992) and typically a modification of existing ideas (van Horne, 1985). This corroborates the definition of innovation that mainly emphasises the perception of newness by the adopters (Brown, 1992), as diffusion of innovation theory has been posited.

Financial innovation can take various forms in the market. It may be taken as a new product, such as a subprime mortgage or a new service, such as Internet banking. In addition, it may also take new processes, for instance, credit scoring, or new organisational forms such as an internet-only bank (Frame & White, 2010). Financial innovation can have a characteristic of financial innovation spirals, in that the presence of a financial innovation would induce the emergence of other financial innovations iteratively (Merton, 1992). The depth of innovation plays a role in the difference in financial innovation. Schindler (2017) contends that the depth of innovation can be grouped into surface, genuine or foundational innovation. Most of the financial innovation occurs at the surface innovation level, in which the innovation does not change the fundamental nature of the product or service, perhaps only changing a superficial element. In contrast with surface innovation, genuine innovation changes the fundamental nature of a product or service; thus, a genuine product or service is introduced to the market. Foundational innovation rarely occurs since it significantly changes the infrastructure and other underpinnings of the financial system.

Environmental conditions can provide a supportive environment for financial innovation to take place in the market. Frame and White (2004), citing Campbell (1988), identified four environmental conditions for financial innovation to emerge: underlying technologies, an unstable macroeconomic environment, regulation and taxes. Firstly, underlying technologies concerning finance mostly relate to telecommunication and data processing to enable gathering information, its transmission, and its analysis. Technological advances stimulate new processes more than new products (van Horne, 1985). Secondly, macroeconomics in unstable conditions is likely to encourage more innovation to reduce risk or uncertainty. Volatile inflation rates and interest rates create

demand for different financial instruments (van Horne, 1985). Thirdly, regulation (legal environment) can drive innovation to arise to circumvent the regulation. Fourthly, taxes influence the rate of innovation, with higher taxes more likely to yield more innovation.

In addition, Frame and White (2004) identified other factors that stimulate the emergence of financial innovation, which are market power, firm size and appropriability (intellectual property protection system). Market power is necessary to generate sufficient profit from the innovation. The size of the enterprise is considered since the larger size of the enterprise suggests the larger sales of products that bring a greater return on investment in innovation and accommodate economies of scale. Product market demand condition that captures market size and growth are more likely to provide a greater return to successful innovation. Moreover, van Horne (1985) argued that the level of economic activity in the period of prosperity and the academic work on financial support the emergence of new ideas. Schindler (2017) categorised drivers to provoke financial innovation as supply and demand drivers. Supply drivers are similar to Campbell's environmental condition, supporting financial innovation with additional innovation spirals that are similar to Merton's financial innovation spirals, whilst demand is driven by regulation and demographics (Schindler, 2017). Financial innovation typically involves more than one factor emerging in the market (van Horne, 1985; Schindler, 2017).

Of the condition that supports financial innovation to emerge, technological advances have stimulated financial innovation to dramatically change the financial sector (Frame & White, 2010). Financial technology is simply defined as the use of technology to provide new and improved financial services (Thakor, 2020). Following the Financial Stability Board, financial technology could result in new business models, applications, processes, products or services with an associated material effect on the financial market and institutions and providing financial services (Schindler, 2017). Automatic Teller Machines (ATM), internet banking, and electronic payment technologies are some examples of applications of financial technology in the banking industry (Berger, 2003; Thakor, 2020) that have changed the way financial services or products are being provided or priced (van Horne, 1985). For instance, Internet banking can take the form of new services such as Internet banking services or new organisational forms such as an Internet-only bank (Frame & White, 2010). Given

recent advances in technology that have had a material effect on the financial sector, financial technology, particularly, is attributed (and not limited) to peer-to-peer lending, equity crowdfunding, robo-advisors, the financial application using distributed ledger technology, and machine learning/artificial intelligence (Schindler, 2017).

Technological advances, as one of the conditions that support emerging financial innovation, benefit the bank. In the financial area, efficiency is crucial since less efficient producers will find it difficult to stay in the competition (van Horne, 1985). The application of technology and its advancement in the financial sector is directed to efficiency. Lowering search costs in the transaction between parties, gaining economies of scale by gathering and managing large data, transmitting data securely with relatively low cost, and reducing verification costs (Thakor, 2020) are several ways for financial technology to achieve this. Technological change has brought considerable change in lowering the cost per transaction, along with the speed and accuracy of the transaction (van Horne, 1985).

3.3 EMPIRICAL STUDIES ON DIGITAL BANKING

Studies on financial innovation, particularly digital banking, have been conducted by many researchers using diverse perspectives. Frame and White (2004) examined empirical studies on financial innovation, resulting in several potential themes for studies under financial innovation areas, such as economic/environmental conditions that encourage financial innovation, customers for innovation and users of innovations, diffusion of innovations and consequences of innovations (profitability and social welfare). Nejad (2016) examined studies on financial innovation that have been conducted for the period January 1990 to March 2015 and found that the most popular and prominent innovation that was investigated in 1990 is Internet banking, whilst mobile banking has been popular in the 2000s and afterwards. In addition, the majority of the studies have focused on the consumer side rather than the firm side. Moreover, the majority of the studies have collected data analysis using consumers as the sample of studies, and only a few studies have used firms' products or employees. This suggests that further research needs to concentrate on the bank as a firm side and take firms, products or firm employees for data collection as well as a unit of analysis.

Against this background and considering the objective of this study, the subsequent section will review the literature on digital banking adoption from the focus of studies on the bank's perspective or the bank as a firm. In particular, subsequent review of the literature only identifies empirical studies with a focus of the studies on digital banking, particularly Internet banking and mobile banking. Considering the objective of this study, the popular and prominent focus of studies in the 1990s and 2000s which were Internet banking and mobile banking (Nejad, 2016) and the growing use of the internet recently.

3.3.1 Empirical Studies on Digital Banking Adoption From The Banking Perspective

The diffusion of innovation theory posited that attributes of innovation play an important role in the adoption of innovation by the members of the social system. Attributes of innovation that explain how the members perceive the innovation influence the decision to adopt the innovation. The perception of the members as potential adopters becomes important in the process of the adoption of innovation. In the digital banking channel, it is of critical importance to have a better understanding of the bank manager's perspective towards digital banking channels (Akinci et al., 2004). Managers are the interface between banks and customers, as well as responsible for designing and marketing the services, since the managers obtain feedback from the customers that enables managers to understand the customer needs (Mbama et al., 2018).

In the nascent phase of Internet banking, empirical research was scarce regarding banks' perspectives on Internet banking. Nath et al. (2001) intended to close this gap with an exploration of banks' perception toward Internet banking concerning strategic and operational values, impact on customers and technology issues. A questionnaire was distributed to high-level bank managers in the United States to collect data regarding banks' perceptions of Internet banking. Of the bank managers who received the questionnaire, 75 bank executives returned it. The study revealed several findings regarding strategic, operational, customer and technology issues of Internet banking perceived by banks' executives. In the strategic issues, most executives

perceived Internet banking as essential for survival (mandatory), not a threat to brick and Mortar, enhancing the good reputation as a cutting-edge bank, and those who have not provided will face potentially losing customers. The result identified the benefits of Internet banking as the operational issues, such as lowering cost per transaction, enabling the bank to offer ancillary services, improving service quality and increasing the number of customer accounts. In the areas of customers, Internet banking increases convenience to the customers by conducting transactions online anytime; however, the majority of bank executives are concerned about the reduction of customer trust as well as customer relationships, perhaps due to Internet banking being in the nascent stage and taking time to full potential take place. Technology issues identified the requirement of careful planning to realise the full benefits and the scarcity of human resources for running Internet banking operations.

Unlike Nath et al. (2001), Aladwani (2001) attempted to identify issues in Internet banking by employing Conger and Mason's (1998) three generic stages: pre-development, development and post-development. More specifically, the study attempted to identify the drivers and challenges concerning online banking and the relative importance of those issues. Drivers are associated with pre-development, whilst challenges are divided into development challenges and future challenges (post-development). Data were collected through interviews and field studies, and then analysed using the rank of importance. The respondents in this study involved eight senior/general managers, eight IT managers and 64 customers of Kuwaiti banks. The study found that most of the ideas for online banking stemmed from the executive management and IT function, not from the customers directly. In addition, online banking was primarily motivated by customer-oriented factors such as faster, easier and reliable services, and market-oriented factors such as competitive consideration and image consideration. Interestingly, large bank managers and small bank managers perceived the motivation of implementing online banking as related to the bank's image, competitive position and operational costs. The top issues in developing online banking concern the top management support, lack of internet specialists, and internet technology progress. Technical obstacles, attitudes and behaviour of online banking customers are the most important issues of future challenges for the adoption of online banking identified by senior and IT managers. Differing from the senior and IT managers, potential customers identified security, regulation, consumer privacy and the

bank's reputation as the most important issues of future challenges in the adoption of online banking.

Other researchers attempted to identify the drivers and barriers faced by the banks in the adoption of digital banking services. Bradley and Stewart (2002) performed a study on technology diffusion in financial services by examining factors that drive and inhibit Internet banking adoption from the corporate context. Based on Rogers' Diffusion of Innovation Theory and Abrahamson and Rosenkopf's Bandwagon theory, the Delphi methodology which is a combination of interviews and questionnaires was used to examine the future perspective on Internet banking drawn from the panellists' perception that consists of decision-makers from retail banking, non-financial entrants, technology and software suppliers, consultants and academics involving in the banking industry in Ireland and USA. The Delphi study was performed during the period from June to December 2001. The study found that the external factors are mainly associated with the key drivers, whilst the internal factors are more associated with the key inhibitors of the adoption of Internet banking. The key factors driving the adoption of Internet banking by the banks include the number of other banks that have adopted Internet banking, competitive forces, demand from the consumer, and technological issues regarding technology availability. In addition, the study also identified a potential source of revenue and improved security as two new drivers for the adoption of Internet banking. The advantage of Internet banking is gained through improving customer experience, and it must be demonstrated. Positive communication and government support may lead to an increase in the rate of adoption since those endeavours have an impact on the perceived risk. The key inhibitors mainly addressed the lack of ability to deal with customers, resistance to change, attitudes within the bank regarding Internet banking, the availability of resources and the presence of existing legacy systems. When the evidence of returns is not present and consumer demand is not sufficient, costs are considered to strongly inhibit the adoption of Internet banking. This study also identified the new factors, namely resistance to change and internal attitudes, as the barriers to adopting Internet banking by banks.

On previous studies that focused on internet banking, Mullan et al. (2017) explored the drivers and barriers to bank adoption of mobile banking by taking stakeholder perspectives that involve various parties related to mobile banking and

based on the Diffusion of Innovation Theory which posits attributes of innovation influence the technology adoption and the Bandwagon theory which states organisation is responsive and adaptive to cumulative pressure from around the organisation. The study used a modified Delphi method that combines blogging with the Delphi method to collect the data, and thematic content analysis was used to analyse the data. Since Delphi involves several rounds to achieve a stable consensus among participants of the expert panel, the study completed the Delphi in two rounds involving 72 participants from various sectors such as academia, retail banks, mobile banking providers and telecommunication.

The study confirmed that the panel members assume the global penetration of mobile phones, competitive advantage, customer convenience, the strategic objective of the bank, customer demand, low perceived risk/security concerns, and the formation of stakeholder partnerships are several key drivers of the mobile banking adoption by the bank. Among the key drivers, compatibility with customer needs (convenience) and strategic objectives of the banks are regarded as the main key drivers of the adoption. The panel members also considered low levels of customer demand and lack of evidence of Return on Investment (ROI) as the key barriers to adopting mobile banking. The panel members also viewed the convenience of other competing channels, risk and uncertainty, communication and influence from the industry and the number of other banks as the barriers to the adoption of mobile banking. Additionally, the study also revealed two other barriers specific to mobile banking adoption, that is, the reach of bank infrastructure and the absence of partnerships. The study concluded that Diffusion of Innovation and the Bandwagon model are still relevant to explain the diffusion pattern of mobile banking, though only some of the variables, although not all, enable to explanation of the diffusion pattern. Given the findings, the study suggested attributes of innovation need to be considered along with its enabling environment (formation of partnerships, competition and demand uncertainty) to have a full understanding of mobile banking adoption.

Other researchers employed different methods and a different sample of respondents. Mishra and Singh (2015) explored electronic banking adoption in a developing country, that is, India. The Analytic Hierarchy Process (AHP) was employed in the study to evaluate the priority of the electronic banking channel

alternative that consists of ATM, Internet banking and mobile banking. Four criteria that construct the AHP model were assumed to influence the selection of electronic banking channel alternatives, namely, demographics, technological factors, service components, and intention to use. A questionnaire for collecting the data was distributed to 110 respondents involved in this study, consisting of customers as well as bank managers, from June to July 2013.

They found that age and occupation were selected by the respondents as the priority in demographic criteria for selecting electronic banking channels. Awareness, followed by perceived ease of use and perceived usefulness, were regarded as a higher priority compared to other factors in the technological factor criteria. Subsequent criteria identify the service component that influences the selection of electronic banking channels, and the respondents choose security concern, trust and risk, respectively, as a higher priority compared to other factors within service component criteria. Additionally, the attitude of customers, followed by subjective norms and perceived behaviour control, was opted as a higher priority by respondents in the intention to use criteria. The study concluded that ATMs were the most preferred among electronic banking channel alternatives. Comparing internet banking and mobile banking, the respondents preferred Internet banking as an electronic banking channel, considering the four criteria involved in the AHP model.

Differing from the previous studies on digital banking that have attempted to explain factors that influence digital banking adoption by banks, others have attempted to explore banks' perspectives on the effects of digital banking channels. Larsson and Viitaoja (2017) investigated the challenges faced by bank managers in maintaining customer loyalty through the digitalisation process. Interpretative Phenomenological Analysis (IPA) was employed to examine the data set to describe the pattern as well as the phenomenon. Eight areas comprising customisation, contact interactivity, cultivation, care, community, choice, convenience and character were investigated by interviewing ten Swedish bank managers from different major banks in April 2016. The study identified that convenience is perceived as the most important challenge faced by the banks' managers, considering the perceived ease of use to fulfil their needs and determining products appropriately for each respective customer. In addition, the study

also identified legal regulations as an issue in developing digitalisation and the necessity of developing omnichannel.

In line with Larsson and Vitaoja (2017) and concentrating on banks' perspectives on customer experience, Mbama et al. (2018) explored how UK bank managers perceive digital banking's effects on the customer experience and bank financial performance. Digital banking in this study includes Internet banking and mobile banking. Data were collected using semi-structured interviews with ten UK bank managers, and thematic analysis was employed to contextualise and uncover the meaning as well as the insight from the collected data. The study found that bank managers perceive digital banking to influence customer experience as well as bank financial performance. Digital banking provides a good experience for customers that leads to satisfaction and loyalty, and loyal customers are willing to pay premiums, recommend friends and minimise the cost to retain the customer, eventually improving the bank's performance. Regarding digital banking, the key attributes affecting customer experience are brand trust, perceived risk, service customisation, service speed, service convenience, perceived value, perceived usability, service quality, functional quality, employee-customer engagement, and digital banking innovation. The study also revealed that customers are shifting towards mobile banking services and demanding more digital banking services. In addition, innovation is the way to meet customer demands and improve customer experience since the bank needs to innovate to be competitive and not lose business.

Table 3.2 Summary of Studies on Digital Banking Adoption From The Banking Perspective

Author(s)/Topic	Sample/Method	Main finding/Critical point	Implication
Nath et al. (2001), Bank perception of Internet banking	75 bank executives, ----- USA banks, ----- Survey/Questionnaire, mean differences	<ol style="list-style-type: none"> 1) Investigated variables: strategic, operational, customer and technology. 2) Internet banking is essential for survival. 3) The main benefits: Improving reputation as a cutting-edge bank, lowering the cost of the transaction, enabling ancillary services, improving service quality, and increasing customer convenience (anytime). 4) The main challenge: The scarcity of human resources for operating the technology 	<ol style="list-style-type: none"> 1. The bank should consider the strategic objectives, operational, customer and technology of the bank when adopting digital banking. 2. Provision of human resources has become a concern to be addressed.
Aladwani (2001), Issues with Internet banking	8 general managers, 8 IT managers, 64 customers ----- Kuwaiti Banks ----- Interviews and field study	<ol style="list-style-type: none"> 1) Ideas of online banking stemmed from the internal bank, not the customer. 2) Customer-oriented: enhancing customer experience 3) Market-oriented: competitive and image consideration 4) Challenges/Issues: top management support, lack of specialists, and internet technology progress. 	<ol style="list-style-type: none"> 1. The bank may inspire employees to innovate in products and services. 2. Customer experience for competitive advantage as the motivation for digital banking adoption.

Author(s)/Topic	Sample/Method	Main finding/Critical point	Implication
Bradley and Stewart (2002), Drivers and Inhibitors of Internet Banking Adoption	Panellists: decision-makers from retail banking, non-financial entrants, technology and software suppliers, consultants, and academics ----- Ireland and the USA banking industry ----- Delphi Study	<ol style="list-style-type: none"> 1) Key drivers associated with external factors, such as the number of other banks that have adopted Internet banking, competitive forces, consumer demand, and technology availability. 2) Key inhibitors associated with internal factors, such as a lack of ability to deal with customers, resistance to change, attitude within the bank, availability of resources, and presence of legacy systems. 3) The benefits of customer experience should be demonstrated. 	<ol style="list-style-type: none"> 1. External factors can be motivations to adopt digital banking, whilst internal factors can be weaknesses to be overcome. 2. The benefits of digital banking on customer experience should be observable by the banks.
Mullan et al. (2017), Drivers and Barriers to Mobile Banking Adoption	72 participants from various sectors: academics, retail banks, mobile banking providers, and telecommunications. ----- Delphi method	<ol style="list-style-type: none"> 1) Key drivers: Compatibility with customer needs (convenience) and compatibility with the strategic objective of the bank. 2) Key barriers: low level of customer demand, lack of evidence of Return on Investment. 3) Specific barriers to consider: the reach of bank infrastructure and the absence of partnerships. 	<ol style="list-style-type: none"> 1. The bank should consider external factors, namely the customer, and internal factors, namely strategic objectives, in the adoption of digital banking. 2. Multiple theories are suggested when employing the Diffusion of Innovation Theory in digital banking studies.

Author(s)/Topic	Sample/Method	Main finding/Critical point	Implication
		4) DOI theory needs to be accompanied by the environmental factor to obtain a comprehensive understanding.	
Mishra and Singh (2015), The Priority of Electronic Banking Channel Alternatives	110 respondents, including customers and bank managers. ----- Banks in India. ----- Analytic Hierarchy Process (AHP)	1) Demographic: age and occupation 2) Technology: perceived ease of use and perceived usefulness 3) Service component: Security concern, trust and risk. 4) Intention to use: customer attitude, subjective norms, and perceived behaviour control. 5) Electronic banking channel priority: (1) ATM, (2) Internet banking, (3) Mobile banking	1. Digital banking should be designed to be easily used by adopters and have usefulness to the adopters. 2. The bank should ensure that mitigation of security and risk has taken place before adopting digital banking to preserve customers' trust.
Larsson and Viitaoja (2017), Challenges for maintaining Customer Loyalty through the digitalisation process	10 bank managers, ----- Swedish banks ----- Interpretative Phenomenological Analysis (IPA)	The main challenge is customer convenience regarding perceived ease of use and determining appropriate products, legal regulations and developing Omnichannel.	Customer (Convenience), Environment (Government/ regulation) and Channel (Omnichannel) have been challenges to be addressed by banks in adopting digital banking.
Mbama et al. (2018),	Ten bank managers ----- UK banks	1) Digital banking is perceived to affect customer experience and bank financial performance.	1. Digital banking matters to improve customer experience

Author(s)/Topic	Sample/Method	Main finding/Critical point	Implication
Perception of digital banking effects on Customer Experience and bank Financial Performance	----- Semi-structured interviews, thematic analysis	2) Digital banking enables a good customer experience that leads to satisfaction and loyalty. 3) Key attributes affecting customer experience: brand trust, perceived risk, service customisation, service speed, service convenience, perceived value, perceived usability, service quality, functional quality, employee-customer engagement, and digital banking innovation. 4) Innovation is needed to be competitive and stay in the business.	and to improve the bank's financial performance. 2. Innovation in digital banking has preserved the bank's capability to compete in the market.

Source: The researcher's Classification

A summary of studies on digital banking adoption using banks' perspectives is shown in Table 3.2. Digital banking includes internet banking and mobile banking. Most of the studies have been conducted in the context of internet banking compared to mobile banking. Various methods have also been applied to examine the perception of digital banking adoption.

Several drawbacks have been identified concerning the studies on digital banking. Nath et al. (2001) employed a simple method by applying the mean difference, whereas this study allowed for the use of more advanced techniques, such as SEM-PLS and AHP, instead of the mean difference. Aladwani (2001) only utilised a simple method to rank the importance of the variables involved. To prioritise variables, AHP or the advanced model of the AHP, namely the ANP method, allow for connecting and feedback among criteria. Instead of separating the customer variable from the market variable, integrating the customer variable into the market variable may provide a comprehensive perspective on the market variable, considering that the customer is a part of the market. For example, market concentration is measured by involving the customers in the calculation.

In addition, Bradley and Stewart (2002) have divided the factors into external factors for the key drivers and internal factors for the key inhibitors. Unfortunately, the division was less likely to reveal the drivers from the internal factors and the inhibitors from the external factors. The Bandwagon theory, as applied in the study, was not clearly elaborated. Mullan et al. (2017) improved the method used by Bradley and Stewart (2002) by integrating internal and external factors to identify the key drivers and key inhibitors. Mishra and Singh (2015) also improved the method for ranking importance, which had previously been conducted by Nath et al. (2001), Aladwani (2001), and Bradley and Stewart (2002) using AHP. Mishra and Singh (2015) identified four main criteria, namely demographics, technological factors, service components, and intention to use. However, the study failed to reveal the most important criterion among the main criteria to consider the most important alternative digital banking services. Larrison and Viitaoja (2017) and Mbama et al. (2018) investigated a similar topic regarding the effect of digitalisation on customer experience, drawing similar conclusions that it positively affects the customer experience. However, Mbama et al. (2018) advanced the studies by incorporating the effect of digital banking on bank

performance and clearly stated that digital banking comprises internet banking and mobile banking. Larrison and Viitaoja (2017) and Mbama et al. (2018) focus solely on the customer, taking the bank managers' perspective, and fail to reveal the internal factors of the bank that promote digital banking adoption and development.

Theory of the Diffusion of Innovation, which has been widely used in the digital technology adoption, was employed by Bradley and Stewart (2002) and Mullan et al. (2017). Mishra and Singh (2017) did not clearly specify the theory used to investigate the prioritisation of electronic banking services. However, from the components involved in the criteria, it was similar to UTAUT (Unified Theory of Acceptance and Use of Technology) and UTAUT 2. Other scholars did not mention the theory and relied on the empirical literature, for example, Nath et al. (2001) and Aladwani (2001). Other studies took a marketing approach to investigate digital banking on customer experience (Larrison and Viitaoja, 2017; Mbama et al., 2018).

3.3.2 Empirical Studies on Determinants of Digital Banking Adoption by Banks

In this section, in line with the objective of the study, digital banking adoption is investigated through a literature review from the bank's perspective or firm side, which mainly identifies empirical papers published by reputable journals and regulator reports as the main reference. To fulfil the objectives of this study, it is important to have a better understanding of the characteristics supporting the adoption of innovation. One of the variables that explains the diffusion of innovation well is the characteristics of the adopters (Dearing & Cox, 2018). Diffusion of innovation occurs in the social system where interrelated units achieve a similar goal, and the nature of the social system influences the degree of innovativeness, impacting the timing of adopting innovation as well as the adopters' categorisation. In addition, compatibility, as one of the attributes of innovation, has an important role in aligning the innovation with the needs, habits, and experiences, and the way to achieve goals belongs to the members of a social system, and the only innovation that is consistent or compatible with those will be adopted by the members of a social system. In terms of digital banking adoption, the characteristics of adopters are manifested with determinant factors such as bank characteristics and environmental conditions supporting financial innovation to take place.

Studies on Internet banking have focused on the determinants of the decision to adopt Internet banking by the bank, the benefits of Internet banking using the bank's point of view, and the retail consumer perspective (Hernando & Nieto, 2007). The first is most relevant since this study was based on the perspective of the bank (firm side) and follows the objective of this study concerning investigating bank characteristics supporting the adoption of digital banking by banks, particularly Islamic banks. Following Frame and White (2004), the determinant in the decision to adopt Internet banking by the bank can be grouped into the theme of economic/environmental conditions that encourage financial innovation, while the benefit of Internet banking can be grouped into the theme of consequences of financial innovation.

Studies on determinants in the decision to adopt Internet banking have evolved with a diverse use of variables, methods, and samples. Furst et al. (2002) examined the landscape of Internet banking in the United States to reveal the factors affecting bank decisions to adopt Internet banking and factors affecting a wide range of services of Internet banking. Data were collected from a questionnaire from the Office of the Comptroller of the Currency in mid-1999 that was distributed to the national banks. Data were analysed using a multivariate logistic model. It was found that banks with Internet banking outperformed relative without Internet banking in terms of profitability. Regarding determinants in the decision to adopt Internet banking, larger banks (of the bank's size) are more likely to adopt Internet banking. In addition, banks that are more likely to adopt Internet banking are banks with the characteristics: younger banks (age of bank), have affiliation as a member of a bank holding company, physical offices located in the urban area, higher expenses on fixed assets and premises, higher non-interest income, relatively profitable and having a good safety and soundness rating assessment from the authority. Among banks that offer Internet banking, larger banks and banks that have experienced Internet banking services for a long time are more likely to offer a wider range of services through Internet banking. In addition, having a good safety and soundness rating assessment from the authority increases the possibility of offering a wider range of services in Internet banking.

Unlike Furst et al. (2002), who examined the sample in a developed country, Malhotra and Singh (2007) examined the factors affecting the probability of Internet banking adoption in a developing country, that is, India, using a sample of 88 banks

operating as of 31 March 2005 and data covering the period 1997-1998 to 2004-2005. Logistic regression was applied to analyse the collected data.

The findings were consistent with the findings of Furst et al. (2002) that the size of banks related to Internet banking adoption, with the larger banks more likely to adopt Internet banking. Another finding suggested that banks with lower branch intensity are more likely to adopt Internet banking. The type of bank is related to Internet banking adoption, with the probability of adoption being higher for the private bank. Share of the bank that has adopted Internet banking is related to the Internet banking adoption, with the increase in the adoption of Internet banking by banks increasing the probability of adoption of Internet banking by banks. The age of the bank, the large number of deposits, premises and fixed asset expenses, and lower market shares are related to the Internet banking adoption; however, they showed a marginal significance of 10%. In contrast to Furst et al. (2002), bank profitability does not significantly affect the possibility of Internet banking adoption. They concluded that the presence of Internet banking complements the existing physical branch to increase market share and decrease expenses.

The study by Malhotra and Singh (2007) has several characteristics that differentiate it from Furst et al. (2002). Furst et al. (2002) focus on the type of bank as a member of a bank holding company, while Malhotra and Singh (2007) ran their study in the context of India by focusing on the private and public sectors for the type of bank. This is in line with Nejad (2016), who suggested further research to examine different parts of the world to provide a comprehensive picture, as the countries differ in the way financial systems operate, as well as the way consumers use the services. Moreover, Malhotra and Singh (2007) enhanced the variables used in the study. Testing the influence of banks that have adopted Internet banking on Internet banking adoption, they included the percentage of Internet banking adoption in the model. Diffusion of innovation theory assumes that the members who have adopted innovation possibly influence other members who have not adopted it (Dearing & Cox, 2018) and diffusion occurs when the agents have communicated with the others who have adopted the innovation (Sullivan & Wang, 2020). Using Frame and White's (2004) framework, Malhotra and Singh's (2007) study was categorised according to the themes of conditions encouraging the decision to adopt innovation.

Other researchers included competitive consideration to examine its role in Internet banking adoption by the bank. Hernandez-Murillo et al. (2010) examined internet banking adoption by banks in the United States focusing on the strategic consideration of internet banking adoption particularly in response to the adoption decisions of competitors in the same market that is proxied by the Multi-Market Contact (MMC) Index, indicating the share of deposit controlled by the competitors of the bank that have already adopted Internet banking in the market where the bank operates. They also included the level of concentration in the market in the study using the Herfindahl-Hirschman Index (HHI) and controlled variables such as bank characteristics and demographic variables for demand factors. The determinants of the timing of the adoption were estimated using the discrete hazard model, and the panel data set consists of quarterly information for commercial banks in the United States, starting from the 1st quarter of 2003 to the 4th Quarter of 2006. The study found that the MMC index is significantly positively related to the Internet banking adoption decision, suggesting that competitive consideration plays an important role in adoption decisions, and the adoption of online banking occurs faster in markets where rivals have already adopted online banking. HHI is not significantly related to the adoption. Banks characterised by a larger bank, affiliated as a member of a bank holding company and soundness of financial health have significantly influenced the adoption. In addition, demographic variables represented by median household income, percentage of households with internet access, and percentage of the population with a college degree have significantly influenced the adoption. Comparison between bank-specific characteristics with competitive motivation measure (MMC index) results that bank-specific characteristics have a substantially larger economic effect on the adoption than competitive motivation. They also concluded that online banking is part of the bank strategy to be an alternative to opening new branches; thus, online banking as a substitute for physical branches is evident since banks with greater branching intensity tend to delay adoption.

The study by Hernandez-Murillo et al. (2010), which included competition consideration and demographic variables in the study aligns with Frame and White (2004), suggesting investigating environmental condition support for financial innovation as one of the areas in financial innovation. The study also grouped the themes of diffusion based on Frame and White (2004) since they estimated the timing

of adoption using the discrete hazard model, although bank characteristics are included in the model. The findings on branch intensity are similar to Malhotra and Singh's (2007) finding of a significant negative effect on the decision to adopt Internet banking. Hernandez-Murillo et al. (2010) supported the hypothesis that internet banking substitutes for physical branches, while Malhotra and Singh (2007) supported the hypothesis that Internet banking complements physical branches based on market share and expenses on-premises and fixed assets.

In the same vein as Hernandez-Murillo et al. (2010), He (2015) investigated the reaction of banks to the adoption of mobile banking by rivals in the same market and whether the reaction depends on market structure. Data for the study were collected from iTunes as a proxy for mobile banking adoption by banks in the United States from July 2008 to June 2012, and bank financial data, as well as demographic data, were obtained from the authority. A Cox proportional hazard model was employed along with the Instrumental Variables (IV) approach to examine the effects of a rival's adoption and market structure that is conditional on the covariates that possibly affect the adoption. Key variables attributed to the rival's adoption were Local Rival Adoptions, which suggest a deposits-weighted sum of the percentage of rival banks with mobile apps in each market where banks operate, and HHI-Deposits, which suggest a deposits-weighted sum of squared deposit shares of banks in each market. The variables involved in Instrumental Variables were rivals' outside-market deposit shares and a dummy variable located in the metropolitan statistical area (MSA). Controlled variables were also included in the model, capturing bank-specific variables and demographics.

Based on the IV approach model employed, the study found that Local Rival Adoption positively and significantly affected the adoption of mobile banking by the banks. This suggests that the likelihood a bank will offer mobile apps increases with the proportion of adoption by proximate rivals. HHI-Deposits also significantly and negatively affect mobile banking adoption, which suggests that banks that operate in less concentrated markets exhibit higher propensities to adopt mobile banking. When the Local Rival Adoptions interacted with HHI deposits, the results were significantly positive, suggesting that the adoptions by proximate competitors have a greater positive impact on adoption decisions in more concentrated markets. Controlled variables display that banks with a larger size, higher advertising expenses, and lower loan

charge-offs are more likely to adopt mobile banking. The study provides evidence that the reaction of firms to the innovational efforts of proximate rivals is positive and depends on the market structure, in which the stimulating impact is the weakest in more competitive markets (suggesting price competition), whilst in a highly concentrated market, the stimulating impact is the strongest (suggesting non-price competition). The findings support the economic theory of oligopolistic competition that firms in the concentrated market tend to compete with rivals through non-price competition, such as technology advances.

He (2015) was similar to Hernandez-Murillo et al. (2010) regarding the focus on a bank's competitor and market structure or market concentration. The hazard model used in the study suggests a theme suited to diffusion that typically investigates the speed or rapidity of diffusion (Frame and White, 2004), and the sample of banks in the United States. Both studies differ in the type of banking services (mobile banking vis-à-vis Internet banking) and the adoption data. The significant result of Local Rival Adoption is consistent with the Multi-Market Contact Index used by Hernandez-Murillo et al. (2010). However, there were conflicting results in the market structure where Hernandez-Murillo et al. (2010) found that HHI did not significantly affect Internet banking adoption. The adoption data used in this study was unique due to the source of mobile banking adoption stemming from the iTunes store, whilst other studies typically are obtained from the results of surveys of the banks or authority reports. Nejad (2016) suggested using alternative sources of data for further research on mobile banking, such as transactional, spatial or temporal.

Dandapani et al. (2018) identified factors contributing to the adoption of web-based services by Credit Unions in the United States from 2001 to 2010, with the exclusion of 2008 since the data were not available. The model specified the probability of adoption of web-based services as a function of institution-specific, performance and demographic variables. More specifically, product mix (proportion of individual loans and proportion of business loans), competition (HHI), new customers (penetration ratio), efficiency and delinquencies, size of Credit Union and age of member (proportion of younger customers) were key variables involved in the model. The product mix was included in the model since, following DeYoung et al. (2007), the web lending channel is suited to individual/consumer loans, whilst lending through the physical branch is

suitable for business loans. A binary logistic regression model was employed in this study to predict the probability of adopting web-based services by the Credit Union.

The study confirmed that all the variables in the model are significantly related to the probability of adoption of web-based services. Credit unions characterised by a higher proportion of individual loans, a lower penetration ratio, larger size, higher efficiency and lower non-performing loans are more likely to adopt web-based services. The higher the proportion of the younger population, the higher the probability of adoption of a web-based service. The HHI is significantly negative, which suggests that Credit Unions adopt web-based services when they face competition from others. They concluded that the finding is consistent with profit maximisation behaviour in which increases in revenue that is generated from attracting new customers, being competitive, and offering web-based services to the younger customers, whilst decreases in costs are obtained by providing web-based services to a large number of customers.

Whilst previous studies normally focus on the banking institution, Dandapani et al. (2018) used different samples by focusing on the Credit Union. By doing so, it has enriched the literature, as Nejad (2016) contended that taking various aspects in the study of financial innovation will offer a better understanding of financial innovation. The findings apply to banking institutions since all firms are aimed at maximising profits (Dandapani et al., 2018).

In contrast with previous studies on the determinant factors of digital banking, which utilise individual bank data, Sullivan and Wang (2020) studied the diffusion of Internet banking, concentrating on the aggregate pattern of diffusion and bank-size distribution. Two-stage least squares (2SLS) were employed in the model with an Instrumental Approach to overcome the endogeneity problem possibly existing in average bank size. Aggregate pattern diffusion was measured by the log-odds ratio for Internet banking adoption adjusted by the Gini coefficient of bank-size distribution. Average bank size was based on average bank deposits.

The findings confirmed that average bank size is significantly different, suggesting that an increase in average bank size would increase the adoption odds ratio. In other words, firm-size distribution has a causal effect on technology diffusion,

particularly Internet banking diffusion. In addition, population density, average age of banks, household internet access rate, the ratio of deposits in out-of-state banks to total deposits, and bank offices per value of deposits have a significant effect on the diffusion of Internet banking. Population density negatively affected the diffusion, suggesting locations with higher travel costs to the bank branches are more likely to experience higher demand for Internet banking. The increasing average age of a state's banks is more likely to decrease the adoption rate. More household access to the Internet is associated with a higher possibility of adopting Internet banking. Greater deposits in out-of-state banks will push more in-state banks to adopt Internet banking. The significance of the bank office variable suggested measures to explore the synergy between branch banking and Internet banking for the banks with more branches. They concluded that the causal effect of firm-size distribution on technology diffusion justifies the external diffusion approach.

Moreover, in the study of the relationship between risk, return and online channel adoption in the Chinese banking industry, He et al. (2020) investigated the determinants influencing the adoption of online banking. The study affirmed that bank sizes (in assets and branches), financial resources, bank strategy, competition among banks, and demographics are determinants of online banking adoption in China. Larger banks are more likely to adopt online banking. The significance of a branch suggests that an online channel is a substitute for a physical branch. ROA has a significant positive influence on online banking adoption, which means more financial resources are required to adopt online banking. In terms of bank strategy, the loan ratio and net interest income ratio are significantly positive, while the business-to-consumer loan ratio is significantly negative. In terms of competition, unlike Hernandez-Murillo et al. (2010), HHI is positive, which means banks with more market power are inclined to adopt online banking. The adoption by competitors affects the decision of banks to adopt online banking. Lastly, banks operating in the populated areas are more likely to adopt online banking.

Bank size is normally associated with bank assets in the previous studies on Internet banking adoption (Furst et al., 2002; Malhotra & Singh, 2007; Hernandez-Murillo et al., 2010). Sullivan and Wang (2020) offered a different view by using bank deposits as an indicator of bank size, and the significant result of average bank deposits

has amplified the important role of bank size on Internet banking adoption. The use of the two-stage least squares (2SLS) model also offered an alternative approach to assessing digital banking adoption, other than the logistic regression and hazard model that have been commonly utilised in the literature. Table 3.3. shows a summary of empirical studies taking the banks' perspective concerning digital banking adoption by the bank.

Empirical studies have shown mixed results concerning the relationship of bank-specific factors with the likelihood of bank adoption of digital banking. Malhotra and Singh (2007) and Sullivan and Wang (2020) found that the relationship between labour expense on the adoption of Internet banking is not evident, while He (2015) confirmed the significant effect of salary expense on the likelihood of banks adopting mobile banking. In addition, Malhotra and Singh (2007) also found no evidence for the relationship between profitability on adoption. The different result on profitability was confirmed by Furst et al. (2002) and Hernandez-Murillo et al. (2010), who found that the more profitable banks are more likely to adopt Internet banking. Despite the significant effect of profitability, a disagreement exists between Furst et al. (2002) and Hernandez-Murillo et al. (2010) regarding the effect of profitability. Furst et al. (2002) utilised ROE as an indicator of profitability and identified the negative effect of profitability on the adoption, while Hernandez-Murillo et al. (2010) utilised ROA as an indicator of profitability and found a positive effect of profitability on the adoption.

Moreover, the relationship of deposits as a proxy for traditional funding on the adoption was not evident (Furst et al., 2002; Hernandez-Murillo et al., 2010). Differently, Sullivan and Wang (2020) found a significant effect of deposits on the adoption of Internet banking using aggregate adoption data, and Malhotra and Singh (2007) found a significant effect of deposits at a marginal level (10%). Concerning the age of banks, newer banks are more likely to adopt Internet banking compared to older banks (Furst et al., 2002). However, Malhotra and Singh (2007) and Hernandez-Murillo et al. (2010) found different results in which the newer banks are less likely to adopt Internet banking at a marginal level of significance (10%). In the mobile banking adoption, He (2015) confirmed no significant effect of banks' age on the likelihood of adopting mobile banking by the banks. In particular, the type of bank membership of a Bank Holding Company or a private bank is associated with the adoption in the bank-

level data (Furst et al., 2002; Malhotra & Singh, 2007; Hernandez-Murillo et al., 2010). Using the aggregate adoption data, Sullivan and Wang (2020) found no evidence for the relationship type of bank on the adoption. Among the bank-specific factors, previous studies have achieved consensus on the relationship between bank size and the adoption of digital banking. All the previous studies confirmed that larger banks are more likely to adopt digital banking.



Table 3.3 Summary of Empirical Studies on Determinants of Digital Banking Adoption by Banks

Authors	Methods/Sample/ Variables	Main Findings	Implication
Furst et al. (2002)	Multivariate Logistic Model	1) Banks that adopt Internet banking outperformed non-Internet banking	1. Digital banking is essential to increase a bank's performance. 2. Bank asset matters for digital banking adoption.
	Banks (Conventional), US, Developed country	2) Banks with larger assets are more likely to adopt Internet banking 3) Bank-specific factors have a relationship to the decision to adopt Internet banking	
	Bank-specifics		
Malhotra and Singh (2007)	Logistic Regression	1) Private banks have more possibilities to adopt Internet banking than public banks.	1. Ownership (Private) and adoption by competitors matter for digital banking adoption. 2. Digital banking plays a role as a complement to physical branches.
	Banks (Conventional), India, Developing country	2) The proportion of banks that have adopted Internet banking has a relationship to the possible Internet banking adoption.	
	Bank-specific Market-specific	3) Internet banking presents as complementary to physical branches to increase market share and decrease expenses.	

Authors	Methods/Sample/ Variables	Main Findings	Implication
Hernandez-Murillo et al. (2010)	Discrete Hazard Model	1) Internet banking is adopted faster in the market where the rivals have adopted Internet banking in a similar market concentration. 2) Demographic characteristics are related to the adoption of Internet banking. 3) Internet banking plays a role as a new branch to substitute the physical branches.	1. Adoption by competitors and demographic characteristics are key drivers for digital banking adoption. 2. Digital banking plays a role as a substitute for physical branches.
	Banks (Conventional), US, Developed country		
	Bank-specific Market-specific Demographic		
He (2015)	Cox Proportional Hazard Model with IV Approach	1) The possibility of adopting mobile banking increases along with the increase in the proportion of adoption of mobile banking by proximate rivals. 2) The propensity for adoption of mobile banking is higher in the banks operating in less concentrated markets. 3) The impact of the adoption of mobile banking by the rivals is greater for banks that operate in a more concentrated market.	1. Adoption by competitors has been a key driver for digital banking adoption by banks. 2. Pressure from the competitive market has motivated bank to adopt digital banking adoption by the banks.
	Banks (Conventional), US, Developed country		
	Bank-specific Market-specific Demographic		

Authors	Methods/Sample/ Variables	Main Findings	Implication
Dandapani et al. (2018)	Logistic Regression	1) Credit Unions that rely on individual/consumer loans tend to adopt Internet banking. 2) Credit Unions adopt Internet banking to attract new customers. 3) Credit Unions are more likely to adopt Internet banking in keeping up with the competition.	A bank may use digital banking as a strategy for customer acquisition and to compete in the market.
	Credit Union (Conventional), US, Developed country		
	Bank-specific Market-specific Demographic		
Sullivan and Wang (2020)	Two-Stage Least Squares with IV approach	1) Firm size distribution has a causal effect on Internet banking diffusion, in which the increased average bank size would increase the possibility of the adoption of Internet banking. 2) Demographic characteristics have a relationship to the adoption of Internet banking. 3) There is evident synergy between Internet banking and branch banking.	1. Bank size and demographic characteristics of customers matter for digital banking adoption by the banks. 2. A bank may employ digital banking as a business strategy for complementing physical branches.
	Banks (Conventional), US, Developed country		
	Bank-specific Demographic		
He et al. (2020)	Logistic Regression	1) Larger banks are more likely to adopt online banking 2) The adoption of online banking requires more resources. 3) Bank strategy affects the adoption of online banking.	1. It is essential to have a considerable amount of assets to stimulate digital banking adoption. 2. Banks adopting digital banking employ digital banking as a strategy to respond to competitive
	Chinese Banks		
	Bank size, Financial resources, Bank strategy,		

Authors	Methods/Sample/ Variables	Main Findings	Implication
	Competition among banks, Demographics	4) A bank with more market power is more likely to adopt online banking 5) The adoption of online banking by competitors influences online banking adoption. 6) Banks operating in populated areas are more likely to adopt online banking.	pressure, such as competitors' adoption, and to maintain their market power or to gain market power.

