

## Digital Transformation in Pakistan's Banking Sector: Adoption Patterns, Performance Outcomes, and Implementation Barriers

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### ABSTRACT

*This study examines digital transformation in Pakistan's banking sector from 2015 to 2025, focusing on technology adoption patterns, performance outcomes, and implementation barriers. Using a mixed-method approach combining a survey of 187 banking professionals and semi-structured interviews with 15 industry experts, the research assesses initiatives including Raast, Roshan Digital Account, and EMI frameworks introduced by the State Bank of Pakistan. During 2021-2025 mobile banking users increased 121% to 24.1 million, digital transaction volume rose from 0.3 to 2.1 billion. Results reveal mobile banking adoption correlated strongly with operational efficiency ( $r = 0.62, p < 0.01$ ). Regression analysis identified mobile infrastructure ( $\beta = 0.31$ ), top management commitment ( $\beta = 0.27$ ), and employee digital competency ( $\beta = 0.26$ ) as the strongest predictors of digital banking success, explaining 58% of the variance. However, significant challenges persist: cybersecurity threats ranked as the most severe barrier ( $M = 4.28$ ), followed by customer digital literacy ( $M = 4.21$ ) and infrastructure limitations ( $M = 4.15$ ). Private banks significantly outperformed public institutions across all digitalization indicators ( $p < 0.001$ ), raising concerns about equitable financial inclusion. Qualitative findings revealed six themes: accelerated COVID-19 adoption, regulatory enablement, talent gaps, urban-rural divides, fintech collaboration, and data security concerns. The study concludes that while Pakistan has made significant digital banking strides, coordinated action among banks, regulators, and technology providers is essential to address persistent barriers and ensure inclusive, secure, and sustainable digital financial growth.*

**Keywords:** digital banking, financial inclusion, cybersecurity, Pakistan, fintech, mobile banking

### INTRODUCTION

Globally, the banking industry is undergoing a dramatic transition due to the quick speed of technology advancement, changing consumer needs, and an increasing focus on financial inclusion. The financial scene in Pakistan is likewise going through a significant change. The sector, which has historically relied on physical branches and traditional banking techniques, is now gradually embracing digital alternatives, from online platforms and mobile banking apps to support systems powered by artificial intelligence and

instant payment systems. These represent a complete transformation of the way banking services are conceived, provided, and regulated across the country, they are not merely minor revisions (Arif, 2023). This study explores the dynamic shifts taking place in Pakistan's banking sector, emphasizing the drivers, challenges, and wider ramifications for all participants in the financial system.

Digital banking has significantly expanded in Pakistan over the last ten years. Numerous factors, including a largely youthful, tech-savvy populace, expanding smartphone and internet access, and encouraging policies implemented by the State Bank of Pakistan (SBP), have contributed to this advancement. According to recent data, mobile banking users have surpassed 19 million, and digital transactions have grown by more than 30% annually. This digital transition has been further accelerated by initiatives like "Go Cashless," Raast, the country's instant payment system, and the Roshan Digital Account program for Pakistanis living abroad (Sikandar, 2025). Retail digital payments in Pakistan grew significantly in the second quarter of financial year 2025. The total value increased by around 12%, to Rupees 154 trillion, while the number of retail transactions increased by roughly 11%, to about 2,143 million (Moin, 2025).

But the path to digital transformation is not easy. Digital tools present new problems in addition to the potential for more efficient services, reduced operating costs, and wider access, especially in underserved or distant areas. Significant concerns include cybersecurity risks, low levels of digital and financial literacy, uneven infrastructure development, and changing regulatory requirements (Waliullah et al., 2025). The conventional banking system is being upended by the quick ascent of FinTech companies, neobanks, and integrated financial technology, which is forcing established banks to develop and establish new alliances. Concerns of inclusion are also raised by differences in digital access between urban and rural communities (Musaddiq et al., 2025).

Significant strides have been made by the government and SBP to provide a supportive regulatory environment. Aiming to promote innovation while protecting the interests of consumers, initiatives include the implementation of open Application Programming Interfaces (API) policies, digital banking frameworks, and electronic money institution (EMI) licenses. Pakistan is now a major participant in the development of digital banking in South Asia as a result of these governmental initiatives as well as partnerships between financial institutions and tech firms.

The digital revolution occurring in Pakistan's banking sector is examined in this study. It looks into the industry's historical growth, contemporary trends, technical developments, governmental reactions, and possible future paths. In addition to evaluating how digitalization is changing fundamental components including customer experience, financial outreach, risk management procedures, and market rivalry, the article attempts to identify the main factors that are facilitating and impeding this shift. This study believes that digital banking is no longer optional for Pakistan; it is required. As the country strives for greater economic modernization and inclusive growth, the digitization of its banking industry will be an important driver of financial stability, innovation, and global economic integration in the coming years.

### **Scope of Research**

This study focuses on the digital transformation taking place in Pakistan's banking industry. It looks into how various financial institutions, including commercial banks, Islamic banks, and emerging fintech firms, are incorporating digital technologies including mobile apps, online banking services, artificial intelligence (AI), and blockchain-based solutions. The analysis runs from 2015 to 2025 and includes important milestones such as the launch of Raast, the introduction of the Roshan Digital Account, and the issuance of digital banking licenses for platforms like Easypaisa. It takes into account changes that

occurred during the COVID-19 epidemic, which considerably hastened the transition to digital financial services.

The paper investigates the primary drivers of this transformation, such as the effect of regulatory frameworks implemented by the State Bank of Pakistan (SBP), changing client preferences, and larger trends in technology usage. It also examines the impact of digitization on key performance areas like as operational efficiency, customer engagement, financial inclusion, and sector competitiveness.

The study's data sources include both primary and secondary data, such as SBP publications, university research, and recent fintech trend studies. This research is especially important for academics, financial regulators, banking professionals, and stakeholders interested in digital financial services and policy