Source: The researcher's Classification

The presence of digital banking raises the question of whether this new alternative channel plays a role in substituting for the existing physical branches. Internet banking has become an alternative strategy to open new bank branches and decrease transaction costs at the same time (Hernandez-Murillo et al., 2010). Substituting physical branches with online banking is expected to decrease overhead expenses, particularly costs associated with the physical branches, for example, staff and rent costs (Hernando & Nieto, 2007), by automating the processes and shifting work associated with the customer to web transactions (DeYoung et al., 2007). Hernandez-Murillo et al. (2010) and He et al. (2020) concluded that Internet banking is associated with a substitute for the physical branch since the likelihood of adoption declines with the branching intensity.

The consensus on findings is centred on market-specific factors. Malhotra and Singh (2007), Hernandez-Murillo et al. (2010) and He (2015) confirmed the significant effect of rivals' adoption on the adoption of digital banking. In contrast with rivals' adoption, mixed results were found in the market-specific factors related to market concentration. He (2015) and Dandapani et al. (2018) used the Herfindahl-Hirschman Index (HHI) based on deposits and assets, respectively, as a proxy for market concentration, confirming that market concentration has a significant relationship with the decision to adopt digital banking. In contrast with those authors, Hernandez-Murillo et al. (2010) found no significant effect of market concentration on the adoption. The insignificance is similar to He (2015) when the HHI is measured based on assets.

Several drawbacks have been identified in the studies on the determinants of digital banking adoption. Furst et al. (2001) and Malhotra and Singh (2007) did not employ a robustness test in their studies. A robustness test is necessary to ensure that the study's findings are stable and valid across different situations. Furst et al. (2001) did not include market-specific factors and relied solely on bank-specific factors, which made the study less comprehensive. Majority of these studies concentrated on the single type of digital banking, that is, internet banking (Furst et al., 2001; Malhtora and Singh, 2007; Hernandez and Murillo, 2010; Dandapani et al., 2018; Sullivan and Wang, 2020; He et al., 2020), and only one study concentrated on the mobile banking, that is study conducted by He (2015). One possible explanation is that developed countries (e.g., the United States and China) have adopted internet banking earlier than mobile banking,

which has led to the diffusion of internet banking being much larger than that of mobile banking. Another explanation is that the study considered data availability. Earlier studies have integrated internet banking and mobile banking as a digital banking in one study, which made this study more significant.

In addition, most studies relied on financial innovation to approach the determinants of digital banking adoption for their theoretical foundation, except Sullivan and Wang (2020), who included Rogers' Diffusion of Innovation Theory. However, assuming bank-specific factors and demographics similar to adopters' characteristics, the studies were more closely aligned with the Diffusion of Innovation Theory, which posits that the characteristics of adopters influence the rate of technology adoption. Market-specific factors stemming from the environment, such as customer and competitor dynamics, suggest the role of environmental pressure in adopting digital banking. Despite the absence of explicit theory, competitor pressure and competition pressure in market-specifics are similar to social pressure in the UTAUT.

Digital technology has been substantial in the banking sector in Indonesia, which has promoted studies on digital technology in banking. Despite the importance of digital technology, studies on digital banking from a bank perspective in Indonesia have been scarce. Alisjahbana et al. (2020) investigated digital technology adoption by banks in Indonesia concerning labour demand. The study found that technology adoption negatively influences labour demand, particularly for small and medium-sized banks. As for the larger banks, technology adoption positively influences the labour demand. In addition, the effect of digital banking adoption on bank performance has also been investigated. Medyawati et al. (2021) and Paminto et al. (2022) confirmed that the effect of digital banking adoption on bank profitability is evident, and the effect is positive. Regarding the type of bank, Paminto et al. (2022) have revealed that the type of bank is crucial concerning the effect of digital banking adoption. Digital banking positively affects bank profitability and stability, in the effect is more pronounced in private banks than in public banks. Kasri et al. (2023) found a relationship between digitalisation in banking and banking stability. Using digital payment as the indicator of digitalisation, the study found that digital payment affects banking stability in the long run. As for the short run, the relationship is positive. The study also found that the relationship between digitalisation and Islamic banking stability is not evident. Moreover, the rise of fintech

firms has encouraged Sapulette et al. (2021) to investigate the impact of fintech on bank performance during the COVID-19 pandemic. The study revealed that banks' stock returns are significantly affected by fintech positively for the big banks. In contrast, the effect is harmful to smaller banks. Yударuddin (2023a) argued that the emergence of fintech start-ups is associated with negative bank performance, while the emergence of fintech start-ups positively affects Islamic banks' performance.

The studies on digital technology in the Indonesian banking sector have been conducted from taking perspective on the effect of digital technology or digital banking on bank performance. To the best of our knowledge, no research has been done to examine the determining factors of digital banking adoption in Indonesia, in particular, the dual banking system with reference to Islamic banking. Table 3.4. presents the comparison of the variables involved in the studies on the determinant factors of digital banking adoption from the bank perspective.

Table 3.4 Comparison of Determinants of Digital Banking Adoption by Banks

Dimension	References						
	F (2002)	MS (2007)	HM (2010)	H (2015)	D (2018)	SW (2020)	H (2020)
Bank Specific							
Size of bank							
• Assets	+,***	+,***	+,***	+,***	+,***		+,***
• Deposits						+,***	
• Branch							-,*
Asset growth				X			
Age of a bank	+,***	-,*	-,*	X		-,***	
Type of bank							
• BHC member	+,***		+,***			X	
• Private bank		+,***					
Association with a BHC	+,**						
Location							
• Urban	+,***						
• Metropolitan						X	
Deposits	X	+,*		X		+,***	
Expenses							
• Premises & FA	+,***	+,*					
• Salary/wage		X		+,**		X	
• Salary per worker				X			
• Number of employees				X			

Dimension	References						
	F (2002)	MS (2007)	HM (2010)	H (2015)	D (2018)	SW (2020)	H (2020)
• Advertising				+,**			
Fee income	+,***			+,*			+,***
Profitability							
• ROE	+,***						
• ROA		X	-,***				+,**
Non-interest expense	X						X
Safety and soundness	-,**						
Branch intensity		-,***	-,***	X		+,***	
Financial health							
• NPL			-,***		-,***		+,*
• Loan Loss Provision				+,**			
• Loan charge-offs				-,**			
Aggressiveness							
• Loan to Assets			+,***				+,***
• Loan to Deposits					+,***		
Capital ratio			-,***	-,***			
Age of adoption				X		X	
Consumer Loans					+,***	X	
Business Loans					-,***		
Business/Consumer							-,**
Penetration ratio					-,***		
Market share		-,*					
Market Specific							
Competitor adoption		+,***	+,***	+,***			+,***
Competition (HHI)			X	X	-,***		+,***
(HHI) deposits				-,***			
Competitor's assets				X			
Demographic							
Household income			+,***			X	
Internet access							
• Household			+,***			+,***	
• Firms						X	
• Penetration							X
Education			+,**				X
Population (Young)				X	+,***		X
Populated area							+,***
Job growth				X			
Area wage				X			

Notes: “+” refers positive relationship; “-” refers to negative relationship;

*, **, and *** refer to significant at 10% level, 5% level and 1% level, respectively;

F = Furst et al. (2002), MS = Malhotra and Singh (2007); HM = Hernandez-Murillo et al. (2010); H = He (2015); D = Dandapani et al. (2018); SW = Sullivan and Wang (2020); H = Dongwei He et al. (2020)

Source: The researcher's classification

3.3.3 Empirical Studies on Digital Banking Adoption by Islamic Banks

Prior studies have identified the issues of innovation or technology adoption, particularly digital banking adoption in conventional banks. However, studies on such issues have been scarce in the Islamic context (Dinc, 2020; Iman, 2020), especially from the bank's perspective. Several researchers turn to financial innovation (Al-Salem, 2009; Iman, 2020) or product innovation (Tipu, 2014; Chaudhry et al., 2020; Dinc, 2020) to investigate technology adoption in Islamic banking and finance by taking the Islamic financial institutions' perspective.

Al-Salem (2009) explored financial product innovation in Islamic finance by reviewing the literature, reports, and articles related to product innovation as well as Islamic finance. The author found that Islamic bank products, Sukuk, Islamic pension funds and securitisation (tawreeq) are several financial product innovations in the Islamic financial sphere, with the Islamic banks being regarded as the most successful ones among Islamic financial institutions. The study identified compliance with Sharia as the main issue that needs to be addressed by the Islamic financial institution. This led to the issue of the inappropriateness of the traditional existing financial instruments with the Sharia, as well as the issue of standardisation, since there are several competing centres of Islamic jurisprudence related to the Islamic finance rules. In addition, the absence of good governance, instruments for monetary operation and managing the risk of the rate of return, and the impact of globalisation concerning competition from international banks also needs to be addressed by Islamic financial institutions. The study concluded that it is imperative to continually innovate in the products, processes and quality to meet the market demand and comply with Sharia.

In a similar method to Al-Salem (2009), Iman (2020) investigated financial innovation in Islamic countries comprising Egypt, Indonesia, Morocco, Pakistan, Turkey and the United Arab Emirates. Focusing on payment systems as a sample of financial innovation, the study confirmed that the large value of payment systems and initiation of electronic payments is evident in those OIC countries. Despite the high potential of mobile commerce, such technology seems still in the nascent stage, and the growth is hindered by certain issues, for instance, trust and security issues. Drawn from elucidation on the payment systems as financial innovation, Iman (2020) identified

several attributes characterising financial innovation in Islamic countries. Despite the variation of adoption in the Islamic countries, the level of adoption is relatively slower compared to non-Islamic countries, and the focus areas for developing the innovation are the payment systems, mobile banking and Internet banking. Interestingly, Iman (2020) confirmed that products in the market do not always comply with Sharia. Regarding customer roles, customers have not been intensely involved in the production process. Moreover, regulation complexity and pursuing the advancement of technology are challenges to be faced in the endeavour of innovating. Since the innovation is driven and regulated by the government, typically, the innovation has taken place in a top-down manner with limited collaboration among stakeholders.

Whilst prior studies focus on financial innovation, product innovation has been an interesting area to be explored from the financial institution perspective, from various angles. Chaudhry et al. (2020) explored financial product innovation in Islamic banks in Pakistan to identify factors inhibiting product innovation. Using a qualitative approach called Interpretative Structural Modelling (ISM) technique, five experts from Islamic banks and five experts from academia were interviewed to collect the data that was subsequently analysed by employing a mathematical approach. The study revealed that barriers to financial product innovation in Islamic banks are related to the high cost of innovation, particularly the introduction of new products, lack of staff training, and lack of research on Islamic banks, as well as the market. Since Islamic banking products should comply with the Sharia, different schools of thought among the members of the Sharia Board and compatibility between the product development department and the Sharia Board are relevant issues. On the customer side, a lack of awareness regarding the Islamic banking concept as well as its products increases the barriers to innovation by Islamic banks. With regards to external factors, critics of Islamic banking only change the name but not the substance; imitation by competitors of the new products and limitation of development tools have been identified to inhibit innovation. Among the identified factors, high cost in performing innovation is the factor that is impacted by all the identified factors, whilst lack of research is the most capable of influencing other factors. The remaining factors are influenced as well, influencing other factors at a moderate level.

Given the importance of product development to sustain the performance of financial institutions (Dinc, 2020), Tipu (2014) investigated the role of the employee in the process of developing product innovation in Islamic banks in the UAE. Two different senior bank officials assigned by each CEO were interviewed using a semi-structured questionnaire to collect the data. Thematic analysis was employed to analyse the data collected through interviews. The study confirms the role of the Sharia board as the centre of the development process in product innovation in Islamic banks and suggests that members of the Sharia board have diverse backgrounds, such as legal/lawyer & Islamic scholars. It also found that the involvement of employees is greater in the product development for the retail consumer compared to corporate customers. Employee involvement can be leveraged through establishing a product champion, stimulating front-line employees, building a multi-functional team and management support.

Unlike Tipu (2014), Dinc (2020) investigated the model utilised by Islamic finance institutions to develop their products, given the importance of product development in sustaining bank performance. From existing literature, Dinc (2020) contended that the two main issues in developing Islamic bank products are Sharia compliance issues and imitation of conventional bank products. Accordingly, Islamic banks have a product development department and a Sharia board as the channels for developing a product, both of which are responsible for product development. By exploring the website links of 26 financial institutions, half of them from the conventional and the remaining from the Islamic sector, the main products are identified and categorised by characteristics. The study revealed two models, namely, conversion modelling and new product development modelling, which are aimed at identifying the role of the Sharia board in the product development process. For the accepted conventional products, it is appropriate to employ conversion modelling. The difference between the two is the generation of ideas, where a new product development model generates new ideas for the bank's benefit. Beyond the stages that need Sharia Board approval, Dinc (2020) contended that the Sharia Board should be involved in the majority of stages of product development, although they act as a sub-committee with the capacity of a legal adviser. By doing so, it is assumed that Sharia-compliant products can be achieved effectively.

Several drawbacks have been identified concerning studies of financial innovation in Islamic banking. Al-Salem (2009) and Iman (2020) suffered from an unclear methodology, such as the method for reviewing the literature and the time frame for selecting the sample. For the qualitative method, the authors may select content analysis or thematic analysis. Financial products in Islamic finance have not been systematically elaborated in the study by Al-Salem (2009). Iman (2020) opted for payment systems as the type of financial innovation elaborated in the study. However, the study has not focused only on the payment system. It also elaborated on the Islamic financial products in the market. According to Financial Innovation, innovations can be categorised into a new product, a new process or a new entity (Merton, 1992). Al-Salem (2009) and Iman (2020) may refer to the Financial Innovation categorisation to arrange the elaboration of financial innovation in Islamic finance. While Chaudhry et al. (2020) have employed a systematic procedure to elaborate on financial product innovation, a lack of discussion on the findings has limited the readers' ability to comprehensively gain information from the study. Tipu (2014) employed thematic analysis, which is more systematic than a literature review. However, the number of respondents was only two, and neither of them was a CEO, which raises questions about the sample selection, since the study did not mention the criteria for respondents. Dinc (2020) is almost similar to Al-Salem (2009) and Iman (2020), which did not elaborate clearly on methodology, especially how to analyse the data from the product information obtained from the website in the process of product development. Instead of only mentioning the author's customised technique, the author may also utilise other standard methods, such as thematic or content analysis, or else explain the step-by-step procedure for analysing the secondary data.

Furthermore, all the studies in Islamic banking mentioned no explicit theory as the theoretical foundation of the studies. By considering the components or variables used to investigate financial innovation, a similarity exists between these components and variables and the Diffusion of Innovation Theory and UTAUT. The importance of complying with Sharia is similar to compatibility with the norm/value in the Diffusion of Innovation Theory. A high cost of innovation that hampered financial innovation development aligns with the facilitating conditions that have been posited by UTAUT.

A summary of previous studies on financial innovation and product development in Islamic banks is presented in Table 3.5. To the best of the researcher's knowledge, there are limited studies on financial innovation in Islamic banking. In particular, there is also a scarcity of studies on digital banking adoption in Islamic banking. Sharia compliance is the main issue that has been identified by the previous studies.

3.4 IDENTIFICATION OF RESEARCH GAPS

The previous section has elaborated on digital banking from the various focus areas, such as the underlying theory and empirical studies that have been conducted. The underlying theory of the digital is mainly drawn upon the diffusion of innovation theory, Unified Theory of Acceptance and Use of Technology (UTAUT) and financial innovation approach. Empirical studies from banks' perspectives or firms' perspectives on digital banking have also been elaborated in the previous section, including in the Islamic banking context.

Table 3.5 Summary of Studies on Financial Innovation and Product Development in Islamic Banks

Author(s)/Topic	Sample/Method	Main finding/Critical point	Implication
Al-Salem (2009), Financial Product Innovation in Islamic Finance	Review of literature, reports and articles	<ol style="list-style-type: none"> 1) Islamic banks are regarded as the most successful institutions in financial product innovation. 2) The main issue is compliance with Sharia. 3) Other issues: Inappropriate traditional financial instruments with Sharia, standardisation of Islamic finance rules, the absence of good governance, monetary instrument operation and rate of return risk management and globalisation impacts. 4) Needs to continually innovate to meet the market demand and comply with Sharia. 	While banks innovate continually to compete in the market, Sharia compliance should be a central issue for Islamic Finance.
Iman (2020) Financial innovation in Islamic countries by focusing on payment systems, Internet banking and mobile banking	<p>Six countries: Egypt, Indonesia, Morocco, Pakistan, Turkey, and the UAE</p> <p>Review of literature, reports and articles</p>	<ol style="list-style-type: none"> 1) Characteristics of financial innovation in Islamic countries: relatively slower in adoption compared to non-Islamic countries, products in the market do not always comply with Sharia, customer engagement in the production process is low, and innovation takes place in a top-down manner (government-driven) 2) The challenges are regulation complexity and pursuing the advent of technology. 	<ol style="list-style-type: none"> 1. Islamic banks in Islamic countries are encouraged to increase financial innovation with the support of the government. 2. Updating regulations to keep up with the advent of technology is a challenge for the Government to support digital banking adoption and development.
Chaudhry et al. (2020),	Five experts from Islamic banks and five experts from academia	<ol style="list-style-type: none"> 1) The barriers are the high cost of innovation, lack of staff training, lack of research on Islamic banks, and different 	Islamic banks should make a priority of adopting digital banking, considering the high cost

Author(s)/Topic	Sample/Method	Main finding/Critical point	Implication
Inhibitors to product innovation in Islamic banks	Pakistan banking industry Interview, Interpretative Structural Modelling (ISM)	schools of thought among members of the Sharia Supervisory Board. 2) The barrier from the customer side: a lack of awareness 3) The barrier from external factors: critics of Islamic banks only changing terminology, imitation by competitors, and the limitation of development tools. 4) The main barrier is the high cost of innovation.	of innovation in the adoption of digital banking.
Tipu (2014), Employee engagement in product innovation	Two senior Islamic bank officials. UAE Islamic banks Interview, semi-structured questionnaire, Thematic analysis	1) The centre of the product innovation process is Sharia compliance issues. 2) Employee involvement is greater for the retail consumer compared to the corporate consumer. 3) Building a multi-functional team and management support are ways to leverage employee involvement in product innovation.	Along with Sharia compliance, Islamic banks are encouraged to involve employees in product innovation by creating a multi-functional team complemented with support from the management.
Dinc (2020), Product development in Islamic banks	26 well-known global financial institutions (13 conventional financial institutions and 13 Islamic financial institutions) Review of literature, review of banks' websites	1) For the accepted conventional products, it is suitable to employ conversion modelling. 2) The Sharia Board should be engaged with the majority stages of product development, although acting as a sub-committee or legal adviser.	Bank may modify conventional products into Islamic banking products as long as the conventional products have been accepted with the involvement of the Sharia Board in all the stages of product development, although as the adviser.

Source: The researcher's Classification

Despite the importance of digital banking as a financial innovation, studies on digital banking taking the bank's perspective (firm side) have been limited. This has also been experienced in the Islamic banking context. Scarcity in the studies of financial innovation might be owing to the difficulty in gathering the appropriate data (Frame & White, 2004). Specifically, the literature review section that elaborates on the determinant factors influencing the decision to adopt digital banking has uncovered gaps in the literature concerning the following:

1. The majority of studies have been conducted using samples in developed countries (e.g. the United States), and only a few studies have been done in developing countries (e.g. India).
2. Most of the studies on financial innovation, particularly digital banking adoption, have been performed in the context of the conventional banking system. A few studies have been conducted to examine financial innovation in the dual banking system, particularly concerning Islamic banking. In fact, to the best of our knowledge, no study has been done to examine digital banking adoption, concentrating on the determinants of digital banking adoption as well as the perception of types of digital banking services in Islamic banking. Table 3.6. presents several studies on financial innovation, particularly digital banking from the bank's perspective, that have been identified in this study. All the studies covering conventional banking are categorised as financial innovation as well as digital banking (internet banking or mobile banking), whilst Islamic banking has only 5 studies categorised as financial innovation, and none of them are categorised as digital banking.

Table 3.6 Number of studies on digital banking from the Bank's perspective*

Category	Method/Topic	Number of Studies		
		Financial Innovation	Digital Banking**	Total
Conventional banking	Qualitative	7	7	14
	Quantitative	7	7	14
	Sub Total	14	14	28
Islamic banking	Qualitative	5	0	5
	Quantitative	0	0	0
	Sub Total	5	0	5
Total		19	14	33

Source: The researcher's calculation

* Based on the collected SCOPUS/WOS articles in this study

**Digital banking comprises internet banking and mobile banking

- Empirical studies have shown mixed results concerning the relationship of bank-specific factors with the likelihood of bank adoption of digital banking. These have led to inconclusive results. For example, regarding cost reduction as a motivation for digital banking adoption, Malhotra and Singh (2007) and Sullivan and Wang (2020) found that the relationship between labour expense on the adoption of Internet banking is not evident, while He (2015) confirmed the significant effect of salary expense on the likelihood of decision bank to adopt mobile banking. Moreover, such mixed result is also applied to other variables such as profitability, deposits, and the type of bank, among others. The mixed results have been prevalent within variables with different indicators. For example, the effect of profitability on the decision of digital banking adoption is evident. However, different indicators have given different direction relationships. Return on Assets indicates a negative relationship with the decision of digital banking adoption (Hernandez-Murillo et al., 2010); conversely, Return on Equity displays a positive relationship (Furst et al., 2002). Table 3.7 presents the mixed results of studies on determinants of digital banking adoption.

Table 3.7 Mixed Results on Digital Banking Adoption Studies

References	L	P	D	A	T
Furst et al. (2002)		+	x	+	+
Malhotra and Singh (2007)	x	x	+	-	+
Hernandez-Murillo et al. (2010)		-		-	+
He (2015) ¹⁾	+, x		x	x	
Sullivan and Wang (2020)	x		+	-	x

Note: L=Labour expense; P=Profitability; D=Deposits; T=Type of the bank; A=Age of the bank; x = insignificant relationship; + = positively significant; - = negatively significant;

¹⁾ He (2015) employed two indicators to analyse the effect of labour costs

4. Empirical studies on the market-specific factors of digital banking adoptions have involved competitor and market concentration. The effect of customer adoption has not been included in the market specifics. In addition, COVID-19, which has increased awareness of digital banking (Mariani et al., 2021), has also not been included in the studies.
5. In particular, to the best of the researcher's knowledge, no study has been done regarding the determinants of digital banking adoption quantitatively in the Islamic banking context.
6. Regarding banks' perception of digital banking adoption, the literature review has shown various approaches, methods and samples of respondents applied to examine the perception. Some studies have attempted to prioritise the relative importance of the elements or criteria that stimulate or inhibit digital banking adoption by banks. However, the evaluation of the criteria or elements by respondents has been conducted independently for each involved criterion or element without interconnecting between criteria or elements. Mishra and Singh (2015) utilised the Analytic Hierarchy Process (AHP) to prioritise the selection of e-channels that enable comparison among elements within criteria. However, the AHP is a top-down approach from goal to alternatives without allowing the connection between elements in criteria with other elements in other criteria, as well as feedback between elements or criteria. None has been done to make a priority on the digital banking services by inter-connecting the criteria.

7. For the studies in Islamic banking, most of the studies have been done by taking broad-term approaches, for instance, financial innovation or product development, without, in particular, focusing on digital banking adoption.
8. In particular, digital technology in the Indonesian banking sector has been investigated concerning the effect of digital technology, especially the effect of digital banking on bank performance and bank stability. To the best of our knowledge, digital banking has not been researched in light of the determinants that affect digital banking adoption from a bank perspective.

A summary of the gaps that have been identified from the literature review is illustrated in Table 3.8. Considering the gap demonstrated by the literature review, it is essential to investigate digital banking adoption by Islamic banks, concentrating on the determinants influencing the decision of digital banking adoption and how the Islamic banks perceive digital banking adoption by identifying the factors that drive and inhibit the adoption. By doing so, the present study provides a better understanding of the technology adoption in the financial sector, in particular, the adoption of digital banking adoption in Islamic banking since it is a possible different system to have a different way to serve its market (Nejad, 2016) and the adoption depend on the environment where the bank operates (Barnes & Corbitt, 2003).

3.5 CHAPTER SUMMARY

This chapter has deliberated on the theory and approach to investigating digital banking adoption by banks. Generally, the Diffusion of Innovation (DOI) theory and the Unified Theory of Acceptance and Use of Technology (UTAUT) are the main theories. Financial innovation is also utilised to deliberate the adoption of digital channels in the financial sector, particularly adoption by banks. However, the literature review has shown that limited studies have been done in this area, taking the bank's perspective, especially for Islamic banking.

Despite the limited studies on the banks' perspective on digital banking adoption, there have been variations in the sample, methods, and dimensions used in

the studies. In the conventional banking context, banks' perspective on digital banking has been elaborated in the quantitative approach such as studies on determinants in digital banking adoption (Furst et al., 2002; Malhotra & Singh, 2007; Hernandez-Murillo et al., 2010; Dandapani et al., 2018; Sullivan & Wang, 2020) and qualitative approach such as studies on the factors driving or inhibiting digital banking adoption by banks (Bradley & Stewart, 2002; Mullan et al., 2017). The majority of the studies on the determinants of adoption are conducted in developed countries, and there have been limited studies conducted in developing countries, for instance, in India. The logistic model (Logit Model) and hazard model are common methods to be used in the quantitative approach. The majority of studies have elaborated on bank-specific factors, market-specific factors, and demographic factors to reveal factors determining the adoption of digital banking by the bank. Other than bank characteristics, the adoption of digital banking has also been elaborated based on drivers, barriers, and challenges to adoption. In particular, Sharia compliance is the central issue in product development, including in financial innovation such as digital banking services.

Against this background, it is important to investigate digital banking adoption, particularly in Islamic banking, to have a better understanding of digital banking adoption by Islamic banks, since elaboration on the other system or geographic area would benefit to elicit a comprehensive understanding of the adoption.

Table 3.8 Summary of Gaps from Literature Review

No	Findings	Gaps	Implication
1	<p><u>Context of the digital banking study from a country perspective</u> Most digital banking studies have been conducted in developed countries.</p>	<p>Only a little in developing countries</p>	<p>Adoption of digital banking varies among countries (Mullan et al., 2017). Studying digital banking in developing countries may reveal the motivation for banks to adopt digital technology, especially in digital banking.</p>
2	<p><u>Context of the digital banking study from the banking system</u> Most digital banking studies have been conducted in the context of the conventional banking system.</p>	<p>In the Islamic banking system: 1. Only a few studies have been conducted on the Islamic banking system. 2. Taking a general topic. 3. Most studies have used qualitative methods.</p>	<p>The Islamic banking system has different characteristics from the conventional banking system. Since the characteristics of the adopter unit may influence the adoption of technology, the study in other banking systems, such as the Islamic banking system, may provide a comprehensive perspective on the adoption of digital banking (Nejad, 2016) by focusing specifically on digital banking and using qualitative and quantitative methods.</p>
3	<p><u>Relationship bank-specific factors and digital banking adoption</u> Mixed results on the significance of variables and the direction of variables.</p>	<p>The significance and direction of the variables may not be concluded based on the mixed results.</p>	<p>The mixed results on the significance of variables and the direction of variables are potential areas to be elaborated in Islamic banking to ensure the significance of variables and their direction.</p>
4	<p><u>Relationship market-specific factors and digital banking adoption</u> Most studies have included competitor and market concentration.</p>	<p>The studies have not included customer adoption and the COVID-19 situation. Theoretically, the advantage of digital banking is to</p>	<p>Customer adoption and the COVID-19 situation are variables to be involved in digital banking adoption studies as market-specific factors to</p>

No	Findings	Gaps	Implication
		enhance customer experience (Mullan et al., 2017), and COVID-19 has increased awareness of using digital banking for transactions (Mariani et al., 2021; Rahman et al., 2024).	comprehensively study determinants of digital banking adoption.
4	<u>Research method</u> The Analytic Hierarchy Process (AHP) has been utilised to conduct prioritisation in digital banking.	Inter-connecting and feedback among criteria and alternatives are not allowed in the AHP.	Analytic Network Process has the potential to be utilised in the prioritisation in digital banking, as the ANP allows for inter-connecting and feedback among criteria and alternatives.
5	<u>Perspective of digital banking studies in Indonesia</u> The studies have taken the effects of digital technology perspectives.	A scarcity has been found in digital banking studies based on the determinants of digital banking adoption in Indonesia, especially in Islamic banking.	It is important to study determinants of digital banking adoption in Indonesia since Indonesian Islamic banking has experienced a lack of research and development. By doing so, the characteristics and motivations of adopting digital banking can be revealed.

CHAPTER FOUR

RESEARCH METHODOLOGY

4.1 INTRODUCTION

The previous chapter discussed the theoretical framework of this study based on the underlying theory used in this study, namely, the Diffusion of Innovation theory, Unified Theory of Acceptance and Use of Technology and Financial Innovation approach. The literature review has also identified research gaps concerning digital banking adoption, especially in Islamic banking. To address the research questions that have been described in section 1.4, this chapter elucidates the research methodology and methods carried out in this study. The research methodology comprises the overall strategy and procedure conducted by the researcher, including the logic behind the research process to answer the research questions. Section 4.2. clarifies the selection of research methodology used in this study. Since this study utilises primary data, Section 4.3. deliberates the sample selection, data collection and method used to analyse the data. Section 4.4 describes the sample selection and data collection as well as the method for analysing secondary data.

4.2 RESEARCH DESIGN

Research design can be considered as a plan or proposal for performing the research in which the process is guided by the selection of research methodology (strategy of inquiry) and the methods used in the research process (Creswell, 2009). Whether the study employs quantitative research or qualitative research will influence the research design. Research design is assumed as a blueprint or plan for collecting, measuring and analysing the data involved in research (Sekaran & Bougie, 2016). At the very least, research design involves the methods for data collection, data measurement and analysis, and how to interpret the results of the analysis. It also includes the development of the instrument to collect and analyse the data.

Research design is not independent of the objective and research question. Instead, it is geared toward the fulfilment of the objectives and answering the question of the research (Cooper & Schindler, 2014). In this present study, the research design was suited to the objectives of the research as well as the research questions.

This study applied a pragmatic worldview, which relied on several approaches for collecting and analysing data rather than selecting only one approach (qualitative or quantitative only) (Creswell, 2014). In this worldview, the study combines qualitative and quantitative methods into a study (mixed methods). The methods are selected to achieve the study's purpose. By doing so, the selected methods are designed to align with and provide the best understanding of the study's objectives. Aligning with the objectives of this study, the qualitative methods were employed to achieve the first to third objectives, while a quantitative method was utilised to achieve the fourth and fifth objectives. Hence, the design of this study followed an exploratory sequential mixed methods design, where the study employs qualitative methods first, followed by a quantitative method (Creswell, 2014).

It was suitable to apply the qualitative method to achieve the first objective, as the goal is to explore the current state of digital banking adoption among Islamic banks. Document analysis was selected since banks have issued annual reports that contain valuable information regarding the banks, including products and services related to digital banking. By applying document analysis, information regarding digital banking adoption can be revealed. The qualitative method was also used to achieve the second to third objectives. The second and third objectives were related to prioritising the types of services in digital banking based on their relative importance. Since the prioritisation of digital banking services involves multiple criteria, it was suitable to utilise the Multi-Criteria Decision Making method, specifically the Analytic Network Process, to prioritise these services. A survey method was employed to collect data by distributing questionnaires to the respondents.

Research Objectives	Research Questions	Data	Methods	Variables
To explore the current state of digital banking adoption among Islamic banks in Indonesia by analysing documents of Islamic banks	How is the current state of digital banking adoption among Islamic banks in Indonesia analysed through the documents of the Islamic banks?	Secondary Data / Annual Report	Document Analysis	Technology Customer Channel Type of Services
To explore the priority of the type of services in digital banking by Islamic banks in Indonesia from the bank's perspective	How are the types of services in digital banking by Islamic banks in Indonesia prioritised from the bank's perspective?	Primary Data / Questionnaire	Analytic Network Process (ANP)	Type of Services: Transfer & Payment Account opening Social Protection Investment Beyond Banking
To explore determinants in considering the priority of the type of services in digital banking by Islamic banks in Indonesia from the bank's perspective	What are the most important determinants in considering the priority of the type of services in digital banking by Islamic banks from the bank's perspective?			Determinants: Customer Technology Internal Bank Environment Sharia Channel
To examine bank-specific factors in determining the decision to adopt digital banking services among banks offering Islamic banking services in Indonesia	What are the bank-specific factors that determine the decision to adopt digital banking among the banks offering Islamic banking services in Indonesia?	Secondary Data / Annual Report and Financial Report	Logistic Regression	Dependent: Digital Banking Adoption Independent: Bank size Labour cost Bank deposit Profitability Bank type Age of the bank Ownership
To examine market-specific factors in determining the decision to adopt digital banking services among banks offering Islamic banking services in Indonesia.	What are the market-specific factors that determine the decision to adopt digital banking among the banks offering Islamic banking services in Indonesia?			Dependent: Digital Banking Adoption Independent: Market concentration Adoption by competitors COVID-19 pandemic Customer adoption

Figure 4.1 Research Design

Quantitative method was applied to achieve the fourth and fifth objectives, considering those objectives that involve a causal relationship between variables. The fourth and fifth objectives involved a causal relationship from bank-specifics and market-specifics on digital banking adoption. Considering digital banking adoption is a

binary choice, with only two alternatives (yes or no), a logistic regression is suitable for analysing data on the adoption of digital banking. Similar to the first objective, data on the adoption of digital banking was identified from the annual reports of the banks, for instance, to identify whether the bank has adopted digital banking or not. Lastly, synthesising the results from the document analysis (qualitative), ANP method (qualitative) and Logistic Regression (quantitative) was performed to achieve a comprehensive understanding of the digital banking adoption, for example, to verify the similarity of the findings among the methods and to verify which findings support other findings from another method. The details of the research design are explained in the next sections. The research design of this study is illustrated in Figure 4.1.

4.3 CONCEPTUAL FRAMEWORK

A conceptual framework was developed to achieve the objectives of the study based on the Diffusion of Innovation theory, UTAUT and financial innovation, as well as incorporating the empirical studies on digital banking that have been previously elaborated. Firstly, the objective of the study was to explore the current state of digital banking adoption by Islamic banks, comprising the technology, the customer, the channel and the type of services. Secondly, the objective of the study was to explore the priority of the type of services in digital banking adoption by Islamic banks from the bank perspective and to explore determinants in considering the priority of the type of services in digital banking by Islamic banks from the bank perspective. Financial needs can be categorised into basic/essential, complementary and embellishment (Ahmed, 2011). Along the same line, Yumna and Marta (2021) categorised financial needs into transaction purposes, security purposes, and investment purposes. In addition, Mariani et al. (2021) contended that beyond-banking services are related to the customer needs beyond financial services. Synthesising the customer needs with the services in digital banking generates the type of services in digital banking, namely, transfer and payment, account opening, protection/security, social/donation, investment, and beyond banking.

Islamic banks must consider determinants to make the priority of the type of services in digital banking. Within the Diffusion of Innovation theory, attributes of innovation that consist of relative advantage, compatibility, complexity, observability

and trialability are assumed to affect the adoption of innovation. UTAUT offers three determinants affecting intention to use technology, namely performance expectancy, effort expectancy and social influence. The intention to use technology, along with facilitating conditions, directly determines the behaviour of using technology. In addition, previous studies on digital banking adoption have provided various factors affecting digital banking adoption. Combining the Diffusion of Innovation Theory, UTAUT, and previous literature on digital banking, identified factors that need to be considered in selecting services in digital banking. This study categorised the various factors into six clusters, namely Customer cluster, Technology cluster, Internal bank cluster, Environment cluster, Sharia cluster and Channel cluster. Details for each cluster and elements within each cluster are provided in the next section.

Lastly, the objective of the study is to examine the determinants of digital banking adoption, namely, bank-specific factors and market-specific factors. The diffusion of Innovation theory posited that adopter characteristics have a critical role in influencing the adoption of technology (Dearing & Cox, 2008). In the context of digital banking adoption, adopter characteristics are identified as bank characteristics, such as bank-specific factors and market-specific factors. Social pressure and economic necessities may influence the adoption of technology by potential adopters. Competition and competitors'/rivals' adoption need to account for the determinants of digital banking adoption. In addition, financial innovation refers to new ideas or products or services that reduce the cost, reduce the risk or improve the products and services. The financial innovation approach has also identified factors or conditions supporting the financial innovation to take place, for instance, the size of the bank, regulation, and market power or competitive consideration. Figure 4.2 illustrates the conceptual framework for analysing digital banking adoption in Islamic banking.

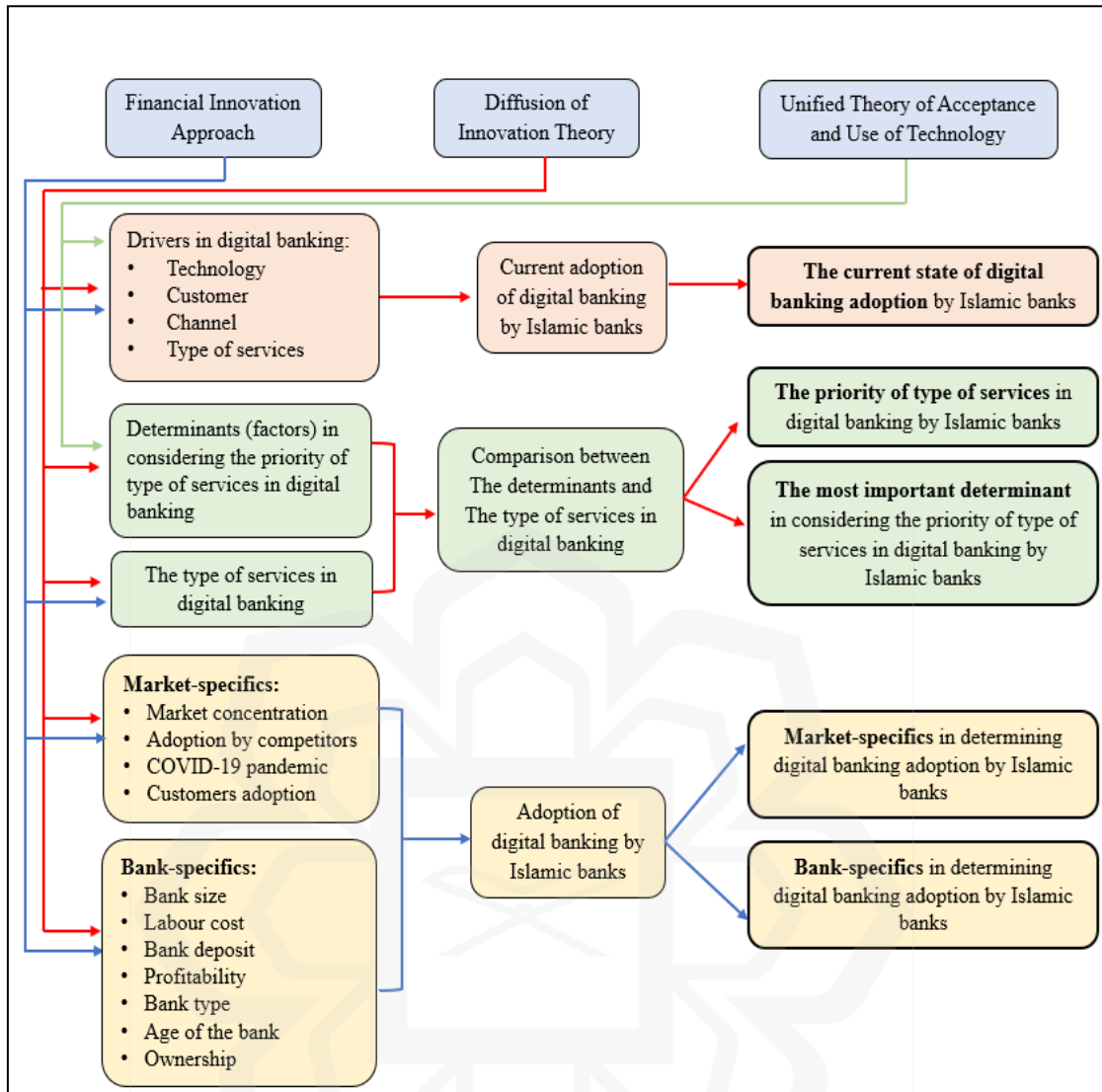


Figure 4.2 Conceptual Framework

4.4 HYPOTHESES DEVELOPMENT

Several hypotheses were developed to guide and achieve the objective of the present study and were derived from the conceptual framework in the previous section. The hypothesis was developed mainly based on the Diffusion of Innovation (DOI) theory and the UTAUT, combined with the financial innovation approach.

4.4.1 Priority of The Type of Services in Digital Banking by Islamic Banks

DOI theory is suitable to examine the adoption of innovation by the individual, consumer or organisation. Most of the studies have employed the DOI theory to examine the behavioural intention toward the adoption of innovation by the individual or consumer (Kolodinsky et al., 2004; Al-Jabri & Sohail, 2012; Jamshidi & Husin, 2018). The DOI theory is also suitable to explain the adoption of innovation in organisational studies, for instance, financial institutions (Mullan et al., 2017). However, to exploit the benefit of the theory, it is suggested that the DOI theory is accompanied by other approaches (Mullan et al., 2017). Within this theory, the adoption of innovation is explained through five elements called attributes of innovation, comprising relative advantage, compatibility, complexity, observability and trialability.

In the present study, the UTAUT was chosen to equip the DOI theory for two reasons. First, both theories explain factors influencing certain individual behaviours, particularly in the field of technology. Second, considerable studies have been undertaken to explore individual behaviour in the financial sector by using the DOI theory and UTAUT. Since digital banking is a part of financial innovation, the DOI theory is also supported by financial innovation to have a better understanding. In particular, Islamic banking must comply with Sharia principles or Islamic law. Therefore, digital banking adoption in the sphere of Islamic banking should adhere to Islamic principles. In this sense, Sharia issues find an important position to support the DOI theory.

The Analysis Network Process (ANP) is suitable for analysing the issues regarding digital banking adoption. ANP is considered a method to analyse problems involving complex criteria (Multi-Criteria Decision Making). In the financial sector, ANP has been utilised to identify the important factors influencing financial inclusion in Indonesia by identifying the relative importance of the financial inclusion factors (Ali et al., 2020). Exploring the issues concerning the adoption of digital banking involves the attributes of innovation and related theory or approach, which can be envisaged as complex criteria.

In addition, ANP requires constructing a network model by identifying the criteria grouped into clusters, connecting the clusters and allowing feedback between the connections. The model demonstrates a framework with which the issues are analysed. The model also displays a connection between the criteria (clusters) forming a network. The present study applies a network model of ANP considering issues on digital banking adoption involving several determinants/criteria (clusters) potentially connected between the criteria (clusters). Bradley and Stewart (2002) and Mullan et al. (2017) identified correlations between the elements within the drivers and barriers in digital banking adoption.

The present study constructed a network model to demonstrate the issues of digital banking adoption by incorporating previous studies on a similar topic. Nath et al. (2001) explored banks' perspectives on Internet banking adoption by approaching strategic issues, operational issues, customer issues and technology issues. Strategic and operational issues generally emphasise the internal issues of the bank, while customer and technology issues stem from the external factors of the bank. Akinci et al. (2004) have identified four areas of issues concerning electronic banking adoption, namely, the offered services by the banks, the customers, the bank's perception, and the alternative channels. Additionally, the enabling environment, such as competition, partnership formation and demand, is important to be added to the analysis (Mullan et al., 2017). Unlike Akinci et al. (2004), Omarini (2022), who are in line with Mullan et al. (2017), have identified environmental factors, namely regulation and new competitors, that need to be considered concerning digital banking, other than technology and customer. Sharia issues are added to the network model since products and services in Islamic banking must adhere to the Sharia principle, which is the central issue for Islamic banking (Al-Salem, 2009; Ahmed, 2014). By incorporating strategic and operational issues into one cluster, namely internal issues, seven categories of issues have been identified to form the network model, such as customer, technology, environment, internal, channels, sharia and type of services.

The initial model was built on the Analytic Hierarchy Process (AHP) that consists of the goal, the criteria, the sub-criteria and the alternatives. The model is geared to the goal of selecting the priority of the type of services in digital banking, considering the factors influencing the adoption of digital banking services by Islamic

banks, as well as the relative importance. The criteria are the determinants/main factors influencing the adoption of digital banking services, while the sub-criteria are the elements that constitute the determinants/main factors. The alternatives are identified as the type of services in digital banking that Islamic banks would like to choose.

Apart from the AHP model that emphasises the hierarchical model where there is no correlation between elements of one criterion to elements of other criteria, the ANP model enables such correlation to take place. By taking the ANP model for the present study, the clusters that build the network model comprise the determinants/main factors cluster (criteria cluster), the group of elements derived from the determinants/main factor (sub-criteria cluster) and the type of services in digital banking (alternatives cluster). Previous studies have provided key issues regarding the adoption of digital banking as well as Islamic banking issues in product development. Each key issues have its theme. Based on the similarity or closeness of themes, key issues are grouped into categories or clusters as follows:

1. The customer cluster identifies key issues related to the customer theme considered to influence the adoption of digital banking services.
2. The technology cluster exhibits the issues that need to be considered regarding the technology supporting digital banking services to take place in the bank.
3. The internal cluster describes the situation or condition encountered by the bank in the adoption of digital banking services.
4. The environment cluster identifies the issues related to the competitor, government or regulators and the vendor providing the technology.
5. The Sharia cluster is related to Sharia compliance, and the internal process should go through as products and services of Islamic banks must adhere to Sharia principles.

6. Channel cluster identifies the digital channel the bank must consider, since several alternative digital channels can be selected in delivering digital banking services.

The details of key issues for each cluster are presented in Table 4.1.

Table 4.1 Key Issues (Determinants) in Digital Banking Services by Islamic Bank

No	Factors	Definition	Reference
1. Customer			
1.1.	Customer convenience	Better service to customers, such as faster, easier, and more reliable, to enhance the ability to deal with customers	Aladwani, 2001; Bradley and Stewart, 2002; Mullan et al., 2017
1.2	Customer demand	Meeting customer demand for the service, customer-driven demand, particularly Islamic bank customers	Aladwani, 2001; Bradley and Stewart, 2002; Mullan et al., 2017; Yumna, 2019
1.3	Customer awareness	Customer awareness of the services provided by Islamic banks	Jamshidi and Husin, 2018; Chaudhry et al., 2020
1.4	Customer religiosity	Religiosity is an important factor for Islamic bank customers in the adoption of products and services.	Jamshidi and Husin, 2018; Suhartanto et al., 2020
2. Technology			
2.1	Competitive advantage	Reducing costs and workforce, improving the bank's image and brand development	Aladwani, 2001; Bradley and Stewart, 2002; Mullan et al., 2017
2.2	Innovation costs	Cost related to the technology, such as the introduction of new technology	Bradley and Stewart, 2002; Chaudhry et al., 2020

No	Factors	Definition	Reference
2.3	Security and Risk	Perceived security and risk concerns, such as authentication issues, security improvement	Bradley and Stewart, 2002; Mullan et al., 2017
2.4	Technology development	Ease of developing the technology	Bradley and Stewart, 2002; Chaudhry et al., 2020
3. Internal (Bank)			
3.1	Strategic objective	Compatibility with the strategic objective/plan of the bank	Mullan et al., 2017
3.2	Human resources	Availability of talented staff/specialists and training for the staff, employee engagement in the development of service innovation.	Nath et al., 2001; Aladwani, 2001; Tipu, 2014; Chaudhry et al., 2020
3.3.	Legacy systems	Compatibility with existing bank systems, technology, and infrastructure	Bradley and Stewart, 2001; Mullan et al., 2017
3.4	Innovation culture	Innovation culture, as well as an attitude toward innovation and resistance to change	Bradley and Stewart, 2001
4. Environment			
4.1	Competitor's adoption	Number of banks adopting the technology	Bradley and Stewart, 2001; Mullan et al., 2017
4.2	Communication by the competitor	Communication and influence from others in the industry	Bradley and Stewart, 2001; Mullan et al., 2017
4.3	Regulation/Government	Government support, including regulations related to digital banking	Aladwani, 2001; Bradley and Stewart, 2002; Iman, 2020

No	Factors	Definition	Reference
4.4	Partnership formation	Availability of partnership formation with other stakeholders	Mullan et al., 2017
5. Sharia			
5.1	SB's school of thought	Sharia Board (SB) members may have different schools of thought that influence the mutual consent	Chaudhry et al., 2017
5.2	Sharia compliance	The product must comply with Sharia as well as satisfy all Islamic legal requirements. Failure to fulfil Sharia requirements will lead to negative perceptions.	Al-Salem, 2009; Ahmed, 2011; Ahmed, 2014; Laldin and Furqani, 2016; Yumna, 2019; Dinc, 2020; Usman et al., 2020
5.3	The Uniqueness of Islamic Products	Critics of Islamic banking as a replication of conventional banking and only changes the terminology. Islamic banks need to differentiate themselves from conventional banks, as well as innovative products (originality)	Al-Salem, 2009; Laldin and Furqani, 2016; Chaudhry et al., 2017; Dinc, 2020
5.4	PD and SB Understanding (Internal Dynamics)	Friction may occur, which causes the involvement of various departments in product development. Product Department (PD) may not be aware of Sharia aspects, while Sharia Boards (SB) may not have a deep understanding of the market.	Ahmed, 2011; Chaudhry et al., 2017
6. Channel			
6.1	Multi-Channel 1	Banks with physical branches may prioritise adopting one of	Laukkanen, 2007; Scornavacca and

No	Factors	Definition	Reference
		the digital channels (Internet banking or mobile banking), which is separately managed.	Hoehle, 2007; Hoehle et al., 2012; Laukkanen, 2016; Mishra and Singh, 2015.
6.2	Multi-Channel 2	Banks with physical branches may conduct channel extension by adopting both digital channels (Internet banking and mobile banking) since each channel has its role for the customer, and the channels are separately managed.	Laukkanen, 2007; Scornavacca and Hoehle, 2007; Hoehle et al., 2012; Laukkanen, 2016; Mishra and Singh, 2015; Verhoef, 2021.
6.3	Omnichannel	Banks with physical branches adopt both digital channels (Internet banking and mobile banking). The channels are integrated to deliver seamless, personalised, consistent, and unified banking services in all channels and enable the customer to switch seamlessly between channels during transaction interactions.	Verhoef et al., 2015; Komulainen and Makkonen, 2018; Hamouda, 2019; Verhoef, 2021.
6.4	Digital Channel Only	Banks may choose to be fully digital companies characterised by a branchless, superior customer experience, adopting advanced technology (for example, Big Data, AI, and Cloud), and digital channels (Internet banking or mobile banking). Banks may adopt both digital channels since each channel has its role.	Schaechter, 2002; Berger, 2003; Choi et al., 2020; Verhoef, 2021.

Regarding the type of services in digital banking (alternative cluster), the present study defines the type of services in digital banking following the categorisation that has been outlined in the previous chapter (Chapter Two). The type of services should comply with the Islamic principle (Sharia) for Islamic banks. For instance, social purpose, which is related to Islamic Social Finance, may take the form of zakat, waqf, infaq or shodaqa. Fulfilling investment purposes involves Islamic financial instruments such as Islamic stocks and Sukuk. The need for leisure and travelling is an example of customer needs beyond financial services, which are categorised as beyond banking services (Mariani et al., 2021), for instance, the halal industry in travelling or recreation. Therefore, the type of services in digital banking (alternative cluster) comprises services to facilitate the purpose of transfer and payment services, account opening services (intermediation), security (Islamic insurance/*takaful*), social (Islamic social finance), investment (Islamic finance), and beyond banking. The details of the category of services in digital banking that have been identified as alternative clusters are illustrated in Table 4.2.

Table 4.2 Category of Digital Banking Services (Alternative Cluster)

No	Type of Services	Definition	Reference
1	Fund Transfer & Payment	Transaction purpose. Money transfers inter-account within the banks, to other banks within the country, and across the globe (different countries)	Furst et al., 2002; Malhotra and Singh, 2007; Nicoletti, 2014.
2	Account Opening	Transaction purpose. Set up new accounts for deposit accounts such as checking and savings accounts, receiving, as well as processing financing (loans) applications.	Furst et al., 2002; Ahmed, 2011; Yumna and Marta, 2021.
3	Security Purpose	An ancillary product for managing the risk. In the context of Islamic finance, it is related to Takaful.	Furst et al., 2002; Tiwari et al., 2006; Nicoletti, 2014
4	Social purpose	The endowment is an ancillary product for a charity donation. In the context of Islamic finance, it is related to Islamic Social Finance, such as <i>zakat or waqf</i> .	Ahmed, 2011; Nicoletti, 2014;
5	Investment	Transaction (selling and purchasing) related to securities or financial instruments. In the context of Islamic finance, it is related to Islamic securities or Islamic financial instruments.	Furst et al., 2002; Tiwari et al., 2006; Ahmed, 2011; Yumna and Marta, 2021.

No	Type of Services	Definition	Reference
6	Beyond banking	Meeting the customer needs beyond banking transactions/financial transactions, such as leisure or managing customer finances. For example, ticket booking, hotel room booking, financial management application, cash flow analysis, and tax calculation for the business customer	Ahmed, 2011; Mariani et al., 2021.

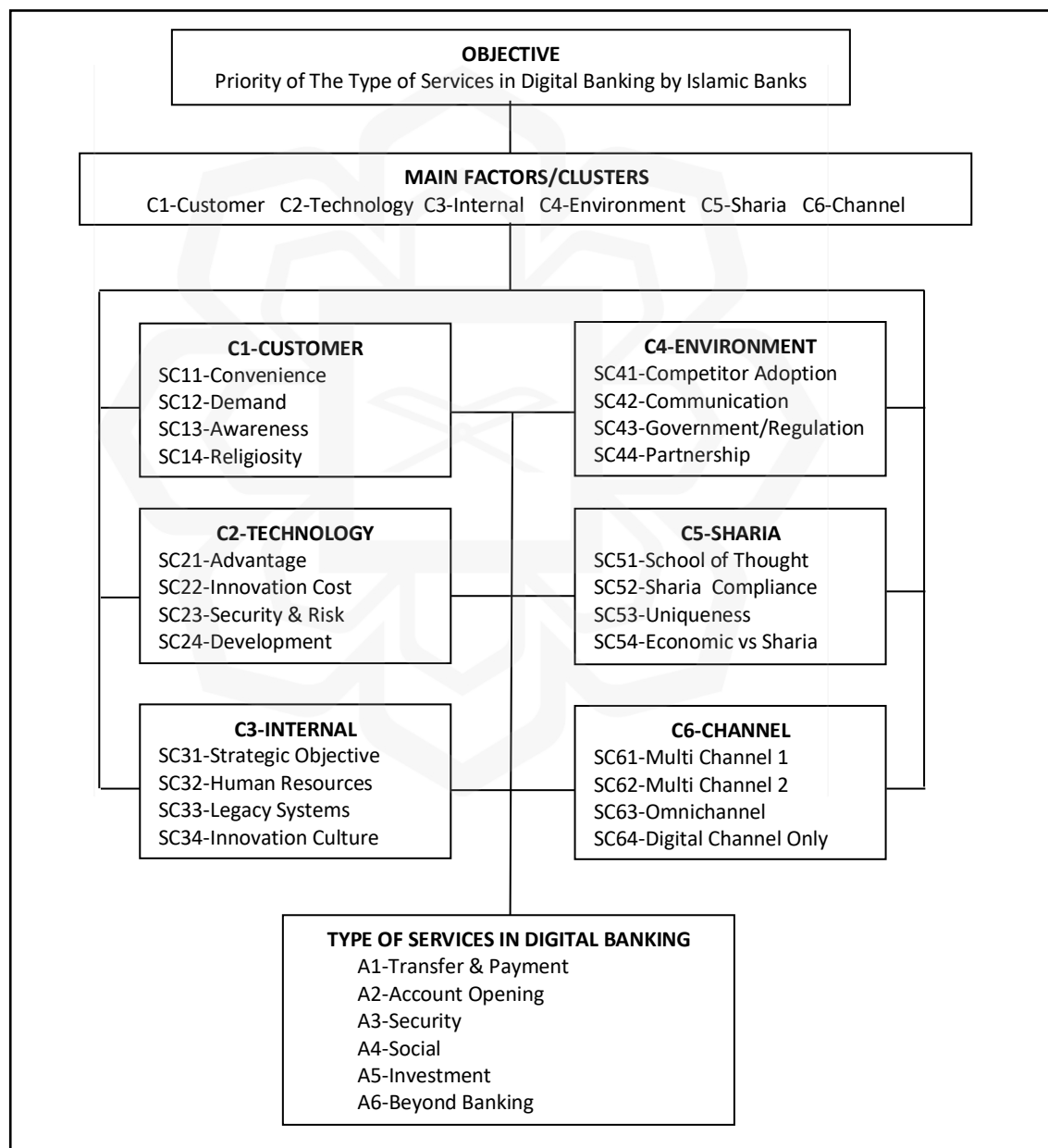


Figure 4.3 The ANP Structure for Priority of The Type of Services in Digital Banking by Islamic Bank

In this study, the structure of the ANP following the AHP model consists of the goal, main criteria clusters, sub-criteria clusters, and alternative services, as illustrated in Figure 4.3. The network of the ANP model, which describes the connection between the clusters, is illustrated in Figure 4.4.

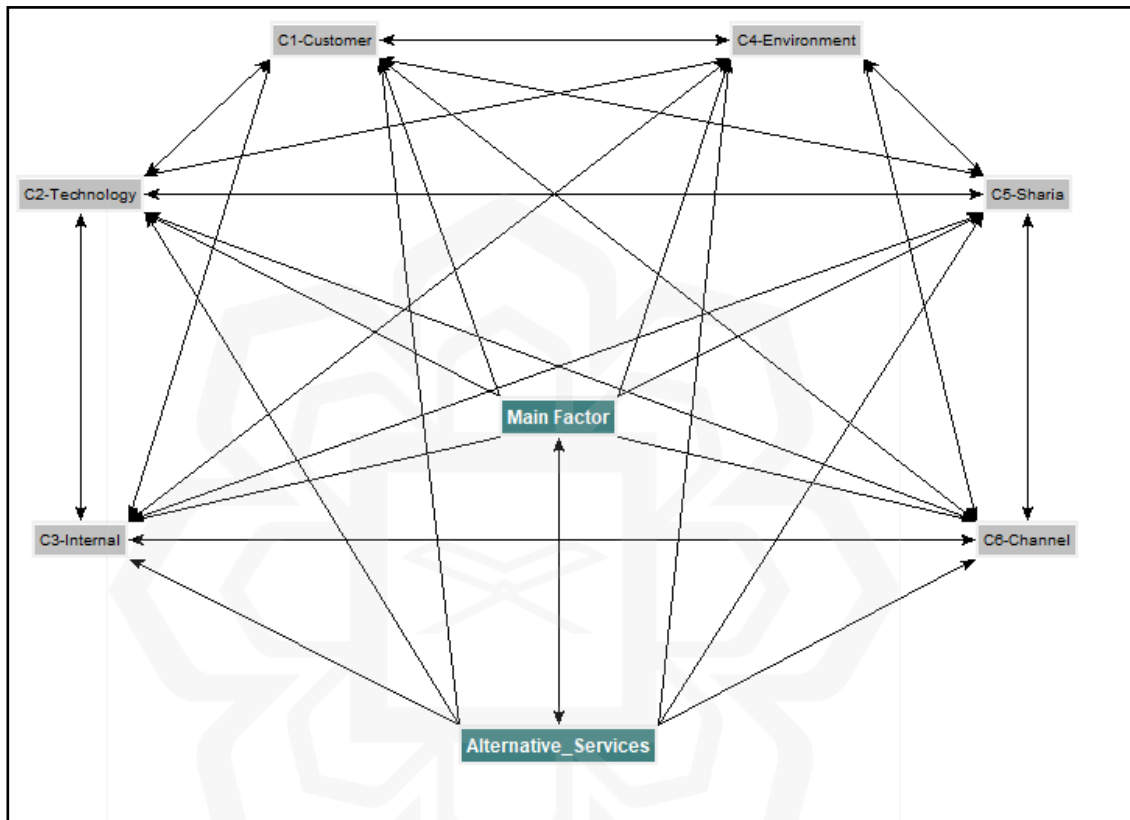


Figure 4.4 The Network Model for Priority of The Type of Services in Digital Banking by Islamic Bank

4.4.2 Factors Determining The Adoption of Digital Banking by Banks

Diffusion of Innovation Theory posited that attributes of innovations may influence the adoption of innovations or technology. Relative advantage, one of the attributes of innovation, has been considered the motive for banks to adopt digital banking. A bank adopting digital banking considers the advantages for both the bank and its customers (Takieddine and Sun, 2015). Ability digital banking to substitute routine tasks into automation and reaching out to customers in areas where the bank has no branch can cut the costs stemming from the operational branch offices, especially labour costs.

Another advantage of digital banking is the ability to improve customer experience, which in turn attracts new customers to increase bank deposits. The bank assumes this ability as an advantage that stimulates the bank to adopt digital banking. In addition, the advantage of digital banking may induce revenue streams to improve the bank's performance.

Diffusion of Innovation Theory has also revealed that compatible technology with the objective of the bank would lead to the adoption of technology. A bank with specialisation considers whether the technology is compatible with specialising in the business. For an Islamic bank, other than specialisation, compatibility to support the Sharia banking products is also considered. An older bank, which generally owns legacy systems, considers compatibility technology for its legacy systems before implementing digital technology. For a younger bank, compatibility with its objective of boosting the business performance is more important.

Technology is more likely to be adopted more quickly when its advantages or benefits can be observed, as posited by the Diffusion of Innovation Theory. The bank observed that digital banking enables banks to provide operational and customer transactions during social distancing in the COVID-19 situation. The Bank also observed that customers have been attracted to use digital banking to facilitate their financial transactions.

In terms of UTAUT, performance expectancy, which is reflected by the ability to cut labour costs, increasing customer databases, and improving bank performance, is considered a benefit to the bank which influences the intention to use technology. In the competitive market, bank encounters pressure from competitors and customers in adopting digital banking. Competitor adoption of digital banking also stimulates banks to adopt digital banking, considering the pressure and communication among the banks in the market. These pressures are similar to the social influence in UTAUT.

From the perspective of Financial Innovation, firm size has been identified to influence the adoption of innovation. Though a larger bank has a different rate of adoption than a smaller bank. In addition, one of the motivations for adopting financial innovation is to reduce costs. Digital banking is expected to enable banks to cut the costs stemming from employee costs. Of the factors provoking financial innovation to

emerge, technology has been a key enabler for innovation to take place. A bank that intensively uses advanced technologies is familiar with technology, which is, in turn, more likely to use digital banking technology. Financial Innovation has also identified a considerable change in macroeconomics as a factor for innovation in financial services to emerge. The COVID-19 outbreak has brought about uncertainty in the environment and economy. However, COVID-19 has also increased awareness of digital technology and accelerated its adoption of digital technology to overcome the situation. Table 4.3 presents the relationship underlying theory in this study with the bank-specifics and market-specifics in the digital banking adoption.

Table 4.3 Relationship Between Underlying Theories and Determinants of Digital Banking Adoption

Theory	DOI	UTAUT	FI
Bank Specific			
Bank size The capability of a larger bank			Capability based on firm size
Labour cost Cutting employee costs	Advantage	Performance expectancy	Reducing cost (motivation)
Bank deposit Increasing customer database	Advantage	Performance expectancy	
Profitability Improving bank performance	Advantage	Performance expectancy	
Bank type Compatibility with objective and value	Compatibility		
Bank age Compatibility with the legacy system and objective	Compatibility		Reducing risk (motivation)
Ownership Technology as an enabler			Technology as a key enabler
Market Specific			
Market concentration Pressure from competition		Social influence	
Competitor adoption Communication & pressure from competition		Social influence	

Theory	DOI	UTAUT	FI
COVID-19 Capability during social distancing	Observability		Change in macroeconomic
Customer adoption Customer attraction	Observability		

Note: DOI = Diffusion of Innovation Theory; UTAUT = The Unified Theory of Acceptance and Use of Technology; FI = Financial Innovation approach.

4.4.2.1 Bank Size and Digital Banking Adoption

Studies on Financial Innovation have identified that bank size has a relationship with the adoption of innovation (Frame and White, 2004; Tufano, 2003). An initial investment to establish the technology, maintenance and operational costs is required to adopt digital banking (Dandapani et al., 2018), which leads to only particular banks having the capability to adopt digital banking. Large banks have the capabilities to manage a broader range of activities, the experience of economies of scale and a greater return on investment stemming from the likelihood of large product sales (Frame & White, 2004), which has made the advantageous for large banks to adopt digital banking earlier than small banks. Small banks adopt digital banking later, depending on the changes in the environment, particularly the cost related to the technology adoption and the customer willingness (Sullivan & Wang, 2020). Tufano (2003) has found that larger firms have the capability to innovate due to the ability to address the firm's constraints and focus on optimising capital. For example, larger banks are more likely to adopt credit scoring. Larger banks may have more financial resources than smaller banks, enabling larger banks to adopt digital banking (He et al., 2020). Therefore, large banks are more likely to adopt digital banking than small banks. It is hypothesised that bank size has a positive relationship with digital banking adoption.

H1: *Bank size has a significantly positive relationship with digital banking adoption by the banks.*

4.4.2.2 Labour Cost and Digital Banking Adoption

Diffusion of Innovation Theory has revealed that the advantage of technology may influence the adoption of technology. Banks consider the benefits to the banks and customers in adopting digital banking (Takeddine and Sun, 2015). One of the advantages of digital banking is efficiency by cutting costs related to the employment reduction stemming from reducing overhead costs related to the personnel supporting the physical branches and substitution of personnel with the automated process has been assumed as the relative advantage of digital banking (Tiwari et al., 2006; Shah & Clarke, 2009). Theoretically, in an Internet bank which provides no physical branches to operate, cost reduction is generated by decreasing the operational cost due to the elimination of branches that affect decreasing expenses related to the labour cost, premises and fixed assets costs (DeYoung et al., 2007). In the click-and-mortar banks which adopted digital banking channels along with the physical branches, the effect of digital banking adoption on the overhead cost is quite similar, in which physical branches possibly be substituted by digital banking channels and reduce the costs related to the physical branches (DeYoung et al., 2007). Thus, banks experiencing higher labour expenses are more attracted to adopt digital banking (Malhotra & Singh, 2007) to decrease overhead labour costs. The relationship between labour cost and the likelihood of digital banking adoption is expected to be a positive one.

H2: Labour cost has a positive relationship with digital banking adoption by banks.

4.4.2.3 Bank Deposit and Digital Banking Adoption

The advantage of digital banking to the customer is to increase the customer experience. Digital banking has made customers' access to banking services flexible without visiting the branch offices. Customers are able to perform financial transactions conveniently anytime and anywhere using digital banking, regardless of the customer's location. The advantage of digital banking is that it increases the customer experience, which can attract new customers and maintain existing customers. The bank relying less on traditional funding or core deposits envisages digital banking as an aggressive business strategy, and the bank is more motivated to offer digital banking (Furst et al.,

2002). In this manner, a bank with lower deposits is more likely to adopt digital banking. The correlation is negative between bank deposits and digital banking adoption. However, Sullivan and Wang (2020) found that the size of the deposits has a positive correlation with Internet banking adoption. The bank concentrating on the client base (i.e., deposits of the bank) is more likely to adopt Internet banking than smaller banks with a smaller number of deposits (Malhotra & Singh, 2007) to maintain and increase the client base. This indicates that a bank with higher deposits is predicted to be more likely to adopt digital banking. Hence, traditional funding or core deposits are considered to affect the decision to adopt digital banking by the bank, with an ambiguous direction.

H3: Bank deposit has a relationship with digital banking adoption by the banks.

4.4.2.4 Profitability and Digital Banking Adoption

Profitability is a motive for banks to adopt innovation and to induce innovation to emerge. The basic reason for banks to innovate in financial services is to achieve profit (van Horne, 1985), which is in line with Tufano (2003), who posited that financial innovation is a part of a continuous process for maximising profit in the economy, as the Schumpeterian process of innovation stated. A more profitable bank is motivated to adopt digital banking to maintain its competitiveness in the market, whilst the less profitable bank intends to improve its performance by adopting digital banking (Malhotra & Singh, 2007). Bank profitability is possible to be a source of funds to finance investment in innovation (Hannan & McDowell, 1984), including digital banking, since bank requires a sizable investment to adopt and develop digital banking (Dandapani et al., 2018; OJK, 2021b; OJK, 2021c). If the internally generated fund limits the investment in the innovation, then the more profitable bank tends to adopt the innovation, considering the bank's capacity (Hannan & McDowell, 1984). In this manner, profitability is expected to have a relationship with digital banking adoption. A less profitable bank is motivated to adopt digital banking to increase profitability and to improve bank performance, while a more profitable bank is more motivated to sustain its competitiveness in the market and create more innovations. Therefore, the expected sign needs to be clarified.

H4. Profitability has a significant impact on digital banking adoption by banks.

4.4.2.5 Bank Type and Digital Banking Adoption

Business specialisation refers to the focus on a particular business or product (Deloitte, 2013). In the banking business, the bank may functionally be separated into a commercial bank and an investment bank or as a universal bank. According to Boot-Thakor's model (1977), specialisation affects the probability of enhancing innovation in financial services, in which a more specialised bank promotes a higher likelihood of innovation and banks with functionally separated have a higher probability of innovation than in a universal banking system (Tufano, 2003; Arnaboldi & Rossignoli, 2015). Regarding the dual banking system, Islamic banking services can be offered to customers by an Islamic bank (a full-fledged Islamic bank) or a conventional bank through an Islamic business unit (an Islamic window). In terms of specialisation, an Islamic bank is more specialised than a conventional bank offering Islamic banking services since the corresponding conventional bank adopts an interest-based system (conventional) and an Islamic banking system, while the Islamic bank only offers Islamic banking services. In particular, the profitability of Islamic banks in Indonesia is higher than that of conventional banks during the rapid adoption of digital banking in 2015-2019 (Yunita, 2021). Therefore, Islamic banks are predicted to have a higher probability of adopting digital banking, which is an example of innovation in financial services.

H5. Islamic banks are more likely to adopt digital banking than other banks.

4.4.2.6 Age of the Bank and Digital Banking Adoption

A bank usually has existing procedures, systems and infrastructure to operate the business, which is often called the legacy systems. To adopt the new technology, the bank considers the compatibility of the new technology with the legacy systems in place (Mullan et al., 2017). The older bank usually has more profound legacy systems, which makes it more difficult for the bank to deploy new technology. The older bank, which

is relatively experienced and longer in the banking business, is expected to have the accumulation of experience and reduced perceived risk in investment, which leads to the adoption of digital banking (Malhotra & Singh, 2007). Despite obstacles stemming from the legacy systems, older banks should adopt digital banking earlier to gain a competitive advantage, which increases customer satisfaction and improves the bank's performance (Mbama et al., 2018). The bank which has not adopted digital banking will be threatened for losing market share (Stulz, 2019; Thakor, 2020). The situation is also applied to the younger bank. In contrast with the older banks, the newer bank is assumed to be less likely to have a legacy system and less likely to have managerial obstacles (Malhotra & Singh, 2007) in the adoption of digital banking. Newer bank assumes new business opportunities can be created from the new technology (Furst et al., 2002), which motivated newer banks to adopt digital banking. In Indonesian Islamic banking, Haryati et al. (2019) confirmed that no evidence of the effect of bank age on Islamic bank profitability has been found. Therefore, the relationship between the age of banks and digital banking adoption is ambiguous.

H6. The age of the bank has a relationship with the adoption of digital banking by the bank.

4.4.2.7 Ownership and Digital Banking Adoption

Diffusion of Innovation Theory posited that characteristics of adopters influence the rate of technology adoption. Banks with different ownership would have different characteristics. A bank may be categorised as a public bank or a private bank based on its ownership. Kangis and Kareklis (2001) found different characteristics in ownership, control and goals between a private bank and a public bank. The different ownership of banks is expected to influence the adoption of digital banking. A public bank is characterised as directly or indirectly controlled by the state, more bureaucratic and much less concerned about profit, while a private bank is more likely under the control of private capital (Kangis & Kareklis, 2001). In banking services, organisational differences in ownership affect bank services to the customer, and a public bank is more likely to offer banking services in poor infrastructure facilities and technology compared to a private bank (Harun, 2023). Technology availability is critical for banks

to deliver digital banking services to customers conveniently. Thus, a private ownership bank is supposed to have a higher probability of adopting Internet banking (Malhotra & Singh, 2007).

H7. A private bank is more likely to adopt digital banking.

4.4.2.8 Market Concentration and Digital Banking Adoption

Market structure matters in the adoption of digital banking (He, 2015). Characteristics of the market where the bank operates influence the adoption of digital banking (Hernandez-Murillo et al., 2010), particularly the concentration of the market. Hannan and McDowell (1984) revealed that a higher probability of new technology adoption is more likely to occur in a bank that operates in a more concentrated market. In contrast, according to Boot and Thakor's model, great competition would lead to increased innovations (Tufano, 2003). If a great competition induces innovations to take place, then a less concentrated market stimulates an increased innovations since a less concentrated market leads to a higher competitive market. A bank adopting digital banking is more likely to increase its competitiveness to compete in the market (He et al., 2020). He (2015) found that concentrated markets have a significant relationship with the adoption of mobile banking, where a bank in a less concentrated market is more likely to adopt digital banking. Dandapani et al. (2018) argued that credit unions operating in high-level competition, which is denoted by a low concentrated market, are more likely to adopt Internet banking to differentiate their services. Cupian and Abduh (2017) confirmed a high concentration of the market of Islamic banking in Indonesia, which leads to a less competitive market. Thus, the relationship between market concentration and digital banking adoption is ambiguous.

H8. Market concentration has a relationship to the digital banking adoption by the bank.

4.4.2.9 Adoption by Competitors and Digital Banking Adoption

Rogers' Diffusion of Innovation Theory assumes that adoption of technology occurs when potential adopters have communicated with others who have adopted the technology (Sullivan & Wang, 2020). When an influential member adopts technology and communicates the adoption with a member of the social system, who then follows to adopt the technology, the rate of adoption is accelerated and the state of the system changes; if the member refuses to adopt the technology, the state of the system remains the same (Dearing & Cox, 2018). The adoption by others within the industry may reduce the uncertainty concerning the benefits or costs of the technology (Malhotra & Singh, 2007). The organisation responds to pressure from the other organisations around them (Mullan et al., 2017). In the case of adoption by the competitor, banks have to decide whether to adopt or not adopt the technology, and both alternatives have their consequences. The bank adopts digital banking to apply a differentiation strategy in the competition (Dandapani et al., 2018). Adoption by a competitor may reduce profits for potential adopters (van Horne, 1985; Malhotra & Singh, 2007). However, the bank that has not adopted the technology may also face potential losses from the movement of customers to another bank that has adopted the technology (He, 2015). Eventually, the bank's motivation in adopting the technology is to stay competitive in the market (Berger, 2003). The proportion of banks adopting digital banking is associated with the bank's reaction or strategy toward competitors' adoption (Malhotra & Singh, 2007; He, 2015). The more competitor adopts digital banking, the more pressure for banks to adopt digital banking and increase the likelihood of digital banking adoption by the banks.

H9: Competitors' adoption of digital banking has a positive impact on digital banking.

4.4.2.10 COVID-19 pandemic and digital banking adoption

The COVID-19 pandemic has changed customer behaviour, in which customers have demanded to perform cashless transactions and anytime-anywhere services (IFSB, 2020; Mariani et al., 2021). The advantage of digital banking is the capability of customers to access banking services anytime and anywhere. Banks have been motivated to adopt digital banking, considering the advantages of digital banking, which are suitable to

overcome the COVID-19 pandemic situation and meet the customer demand. The bank has been pressured to adopt digital banking to retain existing customers or to attract new customers. The effect of COVID-19 has accelerated the adoption of digital banking (Mariani et al., 2021). Several studies have been conducted to investigate the effect of COVID-19 on bank performance in Indonesia. Yударuddin (2023b) found that COVID-19 affected the decline in bank performance, while Sapulette et al. (2021) revealed a positive impact of the fintech on the bank's stock returns for the big banks and the opposite impact of the smaller banks during the COVID-19 pandemic.

***H10:** The COVID-19 pandemic positively influences the adoption of digital banking by the bank.*

4.4.2.11 Customers' Adoption and Digital Banking Adoption

Banks adopt digital banking considering the advantages of digital banking to the customer (Takieddine & Sun, 2015). Digital banking has enabled banks to deliver banking services to the customer conveniently, anytime, anywhere, seamlessly and personalised, which increases the customer experience (Laukkanen, 2007; Laukkanen, 2016; Verhoeff et al., 2015; Sullivan & Wang, 2020). The adoption of digital banking has been regarded as a business strategy to attract new customers (Dandapani et al., 2018). In addition, customer preferences for digital banking services increase sales and transactions in banking. Providing digital banking services to the customer affects bank performance positively by up-selling to existing customers, reaching more customers in remote areas, and increasing sales (Mbama et al., 2018). The bank is also motivated to adopt digital banking, considering the effect of digital banking on bank performance.

***H11.** Customers' adoption of digital banking positively affects banks' adoption of digital banking.*

4.5 DATA AND SAMPLE

4.5.1 Sources of Data

Two sources of data were utilised in this study, namely, primary data and secondary data. Primary data is utilised to achieve the second and third objectives of the study regarding the priority of the type of services in digital banking by Islamic banks through a survey by distributing the questionnaire to the selected respondents. The questionnaire is designed to fulfil the type of services (alternative), determinants (criteria), and elements of determinants (sub-criteria) that have been elaborated in the conceptual framework. Invitations to join the research are sent to the target respondents to ask their willingness to join this study. For the respondents from Islamic banks, the invitation is sent to all the Islamic banks (full-fledged and Islamic windows) through email or by directly visiting the office. The target respondents are provided a link to the online questionnaire to fill out the questionnaire.

Moreover, the secondary data is used to achieve the first, fourth and fifth objectives of the study concerning the current state of digital banking adoption by Islamic banks and the determinant factors of digital banking adoption. The first objective of the study utilises Islamic banks' annual reports to explore the current state of digital banking adoption. The fourth and fifth objectives of the study are achieved by collecting banks' annual reports and half-yearly (semester) financial reports of the banks offering Islamic banking products and services, and Islamic banking statistics to be further analysed. As a document of the institutional report, the annual report of the bank can provide information to assist researchers in indicating and understanding the situation of the phenomena under investigation (Bowen, 2009). Annual reports of the banks can be downloaded from the official websites of the banks, while half-yearly financial reports of the banks and Islamic banking statistics are acquired by downloading through Otoritas Jasa Keuangan's website and Bank Indonesia's website.

Data on the digital banking adoption used in this study is unique due to the hand-collected data, which is drawn from the bank's annual reports and verified with the first mobile banking application launched on the Playstore or App Store. Previously, Arnaboldi and Rossignoli (2015) utilised banks' annual reports to identify financial innovation adoption, while He (2015) used data on the first mobile banking launched

on the App Store to study mobile banking adoption. A procedure to identify digital banking adoption was developed as follows:

1. Collecting banks' annual reports by downloading the reports from the official bank website for the period of the study. Only banks with complete annual reports were included in the study.
2. Identifying the adoption of Internet banking and mobile banking based on the annual reports. In particular, mobile banking adoption data obtained from the annual reports were then verified with the first mobile banking launched on the Playstore or Appstore, which were elicited from the website application (www.appbrain.com, www.apptopia.com) and online newspapers. Banks with unclear information on Internet banking and mobile banking adoption were excluded from the sample.
3. Only banks with complete data on the adoption of digital banking, that is, banks with Internet banking adoption and mobile banking adoption, were included in the sample.
4. The time of adoption of digital banking was determined following the first time a bank adopted one of the types of digital banking, namely Internet banking or mobile banking.

4.5.2 Sample Selection

This study applied a purposive sampling technique to select a sample which is aligned with each objective of the study. As of December 2022, 33 banks have offered Islamic banking products and services to customers, comprising 13 Islamic banks and 20 conventional banks through Islamic business units. Islamic banks generally provide information on the products and services offered to the customer in their Annual Reports. Nevertheless, conventional banks which own Islamic business units rarely provide information on Islamic banking products and services, particularly digital banking services. Therefore, this study utilised the annual reports of 13 Islamic banks to achieve

the first objective of this study, namely, exploring the current state of digital banking adoption by Islamic banks. Concentrating on Islamic banks may reveal the services in digital banking which are tailored to the needs of Islamic banking customers, most of whom are Muslim. Annual reports used to explore the current state of digital banking were the annual reports of Islamic banks for the year 2022, considering the latest annual reports of Islamic banks covering the response to the COVID-19 pandemic.

The purposive sampling technique was suitable for determining sample selection for the second and third objectives since the respondents for the ANP model in the second and third objectives were selected based on certain criteria. The respondents, who consisted of experts in the Islamic banking area, were requested to grant a judgment on the priority of digital banking services, comprising the determinants/criteria and elements of determinants/sub-criteria considered to influence the priority of the type of services offered through digital banking. There is no specific appropriate number of respondents in ANP. Instead, the minimum participant to be involved in ANP is evaluated based on experience in the analysed problem (Guillen-Mena et al., 2023). Following Ali et al. (2020), the respondents comprised three groups, namely Islamic banking practitioners, banking regulators and academics. The criteria of the respondents are stipulated as follows:

1. Islamic banking practitioner

The respondent Islamic banking practitioner should have experience as an Islamic banking practitioner for at least five years. In particular, the respondent should hold a position as a bank manager, which refers to a position at least as a head of a division or group in an Islamic bank, including a director.

2. Banking Regulator

The Indonesian banking industry, including Islamic banking, is regulated and supervised by the Indonesian Financial Services Authority or Otoritas Jasa Keuangan (OJK). Other than that, the Central Bank of Indonesia or Bank Indonesia (BI) also has a similar function pertaining to maintaining

the stability of the payment system and financial stability. Therefore, the respondent from the banking regulator was represented by the respondents from Otoritas Jasa Keuangan and Bank Indonesia, who have experience in the Islamic banking industry.

3. Academics/Consultant

The respondents from academia should have in-depth knowledge of the Islamic banking theory that can be traced through research publications on Islamic banking, which have at least been published in a peer-reviewed paper on Islamic banking. In addition, the respondent should hold a doctoral degree or Ph.D. and have experience teaching Islamic banking/ finance/ economics for at least five years. In particular, following Bradley and Stewart (2002), who involved consultants in the digital banking adoption study, the respondent from the consultant was involved in this study with the criteria of having experience as a consultant in Islamic banking for at least five years in the Islamic banking industry in Indonesia.

The sample for the fourth and fifth objectives of this study regarding determinant factors of digital banking adoption consists of Islamic banks and conventional banks, which own Sharia business units, considering that those banks offer Islamic banking products and services to the customers in the dual banking system in Indonesia. Instead of using a Sharia business unit as the sample of the study, conventional banks which own Sharia business units were chosen as the sample, as the Sharia business unit, which is a part of the conventional bank, depends on the conventional bank for several aspects, such as business strategy, information and technology infrastructure, publication of financial reports and capital requirements.

The sample size covered the period from 2010 to 2022. The beginning of the study was in 2010, considering avoiding the effect of the global financial crisis of 2008. In addition, it was the year when Islamic banking experienced a growing number of Islamic banks relative to previous years, while 2022 was chosen as the end of the period of study to capture the effect of the COVID-19 pandemic on digital banking adoption. As of December 2022, Indonesia's banking statistics have recorded 13 Sharia

commercial banks/Islamic banks and 20 conventional banks offering Islamic banking products and services. The sample size was aligned with the availability of the data on digital banking adoption. Following the procedure to obtain data on the digital banking adoption as elaborated in the previous section, the final sample comprised 10 Islamic banks and 12 conventional banks, which accounted for 82.6% of total Islamic banking assets in Indonesia in 2022, as shown in Appendix II. The unit of analysis used in determining factors of digital banking adoption is half-yearly (semester) financial reports as of 30 June and 31 December for each year during the period of the study. In particular, financial data elicited from the income statement as of 30 June was annualised before further calculation.

4.6 METHOD OF ANALYSIS

4.6.1 Document Analysis

Data for exploring the current state of digital banking adoption by Islamic banks in Indonesia (the first objective of the study) was mainly sourced from the banks' annual reports, which are institutional/organisational reports issued by the Islamic banks. Document analysis, which refers to a systematic procedure for reviewing or evaluating documents taking the form of printed or electronic material, for instance, institutional or organisational reports (Bowen, 2009), was employed to extract data pertaining to digital banking adoption from the bank's annual report. Document analysis has advantages for the researcher in terms of efficiency (less time-consuming), availability (publicly available), cost-effectiveness (less costly), and being unaffected by the research process/non-reactive (Bowen, 2009).

To reveal digital banking adoption from the bank's annual reports and websites, this study followed Arnaboldi and Rossignoli (2015), who analysed banks' annual reports, banks' websites and financial press to uncover the adoption of financial innovation by transforming qualitative information into a quantitative database using content analysis. The quantitative database was constructed by categorising or coding different aspects of qualitative information. The procedure is as follows:

1. Three keywords were defined as the references identifying digital banking adoption, namely, “Internet banking”, “mobile banking”, and “digital banking.”
2. The statements or paragraphs containing reference keywords are reviewed to determine which category the statement is included in the digital banking adoption. Additional information is included if it is relevant to this study.
3. Four categories pertaining to digital banking adoption were defined, comprising technology, customer, channel and services, to be guidelines for the coding process as follows:

- a. Technology

This category covered whether the bank has adopted Internet banking, mobile banking or Internet banking along with mobile banking.

- b. Customer

This category was provided to identify whether the bank is adopting digital banking to be offered to the retail customer, individual customer or business customer.

- c. Channel

The channel identified how banks adopt digital banking. A bank might adopt digital banking along with physical branches, which leads to multi-channel or omnichannel banking, or a bank might adopt digital banking without physical branches, called a digital channel only or a digital bank.

- d. Services

This category comprises a category of services in digital banking following the classification in the previous section, namely, transfer and

payment, account opening, security/protection, social/donation, investment and beyond banking.

4.6.2 Analytic Network Process

Analytic Network Process which is the general form of Analytic Hierarchy Process (AHP) (Onar et al., 2010) was applied to analyse data for the second objective of the study namely, priority of the type of services in digital banking, and the third objective of the study, that is deciding the determinants in considering the priority of the type of services, since the priority of the type of services involves several criteria/factors in which the criteria and the alternative services can be connected each other to create a network. The AHP exploits the pairwise comparisons to measure the relative importance of elements at each level of hierarchy (for example, criteria and sub-criteria) and evaluates alternatives to select the best decision among multiple alternatives as well as transforming subjective judgements into objective measures (Sipahi & Timor, 2010) since both of which enable to assign relative importance to the criteria as well as the global preferences to the alternatives (Onar et al., 2010). AHP is a structural mathematical method following a hierarchical way for the decomposition of unstructured complex problems (Mishra & Singh, 2015). The problem is structured into a hierarchy where the first is the goal of the decision, the second is the criteria/main factors, and the last is the alternatives, and more levels can be added to the hierarchy in complex problems (Ishizaka & Nemery, 2013). An example of the AHP hierarchy with sub-criteria is illustrated in Figure 4.5.

AHP involves two phases of the decision process: problem structuring and the elicitation of priorities through pairwise comparison (Ishizaka & Nemery, 2013). As the general form of AHP, ANP allows for more complex, interdependent relationships and feedback among elements in the hierarchy (Sipahi & Timor, 2010).

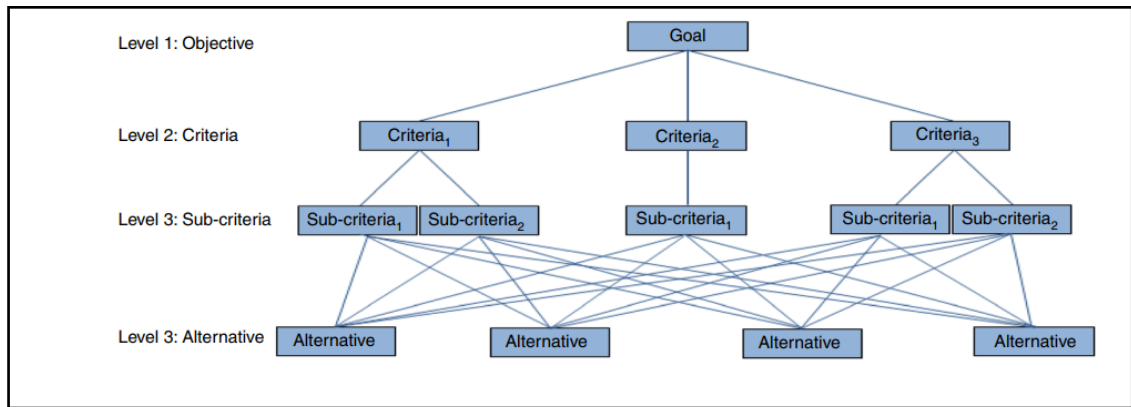


Figure 4.5 General Structure Hierarchy of AHP
(Source: Mishra & Singh, 2015)

Following Ali et al. (2020), the ANP method involved three main steps, namely model construction, model quantification and result analysis. The details of the steps are as follows:

1. Model construction

The model was constructed based on the literature review that was done in section 3.5.2. The framework consists of the goal, the determinant or considered factors (criteria and sub-criteria) and the alternatives. In this study, the goal was to prioritise the type of services in digital banking by Islamic banks. To that end, several criteria/factors were considered to influence the priority of the type of services in digital banking, namely, customer, technology, internal (bank), environment, Sharia aspect, and channel. From this framework, eight clusters were identified as follows:

- a. Main factors /determinants cluster (Criteria)
- b. Customer cluster (Sub-criteria)
- c. Technology cluster (Sub-criteria)
- d. Internal bank cluster (Sub-criteria)

- e. Environment cluster (Sub-criteria)
- f. Sharia cluster (Sub-criteria)
- g. Channel cluster (Sub-criteria)
- h. Type of services cluster (Alternatives)

All the clusters were arranged to build a network by connecting clusters, as illustrated in Figure 4.6.

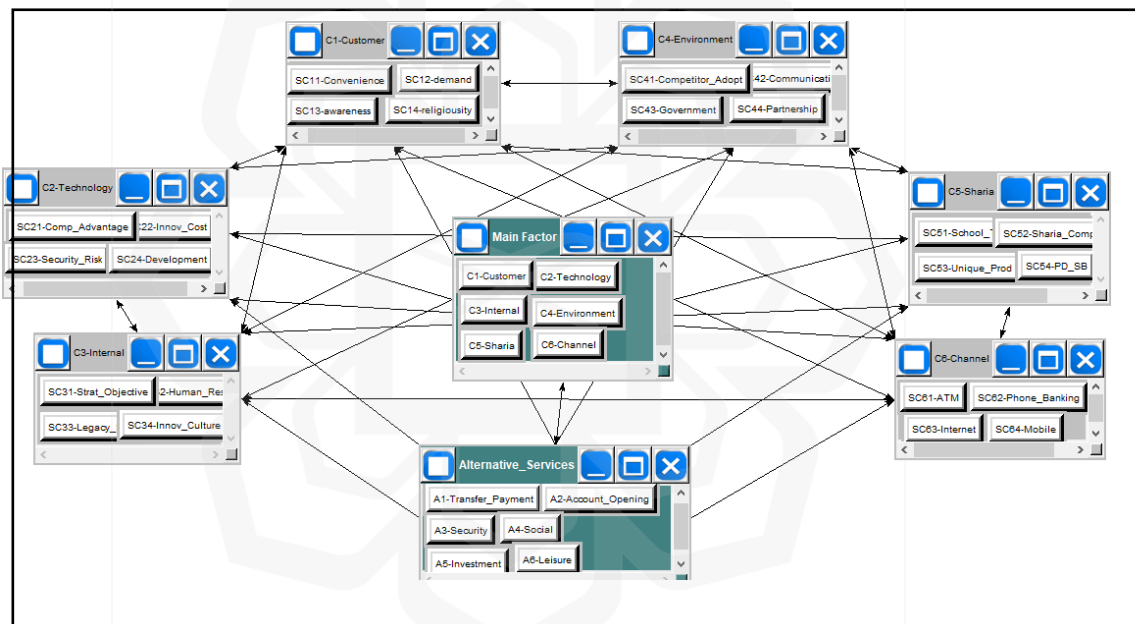


Figure 4.6 Network Model for Priority of the Type of Services in Digital Banking by Islamic Banks

2. Model quantification

In the second phase, quantification and measurement of the ANP network were carried out by exploiting the pairwise comparison questionnaire (Ali et al., 2020) that reflects the relative influence of factors on a specific factor for all possible pairs (Onar et al., 2010). The respondents were requested to answer the pair-wise comparison questions using a nine-point scale

suggested by Saaty (2013), as illustrated in Table 4.4. A value of 1 indicates that two factors that are being compared are equally important or equally influential, whereas a value of 9 indicates a factor extremely influential or important compared to other factors that are being compared. The question may take the form: “Of the influencing factors, which one influences the common factor and how much more?” (Onar et al., 2010). Another form of the question that may be offered is: “With respect to criterion x , how does y_1 perform compared to y_3 ?” or “With respect to x , what is the relative importance of y_1 to y_3 ?” (Ordoobadi, 2012). For example, in this study, a pair-wise comparison between the Customer cluster and the Technology cluster is illustrated in Table 4.5. If the answer is 3, it means that y_1 is three (3) times higher than y_2 . Afterwards, the value of 3 is entered in the first row (y_1) and third column (y_3) and following the reciprocal approach, the value of $1/3$ is entered in the third row (y_3) and first column (y_1) as shown in Table 4.6.

Table 4.4 Fundamental Scale of Absolute Number

Intensity of importance	Definition	Description
1	Equal importance	Two activities contribute equally to the objective
2	Weak or slight	
3	Moderate importance	Experience and judgement slightly favour one activity over another
4	Moderate plus	
5	Strong importance	Experience and judgement strongly favour one activity over another
6	Strong plus	
7	Very strong or demonstrated importance	An activity is favoured very strongly over another; its dominance is demonstrated in practice
8	Very, very strong	
9	Extreme importance	The evidence favouring one activity over another is of the highest possible order of affirmation

Source: Saaty, (2013)

Table 4.5 Example of Pair-wise Comparison between Customer Cluster and Technology Cluster

With respect to the “Competitive Advantage”, which one do you think is more important and how much?																		
Customer convenience	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer demand
Customer convenience	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer awareness
Customer convenience	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer religiosity
Customer demand	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer awareness
Customer demand	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer religiosity
Customer awareness	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer religiosity
With respect to the “Innovation Costs”, which one do you think is more important and how much?																		
Customer convenience	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer demand
Customer convenience	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer awareness
Customer convenience	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer religiosity
Customer demand	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer awareness
Customer demand	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer religiosity
Customer awareness	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer religiosity
With respect to the “Security Risk”, which one do you think is more important and how much?																		
Customer convenience	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer demand
Customer convenience	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer awareness
Customer convenience	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer religiosity
Customer demand	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer awareness
Customer demand	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer religiosity
Customer awareness	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer religiosity

With respect to “Technology Development”, which one do you think is more important and how much?																		
Customer convenience	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer demand
Customer convenience	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer awareness
Customer convenience	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer religiosity
Customer demand	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer awareness
Customer demand	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer religiosity
Customer awareness	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer religiosity

Source: The researcher’s illustration

The result of pair-wise comparison concerning criterion x can be simplified into a matrix which compares among elements in a cluster. For example, the result of a pair-wise comparison of Customer Cluster concerning the “competitive advantage” in the Technology Cluster can be simplified into a matrix as illustrated in Table 4.7.

Table 4.6 Example of Pair-wise Comparison for Competitive Advantage in Technology Cluster

Competitive Advantage	Customer convenience (y1)	Customer demand (y2)	Customer awareness (y3)	Customer religiosity (y4)
Customer convenience (y1)	1	1/5	1/3	1/3
Customer demand (y2)	5	1	3	3
Customer awareness (y3)	3	1/3	1	1
Customer religiosity (y4)	3	1/3	1	1

Source: The researcher’s illustration

Table 4.7 Example of Pair-wise Comparison between Customer Cluster and Technology Cluster (Modified)

With respect to each element in Technology issues, which element of Customer do you think is more important compared to another element in the Customer issues and how much?								
Customer Issues	Technology Issues							
	Competitive advantage		Innovation costs		Security and Risk		Technology development	
Customer convenience	7*							
Customer demand	3*							
Customer awareness	5*							
Customer religiosity	5*							
Scale								
1	2	3	4	5	6	7	8	9
Equal importance		Moderate importance		Strong Importance		Very Strong Importance		Extreme Importance

**example of illustration*

Modification of the questionnaire is allowed to ensure obtaining the appropriate data with transitivity and tolerable inconsistency. Instead of making a pairwise comparison matrix as illustrated in Tables 4.5 and 4.6. which requires considerable matrices, the questionnaire is modified by incorporating several matrices into a single matrix, as illustrated in Table 4.7.

This study identified one criterion cluster (main factors), six sub-criterion clusters (customer, technology, internal, environment, Sharia and channel) and one alternative cluster (services category). Following the modified pair-wise comparison as shown in Table 4.6, referring to the ANP model in this study and the reciprocal approach, the number of pair-wise comparison matrices that should be provided is 22 pair-wise comparison matrices as follows:

1. Interlink between sub-criteria clusters generates fifteen pair-wise comparison matrices (5+4+3+2+1).

- a. Customer cluster with respect to each element in the Technology cluster
 - b. Customer cluster with respect to each element in the Internal cluster
 - c. Customer cluster with respect to each element in the Environment cluster
 - d. Customer cluster with respect to each element in the Sharia cluster
 - e. Customer cluster with respect to each element in the Channel cluster
 - f. Technology cluster with respect to each element in the Internal cluster
 - g. Technology cluster with respect to each element in the Environment cluster
 - h. Technology cluster with respect to each element in the Sharia cluster
 - i. Technology cluster with respect to each element in the Channel cluster
 - j. Internal cluster with respect to each element in the Environment cluster
 - k. Internal cluster with respect to each element in the Sharia cluster
 - l. Internal cluster with respect to each element in the Channel cluster
 - m. Environment cluster with respect to each element in the Sharia cluster
 - n. Environment cluster with respect to each element in the Channel cluster
 - o. Sharia cluster with respect to each element in the Channel cluster
2. The interlink between alternatives and criteria, as well as sub-criteria clusters, generates seven clusters (1+6).

- a. Services category cluster with respect to each element in the Main Factors cluster
- b. Services category cluster with respect to each element in the Customer cluster
- c. Services category cluster with respect to each element in the Technology cluster
- d. Services category cluster with respect to each element in the Internal cluster
- e. Services category cluster with respect to each element in the Environment cluster
- f. Services category cluster with respect to each element in the Sharia cluster
- g. Services category cluster with respect to each element in the Channel cluster

Using pair-wise comparison in Table 4.6, caution should be given when interpreting the value given by the expert (respondent). For example, with respect to competitive advantage, the relative importance of customer convenience compared to customer demand:

- Customer convenience = 7, and Customer demand = 3
- Customer convenience – customer demand = $7 - 3 = 4$
- The value of relative importance for customer convenience = $7 - 3 + 1 = 5$

It means that customer convenience is five (5) times higher than customer demand, and, using the reciprocal approach, the customer demand is 1/5 times relative importance compared to customer convenience.

Another example is given by a comparison between customer demand and customer awareness with respect to competitive advantage.

- Customer demand = 3, and Customer awareness = 5
- Customer awareness – Customer demand = 5 – 3 = 2
- The value of relative importance for customer awareness = 5 – 3 + 1 = 3

It means that customer awareness is three (3) times higher than customer demand, or customer demand is 1/3 times higher than customer awareness with respect to competitive advantage.

The result of the respondent that had been quantified using a pairwise-comparison questionnaire was computed using the Super Decisions software to generate the eigenvector, since the ANP method adopts the supermatrix calculation (unweighted supermatrix, weighted supermatrix, limit supermatrix) to derive the eigenvector result. The pair-wise comparison was also checked to ensure its Consistency Ratio (CR) does not exceed 0.1000 (K et al., 2015), and if the value was more than 0.1000, following Saaty (1995), the judgement must be revised (Ordoobadi, 2012). The CR is calculated as follows (Ordoobadi, 2012):

$$CR = \frac{CI}{RI}$$

Where:

CR = Consistency Ratio

CI = Consistency Index

RI = Average Random Consistency Index that is obtained from Saaty's data as shown in Table 4.8.

CI is calculated using the following formula (Ordoobadi, 2012):

$$CI = \frac{\lambda_{max} - n}{n - 1}$$

Where:

λ_{max} = maximum eigenvalue of the matrix

n = size of the matrix

Table 4.8 Saaty's Random Consistency Index

N	1	2	3	4	5	6	7	8	9	10
RI	0.00	0.00	0.52	0.89	1.11	1.25	1.35	1.40	1.45	1.49

N = size of the matrix

Source: Ordoobadi (2012)

3. Result analysis

In the third phase, the result of ANP that was computed using Super Decision Software was presented and synthesising the result of the ANP network was performed (Ali et al., 2020). The result of the ANP network was exported to the Excel format to calculate the geometric mean of all expert responses for the presentation and interpretation of ANP results. Afterwards, the level of agreement among the experts or respondents was computed using Kendall's coefficient of concordance (Kendall's W), where a higher value of Kendall's coefficient indicates a higher level of agreement. The value of Kendall's coefficient ranges between 0 and 1, with the interpretation as follows (Ali et al., 2020):

- a. $W=1$, a perfect agreement among respondents,
- b. $W=0$, a perfect disagreement among respondents,
- c. $0 < W < 1$, a greater or lesser degree of agreement among respondents

4.6.3 Logistic Regression

Logistic regression was employed to analyse the relationship between bank-specific and market-specific factors with the adoption of digital banking services by an Islamic bank. The goal of logistic regression was similar to other model-building techniques, which is to find the best-fitting and most *parsimonious* reasonable model to describe the relationship between an outcome (dependent) variable and one or more independent variables (Hosmer & Lemeshow, 2000). The difference between logistic regression with linear regression is that the dependent variable of logistic regression takes the form of *binary* or *dichotomous* (Hosmer & Lemeshow, 2000). In this study, since the dependent variable may take the form of a value of 1 if the bank has adopted digital banking or a value of 0 if the bank has not adopted digital banking, the dependent variable is categorised as binary or dichotomous. Therefore, it is suitable to apply logistic regression in this study. Application of logistic regression in analysing the relationship of bank-specific and market-specific factors with the adoption of digital banking services has been done previously, such as by Furst et al. (2002), Malhotra and Singh (2007) and Dandapani et al. (2018). It was not necessary to have a specific distributional form of independent variables (Hair et al., 2014) and a linear relationship between dependent variables and independent variables (Hair et al., 2014; Jaloudi, 2019) in logistic regression. The presence of heteroskedasticity in the model can be handled with logistic regression (Hair et al., 2014).

4.6.3.1 Variables

The dependent variable was indicated with the Digital Banking Adoption (DBA), which denotes a condition whether a bank has adopted or has not adopted digital banking services. A bank was assumed to adopt digital banking if the bank *had at least* adopted one type of digital banking, namely, Internet banking or mobile banking. Digital banking was a dummy variable which takes a value of 1 if the bank *i* has adopted digital banking in period *t*, otherwise, 0.

Bank specifics were categorised into financial characteristics and non-financial characteristics. Bank size (ASSET), labour cost (LABOUR), bank's deposit (DEPOSIT)

and profitability (ROA) were included in the financial characteristics, while bank type (BTYPE), age of the bank (AGE) and ownership type (OWNER) were grouped into non-financial characteristics. Market characteristics were represented with the market concentration using the Concentration Ratio (CR5) and adoption by competitors using the share of digital banking adoption (DBS). Moreover, a dummy variable for the COVID-19 pandemic and customer adoption of digital banking (CUST) were included in the model to capture the effect of the COVID-19 pandemic and the customer interest in digital banking, respectively. Table 4.9. displays variable descriptions and sources of the data involved in the determinant factors of digital banking adoption.

Table 4.9 Variable Description and Sources of the Data

No	Variable	Description	Sign*	Source of the Data
Dependent Variable				
1	Digital Banking Adoption (DBA)	The dummy variable takes a value of 1 for the bank that has adopted at least one type of digital banking.		Banks' annual reports, www.appbrain.com, www.apptopia.com
Independent Variable				
2	Bank Size (ASSET)	The natural log of total assets	+	Banks' financial report
3	Labour Cost (LABOUR)	The ratio of labour expense over total assets	+	Banks' financial report
4	Bank's Deposit (DEPOSIT)	The ratio of total deposits over total assets		Banks' financial report
5	Profitability (ROA)	The ratio of earnings before tax to average total assets)		Banks' financial report
6	Type of Bank (BTYPE)	The dummy variable takes a value of 1 for the Islamic bank and 0 for the conventional bank.	+	Banks' annual reports
7	Age of Bank (AGE)	The natural log of the number of years from the date of establishment to the period of analysis 2)		Banks' annual reports
8	Ownership Type (OWNER)	The dummy variable takes a value of 1 for the private bank and 0 for the public bank.	+	Banks' annual reports

No	Variable	Description	Sign*	Source of the Data
9	Market Concentration (CR5)	The sum of assets for the five largest banks in the Islamic banking industry divided by the total assets of the Islamic banking industry		Islamic banking statistics, Banks' financial reports.
10	Competitors' adoption (DBS)	The number of banks that have adopted digital banking over the total number of banks	+	Banks' annual reports, www.appbrain.com, www.apptopia.com
11	COVID-19 (COVID)	The dummy variable takes a value of 1 for the time of COVID-19 and otherwise is 0	+	Government Regulation No. 21/2020
12	Customers Adoption (CUST)	Natural log of the aggregate of digital banking transactions	+	Proprietary channel statistics

Note:

- 1) The value of ROA is available in the bank's financial reports.
- 2) The date of establishment refers to when the bank received the license or started operating, regardless of whether the bank had converted from a Conventional Bank to a Sharia Commercial Bank.
- 3) Government Regulation No. 21/2020 on Large Scale Social Restriction in the effort to handle COVID-19 was established on March 31, 2020, and the date is set as the starting point for the COVID-19 pandemic.
- 4) Sign is the expected sign of the coefficient

4.6.3.2 Model Specification

The present study specified the probability of digital banking adoption by banks offering Islamic banking services as a function of bank-specific factors and market-specific factors. The model in this study was specified following the literature review, theoretical and conceptual framework and hypotheses development that have been elaborated in previous chapters and sections. Following prior studies by Furst et al. (2002), Malhotra and Singh (2007) and Dandapani et al. (2018), a logistic model was employed to analyse the binary choice of digital banking adoption.

To analyse the effect of bank characteristics and market characteristics on the adoption of digital banking, two logit models were specified, namely, the baseline model and the extension model. The baseline model was provided to analyse the effect

of the financial characteristics of the bank on the adoption of digital banking. The logit model was specified as below:

$$LOGIT(DBA)_{i,t} = \beta_0 + \beta_1 ASSET_{i,t} + \beta_2 LABOUR_{i,t} + \beta_3 DEPOSIT_{i,t} + \beta_4 ROA_{i,t} + \varepsilon_{i,t} \quad (1)$$

The extension model aimed to analyse non-financial bank characteristics, market characteristics, customer adoption and COVID-19 presence by extending the baseline model with the respective variables. The extension models were as follows:

$$LOGIT(DBA)_{i,t} = \beta_0 + \beta_1 ASSET_{i,t} + \beta_2 LABOUR_{i,t} + \beta_3 DEPOSIT_{i,t} + \beta_4 ROA_{i,t} + \beta_5 BTYPE_{i,t} + \varepsilon_{i,t} \quad (2)$$

$$LOGIT(DBA)_{i,t} = \beta_0 + \beta_1 ASSET_{i,t} + \beta_2 LABOUR_{i,t} + \beta_3 DEPOSIT_{i,t} + \beta_4 ROA_{i,t} + \beta_5 AGE_{i,t} + \varepsilon_{i,t} \quad (3)$$

$$LOGIT(DBA)_{i,t} = \beta_0 + \beta_1 ASSET_{i,t} + \beta_2 LABOUR_{i,t} + \beta_3 DEPOSIT_{i,t} + \beta_4 ROA_{i,t} + \beta_5 OWNER_{i,t} + \varepsilon_{i,t} \quad (4)$$

$$LOGIT(DBA)_{i,t} = \beta_0 + \beta_1 ASSET_{i,t} + \beta_2 LABOUR_{i,t} + \beta_3 DEPOSIT_{i,t} + \beta_4 ROA_{i,t} + \beta_5 CR5_{i,t} + \varepsilon_{i,t} \quad (5)$$

$$LOGIT(DBA)_{i,t} = \beta_0 + \beta_1 ASSET_{i,t} + \beta_2 LABOUR_{i,t} + \beta_3 DEPOSIT_{i,t} + \beta_4 ROA_{i,t} + \beta_5 DBS_{i,t} + \varepsilon_{i,t} \quad (6)$$

$$LOGIT(DBA)_{i,t} = \beta_0 + \beta_1 ASSET_{i,t} + \beta_2 LABOUR_{i,t} + \beta_3 DEPOSIT_{i,t} + \beta_4 ROA_{i,t} + \beta_5 COVID_{i,t} + \varepsilon_{i,t} \quad (7)$$

$$LOGIT(DBA)_{i,t} = \beta_0 + \beta_1 ASSET_{i,t} + \beta_2 LABOUR_{i,t} + \beta_3 DEPOSIT_{i,t} + \beta_4 ROA_{i,t} + \beta_5 CUST_{i,t} + \varepsilon_{i,t} \quad (8)$$

4.6.3.3 Model Estimation

Characteristics of the specified model in this study include the introduction of a dichotomous or binary choice in the dependent variable. The type of dependent variable determines the appropriate econometric technique used to estimate the model (Al-Najjar & Kilincarslan, 2016). Thus, the logistic regression or logit model is the suitable model employed in the specified model and the appropriate method to estimate the model utilises maximum likelihood (Hosmer & Lemeshow, 2000). The specific form of logistic regression is :

$$g(x) = \ln \left[\frac{\pi(x)}{1-\pi(x)} \right] = \beta_0 + \beta_1 \cdot x$$

For multiple logistic regression, the model is:

$$g(x) = \ln \left[\frac{\pi(x)}{1-\pi(x)} \right] = \beta_0 + \beta_1 \cdot x_1 + \beta_2 \cdot x_2 + \dots + \beta_i \cdot x_i$$

Where $\pi(x)$ is the probability of the occurrence of the characteristic ($y=1$), in this study, refers to Islamic banks that have adopted digital banking services. x_i is the explanatory variable. $\left[\frac{\pi(x)}{1-\pi(x)} \right]$ is the odds ratio that is the ratio of the probability that an Islamic bank adopted digital banking services to the probability that an Islamic bank has not adopted digital banking services. $g(x)$ is called the logit or log of the odds ratio that is linear in its parameter (Hosmer & Lemeshow, 2020). Maximum likelihood was usually employed to estimate the logit model.

However, the relationship between the bank-specific factor and market-specific factor with the adoption of digital banking utilised the form of panel data, where the data consists of individual/cross-sectional (Islamic banks) and time series (years). Thus, the Hausman test was applied to select the most favourable method among pooled least squares regression, fixed effect regression or random effect regression to estimate the baseline model as well as the extension model. The presence of multicollinearity among the independent variables was checked using the VIF statistics, where the value of the VIF statistics is larger than 10, indicating the presence of multicollinearity (Al-Najjar & Kilincarslan, 2016). Logistic regression holds different assumptions from linear

regression in that logistic regression does not require any specific distributional form of the independent variables, heteroscedasticity issues do not come into play in logistic regression and the relationship between independent variables and the dependent variable does not require a linear relationship (Hair et al., 2014).

4.6.3.4 *Model Evaluation*

Assessing the goodness of fit or the overall fit of the logistic regression model can be performed as follows (Hair et al., 2014):

1. Statistical measures using the Likelihood Ratio Test

The likelihood ratio test (LR test) is equivalent to the F -test in linear regression. In the logistic regression, the chi-square test for the change in $-2LL$ or $-2 \text{ Log Likelihood}$. First, estimate the null model, that is, a model without involving any independent variable, to obtain a $-2LL$ value. Second, estimate the proposed model, which is a model which contains the independent variables to be included in the logistic regression model. If the model fits, the estimation of the proposed model will generate a lower $-2LL$. Lastly, assess the difference between $-2LL$ of the null model vis-à-vis the proposed model. If the statistical test supports the significant difference, the independent variables in the proposed model are significant to improve the model estimation fit. The likelihood ratio test is assumed to follow a chi-square distribution. One of the residual analyses in logistic regression is the deviance or standard deviance (Hilbe, 2015). A likelihood ratio test can be considered as the deviance of the logistic regression model (Shang et al, 2019). Therefore, a likelihood ratio test can also be considered as residual analysis.

2. Pseudo-R² measures

The pseudo-R² measure can be assumed equivalent to R^2 in the linear regression. The higher value of pseudo-R² indicates a greater model fit.

Other “R²-like” measures are Cox and Snell’s R² measure and the Nagelkerke R² measure. The difference between the Cox and Snell’s R² is limited in value in that it cannot reach the value of 1, whereas Nagelkerke's R² has the value of 1. The value of 1 indicates the perfect model fit.

Equivalent to linear regression, in which it performs a significance test of the coefficient using a *t*-test, logistic regression performs a similar test using the Wald statistics, which provide a statistical significance for each estimated coefficient. If the coefficient is statistically significant, it can be interpreted that the coefficient has an impact on the estimated probability.

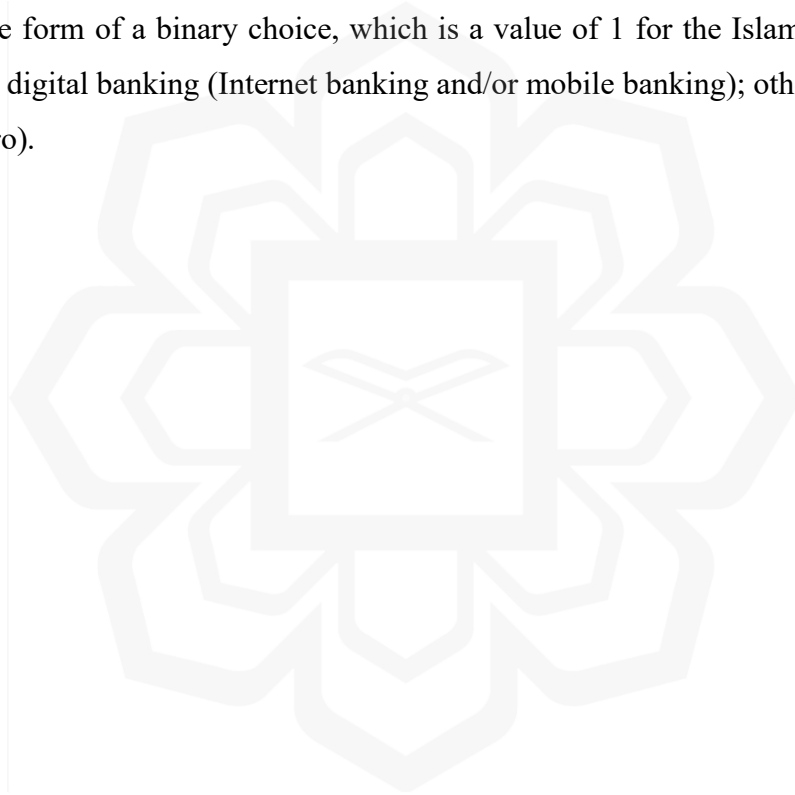
Moreover, robustness tests were employed to explore whether the specified model estimation is robust to specific plausible changes in the model specification. When the estimates from robustness tests do not deviate much or are quite similar to the specified model, then the specified model is said to be robust (Neumayer & Plumper, 2017). Two robustness tests were opted to evaluate the specified logit model. The alternative measures were selected to evaluate the logit model by substituting the measures of explanatory variables with other measures which are still relevant to the explanatory variables. Another robustness test to evaluate the logit model is changes in the sample. Robustness tests potentially improve the perceived validity of causal inference drawn from the regression (Neumayer & Plumper, 2017). All the estimation of logistic regression and robustness tests in this study were calculated using STATA software since STATA enables handling panel data sets, especially an unbalanced panel dataset and calculates the estimation efficiently.

4.7 CHAPTER SUMMARY

This chapter has elaborated on the research methodology of this study, comprising the design of the research to achieve the objectives of the study. Within this chapter, a conceptual framework was developed to assist in achieving the objective as well as answering the research questions. It has discussed the data used in this study, sample selection and the method of analysis.

With respect to the first objective, purposive sampling was applied to the criteria of Islamic banks that have adopted digital banking services. For the second and third objectives, the Analytic Network Process method was employed to explore the priority of the type of services in digital banking by an Islamic bank. The respondents involved in the ANP consisted of Islamic bank practitioners, regulator representatives and academics/ consultants.

Lastly, for the fourth and fifth objectives, the banks offering Islamic banking products and services were included as the sample, with the observation period covering from 2010 to 2022. Logistic regression was employed since the dependent variable takes the form of a binary choice, which is a value of 1 for the Islamic bank that has adopted digital banking (Internet banking and/or mobile banking); otherwise, the value is 0 (zero).



CHAPTER FIVE

FINDINGS AND DISCUSSIONS

5.1 INTRODUCTION

The research methodology used in this study has been discussed in the previous chapter, which underscored the use of qualitative and quantitative methods with triangulation to synthesise the results from qualitative and quantitative methods. Document analysis (qualitative), Analytic Network Process (qualitative) and Logistic Regression (quantitative) were chosen as the analyses to achieve research objectives and to answer research questions. This chapter presents the results of the analysis of the data that have been collected to satisfy the research objectives. The chapter is divided into three main sections. The first section presents the results of the analysis to explore the current state of digital banking adoption by Islamic banks, which is the first objective of this study. The second section centres on the second and third objectives of this study, namely, the priority of the type of services in digital banking by Islamic banks and the determinants in considering the priority of the type of services in digital banking by Islamic banks. The third section elaborates on the result of analysis for the fourth and fifth objectives concerning the determinant factors of digital banking adoption among banks offering Islamic banking products and services, namely bank-specifics and market specifics.

5.2 CURRENT STATE OF DIGITAL BANKING ADOPTION BY ISLAMIC BANKS

Document analysis was employed to reveal the current state of digital banking adoption by Islamic banks in Indonesia. The main document analysed was the banks' annual report for the year 2022. The COVID-19 pandemic, which started in 2020, has stimulated Islamic banks to accelerate the implementation of digital banking, as the advantages of digital banking are suitable to fulfil the financial needs of customers during the COVID-19 pandemic, such as cashless transactions and anytime-anywhere services. The banks' annual reports for the year 2022 generally outline the services offered to customers by Islamic banks, including services in digital banking, which is

expected to reveal the response of Islamic banks to the COVID-19 pandemic via digital banking.

As of December 2022, 13 Islamic banks are operating in Indonesia. All the Islamic banks in Indonesia, as of December 2022, were included as the sample for gauging the current state of digital banking by Islamic banks in Indonesia using document analysis. Information on the banks' websites can be useful to supplement data elicited from the banks' annual reports (Arnaboldi & Rossignoli, 2015). In digital banking, banks' websites generally provide a list of digital banking services to be offered to customers. Other than that, when the customer downloads a mobile application from the App Store, the bank normally publishes information regarding the services delivered to the customer on the App Store. The depth of information pertaining to the services in digital banking has been provided on the bank's annual report, the bank's website and App Store vary across the Islamic banks. The main document to be analysed was the bank's annual report. Information on the bank's website and the App Store were included to supplement the information on digital banking that has not been mentioned in the bank's annual report.

Analysing documents to reveal digital banking adoption was performed using the content analysis approach shown by Arnaboldi and Rossignoli (2015), by transforming qualitative information into a quantitative database using coded guidelines. Identifying the phrases, statements, or paragraphs in the documents based on the stipulated keywords and categorising the findings according to the coded guidelines were assisted with the NVivo 14 software to generate the values for each code on the digital banking adoption. The researcher conducted the coding activities alone. Due to the absence of inter-coder reliability, potential subjectivity may arise. However, this study mitigates the potential subjectivity by designing and applying the coding procedure based on Arnaboldi and Rossignoli (2015). The findings of the document analysis will be elaborated on in the following sections.

5.2.1 Technology

It is less likely for banks to adopt Internet banking and mobile banking at the same time. Bank requires a sizable investment to embrace digital banking (OJK, 2021b). Alternatively, the bank opts to adopt Internet banking for the first time before mobile banking adoption or vice versa. Adopting digital banking is a way for Islamic banks to improve customer experience by increasing the convenience of accessing banking services. Increasing customer databases due to the capability to cover remote areas, increasing fee-based income and reducing the cost of funds are expected to positively influence bank performance, particularly financial performance generated from the digital banking adoption. For the Islamic banks concentrating on the unbanked and underbanked people, digital banking is assumed to be an integrated financial solution to promote financial inclusion.

Table 5.1. displays the adoption of digital banking by Islamic banks in Indonesia. No Islamic bank has the intention to offer Internet banking alone. Instead, Islamic banks offer Internet banking along with mobile banking. More than half of Islamic banks have embraced mobile banking without Internet banking, which suggests these Islamic banks have embraced mobile banking as a first milestone to pave the way toward digital banking. It also suggests that Islamic banks prefer to utilise mobile banking rather than Internet banking to deliver digital banking services to customers. Interestingly, one Islamic bank has yet to adopt Internet banking or mobile banking despite the claim of digital banking's importance.

Table 5.1 Digital Banking Adoption among Islamic Banks

Digital Banking	Number of banks
Internet banking only	0
Mobile banking only	7
Internet banking and mobile banking*	5
Not adopting digital banking	1
Total	13

Note: * including digital banking only, which refers to the adoption of digital banking without physical branches or limited physical branches

This finding aligns with the survey that found that Indonesian people prefer to use mobile banking rather than internet banking (Datareportal, 2021b) and is also supported by the increase in smartphone and mobile phone ownership (ADB, 2020).

5.2.2 Customer

Banks categorise customers to identify which customers are suitable to be offered digital banking services. Such practice is also employed by Islamic banks to assist in identifying digital banking customers. Table 5.2. presents the customer segment served by Islamic banks through digital banking services. For *individual customers or retail segments*, Islamic banks normally offer *Internet banking and mobile banking* to the customer, whilst for *corporate or business unit customers*, *Internet banking* is mostly offered to the customer to manage business transactions. Unlike other Islamic banks, one Islamic bank has offered mobile banking to the business units owned by individuals or corporations. Other than that, certain Islamic banks have concentrated on particular customer segments to encourage them to embrace digital banking. Islamic bank that focuses on financial inclusion have opted to provide digital banking services to the unbanked and underbanked customer segment to promote financial inclusion. In particular, such a bank also provides mobile banking only to funding customers. Another Islamic bank has provided mobile banking targeting the young generation or millennials.

Table 5.2 Customer Segment of Digital Banking

No	Customer Segment	Availability	Description
1	Individual/Personal	✓	<ul style="list-style-type: none"> • Retail segment/consumer • Internet banking and mobile banking
2	Corporate/SME*	✓	<ul style="list-style-type: none"> • Business segment • Internet banking

Note: SME=Small Medium Enterprise

5.2.3 Channel

Islamic banks previously relied on physical distribution, that is, branch offices to deliver banking services (“brick and mortar”). Along with the diffusion of digital banking to the financial sector, Islamic banks have gradually embraced digital banking without leaving their physical branches. Therefore, a multi-channel strategy has been embraced by Islamic banks in adopting digital banking, in which physical branches, along with digital banking, are exploited to deliver digital banking services (“click and mortar”). In 2022, an Islamic bank converted a traditional bank that relied on physical branches into a digital bank that mainly relies on digital banking for delivering banking services. However, the bank still maintains physical branches with a limited number of offices, which are dedicated only to serving corporate customers who need funds to finance their business. In addition, no bank has claimed to deliver digital banking services through omnichannel. However, one bank implicitly claimed that it has mentioned the characteristics of omnichannel, that is, personalised, seamless, and integrated. However, this claim has not been proven in the annual report. Table 5.3. displays delivery channels that have been utilised by Islamic banks.

Table 5.3 Delivery Channel of Digital Banking

No	Channel Type	Availability	Description
1	Multi-channel	✓	Physical branches along with digital channels (unintegrated)
2	Omnichannel	✗	Integrated physical branches and digital channels

5.2.4 Services

The emergence of digital banking has increased customer convenience by allowing access to banking services anytime and anywhere, 24 hours a day, seven days a week. Services provided through digital banking are addressed to fulfil the needs of customers, namely, financial needs and non-financial needs. Based on the variety of services offered by Islamic banks to customers, the services can be grouped into several categories, as presented in Table 5.4.

Table 5.4 Services Offered in Digital Banking

No	Services	Availability	Description
1	Transaction purpose		
	a. Transfer	✓	within the bank, to another bank
	b. Payment and purchase	✓	bill payment, purchase tickets, top-up e-wallet
2	Account opening		
	a. Deposit account	✓	saving, time deposit
	b. Financing account (loan)	✓	refinancing (top-up)
3	Social purpose	✓	zakat, shadaqa, waqf
4	Protection purpose (insurance)	✗	
5	Investment purpose	✗	
6	Beyond banking	✓	Islamic content

Firstly, services related to *the transactional purpose* comprise fund transfer, bill payment and purchase. Digital banking enables customers to transfer funds to their accounts and other accounts within the bank (overbooking) and to other accounts in other banks in the country. The customer utilises bill payment services to tackle various periodical bills such as electricity, phone, credit card, and taxes, among others. The purchase feature provides customers with the purchase facility for telecommunication (top-up prepaid credit for the mobile phone), e-wallet, and transportation tickets (airline, bus, and train). Transactional purpose services have become a standard service in digital banking to be provided by Islamic banks, as all the Islamic banks adopting digital banking have provided such services. Additionally, Islamic banks have equipped digital banking, particularly mobile banking, with the technology to facilitate transactions. For instance, cardless withdrawal enables customers to withdraw cash from ATMs or grocery stores partnering with Islamic banks. Islamic banks have accommodated the Central Bank initiative by adopting the QR code technology applied to digital banking that enables customers to perform transactions without cash using the Indonesian QR code. The largest Islamic bank in Indonesia claimed that QR codes can be used outside of Indonesia, that is, in Thailand.

Secondly, customer behaviour towards digital transactions has gained traction amid the COVID-19 pandemic. In this regard, online account opening services have become vital to acquire new customers to accommodate customer behaviour changes

toward digital transactions and the COVID-19 situation. More than half of Islamic banks adopting digital banking have added online account opening as one of the services provided in mobile banking. Current customers also enable them to open additional accounts, including time deposit accounts. For an Islamic bank that has yet to have the capability to provide online account opening, e-form subscriptions for account opening have been selected as an initial stage toward online account opening services. The customer fills out the e-form subscription online through mobile banking. Afterwards, it is necessary customer to visit the branch office for further processing of the account opening. Nevertheless, only one bank has claimed to provide financing applications through mobile banking, for example, financing for automobiles, refinancing for (top-up) mortgages, and refinancing for gold pawns. Applying account opening for deposit account and financing account in digital banking corroborates the role of Islamic banks as a financial intermediary which facilitates between a saver who deposits funds and a borrower who receives the funds as a loan or financing. Islamic banks exploit mobile banking to offer account-opening services to customers.

Thirdly, as an Islamic financial institution, the Islamic bank carries an inherently social function, which is the embodiment of Islamic tenets. Islamic banks provide donation features to cater for the customer's need for social function in the form of Zakat, Waqf and Shadaqa payments in digital banking services. Almost half of Islamic banks adopting digital banking have provided the Zakat and Shadaqa services in mobile banking. The services encourage customers to actively participate in the development of Islamic social finance.

Lastly, apart from the traditional services, beyond banking services are provided to deliver non-traditional services, generally non-financial transactions, which are potentially to increasing the customer experience in performing banking services. Islamic banks provide features and content related to Islamic tenets in digital banking. Previously, customers had to visit the Department of Religious Affairs and the branch office of an Islamic bank to process a hajj subscription. Nowadays, Islamic banks provide hajj subscriptions in digital banking services, including payments related to the hajj process. In addition, Islamic content has been installed in the mobile banking application for reminding the prayer time, searching the qiblah direction and the nearest mosque location for the customer. Moreover, buying animals for the Qurban and

distributing the Qurban meat have been accommodated in mobile banking. All beyond banking services potentially assist customers in performing Islamic tenets more easily.

Identification services of digital banking by Islamic banks uncover the gap in services that Islamic banks need to provide. Islamic banks have placed the transaction purpose as the priority of services to deliver in digital banking. Despite the growth of cross-border transactions across countries, no Islamic banks provide the transfer of funds to other countries in digital banking. In addition, only one Islamic bank offers account opening for financing (loan) processing among Islamic banks providing digital banking. An Islamic bank is an intermediary institution which collects funds from the surplus unit and provides financing (a loan) to the deficit unit. Islamic banks must consider leveraging digital banking services to contribute as a financial intermediary role through the provision of account opening for deposit accounts and processing the financing (loan) application that complies with the Sharia principle.

Other than fulfilling customer needs, the provision of digital banking services for protection purposes and investment purposes would contribute to the development of Islamic finance, particularly the Islamic insurance and Islamic capital markets, respectively. Linking services in digital banking to another sector of Islamic finance would support the development of Islamic finance as a whole and differentiate Islamic banks from conventional banks. Moreover, beyond banking is a potential area to improve customer experience outside the financial transaction. Islamic banks currently concentrate on Islamic content such as hajj subscription, qibla direction and prayer times, while some areas have the potential to be elaborate supporting the customers for their interest (cash flow application for personal finance), business (e.g. application for managing customer cash flow in the business, tax calculation), supporting sustainability (e.g. application to track carbon footprints), or fulfilling the customer hobbies or lifestyle (e.g. application for managing umrah and travelling).

5.3 PRIORITY OF THE TYPE OF SERVICES IN DIGITAL BANKING BY ISLAMIC BANKS

The second and third objectives concerning the priority of the type of services in digital banking by Islamic banks were achieved by utilising the Analytic Network Process (ANP) method. The data was analysed using the ANP method, which was gathered from the selected respondents following the criteria of the respondents that have been outlined in the sample selection section (see Chapter Four).

Prior to the pair-wise questionnaire distribution, pilot testing was conducted on several respondents, consisting of four bank managers related to digital banking (three managers are Islamic bank managers) and two academicians on Islamic banking/finance/economics. They were requested to grant a judgment of agreement on the ANP model using an online questionnaire. A higher agreement was achieved on the elements involved in the ANP model. Other than that, suggestions were received to improve the pair-wise questionnaire.

This study divided the collection of data through a questionnaire into two phases. The first phase was conducted from July 2022 to August 2022. A list of experts from Islamic bank directors/managers, regulators, academia and consultants was created based on the information on the website. They were invited by phone or by email. When the target respondents expressed willingness to participate in the survey, a link to fill out the online questionnaire was sent to the target respondents through a WhatsApp message. In this first phase, ten responses were received by filling out the questionnaire, comprising four responses from Islamic Banks, three responses from regulators, and three responses from academia and consultants.

Since this study focuses on Islamic banking, the number of respondents from the Islamic Bank category should be higher than in other categories. Therefore, the second phase of data collection was performed from January 2024 to May 2024 in order to increase the respondents from the Islamic banks. The invitation, which contains the link to fill out the online questionnaire, was sent to all Islamic banks in Indonesia, including full-fledged Islamic banks (Sharia Commercial Bank) and Islamic windows (Sharia Business Unit). For the Islamic banks with the head offices in Bandung and Jakarta, the invitation was sent directly to the head offices, while for the Islamic banks

with head offices located outside Bandung and Jakarta, the invitation was sent via email to the official email address of the Islamic banks. In this second phase, five responses from Islamic banks were received by filling out the questionnaire. Hence, this study utilised the population of Islamic banks by distributing the invitation to all Islamic banks in Indonesia (full-fledged Islamic banks and Islamic windows/business units) to participate in this study as the respondents. Nine responses from Islamic banks were received from the first and second phases.

This study received nine responses from the Islamic bank. Of the nine responses (six Islamic banks and three Islamic windows), one response from the Islamic window was excluded as the experience of the respondent does not meet the criteria, which is less than three years in the Islamic banking industry. Finally, eight respondents were involved in this study, as the respondents from the Islamic bank managers who met the criteria of the study. In addition, three respondents from the regulators (Otoritas Jasa Keuangan and Bank Indonesia), two respondents from the academics and one respondent from the Islamic banking consultant were interviewed to be further analysed using the Analytic Network Process. Therefore, the final number of respondents in this study was 14. The profile of the respondents is elaborated in the next section. The modified pair-wise questionnaire is shown in Appendix III.

By filling out the questionnaire, the respondents may be exposed to several risks concerning their data privacy. For example, a respondent may be identified through the data in the questionnaire. Another risk is concerning data protection when the respondents have filled out the questionnaire. Therefore, this study applies ethical considerations to protect the data privacy of respondents. Consent from the respondents to use data obtained from the online questionnaire has been stated in the questionnaire. By filling out the questionnaire, the respondents were assumed to give consent to participate in this study and to use the data for academic purposes. This study collected private respondents' data minimally, only related to this study. The data will not be stored if the respondent does not click the submit button. The data was stored in the cloud, and only the researcher has the authority to access and download the data. Having the data in the cloud requires a password that only the researcher can access to ensure data security and protection.

Data sourced from the questionnaires were extracted manually and then calculated using Super Decisions Software to generate the value of priorities for services in digital banking and the criteria considered in the priority of the type of services in digital banking. The data were also checked to ensure that the Consistency Ratio (CR) was below the value of 0.1 for each pairwise comparison and each respondent using Super Decisions Software. All the data in this study satisfied the CR being below the value of 0.1. The profile of respondents and the value of priorities to determine the most important services and criteria will be elaborated in the next sections.

5.3.1 Respondents Profile

14 respondents fulfilled the criteria outlined earlier. Table 5.5. presents the distribution of respondents based on the category of respondents. Eight respondents, or 57.14 % of the total respondents, were categorised as Islamic Bank managers, and respondents from Regulator and Academicians/Consultants had a similar number, that is, three respondents or 21.43% of the total respondents for each category.

Table 5.5 Distribution of Respondents

Category	No. of Respondents	Percentage
Islamic Banker	8	57.14%
Regulator	3	21.43%
Academicians/Consultant	3	21.43%
Total	14	100.00%

Table 5.6. presents the profile of respondents contributing to this study. Anonymisation is used to present the profile data of respondents for the sake of confidentiality by applying pseudonymisation. The names of respondents were substituted with initial names of the respondents, except for the respondent with a single name; the name of the respondent is substituted with an initial name and a consonant from the name of the respondent. The position and institution of respondents were presented to indicate that the respondents had met the criteria stipulated in this study. Out of eight respondents categorised as Islamic Bank managers, three respondents held

the position of Director, and five respondents worked as Head of Group/Division with more than five years of experience in the Islamic banking industry. In the Regulator category, one respondent held a position as a Deputy Director at the Central Bank of Indonesia (Bank Indonesia), and two respondents held positions as Group Head at Indonesia Financial Services Authority (Otoritas Jasa Keuangan). All these respondents have had positions as representatives of banking regulators with experience in Islamic banking for more than five years. From the Academicians/Consultant, one respondent held a position as a Professor in Islamic Economics, one respondent held a position as a Director of the Centre of Islamic Business and Economics in a university, and one respondent held a position as a Director in an Islamic Banking consultant in Indonesia. Two respondents from the Academicians hold a doctoral degree and have published more than one publication in SCOPUS or WOS journals. Therefore, all the respondents in this study have fulfilled the criteria of respondents stipulated in this study. Details of the respondents are presented in Table 5.6.

5.3.2 ANP Result for Priority of The Type of Services in Digital Banking By Islamic Banks

The calculation of pairwise comparison data generates the value of priorities among the elements in the main criteria, sub-criteria, and alternatives that will subsequently be analysed to determine the most important factor in the clusters. The ANP results of the alternative services of digital banking in Islamic banking are illustrated in Figure 5.1. It is shown that all the respondents select *transfer and payment services* (A1) as the most important alternative services of digital banking in Islamic banking, with a priority value of 0.3034. The value of the Kendall W coefficient for the services is 0.234, which suggests a weak agreement among respondents regarding the prioritisation of the type of services.

Table 5.6 List of Respondents

No.	Name	Title/Institution	Experience
Islamic Bank Managers			
1	KTR	President Director, Bank KB Bukopin Syariah	> 5 years
2	Mn	Director of Risk & Compliance, Bank Mega Syariah	> 5 years
3	AM	Director of Compliance, Bank bjb syariah	> 5 years
4	BH	Head of Sharia Advisory Services, Bank CIMB Niaga Syariah	> 5 years
5	AM	Head of Sales Financing, Bank Aladin Syariah	> 5 years
6	Mk	Head of Digital Banking, Bank Muamalat Indonesia	> 5 years
7	ETS	Head of Business Development, Bank Panin Dubai Syariah	> 5 years
8	MPI	Head of Sharia Business Support, Bank Jatim (Islamic Business Unit)	> 5 years
Regulators			
9	RI	Deputy Director (Islamic Economy), Bank Indonesia	> 5 years
10	TFH	Group Head (Financial Services Supervisor), Otoritas Jasa Keuangan	> 5 years
11	RW	Group Head (Islamic Banking Regulation and Licensing Directorate), Otoritas Jasa Keuangan	> 5 years
Academicians/Consultant			
12	MNRA	Professor (Islamic Economics), Universitas Islam Negeri Syarif Hidayatullah Jakarta	> 5 years
13	RAK	Director (Pusat Ekonomi dan Bisnis Syariah), Universitas Indonesia	> 5 years
14	QS	Director (Islamic Banking Consultant), KARIM Consulting	> 5 years

Following the ANP results, *transfer and payment services* are selected as being the most important services among the services of digital banking delivered by Islamic banks. Transfer and payment services are the basic services delivered to the customer (Furst et al., 2002). Services fulfilling the essential or basic needs of the customers should be the highest priority to deliver (Bello et al., 2017). The bank provides services in digital banking to facilitate transactions for customers. Transferring money to other

parties within the bank and inter-bank, paying the bill (telephone, electricity, post-paid phone, credit card, etc.), e-commerce transactions, and purchasing prepaid phone or prepaid electricity are the basic services to facilitate the daily needs of the customer. Convergence between e-commerce and financial services will grow continuously for a decade to come, which will determine consumer demand, including accessing services using digital channels (Mariani et al., 2021). Payments have been a backbone for the emerging Super-App due to the role of payments as an adhesive holding together various products and services offered through Super-App (PwC, 2024).

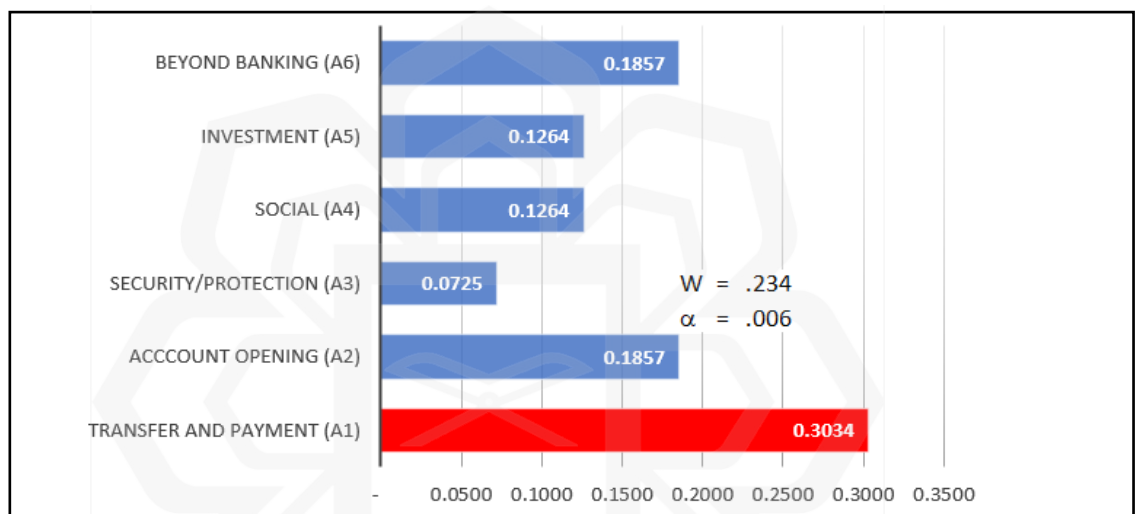


Figure 5.1 ANP Result of Alternative Services

Digital banking transactions in Indonesia have grown rapidly, with the 2018-2022 Compound Annual Growth Rate (CAGR) reaching 19.2% in value and 18.2% in volume of transactions (Bank Indonesia, 2023). Bank Indonesia recorded the growth of digital banking transactions by 28.72% (yoy) to IDR 52,545.8 trillion in 2022, and it is projected to grow by 22.13% to IDR 64,175 trillion in 2023 (Bank Indonesia, 2023). Breaking down the digital banking transactions, transfer transactions, and payment transactions has experienced positive trends in which transfer transactions are relatively higher than payment transactions in terms of volume of transactions (Figure 5.2). It suggests both services will continue to grow positively in the future. E-commerce has also paved the way for the growth of transfer and payment transactions. Indonesia is in the midst of a significant increase in the e-commerce and payment sector (PwC, 2018).

The value of e-commerce transactions grew by 18.7% to IDR 476 trillion in 2022, with 11.8% growth projected to IDR 533 trillion in 2023 (Bank Indonesia, 2023).

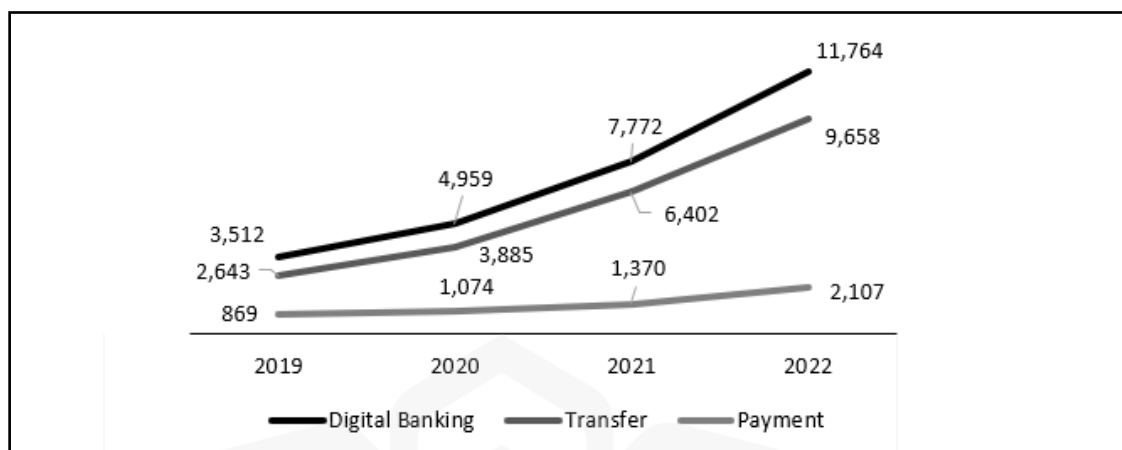


Figure 5.2 The Volume of Digital Banking Transactions (Million Transactions)
Source: www.bi.go.id (with authors' calculation)

The COVID-19 pandemic situation has changed customer behaviour in financial services (IFSB, 2020). People were encouraged to make transactions in a social/physical-distancing situation and to use cashless transactions. The advantage of digital banking, which allows people to access banking services anytime and anywhere, has fulfilled the requirement to make transactions during the COVID-19 pandemic. Accordingly, customers have opted for digital banking to access banking services instead of visiting the branch offices (Mariani et al., 2021). During the COVID-19 pandemic, transfer and payment transactions using digital banking in Indonesia reached 3,885 million transactions and 1,370 million transactions, respectively, in 2020, which are higher than before the COVID-19 pandemic (2019), with 2,643 million transactions and 869 million transactions for transfer and payment transactions, respectively. The transactions continued to increase for the consecutive years (Figure 5.3).

Considering the importance of the transfer and payment transactions, banks, including Islamic banks, envisage the services as being the most important services in digital banking. The capability of a new digital start-up company facilitating transactions and payments for customers such as Go-Jek, Grab, Tokopedia, Alibaba,

and Amazon has caused them to be considered as the banking sector's competitors (PwC, 2018).

During the COVID-19 pandemic, the number of Islamic banking savings accounts reached 35.62 million, which is relatively higher than before COVID-19, with 31.45 million savings accounts in 2019 (Figure 5.3). The number of savings accounts is expected to increase in the future, considering its positive trend. It suggests a business opportunity for Islamic banks to provide opening account services using digital banking to their customers due to the importance of account opening to digital banking transactions.

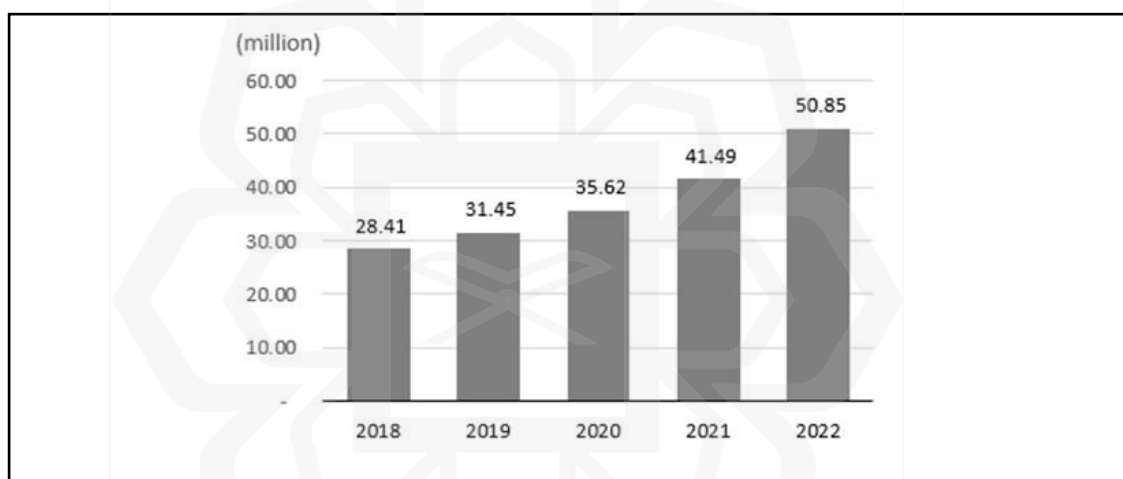


Figure 5.3 Number of Accounts for Saving Accounts
(Source: OJK, 2023 (with the researcher's calculation))

It is not necessary for banks to adopt all the digital banking services all at once since digital technology is a high-cost innovation which requires a sizable investment. In fact, today's Super-Apps initially adopted digital services gradually from a single-purpose application serving various services toward a Super-App covering the digital ecosystem (PwC, 2024). For instance, the largest Islamic bank in Indonesia, BSI, launched its mobile banking in 2021 following the establishment of BSI in early 2021 (Wijayanto, 2021). Until 2023, BSI Mobile has offered fund transfers, payments (bills and e-commerce), online opening accounts, online financing, social finance (paying sadaqah, zakat, and waqf), and beyond banking (Islamic contents such as qiblat direction, Islamic prayer times, and nearby mosque) (BSI, 2023). Considering the

technological advancement, new user experiences/user interface, increased security and connection to the ecosystem, BSI launched a Super-App called BYOND in 2024 (Puspaningtyas, 2024), which will substitute the older mobile banking. Personal finance management such as financial goal setting for the customer and investment are services added to the BYOND other than digital services that have been offered through the older mobile banking (BSI Mobile) and it has been designed to pave the way for investment and connecting to the halal life style and halal ecosystems such as hajj and umrah services and halal travelling (Oktyandito, 2024; Octaviano, 2024; Puspaningtyas, 2024)

Second priority comprises account opening services and beyond-banking services. Digital banking provides account opening online without visiting the branch office. The services have assisted customers during COVID-19 while social distancing was imposed on people. It has also assisted banks in increasing their customer database during the difficult period of COVID-19. Figure 5.4 illustrates the growth of the number of savings accounts from 2019 to 2022. Prior to COVID-19 in 2019, Islamic banking experienced 10.75% growth in the number of savings accounts. When COVID-19 was announced in 2020 and during the COVID-19 pandemic in 2021, Islamic banks continued to experience positive growth, exceeding the period before the pandemic (2019). The growth in the number of savings accounts for 2020 and 2021 was 13.3% and 16.55%, respectively. Online account opening has played a crucial role in sustaining the growth of the customer database during the COVID-19 pandemic, particularly in savings accounts. The trend has continued after the COVID-19 pandemic ended. Mostly, account opening online has been provided solely for savings accounts and time deposits.

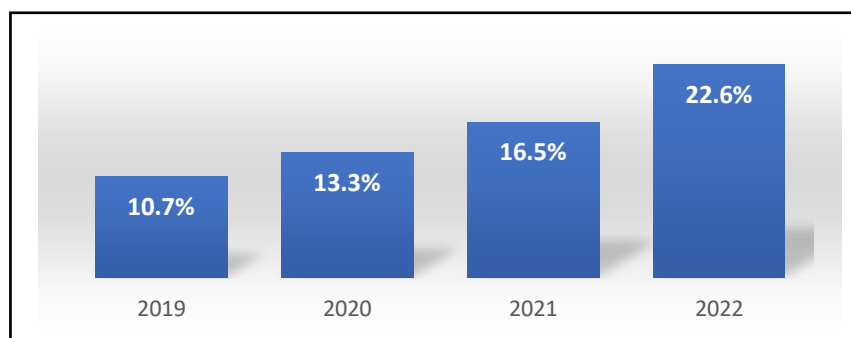


Figure 5.4 The Growth in The Number of Savings Accounts in Indonesian Islamic Banks (Source: OJK, 2023 (With the researcher's calculation))

Furthermore, customer needs have grown beyond the traditional banking services, which rely on financial transactions. The needs for leisure or travelling, personal finance management, and lifestyle are several examples of services provided beyond banking services. Booking tickets for train, plane, and theatre is another service categorised beyond banking. For Islamic banks, beyond banking specifically enables customers to access 'spiritual' features concerning Islamic tenets, such as prayer times (azan), qibla (direction toward the Kaaba in Mecca) for prayer, charities through an app and being part of a community (Bonheure and Gantes, 2021). Beyond banking services, enhance customer experience during interaction with the bank through digital banking. These features attract customers to continue interacting with the Islamic bank through digital banking. Considering the benefits of beyond-banking services, Bank Syariah Indonesia, as the largest Islamic bank in Indonesia, has committed to providing beyond-banking services through mobile banking to satisfy customer needs on financial, social and spiritual (BSI, 2024).

The third and last priorities are investments and social purposes, and protection/insurance, respectively. Share of the Islamic capital market (60.11%) has exceeded share of Islamic banking (33.99%) and share of Islamic insurance or takaful (1.61%) in Indonesia's Islamic finance assets (OJK, 2025). Despite the large share of the Islamic capital market, the importance of investing through digital banking occupies third priority. One possible explanation is that transfer and payment services, online account opening and beyond banking are services to fulfil basic financial needs of customers, the daily needs. Islamic banks make these financial needs available as a top priority in digital banking, which follows customers' preferences to select those financial needs as essential or for transaction purposes. Yumna (2019) and Yumna and Marta (2021) found that customer preference for Islamic bank financial products in Indonesia follows the Pyramid of Maslahah, which acknowledges basic needs such as a savings account as the priority (essential). A study by Ibrahim et al. (2025) on the intention of Muslims in Indonesia to participate in the Islamic capital market found that perception of usefulness, prior experience, and Islamic financial literacy may have hindered them from participating in the Islamic capital market.

Contrary to the findings of Yumna (2019) and Yumna and Marta (2021), who reported that security (insurance) purposes were prioritised over investment purposes,

this study reveals that investment purposes hold greater significance than security (insurance) purposes. The first explanation is that there is a considerable gap in the share between the Islamic capital market and Islamic insurance, where the share of Islamic insurance is still low. The second explanation is that the Islamic capital market has provided a central online system for transactions in the Islamic capital market called Sharia Online Trading System (OJK, 2025), while insurance firms privately own insurance online systems, if applicable. Thus, Islamic banks are more attracted to provide investment purposes than security/insurance purposes.

In particular, social purposes such as endowment or charities have been regarded as complementary to the priority below the basic financial needs (transaction purpose), which is regarded as essential (Ahmed, 2011). In terms of Islamic tenets, social purposes are reflected in the waqf and zakat, among others. Despite the large potential of zakat in Indonesia, the collection has yet to reach its potential. Several obstacles have hindered zakat collection from achieving its potential, namely, a low level of zakat literacy and a lack of digital technology (Kasri and Sosiati, 2023). For collecting zakat funds through an online platform, lack of clarity for the benefit or usability of paying zakat online, zakat literacy and trust in the zakat institutions have influenced the intention to pay zakat online (Kasri and Sosiati, 2023). Zakat is an obligation for every Muslim who has met certain conditions. Therefore, Islamic banks consider social purposes, such as zakat, more important to be provided in digital banking than security purposes (insurance).

Considering that the acquisition of digital banking services is generally adopted gradually, the ANP results offer a strategy to adopt and develop digital banking services for Islamic banks. Figure 5.5. illustrates the strategy for Islamic banks to develop digital banking services.

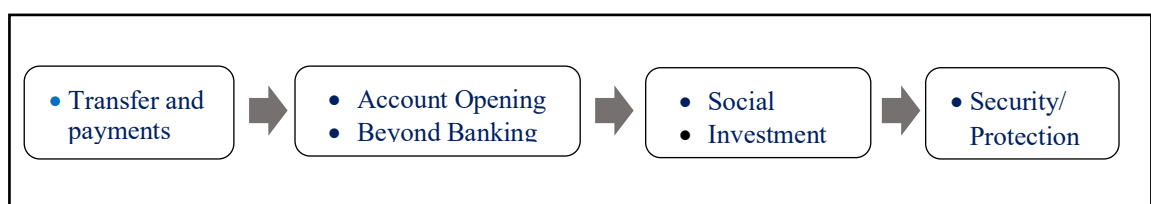


Figure 5.5 The Strategy for Digital Banking Services Development

Islamic banks are suggested to adopt the transfer and payment services for the first time as the strategy of digital banking services adoption to ensure fulfilling the basic needs, particularly for the purpose of transactions. Islamic banks are suggested to adopt Account Opening services and Beyond Banking services to support the needs of the customers, especially supporting transaction purposes. Account opening services, which lead to the opening of an account without visiting the branch office, are in line with the remote services provided by digital banking services. Beyond banking is necessary to provide non-traditional banking services to the customers that are addressed to enhance the customer experience. Social and Investment are the next services that are suggested to be provided in the digital banking services by Islamic banks to fulfil the complementary and growth, such as social function services and investment function services. Social function services refer to the provision of services for social purposes, such as donations, and in Islamic terms, they may refer to the zakat, waqf, and sadaqah. Investment in Islamic finance is related to providing services to facilitate customers for investing in Islamic instruments, for instance, Islamic bonds (sukuk) and stocks in the capital market. Lastly, protection or security functions, such as insurance and pension plans, are suggested for an Islamic bank to adopt the services of digital banking.

5.3.3 ANP Result for Determinants in Considering The Type of Services in Digital Banking By Islamic Banks

5.3.3.1 Main Criteria (Determinants)

The ANP results also exhibited the most important factor among the main criteria to be considered in the prioritisation of the type of services in digital banking by Islamic banks (Figure 5.6). *Technology* (C2) achieved the highest priority among the main criteria considered to influence the prioritisation of the type of digital banking services, with a priority value of 0.2470. Similar to the alternative services cluster, agreement on this cluster was weak since the Kendall W coefficient was low.

Technology has been identified as one of the factors provoking financial innovation to emerge, and it has been the major cause of the new process in the financial sector (van Horne, 1985; Tufano, 2003; Frame and White, 2024). The ATM, Internet

banking, and mobile banking are examples of technological advances that have brought about considerable changes in banking services. The smartphone revolution, along with internet technology, has changed the interaction between humans and business, and vice versa (PwC, 2024; Jhaveri et al., 2024), which was amplified with the COVID-19 pandemic (IFSB, 2020; Mariani et al., 2021). API, the standards-based protocol for security, Artificial Intelligence (AI) and Machine Learning are several technologies as key enablers to enhance customer experience in digital banking services (PwC, 2024; Jhaver et al., 2024).

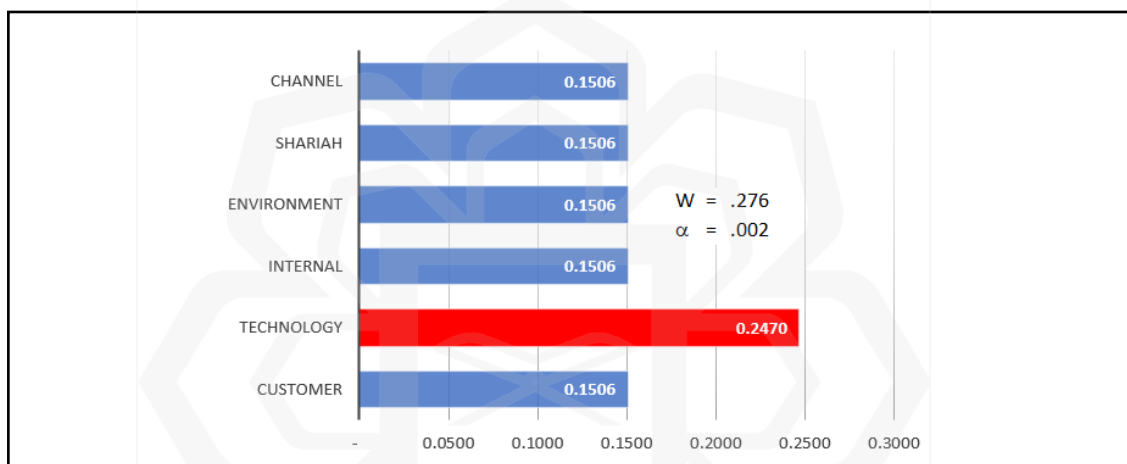


Figure 5.6 The ANP Result of the Main Criteria (Determinants) Cluster

5.3.3.2 Customer

The ANP results provided the value of priorities among the elements (sub-criteria) which constitute the main criteria. Figure 5.7. illustrates priorities among the elements of the Customer cluster. *Convenience (SC11)* is the most important factor in the Customer criteria, with a value of 0.4031. The agreement of respondents in this cluster was quite agreeable with the Kendall Coefficient of 0.51. One of the advantages of digital banking is improving customer satisfaction (Tiwari et al., 2006). Customers can flexibly access banking services anytime and anywhere for a better experience (Mbama et al., 2018). Services that are better than previous services, easier to use by the customer, and faster to access, as well as in processing, are considered to increase the satisfaction of the customer, therefore, enhancing the convenience of the customer (Aladwani, 2001;

Bradley & Stewart, 2002; Mullan et al., 2017). Digital banking enables customers to make real-time financial decisions anytime and anywhere (Hoehle et al., 2012).

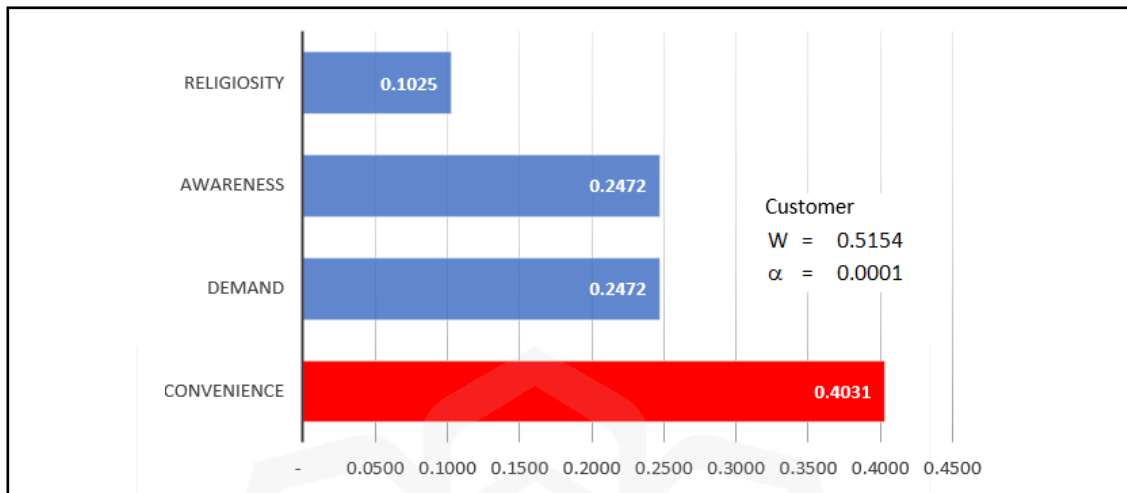


Figure 5.7 The ANP Result of the Customer Cluster

Diffusion of Innovation theory has revealed that the advantages of technology may influence the adoption of technology. Convenience to the customer, as an advantage of digital banking, has been considered by Islamic banks to be the most important in the customer criteria/cluster since banks adopting digital banking consider benefits to the customer and to the bank (Takeddine and Sun, 2015).

5.3.3.3 Technology

In the Technology criteria, *security and risk* (SC23) achieved 0.4433 for the value of priority and was the most important factor to be considered (Figure 5.8). The agreement of respondents in this cluster was almost agreeable. The Diffusion of Innovation theory has revealed that new adopter encounters risk when adopting new technology. Embracing the technology is possible to increase the magnitude of risk of the bank (Pennathur, 2001) that can be caused by operational risk, legal risk, reputation risk, and other related risks (BCBS, 1998). Aladwani (2001) has revealed that the bank should provide measures to deliver more secure services to customers. A digital banking survey of Indonesian banks conducted by PwC Indonesia (2018) has shown that the major threat to the digital business is cybersecurity. It is the biggest risk to be mitigated by the

banks. Consumer protection, cybersecurity and data protection are several issues in digital banking that need to be addressed by the bank (Choi et al., 2020). The allegation of a cyber-attack on one of the biggest Indonesian Islamic banks in May 2023 (Lestari, 2023) suggests that the Islamic bank is required to ensure that the security of the digital banking technology has been maintained and the risk has been mitigated accordingly, since it would affect the customer convenience in accessing the banking services. The allegation has also increased Islamic banks' awareness of mitigating risk stemming from the cyberattack and providing cybersecurity in adopting digital banking. Kasri and Sosianti (2023) have found that trust is a crucial factor in paying zakat using an online platform. Similarly, security and risk are geared towards increasing customers' trust in the adoption of digital banking. A lack of security and risk, along with a lack of trust, may pose another risk to the bank, i.e. reputation risk.

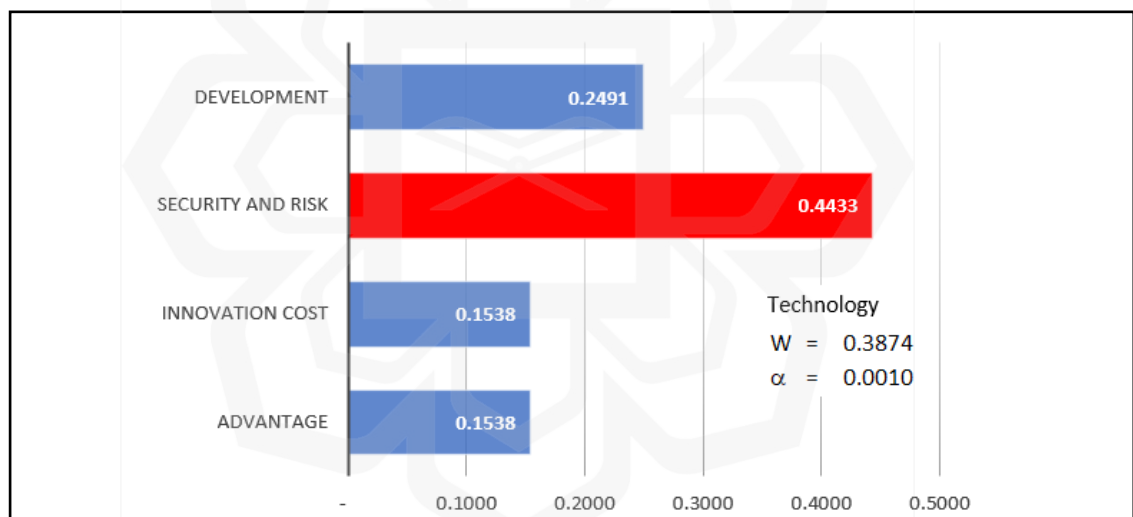


Figure 5.8 The ANP Result of the Technology Cluster

5.3.3.4 Internal (Bank)

Strategic objectives (SC31) and *Innovation culture (SC34)* are the most important factors in the internal criteria, with a similar value of 0.3318 (Figure 5.9). The agreement on this cluster is almost agreeable with the Kendall Coefficient of 0.38. The strategic objectives of the bank are considered to be important by Islamic banks for selecting services in digital banking. The bank has been motivated to adopt mobile banking due

to the compatibility of the technology with the strategic objectives stipulated by the bank (Mullan et al., 2017). Digital is not solely a part of Information Technology. Instead, digital has been embraced as a part of business strategy by most Indonesian banks, including Islamic banks (PwC, 2018). The ability of digital technology to support the achievement of the bank's objective grants maximum benefits of digital technology to the bank (OJK, 2021b). Concerning the business objective, the application of digital banking by the bank is perceived to positively affect the financial performance of the bank (Mbama et al., 2018). Therefore, managing information technology, including digital banking, should align with the strategic objective of the bank, for instance, the business objective, as well as the strategic plan of the bank, which is geared to achieve the strategic objective of the bank (OJK Regulation (POJK) No. 11/POJK.03/2022). As the Diffusion of Innovation theory posited that compatibility is one of the crucial factors in the adoption of technology, Islamic banks consider that the technology should align with their strategic objectives. The advancement of technology has not been guaranteed to be adopted by Islamic banks, unless it is compatible with the strategic objective of the bank, since digital strategy has been a part of business strategy for banks (PwC, 2018).

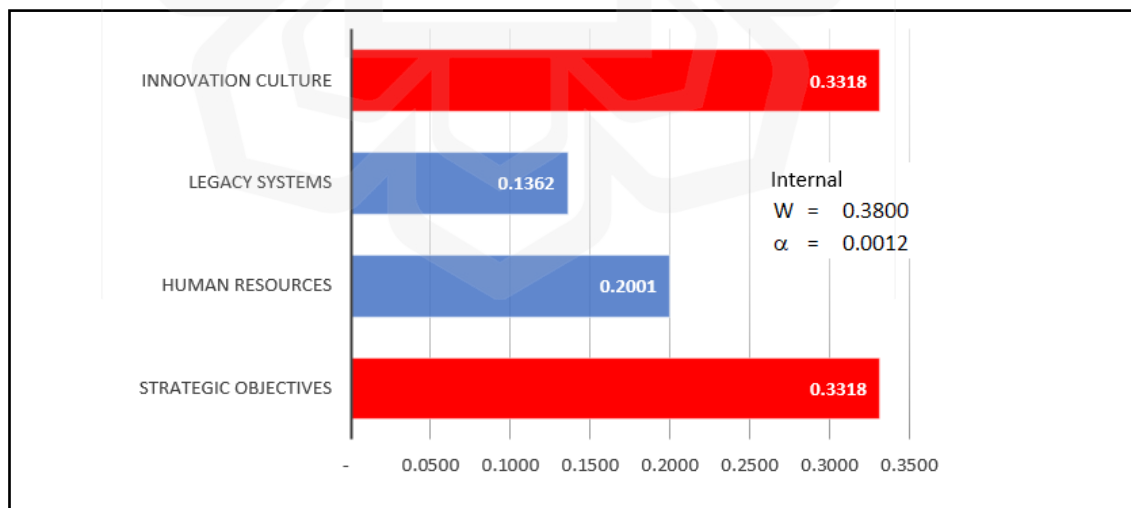


Figure 5.9 The ANP Result of the Internal Cluster

Innovation has brought about considerable change in the financial sector. Innovation should be maintained sustainably for the bank to remain competitive (Mbama et al., 2018). Innovation has the character of spiral innovation (Schindler, 2017) in which an innovation may induce another (new) innovation. An organisation must maintain the positive attitude of the employee toward innovation (Bradley & Stewart, 2002) to induce the sustainable emergence of innovation. For instance, the idea of online banking generally stemmed from the internal bank, not the customer (Aladwani, 2001). A lack of innovation culture has been identified to have a relationship with the inhibitors of online banking adoption that may lead to the negative effect of the adoption (Bradley & Stewart, 2002). Since innovation brings newness, organisations should be aware of identifying and mitigating whether resistance to change toward innovation that spreads among the members of the organisation. A digital culture needs to be developed to change the mindset of management and employees to be oriented toward a digital mindset (OJK, 2021b). Effective digital culture benefits banks in identifying the threats and opportunities responding to digitalisation and supporting the effective building of coordination across functions and business units (OJK, 2021b). Compatibility matters to the adoption of technology, as the Diffusion of Innovation theory identified. Compatibility with the culture in the bank is crucial in the adoption of technology. When the employee culture is not aligned with the technology being adopted, it can be difficult to develop and exploit the advantage of the technology. Consequently, the bank may discontinue using the technology.

5.3.3.5 Environment

Regulation (SC43) has become the most critical factor that needs to be addressed in the priority of the type of digital banking services in terms of the environment. It achieves 39.23% of the priority value (see Figure 5.10). The respondents achieved agreement on this factor. The government plays a critical role in supporting the development of digital banking in the financial sector by designing the regulations. Government intervention supports the credibility and stability of the banking environment (Bradley & Stewart, 2002). Aladwani (2001) found that legal regulation of online banking is a necessary condition to promote the usage of online banking by customers. Most financial innovations in Islamic countries have taken place in a top-down manner, driven by

government initiative or intervention (Iman, 2020). The complexity of the regulation has become a challenge for the government (Iman, 2020) to promote the development of digital banking services. Besides customer protection, regulation should support innovation development in digital banking, as well as support the development of the digital ecosystem. Financial Innovation has identified regulation as one of the factors that stimulate innovation in the financial services to take place (van Horne, 1985; Tufano, 2003). Innovation can be assumed as a response to the regulation (Tufano, 2003). Kane (1986) called “regulatory dialectic” to point out the emergence of innovations in response to changes in the regulation, especially regulatory constraints (Tufano, 2003). For instance, when regulations on social distancing were imposed, banks found a way to facilitate customers in performing transactions using digital banking.

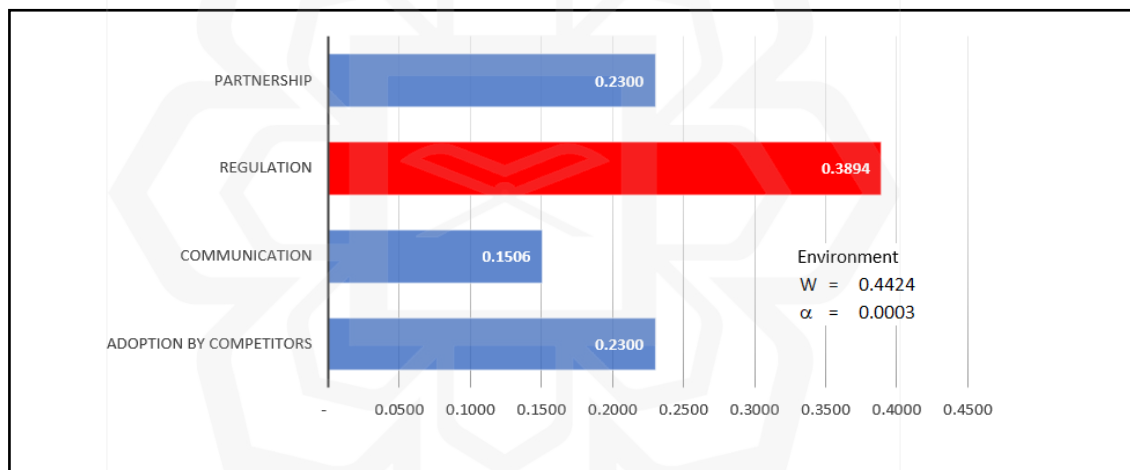


Figure 5.10 The ANP Result of the Environment Cluster

5.3.3.6 *Sharia*

As the Islamic bank should comply with the Sharia principle, much compliance of an Islamic bank with the Sharia principle occupies the highest priority for an Islamic bank in the Sharia aspect, with a value of 0.4320 (Figure 5.11). Kendall W suggests the agreement of respondents in this factor ($W=0.62$). *Sharia compliance* (SC52) is regarded as the most important factor in the *Sharia* criteria since Islamic banks should adhere to the Islamic principle in all their activities (Cihak & Hesse, 2008), including

delivering digital banking services to the customer. Islamic banking products must comply with the Sharia and satisfy all Islamic legal requirements (Ahmed, 2011; Laldin & Furqani, 2016). Al-Salem (2009) have shown the Sharia compliance issue to be addressed, related to the inappropriateness of traditional existing instruments with the Sharia and the issue of standardisation of the instrument. Yumna (2019) found that Sharia compliance is one of the main considerations for selecting Islamic financial products. Non-compliance with the Sharia may lead to a negative perception of the Islamic banks. Sharia compliance has a positive effect on customer satisfaction, while a lack of Sharia compliance can decrease the customer satisfaction of Islamic banks (Usman et al., 2020). Therefore, Sharia compliance occupies a critical role in Islamic banking. Diffusion of Innovation theory has revealed that compatibility may influence the adoption of technology. For Islamic banks, adopting an innovation without compromising Sharia compliance is a central matter that has to be met. Hence, compatibility with Sharia compliance has been considered one of the most important factors that should be met by an Islamic bank in adopting digital banking.

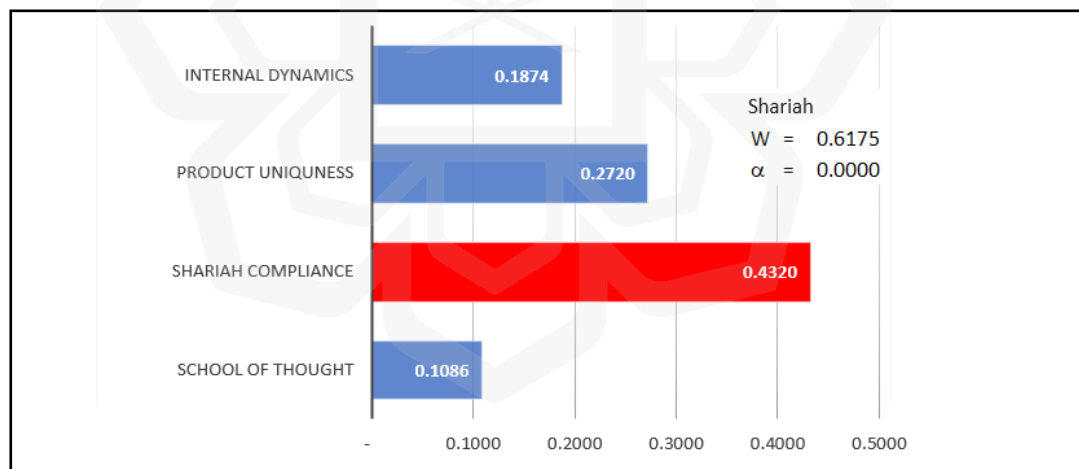


Figure 5.11 The ANP Result of the Sharia Cluster

In the technology factor, risks have been regarded as the most important factor that Islamic banks must consider when adopting digital banking services. The risk is not solely concerning operational risk in terms of the technical operation of digital banking technology. Sharia Non-Compliant Risk (SNCR) has been identified as one of the operational risks that Islamic banks must address in their adoption of digital banking.

Indonesia Financial Services Authority (Otorita Jasa Keuangan/OJK) issued a regulation on Sharia governance for Islamic banks in 2024, which reveals that the Sharia Supervisory Board must ensure that the functions of Sharia compliance, Sharia risk management, and Sharia audit are in place in Islamic banks accordingly. Concerning these functions, the Sharia Supervisory Board must ensure that all the functions are applied in digital banking accordingly. The Sharia Supervisory Board must identify and address Sharia Non-Compliant Risks embedded in the digital banking process. The Sharia Supervisory Board must ensure that the audit on the digital banking process is performed to give assurance on the effectiveness of Sharia risk management to address the Sharia Non-Compliant Risks. The Sharia Supervisory Board must ensure that the services offered in digital banking comply with Sharia principles from product design, contractual relationships, Islamic banking apps and services received by the customers (IFSB, 2023).

The advancement in financial technology has brought about a positive influence on Sharia compliance. Menne et al. (2024) revealed that a Sharia accounting model enables the integration of Sharia accounting and financial technology, which will guarantee the fulfilment of Sharia compliance from transactions, recording transactions, measuring and evaluating, presentation of financial reports, inspection and testing. The use of Artificial Intelligence enables to identify the compliance in digital banking from the transactions to reporting (Shalboob, 2025).

Despite the efficient process from the latest technology in digital banking, such as Artificial Intelligence (AI), Islamic banks have faced several challenges. A lack of Sharia-structured data may hinder the exploitation of the AI benefits optimally in the Sharia compliance process (Shalhoob, 2025). Data availability and organisation are fundamental for AI to operate effectively and efficiently. Data unavailability may hinder AI from detecting Sharia Non-Compliant Risks and interpreting according to Islamic laws. In this manner, the role of Sharia Supervisory Boards is indispensable to interpret the Islamic laws concerning oversight of Sharia compliance in the digital banking process. A lack of technology expertise has also been identified as a barrier factor in understanding adequately the blend of technological innovation in financial services with Islamic-specificities of Islamic banking practices, especially during the Sharia review and product approval process (IFSB, 2023).

5.3.3.7 Channel

Of all the option channels that can be used by an Islamic bank, the *Omnichannel* (SC63) is envisaged to be the most important strategy channel. The priority value of the omnichannel is 0.4162 (Figure 5.12). *Omnichannel* has been selected as the most important factor in the *Channel criteria*. The agreement of respondents on this factor is quite weak, with a Kendall Coefficient of 0.29. Banks have moved forward from traditional banking to digital banking by adopting the Internet and mobile banking. To deliver services more conveniently and enhance customer experience, the banks should integrate all channels such as physical branches, Internet banking and mobile banking. Omnichannel also allows the customers to switch seamlessly between channels during transactions or interactions with the bank (Komulainen & Makkonen, 2018), for instance, when the customer starts a transaction in the mobile banking and continues to finalise the transaction in the other channel, such as Internet banking, without having any distractions. Therefore, maintaining the integration quality of omnichannel may lead to an increase in and enhance the customer experience as well as customer satisfaction (Hamouda, 2019). As the Diffusion of Innovation has been posited, the advantages of technology may positively affect technology adoption. The Islamic bank considers that omnichannel is superior to other channels due to the advantages of omnichannel. The capability of omnichannel to integrate banking services across the channels has been acknowledged as an advantage.

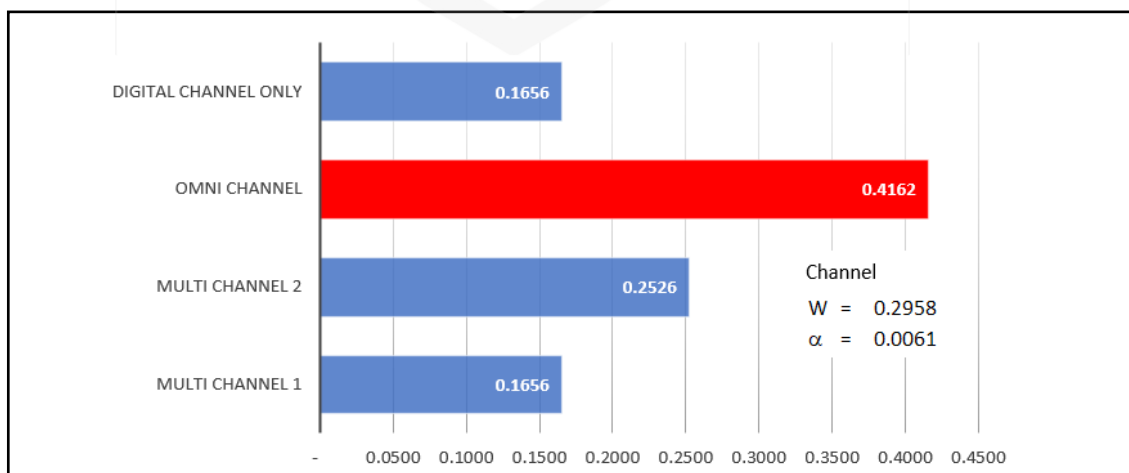


Figure 5.12 The ANP Result of the Channel Cluster

5.3.3.8 The Model for Priority of The Type of Services in Digital Banking by Islamic Banks

Providing banking services in digital banking requires considering several criteria which are related to digital banking. Prioritisation of the type of services in digital banking may consider the *customer* dimension, *technology* dimension, *internal* condition of the bank, *environment* in which the bank operates, and the *channel of* distribution used to deliver services. The bank should identify services that will increase the convenience and experience of the customer while using the services. Before the implementation of the technology used to deliver digital banking services, the bank must ensure that the data and system have secured the risks involved in the technology, have been identified, and mitigation has taken place. In addition, due to the importance of innovation supporting the competition, the culture that arises in the bank is necessary to induce the emergence of innovation, and the adoption of digital banking should align with the strategic objectives of the bank. Furthermore, regulation should support the development of digital banking, and banks must comply with the regulation stipulated by the government, which is addressed to the stability of the bank as well as customer protection. Omnichannel enables the bank to deliver banking services seamlessly, consistently, and personalised to the customer, which will lead to increased customer satisfaction and experience as well. In particular, Islamic banks should adhere to the Sharia principle; therefore, *Sharia compliance* is a central issue for Islamic banks. Each service delivered through digital banking should comply with the Sharia principle. The model for the priority of the type of services in digital banking by Islamic banks is illustrated in Figure 5.13.

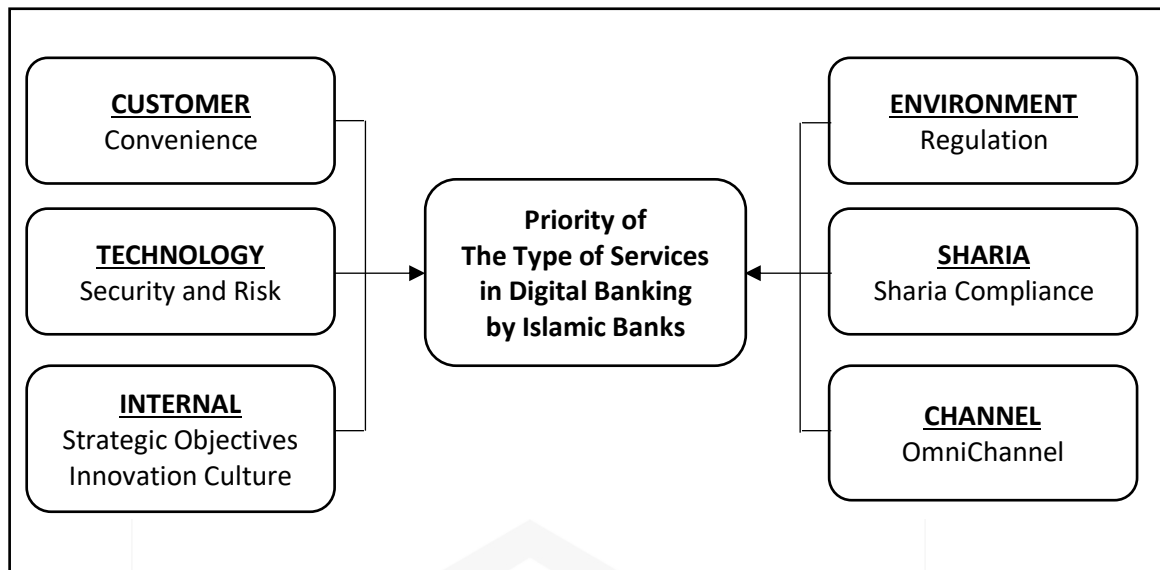


Figure 5.13 The Model for Priority of the Type of Services in Digital Banking by Islamic Banks

5.4 DETERMINANTS OF DIGITAL BANKING ADOPTION

5.4.1 The Data Set

As of December 2022, 33 banks have offered Islamic banking services to customers. Following the procedure to obtain data on digital banking adoption that has been outlined in the previous chapter, this study utilised a panel data set covering 22 banks offering Islamic banking services in Indonesia, which consists of 10 Islamic banks and 12 Conventional banks offering Islamic banking services spanning from 2010 to 2022. During the initial period of study, the number of banks offering Islamic banking services accounted for 28 banks. In 2021, three Islamic banks were merged into the largest Islamic bank in Indonesia, which caused the number of banks in the sample to decrease to 26 banks. The presence of three Islamic banks before merger activity and an Islamic bank resulting from merger activity was maintained in the sample to capture the characteristics of banks offering Islamic banking services on the adoption of digital banking. The merger activity also affected data observation in this study to utilise an unbalanced panel data set. Following Alisjhabana et al. (2020), who used semi-annual (half-yearly) data for observation of the digital technology adoption in the banking sector, the data set in this study consisted of 720 observations covering 2010-2022. The

sample is considered representative as it covers 82.6% of Islamic banking assets in Indonesia in 2022.

Table 5.7. displays the distribution of the sample based on whether the bank in the sample adopts digital banking (adopter) or does not adopt digital banking (non-adopter). More than half of the banks in the sample (56.81%) are categorised as adopters. Of the banks categorised as adopters, 60.6% of banks are in the type of conventional banks, which is higher than Islamic banks categorised as adopters. 38.19% of the total observations are categorised as Islamic banks, and the rest are conventional banks.

Table 5.7 Sample Distribution

Digital banking adoption	Bank Type		
	Conventional banks	Islamic banks	Total
Non-adopter	197	114	311
Adopter	248	161	409
Total observations	445	275	720

According to the OJK, Indonesian banking experienced a rapid digital banking adoption from 2015 to 2019 (Yunita, 2021), which is also denoted in the sample distribution. In the beginning period of observations, six banks were recorded adopting digital banking. Afterwards, from 2015 to 2019, the adoption of digital banking increased rapidly. Finally, only one bank had not adopted digital banking at the end of 2022. Figure 5.14. illustrates the dynamics of digital banking adoption across the banks in the sample.

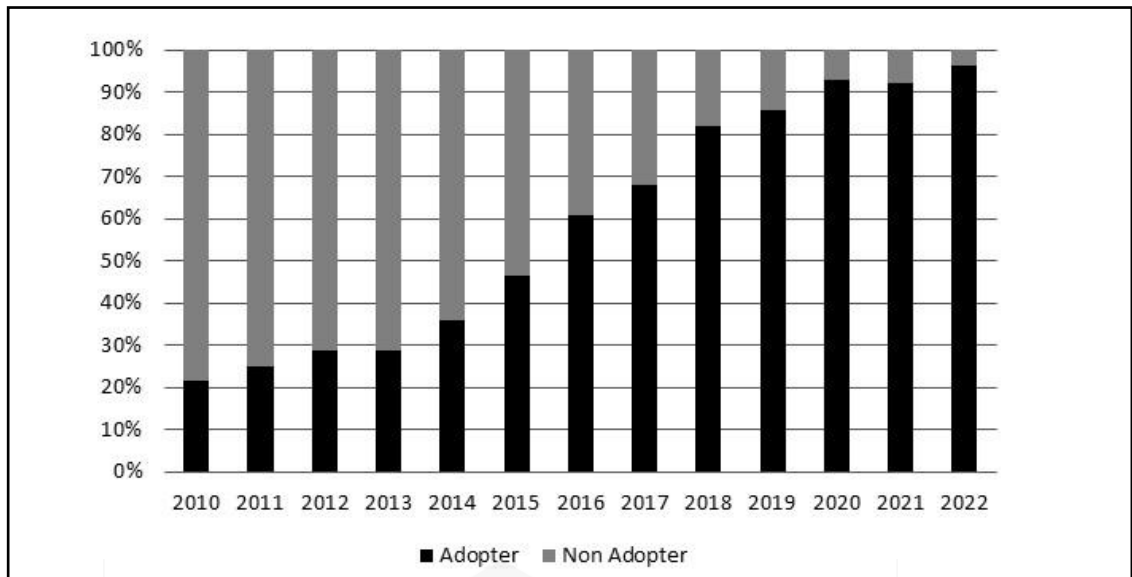


Figure 5.14 Digital Banking Adoption By the Banks in the Sample

5.4.2 Descriptive Statistics

Table 5.8. shows descriptive statistics of the data covering the independent variables in this study, except for the dummy variables. Assets of banks, labour expenses, and deposits of the banks, on average, are IDR 48,307 billion, IDR 766 billion, and IDR 37,352 billion, respectively. Banks with higher assets, labour expenses and deposits are more likely to adopt digital banking. Profitability, which is indicated by ROA, is 1.9% on average per annum, and it is higher than ROA for banks adopting digital banking. The average age of banks in this study is almost similar to the average age of banks adopting digital banking, that is, 47 years. The mean of digital banking adoption share (DBS) is 56.8% which denotes that the proportion of banks adopting digital banking is slightly higher than non-adopting digital banking, while the mean of concentration ratio (CR) is 65.1%.

Table 5.8 Descriptive Statistics

Variable	Obs	Mean	Std.Dev.	DbA(0)		DbA(1)	
				Obs.	Mean	Obs.	Mean
Asset	720	48,307	70,637	311	16,433	409	72,543
Labour	720	766	949	311	300	409	1,120
Deposit	720	37,352	53,939	311	12,753	409	56,057
ROA	720	0.019	0.024	311	0.024	409	0.015
Age	720	47	17	311	45.06	409	47.77
DBS	720	0.568	0.279	311	0.388	409	0.705
CR5	720	0.651	0.061	311	0.679	409	0.629

Notes: Asset, labour expense, deposit in IDR Billion; DbA(0) = bank non-adopting digital banking, DbA(1) = bank adopting digital banking.

5.4.3 Correlation Analysis

Correlation analysis was conducted to check whether a high degree of correlation among the independent variables, as the presence of collinearity, could be an issue in the logistic regression (Hair et al., 2014). Following Al-Najjar and Kilincarslan (2016) and He et al. (2020), all independent variables lagged one period of study to mitigate the endogeneity problem and were winsorized at 1% and 99% to mitigate the presence of outliers before further calculation, including correlation analysis. Table 5.9. presents correlation coefficients among the independent variables in the model. The presence of collinearity is not evident if the correlation coefficient is below the value of 0.9 (Hair et al., 2014). In this study, all the correlation coefficients among the independent variables were below the value of 0.9, which denotes that the issue of collinearity is not evident.

5.4.4 Logistic Regression Result

The econometric models to examine the effect of bank-specific factors and market-specific factors on digital banking adoption are divided into two econometric models, namely the baseline model and the extension model. The baseline model investigates the influence of bank-specific factors on digital banking adoption in terms of finances. The extension model combines the baseline model with a variable categorised in the

non-financial bank specifics and market-specific factors as the variable of interest in the investigation to capture the effect of bank-specific factors concerning the non-financial and market-specific factors on the adoption of digital banking.

Logistic Regression was used to test the relationship between a dependent variable and the explanatory variables, as the dependent variable in this study is a binary choice variable. The dependent variable was indicated with the digital banking adoption taking the form of a dummy variable, which has a value of 1 for banks adopting digital banking, 0 otherwise. Random effects for the logistic regression were applied in the estimation to retain the existence of early adopters, considering the presence of banks adopting digital banking (adopters) in the first period of study.

A good model can be measured using the goodness of fit of the model, which can be achieved by performing the Likelihood Ratio Test (LR Test) and inspecting the Pseudo R^2 . The LR test result showed the coefficients were simultaneously different from zero and the models are significant at a one per cent level, which confirms the goodness of the model fit (Malhotra & Singh, 2007; Hair et al., 2014; Jaloudi, 2019). The pseudo- R^2 corroborated the LR test result for the goodness of fit of the model. The Pseudo R^2 , which is similar to coefficient determination in multiple regression, for all the models in this study exceeded the value of 0.5, which indicated a good model fit for all the models (Hair et al., 2014).

Table 5.9 Correlation Matrix

	ASSET	LABOUR	DEPOSIT	ROA	BTYPE	AGE	OWNER	CR5	DBS	COVID
ASSET	1									
LABOUR	-0.3512	1								
DEPOSIT	0.3396	-0.0166	1							
ROA	0.0425	0.1052	0.0237	1						
BTYPE	-0.4627	0.1290	-0.1677	-0.4133	1					
AGE	0.4226	-0.1577	0.1077	0.2900	-0.5809	1				
OWNER	-0.0992	-0.1209	-0.3191	-0.2837	0.3416	-0.1551	1			
CR5	-0.1968	0.1221	0.1055	0.1750	-0.0417	-0.1362	-0.0028	1		
DBS	0.2457	-0.1792	-0.1050	-0.2063	0.0412	0.1896	0.0090	-0.7414	1	
COVID	0.1397	-0.1128	-0.0499	-0.1119	0.0008	0.1257	0.0159	0.0083	0.5868	1

Note: The correlation coefficient for customer adoption is not displayed in Table 4 since the period of the sample differs from Table 4. However, the estimation for customer adoption is still maintained to avoid the correlation issue among independent variables.

5.4.4.1 The Baseline Model Result (H_1 , H_2 , H_3 , H_4)

The baseline model incorporated bank size, labour cost, the bank's deposit and profitability as the explanatory variables into one model to test hypotheses one, two, three, and four, respectively. Table 5.10. presents the result of logistic regression estimation for testing the relationship between digital banking adoption and bank size (ASSET), labour cost (LABOUR), bank's deposit (DEPOSIT) and profitability (ROA). The LR test result was significant at a 1% level, which indicated the goodness of fit of the baseline model is fit or a good fit. The value of Pseudo R^2 was 0.6578, which is above the value of 0.5, indicating that the baseline model was fit. Therefore, based on the LR test and the Pseudo R^2 , the baseline model was a good fit for assessing the relationship between explanatory variables (bank size, labour cost, bank's deposit, profitability) and digital banking adoption. The next section provides the analysis based on the results of logistic regression for each explanatory variable.

Table 5.10 Logistic Regression Result for the Baseline Model

	Baseline Model
ASSET	23.20338*** (3.5409)
LABOUR	16.74307 (56.60565)
DEPOSIT	-26.89035*** (7.12188)
ROA	-146.2332*** (43.93985)
Cons.	-194.9503*** (28.92202)
LR $\chi^2(4)$	486.93***
Pseudo R^2	0.657827
Obs.	691

Note: Standard errors in parentheses, *, **, *** Significant at 10, 5, and 1 per cent levels, respectively.

5.4.4.1.1 Relationship between Bank Size and Digital Banking Adoption

The coefficient of bank size (ASSET) was positive and statistically significant at a 1% level, which is consistent with the expected sign of this study. This result is consistent with the findings of Furst et al. (2002), Malhotra and Singh (2007), Hernandez-Murillo et al. (2010), He (2015) and Dandapani et al. (2018). The significance of the positive sign implied that larger banks are more likely to adopt digital banking. The adoption of

digital banking requires a sizable investment (OJK, 2021b), which larger banks are more likely to do since a larger bank has more financial resources to invest in the adoption of digital banking (He et al., 2020). A larger bank also has the capability to generate economies of scale from the technology (He, 2015), which has been a stimulus for banks to adopt digital banking. Furthermore, other than the advantage of technology, the Diffusion of Innovation Theory states that adopting a new technology or innovation might bring risks to the adopter. In this situation, a larger bank is more capable of managing the risks associated with the adoption of digital banking.

Financial innovation has revealed that bank size matters in adopting technology in financial services. PwC's survey in Indonesia (2018) has shown that larger banks have earlier started to embrace digital transformation, with challenges to overcome siloed among involved departments in digital transformation. Similarly, Bank Indonesia's survey (2019) found that larger banks have embraced digitalisation more advanced than smaller banks, which suggests that larger banks have earlier adopted digital banking than smaller banks. Larger banks have embraced banking digitalisation as digital business (second stage), while smaller banks have developed digitalisation in the nascent stage, digital as business as usual (first stage). Larger banks have the capability to manage challenges arising from the broad activities in digital banking due to resources such as financial resources, which have enabled them to embrace digital banking earlier than smaller banks.

5.4.4.1.2 Relationship between Labour Cost and Digital Banking Adoption

The coefficient of labour cost (LABOUR) was positive, which is consistent with the expected sign in this study, implying that banks with higher labour costs have a higher probability of adopting digital banking to reduce the overhead costs related to the bank branches, particularly the labour cost. However, the positive sign of labour cost was not statistically significant, contradicting the expectation of this study. The finding supports the studies by Malhotra and Singh (2007) and Hidayat and Kassim (2022). Using a Granger causality, Hidayat and Kassim (2022) found no relationship between labour cost and digital banking transactions in Indonesian Islamic banking, which comprises Internet banking and mobile banking. In contrast with this finding, He (2015) found a

significant relationship between labour cost and digital banking adoption. One possible explanation is that decreasing labour costs has not been a primary motivation for banks to adopt digital banking. A PwC survey in 2008 indicated that 44% of Indonesian banks were adopting a digital strategy to improve customer experience.

Diffusion of Innovation Theory posited that the advantage of technology influences the adoption of technology. One of the digital banking advantages is cost efficiency. In terms of UTAUT, it is similar to performance expectancy. Financial Innovation has also revealed that innovation in financial services is motivated to reduce costs. Theoretically, cost efficiency from labour costs is achieved through the substitution of branch offices by digital banking, which eliminates branch offices along with the employee costs associated with operational branch offices. However, the substitution of branch offices by digital banking has not occurred in the Indonesian Islamic banks. In 2014, OJK recorded 2,483 offices supporting Islamic banks to operate in Indonesia (OJK, 2025). In 2024, the number of offices dropped to 2,371 (OJK, 2025). For a decade, the decline in the number of offices is only 112 offices or 4.5% which is not significant enough to eliminate the employee costs. PwC survey in Indonesia (2018) found that 44% of Indonesian banks adopted digital banking to improve customer experience, while only 14% of banks were motivated to reduce costs. Apparently, customer-oriented is superior to cost-oriented in the adoption of digital banking by banks in Indonesia. Digital banking has been treated to complement traditional services based on the physical branches.

5.4.4.1.3 Relationship between Bank's Deposit and Digital Banking Adoption

Furthermore, the baseline model result shows that the bank's deposits (DEPOSIT) were statistically significant in influencing digital banking adoption by the banks at a 1% level with a negative sign. This result supports the study of Malhotra and Singh (2007) and Sullivan and Wang (2020). This finding indicated that banks which has a lower deposit are more likely to adopt digital banking. Bank with lower deposits relies on traditional funding sources, for instance, current accounts, savings accounts and time deposits, rather than other sources such as money market funds. Adopting digital banking is envisaged as having the capability to increase the customer database. This

finding is in contrast with previous studies, which found an insignificant relationship between bank deposits and digital banking adoption (He, 2015). It is possibly due to the different characteristics of banks, where Islamic banks in Indonesia have relied more on traditional funding compared to non-traditional funding, such as the money market. A bank with lower traditional funding is more likely to adopt digital banking.

Digital banking is superior to physical branches in reaching out to customers, which transcends the geographical boundaries of physical branches (DeYoung, 2007). Digital banking enables banks to attract customers and funds from areas that local banks are unable to visit due to geographical boundaries by exploiting account opening online and fund transfer services embedded in digital banking services. These advantages have stimulated banks to adopt digital banking, according to the Diffusion of Innovation theory. For the UTAUT, performance expectancy has driven banks to adopt digital banking. The banks have perceived that digital banking may increase their performance.

Table 5.11 Number of Saving Accounts and Volume of Savings Accounts in Indonesian Islamic Banking (2017-2022)

	2017	2018	2019	2020	2021	2022
Savings - NoA	25.24	28.41	31.45	35.62	41.49	50.85
<i>Growth</i>	16.9%	12.5%	10.7%	13.3%	16.5%	22.6%
Savings Volume	98.50	114.44	133.26	159.38	183.74	218.04
<i>Growth</i>	15.6%	16.2%	16.4%	19.6%	15.3%	18.7%

Note: Number of accounts (NoA) in million accounts; Volume in IDR trillion
Source: Islamic Banking Statistics - May 2025 (OJK, 2025)

Table 5.11 presents the number of saving accounts (NoA) and the volume of saving accounts three years before COVID-19 and three years during COVID-19 for Islamic banking in Indonesia (the Government of Indonesia announced the COVID-19 pandemic ended in 2023). The growth in the number of savings accounts continually declined until 2019. However, during COVID-19 (2020-2022), the growth in the number of savings accounts gradually increased due to changes in customer behaviour towards digital transactions (IFSB, 2020), facilitated by digital banking. On average, the growth in the number of savings accounts during COVID-19 (17.4%) was higher than before COVID-19 (13.4%). Similarly, average growth in the volume of savings

accounts during COVID-19 (17.9%) was higher than before COVID-19 (16.1%). Digital banking has enabled customers to open savings accounts and transfer funds without visiting the branch offices. It benefits banks to increase their customer database and the bank deposit, especially from savings accounts.

5.4.4.1.4 Relationship between Profitability and Digital Banking Adoption

The baseline model result confirmed that profitability (ROA) significantly affected the decision of banks to adopt digital banking at a 1% level, which is consistent with the expectation of this study. The direction of the profitability coefficient was negative, which means that a less profitable bank has a higher probability of adopting digital banking. This finding is consistent with the study of Hernandez-Murillo et al. (2010). Less profitable banks have been motivated to adopt digital banking to improve their performance (Furst et al., 2002) since digital banking is assumed to be a potential business strategy for improving the bank's performance. This finding contradicts Malhotra and Singh (2007), who found an insignificant relationship between profitability and digital banking adoption. It is possible that digital banking was not adopted as a business strategy to improve bank performance. Instead, it was adopted to enhance customer satisfaction in order to increase the customer database.

The banks have perceived that digital banking may increase their profitability. According to the Diffusion of Innovation theory, this advantage plays a pivotal role in the process of adoption of digital banking. For the UTAUT, performance expectancy is similar to the advantage in the Diffusion of Innovation theory. Bank is intended to move banking services from the high-cost services (e.g, customer services and financial transactions in branch offices) to the low-cost services provided by digital banking. The bank encourages customers to use digital banking services intensively. Customers may choose between digital banking services and branch office services, or use both channels, whichever suits them best. Hence, a revenue stream will be received by banks from the charges to the customer for compensating the convenience and high-tech services provided by digital banking (DeYoung, 2007).

PwC survey in Indonesia (2018) found that most banks, including Islamic banks as part of the respondents, have embraced digital banking as a business strategy to

increase bank performance. 66% of banks have incorporated a digital strategy as a part of their corporate strategy, and 16% of banks have incorporated a digital strategy as part of their product/customer strategy. 62% of banks have set the target contribution from digital to the revenue in various amounts, and 38% of banks have adopted a digital strategy without setting any target revenue contribution from the digital strategy. It suggests that digital banking has not been solely a cost to the bank. Instead, digital banking has been expected to be a revenue stream for the bank, especially a fee-based income for Islamic banks.

Moreover, the baseline model results confirmed the results on testing of hypotheses, particularly hypotheses one to four. It can be concluded that hypotheses one, three and four concerning the relationship between bank size (H₁), bank's deposit (H₃) and profitability (H₄), respectively, were supported, while hypothesis two of a positive relationship between labour cost (H₂) and digital banking adoption was not supported. The findings that show the significance of deposits, which is contrary to the insignificance of labour cost on the digital banking adoption, denote that a bank's orientation on digital banking adoption is more on customer orientation than operational orientation. The bank has been motivated to increase the customer database rather than reduce the labour cost.

5.4.4.2 The Extension Model Result (H₅, H₆, H₇, H₈, H₉, H₁₀, H₁₁)

The extension model was specified to test the hypothesis of the relationship between explanatory variables in hypotheses five to eleven and digital banking adoption by incorporating each explanatory variable into the baseline model. For instance, testing the relationship between Bank Type (H₅) and Digital Banking Adoption was performed by incorporating Bank Type into the baseline model, and testing the relationship between Age of the Bank (H₆) and Digital Banking Adoption was performed by incorporating Age of the Bank into the baseline model, and so on.

5.4.4.2.1 Relationship between Bank Type and Digital Banking Adoption

Table 5.12. presents the result of logistic regression for the baseline model with the addition of Bank Type as an explanatory variable (Extension Model 1). The result of the LR test was significant at 1% level, and the value of Pseudo R² is 0.668, which denotes that the goodness of fit of the model was good. It suggests that the Extension Model 1 can be used to test the relationship between Bank Type and Digital Banking Adoption.

Table 5.12 Logistic Regression Result for Extension Model 1 (Bank Type)

	Extension Model 1
ASSET	20.19121*** (1.4338)
LABOUR	21.44618 (52.0402)
DEPOSIT	-23.22211*** (5.298187)
ROA	-128.1275*** (38.94281)
BTYPE	23.35401*** (4.362918)
Cons.	-182.8454*** (14.63936)
LR chi ² (4)	494.43***
Pseudo R ²	0.667951
Obs.	691

Note: Standard errors in parentheses, *, **, *** Significant at 10, 5, and 1 per cent levels, respectively.

The coefficient of Bank Type (BTYPE) was positive and statistically significant at a 1% level, which is in line with the expected sign of this study. It implied that Islamic banks are more likely to adopt digital banking. This finding is consistent with Hannan and McDowell (1984), who revealed that specialisation influences banks to adopt innovation. Islamic banks, which are more specialised in offering Islamic banking services compared to conventional bank, which employs conventional banking principles along with Islamic banking principles. Therefore, Islamic banks should concentrate on Islamic banking products and services, including exploiting digital banking to offer Islamic banking services. Based on the result above, it can be concluded that hypothesis five (H₅) of a positive relationship between bank type and digital banking adoption is supported.

Otoritas Jasa Keuangan (OJK) has declared that the acceleration of digital technology in banking is one of the pillars of the Islamic banking development strategy

(OJK, 2021c; OJK, 2024). Within this strategy, digital technology is a key success factor to support Islamic banking product development for competing in the market. However, Islamic banks should implement digital technology that enables them to support products, services and operations that comply with Sharia principles. In this manner, Islamic banks, which have specialised in Islamic banking products and services, have been stimulated to exploit digital technology to enhance specialisation in Islamic banking products and services. From the Diffusion of Innovation theory perspective, compatibility with the objectives of Islamic banks has driven Islamic banks to adopt digital banking since it can assist banks to specialise in Islamic banking products and services.

5.4.4.2.2 Relationship between the Age of the Bank and Digital Banking Adoption

Table 5.13 presents the logistic regression result for the Extension Model 2, which was the baseline model with the additional age of the bank treated as an explanatory variable. The LR test result was significant at a 1% level, which indicates the goodness of fit of the extension model was or good model. The Pseudo R², which was above the value of 0.5, corroborated the LR test result, which indicated the extension model is fit. Therefore, based on the LR test and the Pseudo R², the Extension Model 2 is a good model fit for assessing the relationship between the age of the bank and digital banking adoption.

Table 5.13 Logistic Regression Result for Extension Model 2 (Age of The Bank)

	Extension Model 2
ASSET	15.29351*** (1.130459)
LABOUR	47.80108 (50.94396)
DEPOSIT	-16.23301*** (4.715065)
ROA	-111.3137*** (33.68386)
AGE	9.415302*** (1.625488)
Cons.	-165.5603*** (9.344929)
LR chi ² (4)	491.71***
Pseudo R ²	0.664285
Obs.	691

Note: Standard errors in parentheses, *, **, *** Significant at 10, 5, and 1 per cent levels, respectively.

The extension model 2 result shows that the coefficient of the age of the bank (AGE) was statistically significant at a 1% level, which is in line with the expectation relationship in this study. The positive sign of the bank's age coefficient implied that an older bank has a higher probability of adopting digital banking. This finding of banks' age is in contrast with Furst et al. (2002), Malhotra and Singh (2007), Hernandez-Murillo et al. (2010) and Sullivan and Wang (2020), which suggests that a newer bank is more likely to adopt Internet banking.

The sample statistics of this study, which suggest that banks adopting digital banking have longer ages than non-adopting banks, support the finding of the likelihood of older age adopting digital banking. One possible explanation can be elicited from the perspective of experience and risk. Due to longer years of activity in the banking sector, older banks have accumulated experience, and the perceived risks in digital banking investment have been reduced (Malhotra & Singh, 2007). Bank encounters uncertainty before the adoption of digital banking since digital banking is regarded as an innovation which carries risks along with the benefits. Information from accumulated experiences reduces uncertainty embedded in the adoption of digital banking, which is perceived as a new product or process. It also reduces perceived risk in digital banking investment. Along with the decrease in uncertainty and risk, banks are more confident in adopting digital banking. This process of adoption is in line with the adoption process of innovation in the Diffusion of Innovation Theory.

Furthermore, OJK has stipulated that accelerating digital transformation is a strategic direction of Indonesian banking development from 2020 to 2025, and it has supported the improvement of banks' competitiveness by improving synergy and technology collaborations between banks and the digital ecosystem (OJK, 2021c). Therefore, the finding above supports hypothesis six (H₆) of the relationship between the age of the bank and digital banking adoption.

5.4.4.2.3 Relationship between Ownership and Digital Banking Adoption

Table 5.14. presents the logistic regression result for the extension model 3, which is the baseline model with Ownership treated as an explanatory variable in the model. The LR test result was significant at a 1% level, suggesting that the inclusion of explanatory

variables into the model has improved the goodness of fit of the model. The Pseudo R² also aligned with the LR test result, in which the Pseudo R² is higher than 0.5, assuming a good model.

Table 5.14 Logistic Regression Result for Extension Model 3 (Ownership)

	Extension Model 3
ASSET	23.12837*** (2.575836)
LABOUR	18.07003 (56.03316)
DEPOSIT	-26.67086*** (6.423183)
ROA	-138.4776*** (41.00019)
OWNER	22.07041** (10.58587)
Cons.	-202.0588*** (22.63879)
LR chi ² (4)	493.41***
Pseudo R ²	0.666573
Obs.	691

Note: Standard errors in parentheses, *, **, *** Significant at 10, 5, and 1 per cent levels, respectively.

The coefficient of ownership (OWNER) was positive and statistically significant at the 5% level. The significantly positive relationship between ownership and digital banking adoption is consistent with the expected sign in this study. Private banks are more likely to adopt digital banking. The result supports a study conducted by Malhotra and Singh (2007), which found that the probability of Internet banking adoption is higher for private banks as compared to the public sector banks. The finding supports the hypothesis on the relationship between ownership and digital banking adoption (H₇).

The result is supported by the characteristics of private banks, which have been identified more extensively using information systems as compared to public banks (Kangis & Kareklis, 2001). In the customer's view, private banks are more competitive in exploiting information and technology and offering banking services than public banks (Harun, 2023). Compatibility with the characteristics of private banks, that is, extensive use of information systems and technology, leads to the adoption of digital banking by private banks. Diffusion of Innovation Theory has posited that compatibility, as one of the attributes of innovation, may influence the adoption of technology. The advantage of private banks in terms of information systems and technology makes the

banks more receptive to adopting and adapting to digital technology. Considering technology as a pivotal factor for financial innovation (van Horne, 1985; Tufano, 2003), private banks are more likely to upgrade information systems and technology to advanced technology earlier than public sector banks, including digital banking. For instance, the first Islamic digital bank, which relies solely on digital channels, was established by a private bank, Aladin Syariah.

5.4.4.2.4 Relationship between Market Concentration and Digital Banking Adoption

Table 5.15 shows the result of logistic regression for incorporating the market concentration as an explanatory variable into the baseline model as the extension model 4. The LR test result was significant at a 1% level, which suggested that the addition of explanatory variables into the model has improved the goodness of fit of the model. The Pseudo R² was 0.68, which exceeds the value of 0.5, suggesting that the model is a good model to assess the relationship between market concentration and digital banking adoption.

The extension model 4 result shows a significant relationship between market concentration and digital banking adoption. This result is consistent with the expected relation in this study. The coefficient of market concentration was negative, which suggests that the market where the bank operates is less concentrated, and it is more likely for the bank to adopt digital banking. The finding supports the findings of He (2015) and Dandapani et al. (2018).

High market concentration normally will lead to a less competitive market (Cupian & Abduh, 2017), and less concentration in the market generally will lead to a highly competitive market. Therefore, the result above suggests that a highly competitive market increases the likelihood of the bank adopting digital banking. In a low market concentration, the bank is exposed to highly competitive pressure due to the highly competitive market. The bank as an organisation is persuaded to react and adapt to the institutional or competitive pressures the bank has received cumulatively as organisational stress (Mullan et al., 2017).

Table 5.15 Logistic Regression Result for Extension Model 4 (Market Concentration)

	Extension Model 4
ASSET	25.0466*** (3.288616)
LABOUR	131.3842* (67.81675)
DEPOSIT	-21.41084*** (6.238547)
ROA	-134.3378*** (38.71092)
CR5	-35.17711*** (8.139164)
Cons.	-195.1439*** (26.34316)
LR chi ² (4)	509.53***
Pseudo R ²	0.688350
Obs.	691

Note: Standard errors in parentheses, *,**,*** Significant at 10, 5, and 1 per cent levels, respectively.

The bank may opt for a differentiation strategy to respond to the competitive pressures. Adopting digital banking is regarded as a strategy for the bank to differentiate from the competitors in the market, particularly for the non-adopting digital banking competitor, and for the adopting digital banking competitor, digital banking is provided to the customer to prevent customer churn or to maintain the current customers (Dandapani et al., 2018). Thus, banks operating in a low market concentration are more likely to adopt digital banking. Based on the result above, hypothesis eight (H₈) of the relationship between market concentration and digital banking adoption is supported.

Humairoh and Usman (2016) contended that Islamic banks in Indonesia have operated in a monopolistic competition. Sunarmo (2018) found that competition in Indonesian Islamic banking falls within a perfect market and a monopolistic market, which suggests that product differentiation has been performed by Islamic banks in the market, along with the presence of high competition (Sunarmo, 2018). With a similar product category, that is, Islamic banking products and services, Islamic banks are required to differentiate their products and services. Digital banking is adopted as a business strategy for differentiating products and services since banking products and services have relied more on the advances of information systems and technology. By doing so, the Islamic bank expects to increase its competitiveness and remain in the competition. The pressure stemming from competition aligns with the environmental pressure. In terms of UTAUT, social or environmental influence, reflected in the pressure from the competition, has driven Islamic banks to adopt digital banking.

5.4.4.2.5 Relationship between Adoption by Competitors and Digital Banking Adoption

Table 5.16 presents logistic regression estimation results for the adoption by competitors, which was incorporated into the baseline model to assess the relationship between adoption by competitors and digital banking adoption. The goodness of fit of the model, which was assessed using the LR test, shows that the extension model 5 is fit as indicated by the significance of the LR test result. The Pseudo R² supported the LR test result, with the value of 0.79 exceeding the value of 0.5 as the threshold of a good model. It suggested that the extension model 5 is a good model fit based on the Pseudo R².

Table 5.16 Logistic Regression Result for Extension Model 5
(Competitors' Adoption)

	Extension Model 5
ASSET	10.95515*** (1.749678)
LABOUR	210.8219 (139.952)
DEPOSIT	-2.38471 4 (9.66555)
ROA	-99.60893 (63.17159)
DBS	50.43323*** (8.540812)
Cons.	-127.997*** (20.62579)
LR chi ² (4)	584.9***
Pseudo R ²	0.790172
Obs.	691

Note: Standard errors in parentheses, *, **, *** Significant at 10, 5, and 1 per cent levels, respectively.

The coefficient of competitors' adoption (DBS) was positive and statistically significant at a 1% level, as expected with the sign in this study. The positive sign of the coefficient meant that the bank is more inclined to adopt digital banking when the adoption by the competitors increases. The finding is consistent with the findings of Malhotra and Singh (2007) and He (2015).

The Diffusion of Innovation Theory has revealed the critical role of communication and observability in the process of adopting innovation or technology. The adoption rate will increase when a member of a social system who has adopted

innovation communicates to others (Dearing & Cox, 2018; Sullivan & Wang, 2020). Observability, which refers to the number of other banks adopting digital banking, is one of the critical determinants influencing the pace of digital banking adoption (Mullan et al., 2017). Based on the Diffusion of Innovation theory, observation and communication on digital banking among the members of the banking system, particularly between banks adopting digital banking and non-adopter banks, enables an increase in the understanding of the benefits and risks of adopting digital banking. Hence, the risks following the adoption of digital banking perceived by late adopters can be lowered. UTAUT has revealed that social influence may play a role in the intention to use technology and, afterwards, in the behaviour of using technology. Within this framework, competitor pressure is similar to social influence that plays a crucial role in adopting digital banking by Islamic banks.

Interestingly, the significance of competitors' adoption had altered banks' deposit (DEPOSIT) and profitability (ROA), becoming insignificant, whereas, in the initial baseline model, those variables were significantly affecting digital banking adoption. This finding suggests that banks adopting digital banking have been stimulated more by the competitive pressure due to competitors' adoption (market-specifics) than the bank's financial performance (bank-specifics). The result of extension model 5 suggests that hypothesis nine (H₉) of a positive relationship between competitors' adoption and digital banking adoption is supported.

5.4.4.2.6 Relationship between the COVID-19 Pandemic and Digital Banking Adoption

Table 5.17 shows the result of logistic regression estimation for the presence of the COVID-19 pandemic with the baseline model and digital banking adoption. The LR test result was significant at the 1% level, which denoted that the addition of explanatory variables into the model improved the goodness of fit of the model. The pseudo-R² measure was above 0.5, asserting that the estimated model is a good model to assess the relationship between the COVID-19 pandemic and digital banking adoption.

Table 5.17 Logistic Regression Result for Extension Model 6 (COVID-19 Pandemic)

	Model Extension 6
ASSET	19.7278*** (2.968864)
LABOUR	-20.03164 (57.84728)
DEPOSIT	-22.61576*** (6.3033)
ROA	-132.4559*** (35.99496)
COVID	13.50421** (5.834077)
Cons.	-166.3926*** (25.20348)
LR chi ² (4)	499.02***
Pseudo R ²	0.674153
Obs.	691

Note: Standard errors in parentheses, *, **, *** Significant at 10, 5, and 1 per cent levels, respectively

The coefficient of the COVID-19 pandemic was positive and statistically significant at a 5% level, which is in line with the expected sign in this study. The result suggests that the presence of the COVID-19 pandemic has stimulated banks to adopt digital banking; hence, banks are more likely to adopt digital banking during the COVID-19 pandemic. Authorities imposed social/physical distancing during the spread of the COVID-19 outbreak, encouraging customers to access banking services remotely. The COVID-19 pandemic has altered customer behaviour related to fulfilling financial needs using cashless transactions (IFSB, 2020). Banks need to respond to the situation by providing anytime and anywhere services, and digital banking services are suitable since digital banking provide banking services to customers conveniently. Banks needed to respond to the COVID-19 situation by accelerating digital banking transformation (OJK, 2021b; Mariani et al., 2021). The result above supports hypothesis ten (H10) of a positive relationship between the COVID-19 pandemic and digital banking adoption.

Financial Innovation has identified one crucial factor that changes the financial landscape through innovation: a macroeconomic shock or a considerable change in economic activities. COVID-19 has affected economic activities in Indonesia by changing customer behaviour, from a physical economy to a virtual economy, such as shopping online (e-commerce) and digital payment (OJK, 2021b). Table 5.18 presents e-commerce transactions and digital banking transactions during the COVID-19 pandemic. In 2020, when the COVID-19 pandemic was announced officially by the

Government of Indonesia and social distancing was imposed on the people, the growth of e-commerce transactions dropped to 22,8%. Similarly, digital banking transactions profoundly dropped to 0.3%. At that time, all parties involved in economic activities had to suit the situation, including banks. Banks have been forced to accelerate digital transformation and to innovate in banking services to meet customers' preferences for transactions. Banks accelerated digital banking not solely to facilitate financial transactions. Banks have gone beyond financial transactions by providing non-banking services to satisfy the non-financial needs of customers (OJK, 2021b). As the people and banks made adjustments to the situation, e-commerce transactions and digital banking transactions drastically grew to amounts exceeding those of the previous year, that is, 58.5% and 49.2%, for e-commerce transactions and digital banking transactions, respectively.

Table 5.18 E-commerce and Digital Banking Transactions in Indonesia (2019-2020)

	2019	2020	2021
E-commerce transactions (IDR Trillions)	206	253	401
<i>Growth</i>	94.3%	22.8%	58.5%
Digital banking transactions (IDR Trillions)	27,287	27,356	40,820
<i>Growth</i>	20.9%	0.3%	49.2%

(Source: <https://pusatdata.kontan.co.id/infografik/88/Transaksi-Ecommerce-Indonesia-2019-2024>; www.bi.go.id (with the researcher's calculation)

5.4.4.2.7 Relationship between Customers' Adoption and Digital Banking Adoption

Research in digital banking adoption is challenging due to difficulties in data availability (Frame & White, 2010), which is true for this study as well. Analysing the effect of customers' adoption of digital banking by the bank, this study was suited to the available data. It, therefore, utilised the sample covering 2013 to 2022, following data availability on the digital banking transactions in the aggregate banking industry. Before conducting logistic regression estimation, correlation analysis was performed to ensure no collinearity issues.

Table 5.19 presents the extension model 7 result, which is the result of logistic regression for the customers' adoption with a baseline model on digital banking

adoption. The LR test result to assess the goodness of fit of the model showed the LR test result was significant at 1% level, which means that the estimated logistic regression model was a good fit and the addition of explanatory variables to the model improved the goodness of fit of the model. The Pseudo R² also has a similar result to the LR test, with the value exceeding 0.5.

Table 5.19 Logistic Regression Result for Extension Model 7 (Customers' Adoption)

	Model Extension 7 ¹⁾
ASSET	25.02299*** (5.438969)
LABOUR	31.74109 (80.87118)
DEPOSIT	-33.63312*** (11.56606)
ROA	-162.1646*** (45.39095)
CUST.	6.264183*** (1.587105)
Cons.	-300.4683*** (59.46795)
LR chi ² (4)	302.92***
Pseudo R ²	0.6032461
Obs.	523

Note: Standard errors in parentheses; *, **, *** Significant at 10, 5, and 1 per cent levels, respectively.

¹⁾ Logit estimation utilises data from 2013 – 2022, following digital banking transaction data availability.

The coefficient of customer adoption was positive and statistically significant at a 1% level, as expected in this study. This result suggests that customers' adoption of digital banking has stimulated banks to adopt digital banking, and banks are more likely to adopt digital banking when customers increasingly use digital banking services. The Diffusion of Innovation Theory claims that the advantage of technology is one of the attributes of innovation, and in this case, it was identified to have influencing the adoption of technology. Customers prefer to use digital banking services since digital banking services have enabled customers to access banking services anytime and anywhere (Tiwari et al., 2006; Shah & Clarke, 2009), which will lead to increased customer experience and efficiency in accessing banking services (Laukkanen, 2007). Customer preferences for digital banking transactions have motivated banks to adopt digital banking to increase customer satisfaction and, subsequently, increase customer databases. Based on the result above, it can be concluded that hypothesis eleven, a positive relationship between customers' adoption and digital banking adoption, is evident.

In the Diffusion of Innovation theory, the benefits of innovation that can be observed may positively affect the adoption of technology. The benefits of digital banking to the customer (e.g. to improve customer experience) and to the banks (e.g. to improve bank performance) have been observable to the bank. Bank managers have witnessed customer experience increase due to digital banking (Mbama et al., 2018). Customers have demanded to be provided with digital transactions and payments through digital banking. For a bank that has not provided digital banking, customers will switch to a bank providing digital banking (Dandapani et al., 2018). Bank managers have also observed that customer attraction on digital banking may grant a bank a revenue stream (DeYoung, 2007). For instance, Bank Syariah Indonesia claimed that fee-based income has grown 39.3% during 2024, and the income was 20.34% of total BSI income in 2024 (BSI, 2025). Figure 5.20 illustrates the increase in digital banking transactions in Indonesia as a proxy for customer attraction on digital banking and the total fee-based income of Islamic banking as a proxy for a revenue stream from digital banking in Indonesia. The increase in digital banking transactions has always been followed by an increase in fee-based income of Islamic banking. Therefore, Islamic banks have been attracted to increase customer adoption in digital banking and their transactions as well.

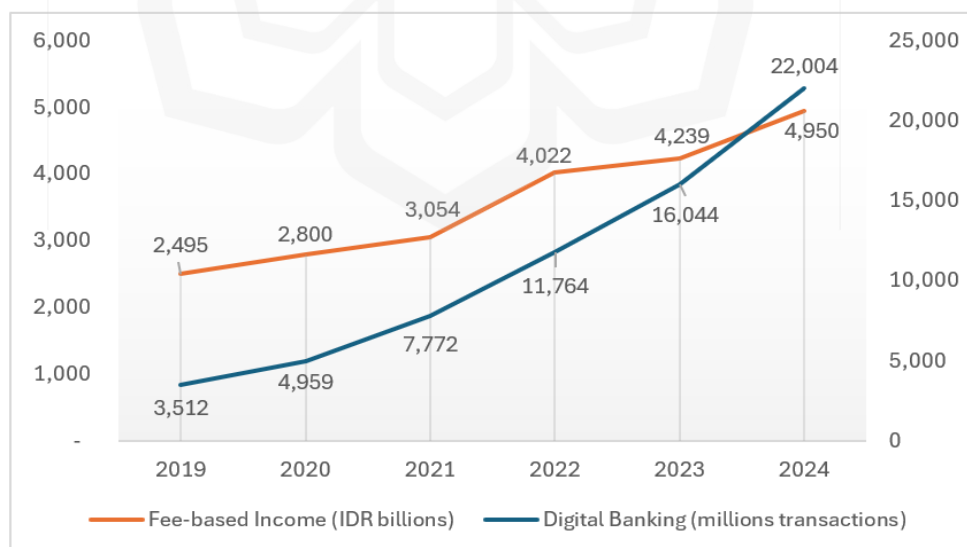


Figure 5.15 Fee-based Income (Islamic banking) and Digital Banking Transactions in Indonesia

(Source: Shariah Banking Statistics May 2025 (OJK, 2025); www.bi.go.id, based on the researcher's calculation)

5.4.5 Robustness Test

The robustness test is aimed at exploring the stability of the estimated model and whether the estimates are robust to specific plausible changes in the model specification (Neumayer & Plumper, 2017). This study employed two robustness tests for exploring the robustness of the models following specific changes in model specification, namely, alternative measures and sample changes.

The first robustness test, alternative measures, was performed by substituting measures of variables with other relevant parameters. Digital banking theoretically carries an advantage for banks to increase efficiency through reducing labour costs and increasing profitability. The baseline model employed labour expenses and Return on Assets (ROA) to indicate labour costs and profitability of the bank, respectively.

Alternative measures substituted the labour expenses and Return on Assets with the operational cost to operational income ratio (OCOI) and the Return on Equity (ROE), respectively. Following a similar procedure to estimate the baseline model and extension models using logistic regression, the results of logistic regression estimation for the alternative measure in the baseline model and the extension models are presented in Appendix IV. The robustness test of the alternative measure was consistent with the previous finding on the baseline model and the extension models. It suggests that the robustness test of alternative measures corroborated the findings in this study.

The second robustness test was related to the changes in the sample. A sub-sample was created for the robustness test. The Indonesian Islamic banking sector experienced a merger activity in 2021, which involved three Islamic banks merging into the largest Islamic bank in Indonesia. For the second robustness test, the three Islamic banks involved in the merger activity and one Islamic bank as a result of the merger activity were eliminated from the sample. In addition, the previous sample involved banks adopting digital banking at the beginning period of the study (early adopters) and nonbanks adopting digital banking (non-adopters). In the second robustness test, early adopter and non-adopter banks were excluded from the sample. Finally, the sample of the robustness test only comprised banks adopting digital banking within the period of the study. A similar procedure of logistic regression on the baseline and

extension models was employed for the robustness test. Again, the result of logistic regression using the sub-sample has supported the findings of this study, as presented in Appendix V.

5.5 TRIANGULATIONS

Two qualitative methods, namely document analysis and Analytic Network Process, and one quantitative method, namely Logistic Regression, were employed to achieve research objectives. The findings from one method may support those from other methods, as follows:

1. The result of document analysis has revealed that transfer and payment services have become a standard for all digital banking by Islamic banks. This finding supports the findings from the ANP model, which selects transfer and payment services as the most important digital banking services by Islamic banks. The logistic regression result has also confirmed this finding. The customer adoption variable, as indicated by digital banking transactions, has a significant impact on digital banking adoption. It highlights the importance of transfer and payment services, as these facilitate the growth of digital banking transactions.
2. The result of document analysis has also revealed that investment and protection are two digital banking services that Islamic banks have not adopted. One possible explanation is provided by the ANP result, which regards protection as the least important service for digital banking among Islamic banks, and investment as the second least important service.
3. Security and risk of technology have been the most important determinants in considering the priority of types of services in digital banking by Islamic banks. This finding aligns with the logistic regression result, which reveals that a larger (asset) bank is more likely to adopt digital banking since a larger (asset) bank has the capability to handle broader activities as well as manage the risk in the activities.

4. The result of document analysis has shown that all the Islamic banks have adopted multi-channel, while no Islamic bank has adopted omnichannel to deliver digital banking services. It seems opposite to the findings of ANP, which reveal that omnichannel is the most important channel to be considered by Islamic banks. One possible explanation is the risk and security of technology. Although it enables enhancing customer experience, the banks should ensure that the security and risk have been mitigated. In the ANP, the importance of security and risk of technology is higher compared to the customer convenience.

5.6 CHAPTER SUMMARY

This chapter elaborated on the results of the analysis based on all the research objectives. The first research objective concerning the current state of digital banking adoption has revealed that Islamic banks in Indonesia have adopted Internet banking and mobile banking to various degrees. Transfer and payment services have been widely offered by Islamic banks, though two categories of services have not been adopted. For the second and third objectives, transfer and payment services have been selected as the most important services in digital banking by Islamic banks, while technology is the most important criterion to be considered in the prioritisation of the type of services in digital banking. Moreover, for the fourth and fifth objectives concerning bank-specifics and market-specifics affecting digital banking adoption among banks offering Islamic banking services, the effect of bank-specific and market-specific factors on the adoption of digital banking is evident, except for one bank-specific factor, namely, labour cost is not supported. Robustness tests using alternative measures and sub-sample methods also assert the findings of this study. Table 5.20 presents the summary of the findings for the fourth and fifth objectives.

Table 5.20 Summary of The Findings for the Fourth and Fifth Objectives

	Hypothesis	Findings	Hypothesis Decision
Bank Specifics Factors			
H1	Bank size has a significantly positive relationship with digital banking adoption by banks.	Significant and positive	Accepted
H2	Labour cost has a positive relationship with digital banking adoption by banks.	Not significant	Rejected
H3	Banks' deposit has a relationship with digital banking adoption by the banks.	Significant and negative	Accepted
H4	Profitability has a significant impact on digital banking adoption by banks.	Significant and negative	Accepted
H5	Islamic banks are more likely to adopt digital banking than other banks	Significant and positive	Accepted
H6	The age of the bank has a relationship with the adoption of digital banking by the bank.	Significant and positive	Accepted
H7	A private bank is more likely to adopt digital banking	Significant and positive	Accepted
Market Specifics Factors			
H8	Market concentration has a relationship to the digital banking adoption by the bank.	Significant and negative	Accepted
H9	Competitors' adoption of digital banking has a positive impact on digital banking.	Significant and positive	Accepted
H10	The COVID-19 pandemic positively influenced the adoption of digital banking by the bank.	Significant and positive	Accepted
H11	Customers' adoption of digital banking positively affects banks' adoption of digital banking.	Significant and positive	Accepted

Note: Sign = Expected sign

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 INTRODUCTION

The previous chapter has presented the results for each method used in this study and discussed the findings for each method to answer the research questions. This final chapter summarises this study, its contribution, and suggestions for future studies. It is divided into six main sections. Before presenting the contribution of this study, section 6.2 concludes this study by summarising the research objectives, research questions, and methods used to answer the research questions. It also summarises the findings of the study, classified according to research objectives. Section 6.3 outlines the contribution of this study in terms of theoretical, methodological and practical. Section 6.4 discusses recommendations drawn from the findings of the study. Limitations of the study and suggestions for future research are discussed in sections 6.5 and 6.6, respectively.

This study investigated the adoption of digital banking among the banks offering Islamic banking services, particularly Islamic banks, and was divided into five research objectives. The first objective was to explore the current state of digital banking services. The technology used, customer served, the channel used, and services delivered to the customers using digital banking by Islamic banks were identified using document analysis, in which Islamic banks' annual reports for the year 2022 were gathered to identify the theme on technology, customer, channel and services concerning digital banking. The second and third objectives were to explore the priority of the type of services in digital banking by Islamic banks, particularly to determine the most important type of services in digital banking for research objective two, and to explore determinants in considering the priority of the type of services in digital banking, particularly to explore the most important determinant in considering the priority of the type of services in digital banking by Islamic banks. The Analytic Network Process (ANP) method was used to prioritise the type of services in digital banking and determinants in considering the prioritisation of the type of services in digital banking,

since the ANP method was suitable as the ANP method categorised as Multi-Criteria Decision Making (MCDM). Data for the ANP method were gathered using the modified pair-wise comparison questionnaire that was distributed to 14 selected respondents, comprising respondents from Islamic bank managers, Islamic banking regulators (OJK and Bank Indonesia), Islamic banking academics and consultants.

Lastly, the fourth and fifth objectives regarding the determinant factors of digital banking adoption by banks offering Islamic banking services were met using the logistic regression method. In particular, the fourth objective was to examine bank-specific factors influencing digital banking adoption, and the fifth objective was to examine market-specific factors influencing digital banking adoption by banks offering Islamic banking services. The data for determining the bank-specific and market-specific factors were gathered from banks' annual reports, first-time mobile banking applications launched on the Play Store and App Store, banks' financial reports and Islamic banking statistics spanning from 2010 to 2022. 22 banks offering Islamic banking services, comprising 10 Islamic banks and 12 conventional banks that offer Islamic banking services, were selected as the sample of the study. Logistic regression was used to test seven hypotheses categorised as bank-specific and four hypotheses categorised as market-specific since the dependent variable was identified as a binary choice variable. The next section will summarise the findings of the study grouped by the research objectives.

6.2 SUMMARY AND DISCUSSION OF MAJOR FINDINGS

The results of the study are based on the objectives of the study and answer the research questions that have been stipulated previously. Table 6.1 presents a summary of the findings of this study.

Table 6.1 Summary of The Findings

Research Objectives	Research Questions	Methods	Findings	Implications
<p>RO1: To explore the current state of digital banking adoption among Islamic banks in Indonesia by analysing documents of Islamic banks.</p>	<p>RQ1: How is the current state of digital banking adoption among Islamic banks in Indonesia analysed through the documents of the Islamic banks?</p>	<p>Document analysis</p>	<ul style="list-style-type: none"> • Most Islamic banks in Indonesia have adopted <i>Internet banking</i> and/or <i>Mobile banking</i>. However, more Islamic banks have adopted mobile banking compared to Internet banking. • Internet banking and mobile banking are provided to serve the <i>individual customer</i>, while Internet banking is offered to the <i>business customer</i>. • <i>A multi-channel strategy</i> has been selected to deliver digital banking services by most Islamic banks, and only one Islamic bank has selected a <i>digital channel</i> (a digital bank). • All types of digital banking services have been offered to the customers (<i>fund transfer and payment, account opening, social purpose, and beyond banking services</i>), except for <i>the protection/</i> 	<ul style="list-style-type: none"> • Islamic banks in Indonesia prefer to deliver digital banking services through mobile banking compared to Internet banking. This finding aligns with the survey that found that Indonesian people prefer to use mobile banking rather than internet banking to access the internet. • By doing so, Islamic banks have targeted individual customers to access digital banking services relative to business customers. • More services in digital banking are offered to customers through mobile banking, and Islamic banks focus on mobile banking development to deliver digital banking services.

Research Objectives	Research Questions	Methods	Findings	Implications
			<i>insurance and investment services.</i>	
RO2: To explore the priority of the type of services in digital banking by Islamic banks in Indonesia from the bank's perspective.	RQ2: How are the types of services in digital banking by Islamic banks in Indonesia prioritised from the bank's perspective?	Analytic Network Process (ANP)	<p>The priority of the types of services in digital banking by Islamic banks:</p> <ul style="list-style-type: none"> • 1st priority: fund transfer and payment services • 2nd priority: account opening services and beyond banking services • 3rd priority: social purpose and investment purpose • 4th priority: protection purpose (insurance) <p>Fund transfer and payment services, which are provided to fulfil transaction needs or basic financial needs, are regarded as the most important type of services in digital banking by Islamic banks.</p>	<ul style="list-style-type: none"> • Islamic banks have focused on facilitating the transaction purpose, namely, fund transfer and payment services, supported by the convergence between e-commerce and financial services and the increased e-commerce transactions. • The priority of the type of services in digital banking provides Islamic banks with the strategy for developing digital banking services by following the 1st priority, 2nd priority, 3rd priority and 4th priority, respectively. • Since digital technology requires a sizable investment, Islamic banks may adopt digital services gradually toward a Super-App covering the digital ecosystem.
RO3: To explore determinants in considering the priority of the type of services in	RQ3: What are the most important determinants in considering the	Analytic Network Process (ANP)	The most important determinant in considering the priority of the type of services in digital banking	<ul style="list-style-type: none"> • The Islamic bank is required to ensure that the security of the digital banking technology has been maintained and the

Research Objectives	Research Questions	Methods	Findings	Implications
digital banking by Islamic banks in Indonesia from the bank's perspective.	priority of the type of services in digital banking by Islamic banks from the bank's perspective?		<p>by Islamic banks is the <i>technology cluster</i>.</p> <p>For each determinant cluster, the most important factors are:</p> <ul style="list-style-type: none"> • Customer: <i>Convenience</i> • Technology: <i>Security and Risk</i> • Internal (condition) of Bank: <i>Innovation culture and Strategic objectives</i> • Environment: <i>Regulation</i> • Sharia: <i>Sharia Compliance</i> • Channel: <i>Omnichannel</i> 	<p>risk has been mitigated accordingly, since it would affect the customer's convenience in accessing the banking services.</p> <ul style="list-style-type: none"> • To adopt services in digital banking, Islamic banks need to consider the model of priority of the type of services in digital banking, which consists of: the convenience of the customer, security and risk of technology, innovation culture and strategic objective of the firm, regulation concerning digital banking, Sharia compliance and the usage of omnichannel.
RO4: To examine bank-specific factors in determining the decision to adopt digital banking services among banks offering Islamic banking services in Indonesia.	RQ4: What are the bank-specific factors that determine the decision to adopt digital banking among the banks offering Islamic banking services in Indonesia?	Logistic Regression	<p>Bank-specific factors that significantly determine the decision to adopt digital banking are:</p> <ul style="list-style-type: none"> • Bank size • Bank's deposit • Profitability • Bank type (Islamic bank) • Age of the bank • Ownership type (Private) 	<ul style="list-style-type: none"> • An Islamic bank characterised by a larger bank with a lower deposit, a less profitable bank, a specialised bank, an older bank and a bank with private ownership is more likely to adopt digital banking.

Research Objectives	Research Questions	Methods	Findings	Implications
<p>RO5: To examine market-specific factors in determining the decision to adopt digital banking services among banks offering Islamic banking services in Indonesia.</p>	<p>RQ5: What are the market-specific factors that determine the decision to adopt digital banking among the banks offering Islamic banking services in Indonesia?</p>	<p>Logistic Regression</p>	<p>Market-specific factors that significantly determine the decision to adopt digital banking are:</p> <ul style="list-style-type: none"> • Market concentration • Adoption by competitors • COVID-19 situation • Customers' adoption 	<ul style="list-style-type: none"> • Islamic banks are more likely to adopt digital banking under the conditions as follows: low market concentration, which leads to a highly competitive market, the increased adoption of digital banking by competitors, the COVID-19 situation, which imposes physical distancing, and the increased usage of digital banking services by customers.

6.2.1 Current State of Digital Banking Adoption by Islamic Banks

The result of research objective one denoted that the majority of Islamic banks in Indonesia have adopted digital banking to deliver Islamic banking services, including Internet banking and mobile banking. Of all the digital banking adopters, no Islamic bank has adopted Internet banking without adopting mobile banking; thus, every Islamic bank has adopted Internet banking along with mobile banking. In contrast, several Islamic banks have adopted mobile banking without adopting Internet banking. Interestingly, despite the importance of digital banking in the banking industry, one Islamic bank has not adopted Internet banking or mobile banking.

In addition, digital banking provision is geared towards serving retail or individual customers and business customers. Mobile banking generally has been offered to access banking services for retail or individual customers, while Internet banking has mostly been offered to business customers, regardless of corporate or individual business. In terms of channel used, digital banking services have mostly been delivered to the customer along with physical branches, known as multi-channel. Only one Islamic bank delivered digital banking services, specifically taking the form of a digital bank which utilises digital channels only with limited physical branches. Interestingly, though the bank takes the form of a digital bank, the bank has collaborated with the retail store network for cash withdrawal. It suggests that the customer still depends on the cash transaction. Moreover, Islamic banks have emphasised providing services concerning fund transfer and payment services. Other services that have been provided are account opening, social purpose (donation), and beyond banking services. Two categories of services have not been offered to the customers, namely protection (insurance) and investment (Islamic securities).

6.2.2 Priority of The Type of Services of Digital Banking by Islamic Banks

The result of the ANP method revealed the priority for the type of services in digital banking by Islamic banks and the priority for determinants in considering the priority of type of services in digital banking, which are geared to satisfy research objectives two and three, respectively. In terms of services in digital banking, the ANP method

result showed that fund transfer and payment services have been selected as the first priority of services in digital banking by Islamic banks to be offered to the customers. Account opening and beyond banking services occupied the second priority of services in digital banking. Afterwards, social purpose and investment have been regarded as a third priority to be provided in digital banking. Lastly, protection purpose (insurance) occupied the last priority for services in digital banking by Islamic banks.

Based on the ANP method, fund transfer and payment services are the most important services in digital banking by Islamic banks. The convergence between e-commerce and financial services, supported by the COVID-19 pandemic, which has encouraged customers to opt for cashless transactions, has stimulated banks to accelerate digital banking services (Mariani et al., 2021) to facilitate cashless financial transactions. The COVID-19 pandemic, which has changed customer behaviour to conduct transactions remotely, has stimulated banks to provide services without visiting the physical branches.

In terms of determinants for the priority of the type of services in digital banking, the ANP result indicated that technology is the most important determinant among the identified determinants. Technology has been acknowledged as the factor provoking innovation in financial services (van Horne, 1985). Technology has frequently played a role in financial innovation, and it is an important supply factor for financial innovation (Schindler, 2017). Several considerable changes in financial services have taken place due to technological development, for example, the Automated Teller Machine (ATM), online banking and mobile banking. However, along with the benefits, technology also carries risks. Therefore, the security and risk of technology adopted in digital banking were selected as the most important factors to be considered in the technology. The PWC survey on digital banking in Indonesia (2008) revealed that the major threat to digital banking is cybersecurity, which corroborated the importance of security and risk in digital banking technology.

6.2.3 Determinants of Digital Banking Adoption by Banks Offering Islamic Banking Services

The logistic regression results provided analysis for research objectives four and research objective five regarding determinants of digital banking adoption by banks offering Islamic banking services. Research objective four addresses the bank-specific factors which are predicted to influence digital banking adoption involving seven explanatory variables, namely, bank size, labour cost, bank deposit, profitability, type of bank, age of bank and ownership. Research objective five deals with the market-specific factors involved, four explanatory variables, namely, market concentration, competitors' adoption, the COVID-19 pandemic, and customers' adoption. Based on the explanatory variables, eleven hypotheses covering bank-specifics and market-specifics were created to be tested using logistic regression.

Logistic regression results indicated that all the explanatory variables categorised as bank-specific affect digital banking adoption, except for the labour cost, which was not evident. These findings suggest that a larger bank, a lower deposit bank, and a less profitable bank are more likely to adopt digital banking. In addition, Islamic banks are more inclined to adopt digital banking. Older banks and private banks have a higher likelihood of embracing digital banking for banking services. Labour cost is not evident to affect the decision to adopt digital banking. One possible explanation for the finding is that the bank has been more stimulated by customer orientation to increase the customer database than by operational orientation to reduce overhead costs. In sum, based on the findings, bank-specific factors significantly affect the decision of banks offering Islamic banking services to adopt digital banking.

For the market-specific factors, all the explanatory variables affected digital banking adoption. A bank that operates in a less concentrated market, which is similar to a higher competitive market, is more likely to adopt digital banking. Competitors' adoption matters to motivate banks to adopt digital banking. Banks are more stimulated to embrace digital banking when more competitors have done so. Furthermore, the COVID-19 pandemic has provided a situation to urge banks to embrace digital banking. Thus, banks are more likely to adopt digital banking in the situation of the COVID-19 pandemic. Lastly, banks are more inclined to adopt digital banking when more

customers adopt digital banking, for instance, by using digital banking to access financial transactions. Based on the result above, it can be concluded that the market specifics significantly affect digital banking adoption by the banks offering Islamic banking services.

6.3 CONTRIBUTIONS OF THE STUDY

This section outlines the contribution of this study regarding digital banking adoption among Islamic banks. The significant contribution of this study can be viewed from two perspectives, namely, the banking industry and knowledge. The banking industry contribution will explain the contribution of this study to improve managerial Islamic banks concerning the adoption of digital banking services, as this study was conducted taking the bank perspective in adopting digital banking. It is also aimed towards the policy makers or regulators to design sound policies in favour of developing digital banking adoption. In terms of knowledge, this study contributes to enhancing the knowledge concerning digital banking adoption regarding Islamic banking in Indonesia.

6.3.1 Contribution to the Banking Industry

6.3.1.1 *Contribution to the Bank*

Digital banking services have been critical to banks, including Islamic banks, amidst the change in customer behaviour toward digital transactions, especially due to the COVID-19 pandemic. The importance of digital banking has been amplified by the convergence between electronic commerce and financial services. Exploration of the current state of digital banking services by Islamic banks in this study provided insights into potential improvement for increasing customer satisfaction and customer experience on digital banking services based on the gaps between existing services with the potential services delivered through digital banking that can be a benefit to the Islamic bank managers. For instance, offering Internet banking to the individual customer/consumer, offering mobile banking to the business customer, implementing omnichannel to deliver personalised and seamless banking services and developing

beyond banking services to improve customer experience by satisfying non-financial transaction needs, especially concerning Islamic finance.

It is necessary to consider various factors for Islamic banks to make a priority and select the most important banking services that will be provided through digital banking, as developing digital banking requires a sizable investment. This study provides a framework for making a priority and selecting the most important services in digital banking, specifically the Islamic bank. It is designed based on the evaluation of several criteria considered to influence the priority of the type of digital banking services, following the ANP method. Islamic bank managers can exploit the framework to design a plan or roadmap for implementing and developing digital banking services. It also enables Islamic banks to decide which services will be provided first to the customers among the alternative services owned by Islamic banks.

Concerning the determinants of digital banking adoption among banks offering Islamic banking services, the findings of the study are divided into two categories, namely bank-specifics and market-specifics. The findings provide Islamic bank managers with bank-specific factors influencing digital banking adoption that Islamic bank managers should concentrate on.

This study provides findings on determinant factors influencing digital banking adoption among banks offering Islamic banking services, which are categorised into bank-specific and market-specific. The findings provide insights to Islamic bank managers for consideration that enable them to have a greater understanding, especially when the Islamic bank manager has an intention to adopt and develop digital banking. The primary concern is to concentrate more on bank-specifics such as the size of the bank and the type of the bank, among others, as these factors are more within the management's control rather than market-specifics. Islamic bank managers can exploit digital banking as a business strategy to improve the bank's performance, for instance, by increasing deposits and profitability. However, Islamic banks should also be concerned about the dynamics of market specifics. Islamic banks operating in a less concentrated market or higher competitive market may receive more pressure to adapt to digital technology. In addition, dramatic changes in the market, which is similar to the COVID-19 pandemic, should be anticipated by Islamic bank managers to respond

accordingly. Therefore, the findings on determinants of digital banking adoption provide Islamic bank managers with an awareness of environmental changes categorised under market specifics on the digital banking adoption among banks offering Islamic banking services.

In summary, the findings of the study are useful to guide Islamic bank managers in designing a framework for implementing services delivered through digital banking. The findings are also meaningful for Islamic bank managers to achieve a greater understanding of digital banking adoption, allowing for better policy design for digital transformations in banking.

6.3.1.2 Contribution to the Regulators

The findings of this study provide potential areas for Islamic banks to improve digital banking services, a framework for prioritising services in digital banking for Islamic banks and insights into factors determining digital banking adoption by banks offering Islamic banking services. These findings are useful to policymakers or regulators for designing sound policies and regulations that would stimulate Islamic banks to adopt and develop digital banking services properly, which would enhance customer experience. Based on the findings, fund transfer and payment services are the most important services in digital banking. The Central Bank of Indonesia, which has authority in the payment system, may design a policy to facilitate an easier payment system for the banks as well as the customers. QR code Indonesian Standard (QRIS) is an example of a sound policy issued by the Central Bank of Indonesia that promotes a convenient payment system by standardising the use of QR codes in Indonesia, i.e. one form of QR code for all digital transactions. The findings have shown that technology is the primary concern for adopting digital banking services, particularly concerning security and risk of technology. Authorities should design policies ensuring that each digital banking service offered to customers by the bank is prepared for the mitigation of security and risk concerning digital banking technology.

The authority may design sound policies drawn upon the findings on determinants of digital banking adoption to stimulate digital banking adoption and

development. One of the determinants of digital banking adoption is the size of the bank, where a larger bank is more likely to adopt digital banking. It may design a policy to encourage or stimulate banks to pursue becoming larger banks, as the bank size has a positive relationship to digital banking adoption. In the market specifics, a bank that operates with less market concentration, which is similar to a higher competitive market, is more likely to adopt digital banking. The authority may encourage the adoption and development of digital banking by designing a policy or regulation that creates less market concentration or higher competition so that banks in the market compete to adopt and enhance digital banking that satisfies the customer. The findings of the study provide a meaningful framework and knowledge for regulators/authorities to design sound policies and regulations for stimulating banks to adopt and develop digital banking properly.

6.3.2 Contribution to Knowledge

The findings of this study have theoretical contributions concerning the underlying theories used in this study, especially in the realm of digital banking, as follows:

1. Perspective of the study: the Islamic banks' perspective

Digital banking adoption has been researched from various perspectives, and most of them are from the customers' perspective. This study differs from the other studies on digital banking adoption in that it has taken a bank (firm) perspective to investigate digital banking adoption. The data used to explore the current state of digital banking and investigate determinants of digital banking adoption were mainly sourced from annual reports and financial reports issued by the bank. Data for the prioritisation of the type of services in digital banking were gathered from selected respondents, involving Islamic bank managers (along with banking authorities, Islamic banking academics and consultants).

2. Context of the study: Dual banking systems, especially Islamic banking

Most of the studies in digital banking from the banks' perspective have been conducted solely in the conventional banking system. This study differentiates itself in terms of the banking systems chosen, where the selected banks operate in dual banking systems, i.e. conventional banking systems along with Islamic banking systems, with emphasis on the Islamic banking system. By investigating other banking systems, the study has contributed to the comprehensive understanding of digital banking adoption and the use of underlying theories in digital banking studies (Nejad, 2016).

3. Research methodology: The use of mixed methods, the Analytic Network Process (ANP) Method, along with the Sharia Aspect, and the COVID-19 phenomenon.

In this study, mixed methods are applied to investigate digital banking adoption among Islamic banks in Indonesia, namely, qualitative methods (document analysis and Analytic Network Process) and a quantitative method (Logistic Regression). A triangulation is also applied to ensure the validity of the findings by synthesising the main findings from the three methods used in this study. A convergence is achieved from the triangulation that makes the findings valid. What makes this study different from other studies in digital banking is the use of the ANP method to explore the priority of services in digital banking by Islamic banks, with the inclusion of Sharia issues/clusters into the model, considering that Islamic banks operate based on Islamic principles. To the best of the researcher's knowledge, this is the first study on digital banking adoption by Islamic banks using the ANP method and Sharia cluster involvement. The recent phenomenon of the COVID-19 pandemic has also been included in the model to test whether COVID-19 influenced digital banking adoption. Thus, the use of qualitative and quantitative methods in digital banking adoption study which comprise the use of documents for analysis, the application of ANP to analyse the data

obtained from the survey questionnaire and the use of panel data logistic regression analysis have granted a methodological extension to the study on digital banking adoption, particularly in the context of Islamic banks in the dual banking system.

4. Validity of underlying theories

The findings of this study affirm the validity of the underlying theories. This study is based on the Diffusion of Innovation Theory (DOI), the Unified Theory of Acceptance and Use of Technology (UTAUT) and Financial Innovation. Most of the findings support the underlying theory, albeit with a contradiction in one finding. The empirical findings have shown that fund transfer and payment services, along with account opening services, have been selected as the most important services in digital banking by Islamic banks. Fund transfer and payment services and account opening services through digital banking have granted customers the ability to access banking services for transactions remotely, anytime and anywhere. These advantages align with the DOI theory (relative advantage) and UTAUT (performance expectancy). Technology has been selected as the most important criterion to be considered in the prioritisation of the type of services in digital banking. It supports the Financial Innovation approach, which states that technology has played an important role in provoking the emergence of financial innovation (van Horne, 1985; Schindler, 2017). The empirical findings of the study outline more detailed technology criteria; the primary concern is related to security and risk of technology. DOI theory confirms that, along with the benefit of technology, the risks embedded inherently with the technology would be the primary concern of the adopter, particularly the late adopter. Moreover, the DOI theory has revealed characteristics of adopters that are predicted to influence the adoption of technology. Empirical findings of the study have identified in more detail the characteristics of banks more likely to adopt digital banking, namely bank size, deposits, profitability, type of bank, age of bank, and ownership type. In addition, the empirical findings of the study denoted a less concentrated market, which leads to high pressure of competition and adoption of the technology by

competitors, affecting digital banking adoption by the bank. The finding is in line with attributes of innovation in DOI (advantage and compatibility), the social influence factor of the UTAUT, and determinant factors paving the way for innovation in Financial Innovation. Therefore, the findings of this study have shed light on a greater understanding of the underlying theories on digital banking adoption, particularly concerning Islamic banks.

5. The use of multiple theories

The use of multiple theories in this study has assisted the process of investigation comprehensively, in which each details in the theories complement the others. It suggests that the Diffusion of Innovation Theory is more comprehensive to be applied along with another relevant theory in the investigated area. In this study, DOI has been applied along with UTAUT and Financial Innovation. Several details have not been identified in the DOI, for example, social influence (UTAUT) and determinant factors on innovation, such as technology and considerable change in economic activity. For example, based on the DOI, it is an advantage that encourages the adoption of technology. In terms of digital banking, reducing labour costs is one of the advantages. According to the Financial Innovation approach, innovations in the financial sector have emerged in order to reduce cost, to reduce risk or to complete the market with the products/services. Apparently, this study confirms that the primary motive for banks in adopting digital banking is not cost efficiency from labour costs. Instead, banks are more oriented to the customer experience and competition pressure in adopting digital banking since the significant role of labour costs is not evident in this study. The role of customer experience and competition pressure is found in the UTAUT, which reveals that social influence may affect the intention to use technology. Therefore, the presence of UTAUT has complemented the DOI theory.

6.4 RECOMMENDATIONS

Several recommendations can be proposed to improve and develop digital banking adoption, particularly for Islamic banks, based on the findings of the study. The recommendations are geared toward the bank offering Islamic banking services, particularly Islamic banks, as the firm institutions providing digital banking services to the customers and the Otoritas Jasa Keuangan (OJK) and Bank Indonesia (BI) as the regulators who are responsible for supervising the banking industry and payment system in Indonesia, respectively, including Islamic banks. The recommendations are outlined in order of importance as follows:

1. The Islamic banks:
 - a. Islamic banks may benefit from the use of digital banking to improve customer experience, as the advantage of digital banking services is to deliver banking services anytime and anywhere to the customer conveniently. The capacity to adopt digital banking services among Islamic banks has varied. Most Islamic banks are categorised as small banks with total assets below IDR 30 trillion (Appendix II), which hinders Islamic banks from adopting digital banking services all at once. Alternatively, the Islamic bank should adopt and develop digital banking services gradually based on the priority of importance, following the result of the prioritisation of the type of services in digital banking by Islamic banks. Firstly, transfer and payment services. Secondly, account opening and beyond banking services. Subsequently, the social and investment purposes. Lastly, for security /protection purposes.
 - b. Transfer and payment services have occupied the most important services in digital banking. Islamic banks are advised to simplify the use of transfer and payment services by customers to improve customer experience and customer satisfaction. Considering the limited budget to invest and the lack of information technology infrastructure faced by Islamic banks, the advanced technology used by fintech firms may

enhance banking services to meet customer needs efficiently. Fintech firms generally employ advanced technology, such as big data analytics and artificial intelligence, to provide financial services to customers. Hence, Islamic banks are encouraged to collaborate with fintech firms and other members of the digital ecosystem at large to enhance their banking services.

- c. Other than advantages, technology comes along with risks. The security and risks associated with digital banking, such as cybersecurity risks, have been a primary concern for banks in adopting this technology. Risk events in digital banking can potentially lead to other risks that may harm the bank at large. For example, data breaches by external parties may cause reputation damage to the bank. Therefore, Islamic banks should ensure that mitigation of security and risks has taken place before adopting and delivering digital banking services to the customers, including data protection. Designing appropriate IT architecture, designing policy and procedure on digital banking operation containing risk identification and controls, and pilot testing before implementation of digital banking are several measures that can be performed by Islamic banks to ensure the mitigation of risk and security has taken place accordingly.
- d. Digital banking is not solely a siloed strategy to develop information technology. Instead, digital banking can be applied as a part of a business strategy to increase the database, to improve bank performance and to increase the bank's competitiveness. Given less competitive products and services, Islamic banks are recommended to integrate an information technology strategy, including digital banking, into their corporate and business strategy to support the achievement of the banks' objectives. By doing so, Islamic banks are expected to offer high-quality products and services that meet the customer's financial needs without compromising Sharia compliance. Islamic banks have been identified as suffering from the adoption of the latest advanced technologies due to a limited budget to invest. The use of new advanced technologies

should be a concern for Islamic banks, for example, Big Data Analytics, Artificial Intelligence and Blockchain, as these technologies enable Islamic banks to obtain valuable insights from customer databases, customer behaviour, products and services and deliver high-quality products and services to the customers. A partnership or outsourcing scheme is one alternative for Islamic banks to embrace the advanced technologies efficiently.

- e. Competitor adoption of digital banking may persuade banks to adopt digital banking. The late adopter considers the risks embedded in technology before adoption. Communication among the members of the banking system, particularly between banks adopting digital banking with non-adopter banks, regarding the advantages, risks and mitigation of digital banking can increase greater understanding and lower the perceived risk of digital banking adoption and stimulate banks to adopt digital banking. Considering that most Islamic banks are categorised as small banks, Islamic banks are more likely to adopt new technology as late adopters. As such, Islamic banks should communicate with the banks in the industry, especially with the banks that have adopted digital banking. For instance, performing benchmarking to elicit insights on the advantages, risks and mitigations of digital banking. These measures may benefit Islamic banks in collecting positive and negative information that may reduce uncertainty and potential risk in adopting digital banking.

2. Regulators

- a. Bank size matters for adopting digital banking. A larger bank is more likely to adopt digital banking. As such, the regulator could design a policy ensuring that banks offering Islamic banking services, particularly Islamic banks, reach a size that adequately adopts and develops digital banking. Most Islamic banks are categorised as small banks with limited resources to adopt and develop digital banking. Bank consolidation policy is crucial in strengthening the capacity of the banks

in adopting and developing digital banking. For example, a policy to merge several Islamic banks, especially smaller banks, into a solid bank is required to exploit the advantage of digital banking. For Islamic windows with a large asset (size), a spin-off policy which separates a Sharia business unit or division of a conventional bank into an Islamic bank entity should be considered to support. In terms of specialisation, a spin-off policy is directed to Islamic windows to be a more specialised bank in Islamic banking products and services, including managerial. More specialised banks are more inclined to adopt and develop digital banking. However, bank consolidation policy, including spin-off policy, should be applied cautiously, considering the size of the bank and the impact on the market concentration or degree of competition.

- b. Banks operating in a less concentrated market, which leads to a more competitive market, are more likely to adopt digital banking. As such, the regulator should design a policy to encourage the market concentration of the Islamic banking industry to a degree where market concentration is sufficient to support the competitive pressure for stimulating banks in adopting and developing digital banking. Currently, there is a considerable gap in bank size between the largest Islamic bank and other Islamic banks (Appendix II). The regulators should monitor market concentration to prevent a market structure concentrated in the largest Islamic bank or several larger Islamic banks. A highly concentrated market may decrease the degree of competition to induce financial innovation. A low market concentration, which suggests a highly competitive market, may encourage Islamic banks to differentiate their digital banking products and services in the market.
- c. Communication among the members of the system would encourage the adoption of innovation to take place. Regulators are recommended to build communication among members of the banking system, especially the Islamic banking system. Hence, the banks will have a greater understanding of digital banking adoption and may lower the perceived risk by mitigating the risks concerning digital banking. Focus group

discussions, seminars, or workshops on digital banking are several initiatives that can be considered for communication among the banks, particularly Islamic banks.

- d. Banks must provide adequate mitigation of security risks and other risks in digital technology. It is the responsibility of regulators to ensure that banks adopting digital banking have an adequate policy and procedure to address the issue of security and risk in digital banking, including but not limited to cyber-risks, cybersecurity, and data protection. This must be in place before the adoption of digital banking. Regulators must also ensure emerging risks associated with digital banking are regularly identified and mitigated by the Islamic bank. Regular supervision should include these matters.
- e. It is recommended that regulators design a policy or initiative to build synergy and collaboration among the banks, with the fintech firms and the stakeholders of the digital banking ecosystem to enhance services in digital banking accordingly. Customer needs have grown beyond traditional banking services. Digital banking will be developed towards Super-Apps by collecting multiple services into one application, and it has the capacity to connect to a digital ecosystem simultaneously using advanced technologies such as Big Data Analytics, Artificial Intelligence and Blockchain. It is more likely that fintech firms possess more advanced digital technology than banks. Banks may benefit from the technology used by fintech firms to enhance their services, which will increase customer experience for the parties within the digital banking ecosystem at large. In this manner, fintech firms are treated as a complement to increase Islamic bank competitiveness and not a competitor for Islamic banks.

6.5 LIMITATION OF THE STUDY AND SUGGESTIONS FOR FUTURE RESEARCH

This study has been conducted under several limitations. Firstly, this study was limited by the sample chosen. The current state of digital banking adoption was analysed using banks' annual reports for the year 2022. The respondents for the priority of the type of services in digital banking were limited to 14 respondents covering three categories of respondents, comprising Islamic bank managers, regulators and academics/consultants. In addition, factors affecting digital banking adoption were determined using unbalanced panel data spanning from 2010 to 2022 and covering 22 banks offering Islamic banking services. Therefore, this study was limited due to the number of respondents and the time frame used in the sample. Different numbers of respondents and different categories of respondents may generate several different judgments on the ANP questionnaire that may bring about different ANP results. Future research may extend the number of respondents in terms of quantity and the categories of respondents to explore digital banking adoption. Future research may involve other stakeholders in the digital banking ecosystem, considering that digital banking will be developed toward a digital ecosystem and open banking system in the future. For instance, fintech companies, information technology providers, and halal industries representatives are some stakeholders. In addition, future research could use a longer time series and cover more banks in the sample for the logistic regression analysis. A different time frame may affect the findings. These would provide more perspectives on the digital banking studies to understand comprehensively.

The second limitation is related to the variables used in this study. To determine the most important services in digital banking, this study was limited to six alternative services and six main criteria. For determinants of digital banking adoption, bank-specific factors were characterised by seven explanatory variables, and market-specific factors were characterised by four explanatory variables. Logistic regression is sensitive to the number of involved variables and to the number of samples. Different numbers of variables should be followed by the appropriate number of samples, which has been considered in this study. However, the sensitivity has limited the use of logistic regression cautiously. In this study, security and risk of technology have been identified as a main factor in the prioritisation of digital banking services. Future research may

include risk factors in the logistic regression to examine determinants in digital banking adoption, since cybersecurity is currently a threat to digital banking adoption. Future research may also cover more variables that are relevant to digital banking adoption. In this study, cost efficiency is not significantly evident by using labour costs. Future research may use another variable, such as premises costs associated with the physical branches or the aggregation of all the costs stemming from physical branches. Furthermore, determining factors on the adoption of digital banking have been investigated using panel data logistic regression without the involvement of mediating or moderating variables due to data unavailability. Future research may include mediating or moderating variables, such as the role of Sharia aspects in the adoption of digital banking by Islamic banks. Sharia compliance is a crucial factor for Islamic banks to operate in the market, considering that Islamic banks should comply with the Sharia principle.

The third limitation concerns the context of the study. This study has been conducted in Indonesia, which has adopted a dual banking system where the Islamic banking system operates along with the conventional banking system. This study also concentrated on the banks offering Islamic banking and services, particularly Islamic banks. The findings of the study may be generalised in the context of the dual banking system in Indonesia, particularly the Islamic banking sector. Different countries may have different banking systems along with different characteristics and environments that may result in variations on the findings (Nejad, 2016). Consequently, the findings may not be applied to other banking systems that have differences from the Indonesian dual banking system and the Indonesian Islamic banking system. Therefore, studies conducted in different systems or countries are substantial in providing a more comprehensive picture of the adoption of digital banking. For example, despite the similarity in the use of the dual banking system, the adoption of digital banking in Malaysia may provide different findings due to differences in the characteristics and environment of the banking system.

The fourth limitation is regarding the use of multiple theories. This study employs Diffusion of Innovation Theory, Unified Theory of Acceptance and Use of Technology (UTAUT) and Financial Innovation. The framework of this study has been limited to align with these theories, which affects the process of investigation in this

study. Various theories have been applied in the studies of technology adoption. Involving other theories may reveal a new finding or new insight, as long as the theories are relevant and align with the study objectives. Therefore, future research may consider applying other theories in the studies of technology adoption, for instance, the Technology Acceptance Model (TAM), Information System Theory, DeLone and McLean Model, and Task Technology Fit (TTF).

The fifth limitation is the methods used in this study. The selection of methods in this study is aligned with the objectives of this study. Application of other methods, especially up-to-date methods that involve machine learning or data analytics, may give a new insight. Future research may use other methods that rely on data analytics to have a more comprehensive understanding. For example, the current state of digital banking may apply text mining, prioritisation of digital banking services may apply Artificial Neural Network (ANN), and determinant factors on digital banking adoption may use Decision Trees, Random Forest, Naive Bayes, K-Nearest Neighbour, and Support Vector Machine.

6.6 CHAPTER SUMMARY

This study has investigated digital banking adoption among Islamic banks concerning the current state of digital banking, the priority of the type of services in digital banking by Islamic banks and determinant factors of digital banking adoption by banks offering Islamic banking services. This chapter has outlined the main findings of the study based on the results of the analysis. The current state of digital banking adoption has shown that Internet banking and mobile banking have been adopted by a majority of Islamic banks in Indonesia. The priority of the type of services in digital banking indicates that transfer and payment services have been selected as the most important services in digital banking by Islamic banks. In addition, technology criteria are the main criteria considered in the priority of the type of services in digital banking. Furthermore, bank-specifics and market-specifics significantly affect digital banking adoption by banks offering Islamic banking and services.

The contribution of the study in terms of knowledge, practices or managerial, policy and regulation has also been presented in this chapter. The limitations of the study offer opportunities for further research on digital banking adoption by extending the sample, the time preferences and respondents, as well as including more variables used in the study and examining other countries and banking systems.



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APPENDIX I

LIST OF BANKS OFFERING ISLAMIC BANKING PRODUCTS AND SERVICES IN INDONESIA AS OF DECEMBER 2022

No	Bank	Bank Type
1	PT. Bank Aceh Syariah	Ib
2	PT BPD Riau Kepri Syariah	Ib
3	PT BPD Nusa Tenggara Barat Syariah	Ib
4	PT. Bank Muamalat Indonesia	Ib
5	PT. Bank Victoria Syariah	Ib
6	PT. Bank Jabar Banten Syariah	Ib
7	PT. Bank Syariah Indonesia, Tbk	Ib
8	PT. Bank Mega Syariah	Ib
9	PT. Bank Panin Dubai Syariah, Tbk	Ib
10	PT. Bank Syariah Bukopin	Ib
11	PT. BCA Syariah	Ib
12	PT. Bank Tabungan Pensiunan Nasional Syariah, Tbk	Ib
13	PT. Bank Aladin Syariah, Tbk	Ib
14	PT Bank Danamon Indonesia, Tbk	Cb
15	PT Bank Permata, Tbk	Cb
16	PT Bank Maybank Indonesia, Tbk	Cb
17	PT Bank CIMB Niaga, Tbk	Cb
18	PT Bank OCBC NISP, Tbk	Cb
19	PT BPD DKI	Cb
20	PT BPD Daerah Istimewa Yogyakarta	Cb
21	PT BPD Jawa Tengah	Cb
22	PT BPD Jawa Timur, Tbk	Cb
23	PT BPD Jambi	Cb
24	PT BPD Sumatera Utara	Cb
25	PT BPD Nagari	Cb

No	Bank	Bank Type
26	PT BPD Sumatera Selatan dan Bangka Belitung	Cb
27	PT BPD Kalimantan Selatan	Cb
28	PT BPD Kalimantan Barat	Cb
29	PT BPD Kalimantan Timur	Cb
30	PT BPD Sulawesi Selatan dan Sulawesi Barat	Cb
31	PT Bank Sinarmas	Cb
32	PT Bank Tabungan Negara (Persero), Tbk.	Cb
33	PT Bank Jago, Tbk	Cb

Notes: Ib = Islamic Bank; Cb = Conventional bank that owns Islamic Business Unit



APPENDIX II

SAMPLE OF THE STUDY FOR THE DETERMINANT FACTORS OF DIGITAL BANKING ADOPTION

No	Bank	Bank Type	Bank Asset	Islamic Banking Asset
1	PT. Bank Syariah Indonesia, Tbk	Ib	305,727	305,727
2	PT. Bank Muamalat Indonesia	Ib	61,364	61,364
3	PT. Bank Aceh Syariah	Ib	28,767	28,767
4	PT. Bank Mega Syariah	Ib	16,071	16,071
5	PT BPD Nusa Tenggara Barat Syariah	Ib	13,002	13,002
6	PT. BCA Syariah	Ib	12,672	12,672
7	PT. Bank Jabar Banten Syariah	Ib	12,446	12,446
8	PT. Bank Syariah Bukopin	Ib	7,013	7,013
9	PT. Bank Aladin Syariah, Tbk	Ib	4,733	4,733
10	PT. Bank Victoria Syariah	Ib	2,111	2,111
11	PT Bank CIMB Niaga, Tbk	Cb	301,516	62,957
12	PT Bank Tabungan Negara (Persero), Tbk.	Cb	402,148	45,336
13	PT Bank Permata, Tbk	Cb	255,112	32,732
14	PT Bank Danamon Indonesia, Tbk	Cb	183,708	9,983
15	PT Bank Sinarmas	Cb	402,148	7,459
16	PT BPD Jawa Tengah	Cb	84,494	6,277
17	PT BPD Sumatera Selatan dan Bangka Belitung	Cb	35,300	4,129
18	PT BPD Nagari	Cb	30,096	3,281
19	PT BPD Jawa Timur, Tbk	Cb	103,031	3,071
20	PT BPD Kalimantan Selatan	Cb	21,359	2,785
21	PT BPD Sulawesi Selatan dan Sulawesi Barat	Cb	29,653	2,295
22	PT BPD Daerah Istimewa Yogyakarta	Cb	16,851	1,863
	Total		2,329,322	646,074

Notes: Asset in IDR Trillion; Ib = Islamic Bank; Cb = Conventional bank that owns Islamic Business Unit

APPENDIX III

THE QUESTIONNAIRE FOR SELECTION SERVICES IN DIGITAL BANKING BY ISLAMIC BANKS

Page 1 – Cover

Dear Respected Respondent,

Assalamualaikum wr. wb.,

I am a student for a Doctoral degree at the IIUM Institute of Islamic Banking and Finance, International Islamic University Malaysia, researching the adoption of digital banking by Islamic banks in Indonesia. As such, I intend to conduct a survey that addresses factors considered in the prioritisation of selecting services in digital banking by Islamic banks in Indonesia and the prioritisation of selecting alternative services in digital banking by Islamic banks in Indonesia.

The consent to participate in this research is granted by filling out the questionnaire as attached. We would like to thank you for your willingness to participate in this research. Your responses or judgments in this survey are important and meaningful. It is estimated to take 15 to 30 minutes to fill out the questionnaire.

If the internet browser (for example, Chrome, Mozilla Firefox, etc.) is unexpectedly closed during the process of filling out the questionnaire, the respondent will be brought to the latest question/page filled out by the respondent when the respondent uses a similar browser and mobile devices (smartphone/ tablet) or personal computer/laptop for the next access. Otherwise, the process of filling out the questionnaire will start from the beginning when the respondent accesses the link to the questionnaire using a different mobile device or PC/laptop. Your responses will be confidential and will only be used for academics.

We would like to thank you for your attention and participation in this survey.

Wassalamu'alaikum wr wb.,

Achmad Hidayat

Student of Doctoral Program,
IIUM Institute of Islamic Banking and Finance,
International Islamic University Malaysia,
e-mail: achmadh2017@gmail.com
WhatsApp: +62 878 2430 1064

Page 2: Introduction

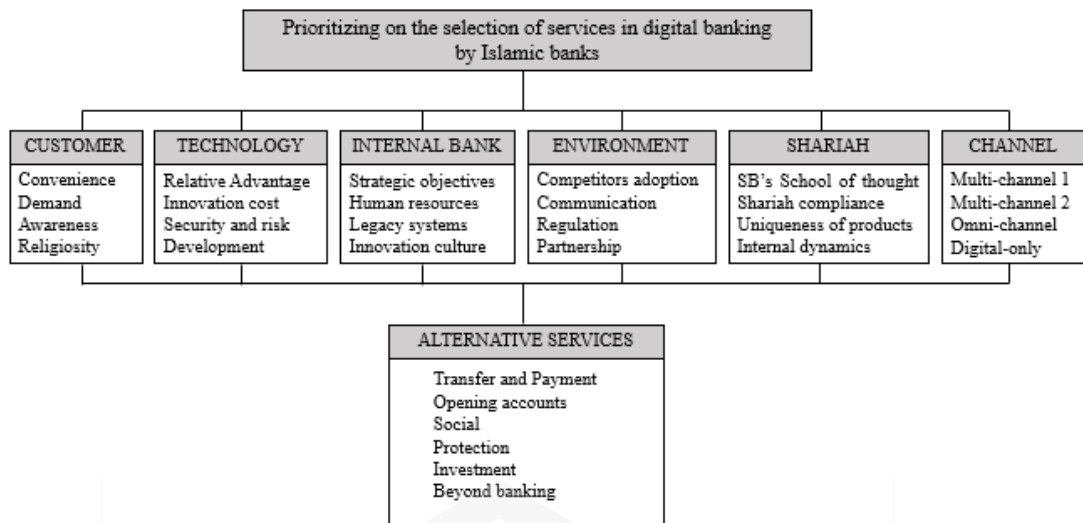
Digital banking is generally defined as banking services offered to the customer through Internet banking and/or mobile banking. Internet banking can be accessed through a website using a Personal Computer or laptop, whilst mobile banking can be accessed through mobile apps using gadgets/mobile devices, for example, smartphones or tablets.

Digital banking services theoretically may take the form of transfer of funds and payments for financial transactions, account opening for deposit, receiving and processing financing applications, investing in Islamic securities, Islamic insurance and non-financial services, for example, leisure and managing finance called beyond banking services.

Various factors needed to be considered by the bank in the adoption of digital banking can be categorised into: Main Criteria Cluster, Sub-Criteria Cluster and Alternative Cluster, as illustrated in the Research Model. Those factors have been identified from the literature on digital banking, Internet banking, mobile banking and Islamic banking, as well as suggestions or outputs of discussions with Islamic banking practitioners and experts.

This research is aimed at determining a priority to select categories of services in digital banking adopted by Islamic banks in Indonesia and various factors influencing the selection. Respondent is asked to grant judgment on those factors (Main Criteria cluster and Sub-Criteria cluster) and categories of services in digital banking (Alternative cluster) by considering the relative importance or the relative influence on the selection of services in digital banking adopted by Islamic banks in Indonesia, based on the Scale as illustrated in the Table of Relative Importance Scale.

Research Model:



The Scale of Relative Importance

The relative importance or relative influence refers to the relative importance scale as illustrated in Table 1 (Relative Importance Scale) below. It is possible to grant similar values on the factors/elements in a similar cluster; however, it is suggested to avoid granting similar values to avoid inconsistency in the judgment.

Table 1. Relative Importance Scale

1	Indifference importance
2	
3	Moderate important
4	
5	Strong importance
6	
7	Very strong importance
8	
9	Extreme importance
*2,4,6,8 = intermediate value	

Example:

It is suggested to avoid granting similar values on the items/elements/factors in the cluster.

Main Criteria Cluster

How much is the degree of influence or relative importance of each factor in the Main Cluster below on the selection of services in digital banking by Islamic banks in Indonesia? (Scale 1-9)

	How much
Customer	8
Technology	7
The internal factor of the Bank	6
Environment	5
Sharia Aspect	9
Channel	4

Page 3: Questionnaire Preview

The questionnaire consists of eight (8) questions/clusters, where each question is required to be answered by filling out the table as illustrated in the Example above, as follows:

1. Main Cluster (six elements/items)
2. Customer factor (four elements/items)
3. Technology factor (four elements/items)
4. Bank Internal factor (four elements/items)
5. Enelementsnt factor (four elements/items)
6. Sharia aspect (four elements/items)
7. Digital channel (four elements/items)
8. Alternative services of digital banking (six elements/items)

Examples of eight questions which are required to be answered are illustrated in the figures below.

Q1: Main Cluster

	How much
Customer
Technology
Internal factor of the Bank
Environment
Sharia Aspect
Channel

Q2: Customer Cluster

	How much
Customer convenience
Customer demand
Customer awareness
Religiosity

Q3: Technology Cluster

	How much
Relative advantage
Innovation cost
Security and risk
Technology development

Q4: Internal Bank Cluster

	How much
Strategic Objectives
Human Resources
Legacy Systems
Innovation Culture

Q5: Environment Cluster

	How much
Competitor adoption
Communication with the competitor
Regulation/Government
Partnership/Collaboration formation

Q6: Sharia Aspect Cluster

	How much
Difference in the school of thought of the Sharia Board members
Sharia compliance
Islamic product uniqueness
Internal dynamics

Q7: Digital Channel Cluster

	How much
Multi-channel 1
Multi-channel 2
Omnichannel
Digital-only

Q8: Alternative Services of Digital Banking

	How much
Fund transfer and payments
Account opening
Security/Protection
Social
Investment
Beyond banking (leisure)

Do you agree to:

1. Participate as a respondent in this research by filling out the questionnaire
2. Grant the right to exploit the responses in this questionnaire, including the respondent data, for academic purposes.

Yes

No

Page 4: Respondent Data

1. Name:

2. Institution:

- Bank/Islamic Bank
- Regulator/Banking Authority/Government
- University/Consultant

3. Institution Name:
4. Department/Division/Faculty:
5. Title/Position:
6. Education level:
 - Bachelor (Diploma III)
 - Sarjana (S1) / Diploma IV
 - Master/Magister (S2)
 - Doctor (S3)
 - Others
7. How long have you had experience in the activities related to Islamic banking/Islamic finance/Islamic economics? (For the respondent from the university, the experience is actively teaching course(s) related to Islamic banking/Islamic finance/Islamic economics; For the respondent from the bank/Islamic bank, government/regulator or consultant, the experience is the title/position related to Islamic banking.)
 - Less than 1 year
 - More than 1 year to 3 years
 - More than 3 years to 5 years
 - More than 5 years
8. (Only for the respondent from the University) Do you have experience publishing any papers related to Islamic banking/Islamic finance/Islamic economics?
 - Never
 - Once in a non-SCOPUS/WOS-indexed journal
 - More than once in non-SCOPUS/WOS-indexed journals
 - Once in a SCOPUS/WOS-indexed journal
 - More than once in the SCOPUS/WOS-indexed journal
9. Your email address:

Page 5: Q1-MAIN CRITERIA Cluster

Concerning Internet banking and/or mobile banking adoption, the bank needs to consider various factors related to Internet banking and/or mobile banking, as follows:

- **Customer** concerning the attitude or behaviour of the customer (Nath et al., 2001; Akinci et al., 2004; Omarini, 2022)

- **Technology**, for example, the advantages of technology (Nath et al., 2001; Omarini, 2022)
- **Internal Factors of the Bank**, for example, strategic and operational issues of the bank (Nath et al., 2001)
- **Environment**, for example, competitors and regulation (Mullan et al., 2017; Omarini, 2022)
- **Sharia Aspect**, for example, Sharia compliance (Al-Salem, 2009; Ahmed, 2014)
- **Channel**, for example digital channel to deliver the services (Akinci et al., 2004; Omarini, 2022)

Main Criteria Cluster

How much is the degree of influence or relative importance of each factor in the Main Cluster below on the Selection of Services in Digital Banking by Islamic Banks in Indonesia? (Scale 1-9)

	How much
Customer	
Technology	
The internal factor of the Bank	
Environment	
Sharia Aspect	
Channel	

Page 6: Q2-Sub-Criteria Cluster for CUSTOMER

- **Convenience**
Better service to customers, such as faster, easier, and reliable, enhances the ability to deal with customers (Aladwani, 2001; Bradley and Stewart, 2002; Mullan et al., 2017).
- **Customer Demand**
Meeting customer demand for the service, customer-driven demand, particularly Islamic bank customers (Aladwani, 2001; Bradley and Stewart, 2002; Mullan et al., 2017; Yumna, 2019).

- **Customer Awareness**

Customer awareness of the services provided by Islamic banks (Jamshidi and Husin, 2018; Chaudhry et al., 2020; Mariani et al., 2021).

- **Religiosity**

Religiosity is an important factor for Islamic bank customers in the adoption of products and services (Jamshidi and Husin, 2018; Suhartanto et al., 2020)

CUSTOMER Cluster

How much is the degree of influence or relative importance of each factor in the Customer Cluster below on the Selection of Services in Digital Banking by Islamic Banks in Indonesia? (Scale 1-9)

	How much
Customer convenience
Customer demand
Customer awareness
Religiosity

Page 7: Q3-Sub Criteria Cluster for TECHNOLOGY

- **Relative advantage**

The advantages brought about by technology, for example, reducing costs and workforce, improving the bank's image and brand development (Aladwani, 2001; Bradley and Stewart, 2002; Mullan et al., 2017)

- **Innovation costs**

Cost related to the technology, such as the introduction of new technology, requires high costs (Bradley and Stewart, 2002; Chaudhry et al., 2020).

- **Security and risk**

Mitigation of the perceived security and risk concerns, such as authentication issues, and security improvement (Bradley and Stewart, 2002; Mullan et al., 2017).

- **Technology development**

Ease of developing the technology to provide digital banking services (Bradley and Stewart, 2002; Chaudhry et al., 2020), for instance, *big data analytics*, *artificial intelligence*, *blockchain*, and others (Thakor, 2020).

TECHNOLOGY Cluster

How much is the degree of influence or relative importance of each factor in the Technology Cluster below on the Selection of Services in Digital Banking by Islamic Banks in Indonesia? (Scale 1-9)

	How much
Relative advantage
Innovation cost
Security and risk
Technology development

Page 8: Q4-Sub Criteria Cluster for BANK INTERNAL Factors

- **Strategic objectives**

Compatibility of the technology with the strategic objective/plan of the bank (Mullan et al., 2017).

- **Human Resources**

Availability of talented staff/specialists to operate the technology and training for the staff, employee engagement on the developing service innovation (Nath et al., 2001; Aladwani, 2001; Tipu, 2014; Chaudhry et al., 2020).

- **Legacy Systems**

Compatibility with existing bank systems, technology and infrastructure (Bradley and Stewart, 2001; Mullan et al., 2017).

- **Innovation culture**

Innovation culture as well as an attitude toward innovation and resistance to change (Bradley and Stewart, 2001).

INTERNAL FACTOR OF THE BANK

How much is the degree of influence or relative importance of each factor in the Internal Factor of Bank Cluster below on the Selection of Services in Digital Banking by Islamic Banks in Indonesia? (Scale 1-9)

	How much
Strategic Objectives
Human Resources
Legacy Systems
Innovation Culture

Page 9: Q5-Sub Criteria Cluster for ENVIRONMENT

- **Competitor adoption**

The number of banks adopting digital banking services (Bradley and Stewart, 2001; Mullan et al., 2017).

- **Competitor communication**

Communication and influence from others in the industry, including the competitors (Bradley and Stewart, 2001; Mullan et al., 2017).

- **Regulation/Government**

Government support, including regulation related to digital banking (Aladwani, 2001; Bradley and Stewart, 2002; Iman, 2020).

- **Partnership and collaboration**

Availability of partnership formation with other stakeholders (Mullan et al., 2017).

ENVIRONMENT Cluster

How much is the degree of influence or relative importance of each factor in the Environment Cluster below on the Selection of Services in Digital Banking by Islamic Banks in Indonesia? (Scale 1-9)

	How much
Competitor adoption
Communication with the competitor
Regulation/Government
Partnership/Collaboration formation

Page 10: Q6-Sub Criteria Cluster for SHARIA ASPECT

- **Difference in the school of thought of the Sharia Board members**

Sharia Board (SB) members may have different schools of thought that influence mutual consent (Chaudhry et al., 2017).

- **Shariah compliance**

The product must comply with Sharia as well as satisfy all Islamic legal requirements. Failure to fulfil Sharia requirements will lead to negative perceptions (Al-Salem, 2009; Ahmed, 2011; Ahmed, 2014; Laldin and Furqani, 2016; Yumna, 2019; Dinc, 2020; Usman et al., 2020).

- **Islamic product uniqueness**

Critics of Islamic banking as a replication of conventional banking and only changes the terminology. Islamic banks need to differentiate from conventional banks as well as innovative products (originality) (Al-Salem, 2009; Laldin and Furqani, 2016; Chaudhry et al., 2017; Dinc, 2020).

- **Internal dynamics**

Friction may occur, causing the involvement of various departments in product development. Product Department (PD) may not be aware of Sharia aspects, while Sharia Boards (SB) may not have a deep understanding of the market (Ahmed, 2011; Chaudhry et al., 2017).

SHARIA ASPECT Cluster

How much is the degree of influence or relative importance of each factor in the Sharia Aspect Cluster below on the Selection of Services in Digital Banking by Islamic Banks in Indonesia? (Scale 1-9)

	How much
Difference in the school of thought of the Sharia Board members
Sharia compliance
Islamic product uniqueness
Internal dynamics

- **Multi-Channel 1**

Banks with physical branches may prioritise **adopting one of the digital channels** (Internet banking or mobile banking), which is separately managed (Laukkanen, 2007; Scornavacca and Hoehle, 2007; Hoehle, 2012; Laukkanen, 2016; Mishra and Singh, 2015).

- **Multi-Channel 2**

Banks with physical branches may conduct channel extension by **adopting both digital** channels (Internet banking and mobile banking) since each channel has its role for the customer and the channels are separately managed (Laukkanen, 2007; Scornavacca and Hoehle, 2007; Hoehle, 2012; Laukkanen, 2016; Mishra and Singh, 2015; Verhoef, 2021).

- **Omnichannel**

Banks with physical branches adopt both digital channels (Internet banking and mobile banking). The channels are integrated to deliver seamless, personalised, consistent, and unified banking services in all channels and enable the customer to switch seamlessly between channels during transaction interactions (Verhoef et al., 2015; Komulainen and Makkonen, 2018; Hamouda, 2019; Verhoef, 2021)

- **Digital channel only**

Banks may choose to be fully digital companies characterised by branchless, superior customer experience, adopting advanced technology (for example, Big Data, AI, and Cloud), and adopting digital channels (Internet banking or mobile banking). Banks may adopt both digital channels since each channel has its role (Schaechter, 2002; Berger, 2003; Choi et al., 2020; Verhoef, 2021)

DIGITAL CHANNEL Cluster

How much is the degree of influence or relative importance of each factor in the Channel Cluster below on the Selection of Services in Digital Banking by Islamic Banks in Indonesia? (Scale 1-9)

	How much
Multi-channel 1
Multi-channel 2
Omnichannel
Digital-only

- **Funds transfer and payments**

Transaction purpose. Money transfers inter-account within the banks, to other banks within the country, across the globe (different countries) (Furst et al., 2002; Malhotra and Singh, 2007; Nicoletti, 2014).

- **Account opening**

Transaction purpose. Set up new accounts for deposit accounts such as checking and saving accounts, receiving as well as processing financing (loans) applications (Furst et al., 2002; Ahmed, 2011; Yumna and Marta, 2021).

- **Security/Protection**

An ancillary product for managing the risk. In the context of Islamic finance, it is related to the Takaful (Furst et al., 2002; Tiwari et al., 2006; Nicoletti, 2014).

- **Investment**

Transaction (selling and purchasing) related to securities or financial instruments. In the context of Islamic finance, it is related to Islamic securities or Islamic financial instruments (Furst et al., 2002; Tiwari et al., 2006; Ahmed, 2001; Yumna and Marta, 2021).

- **Social**

The endowment is an ancillary product for a charity donation. In the context of Islamic finance, it is related to Islamic Social Finance, such as *zakat* or *waqf* (Ahmed, 2011; Nicoletti, 2014)

- **Beyond banking**

Meeting the customer needs beyond banking transactions/financial transactions, such as leisure or managing customer finances. For example, ticket booking, hotel room booking, financial management application, cash flow analysis, and tax calculation for the business customer (Ahmed, 2011; Mariani et al., 2021)

ALTERNATIVE SERVICES Cluster

How much is the degree of influence or relative importance of each factor in the Alternative Services Cluster below on the Selection of Services in Digital Banking by Islamic Banks in Indonesia? (Scale 1-9)

	How much
Fund transfer and payments
Account opening
Security/Protection
Social
Investment
Beyond banking (leisure)

Page 13: Contact Detail

-
- Would you be willing, if necessary, to grant an interview concerning this research?
.....
 - If the answer is “Yes”, please provide us with your contact number or WhatsApp number:
.....

APPENDIX IV

**LOGISTIC REGRESSION RESULT FOR ROBUSTNESS TEST 1
(ALTERNATIVE MEASURES)**

	Baseline Model	Extension Model 1	Extension Model 2	Extension Model 3
ASSET	23.63523*** (3.813782)	22.18483*** (3.415973)	14.19192*** (0.885776)	23.37555*** (3.072013)
OCOI	4.579126 (3.623002)	3.899696 (3.190459)	1.331609 (3.331141)	4.204989 (3.066675)
DEPOSIT	-25.70848*** (7.190407)	-24.10411*** (6.802498)	-14.09569*** (4.330342)	-25.24529*** (6.613205)
ROE	-13.95055** (6.694537)	-14.43592** (5.993574)	-14.1321** (5.559824)	-14.17713** (5.674951)
BTYPE		22.83237*** (6.529436)		
AGE			6.622243*** (1.431448)	
OWNER				23.48265*** (4.282691)
CR5				
DBS				
COVID				
CUST.				
Cons.	-203.8507*** (31.93973)	-202.8177*** (32.95033)	-146.8921*** (7.196435)	-209.0794*** (26.53743)

	Baseline Model	Extension Model 1	Extension Model 2	Extension Model 3
LR chi2(4)	487.41***	495.82***	486.99***	493.9***
Pseudo R2	0.658464	0.669830	0.657906	0.667235
Obs.	691	691	691	691

Note: Standard errors in parentheses, *, **, *** Significant at 10, 5, and 1 per cent levels, respectively.

¹⁾ Logit estimation utilises data from 2013 to 2022, following the availability of digital banking transaction data.

	Extension Model 4	Extension Model 5	Extension Model 6	Extension Model 7¹⁾
ASSET	24.41797*** (2.926083)	8.855776*** (1.334937)	18.50795*** (1.785599)	18.19778*** (1.156492)
OCOI	4.688133 (3.438522)	-0.656406 (5.769804)	-4.595125 (4.87186)	-0.023043 (5.869054)
DEPOSIT	-20.87926*** (5.947436)	-1.156181 (8.29773)	-18.16296*** (5.272956)	-21.2193*** (6.390543)
ROE	-10.09896* (5.900849)	-11.0394 (9.888331)	-22.48715*** (7.015814)	-20.63129** (8.204902)
BTYPE				
AGE				
OWNER				
CR5	-27.57855*** (7.086373)			
DBS		42.60169*** (5.74732)		

	Extension Model 4	Extension Model 5	Extension Model 6	Extension Model 7¹⁾
COVID			16.23882** (6.452769)	
CUST.				5.932353*** (1.342164)
Cons.	-196.7712*** (24.71561)	-101.3782*** (15.13042)	-153.7367*** (17.45312)	-239.7345*** (23.25979)
LR chi2(4)	503.56***	579.49***	501.96***	300.47***
Pseudo R2	0.680293	0.782868	0.678127	0.59837484
Obs.	691	691	691	523

Note: Standard errors in parentheses, *, **, *** Significant at 10, 5, and 1 per cent levels, respectively.

¹⁾ Logit estimation utilises data from 2013 to 2022, following the availability of digital banking transaction data

APPENDIX V

LOGISTIC REGRESSION RESULT FOR ROBUSTNESS TEST 2 (SUB-SAMPLE)

	Baseline Model	Extension Model 1	Extension Model 2	Extension Model 3
ASSET	22.90298*** (3.905278)	23.41199*** (4.076504)	15.87581*** (1.992684)	23.54121*** (4.268399)
LABOUR	16.35583 (56.4962)	15.36756 (57.34215)	94.72318 (61.9867)	3.663163 (3.363164)
DEPOSIT	-25.89594*** (7.517034)	-26.76079*** (7.705142)	-16.25501*** (5.375944)	-24.77435*** (7.550844)
ROA	-157.1349*** (45.76629)	-144.0036*** (43.91664)	-113.2258*** (39.98037)	-16.66588** (6.529822)
BTYPE		26.61835** (10.26374)		
AGE			26.22578*** (2.904319)	
OWNER				25.3314*** (7.180924)
CR5				
DBS				
COVID				
CUST.				
Cons.	-198.733*** (33.91147)	-212.481*** (37.49842)	-239.5581*** (14.16628)	-215.2056*** (39.60922)

	Baseline Model	Extension Model 1	Extension Model 2	Extension Model 3
LR chi2(4)	423.24***	430.71***	446.48***	430.65***
Pseudo R2	0.639852	0.651139	0.674985	0.651048
Obs.	500	500	500	500

Note: Standard errors in parentheses, *, **, *** Significant at 10, 5, and 1 per cent levels, respectively.

¹⁾ Logit estimation utilises data from 2013 to 2022, following the availability of digital banking transaction data.

	Extension Model 4	Extension Model 5	Extension Model 6	Extension Model 7¹⁾
ASSET	25.15203*** (4.781076)	8.046645** (3.902063)	19.91733*** (3.839284)	25.6541*** (4.118398)
LABOUR	137.9038** (69.2959)	248.996 (197.5819)	-23.75816 (59.86782)	28.20891 (82.18701)
DEPOSIT	-21.21477*** (6.931218)	11.06814 (14.04251)	-21.9505*** (6.915878)	-34.4629*** (10.86595)
ROA	-141.7542*** (41.46941)	-117.3393* (69.1399)	-138.5687*** (39.84338)	-162.7406*** (46.18667)
BTYPE				
AGE				
OWNER				
CR5	-36.35916*** (8.916547)			
DBS		77.33966*** (20.65775)		

	Extension Model 4	Extension Model 5	Extension Model 6	Extension Model 7¹⁾
COVID			28.38631*** (10.42945)	
CUST.				6.388801*** (1.588466)
Cons.	-203.3855*** (39.92565)	-132.1112*** (43.50299)	-173.71*** (34.24082)	-309.8116*** (48.05114)
LR chi2(4)	446.34***	536.9***	435.71***	267.3***
Pseudo R2	0.674772	0.811673	0.658696	0.57929151
Obs.	500	500	500	380

Note: Standard errors in parentheses, *, **, *** Significant at 10, 5, and 1 per cent levels, respectively.

¹⁾ Logit estimation utilises data from 2013 to 2022, following the availability of digital banking transaction data.

GLOSSARY

- Adoption.** A decision to fully utilise an innovation as the best course of action available.
- Beyond banking.** Banking services outside the financial services or non-financial services, for example, personal finance management and leisure or lifestyle.
- Diffusion.** The process of communicating an innovation over time to the members of a given social system through a certain channel
- Digital banking.** The process to deliver banking services to customers through digital channels, including internet banking and mobile banking.
- Digital bank.** A bank characterised by a branchless office which offers banking services only through digital banking channels without relying more on the physical branch to deliver banking services (a fully digital company).
- Digital channel.** A virtual delivery channel emphasises the use of data communication or internet connectivity to enable customers to access services.
- Internet banking.** Remote delivery channel using the Internet to deliver banking services by using a bank's website, and a computer or a personal computer to access computer-based websites.
- Innovation (Technology).** A design for instrumental action that reduces the uncertainty in the cause-and-effect relationships involved in achieving a desired outcome.
- Islamic bank.** A bank that operates banking activities in compliance with Islamic law (Sharia), by satisfying all Islamic legal requirements and without violating any of the conditions defined by the Islamic system.
- Islamic banking.** A system of banking or banking activity that complies with the Sharia principle.
- Mobile banking.** A channel used by customers to interact with the bank using a mobile device and mobile phone applications to access banking services.
- Multi-channel.** A strategy to deliver banking services using multiple channels, for example, by using physical branches and digital channels (Internet banking and mobile banking) without integrating the involved channels.
- Omnichannel.** A strategy to deliver banking services using multiple channels, for example, physical branches and digital channels, by integrating the involved channels in a seamless and personalised service to enhance customer experience.

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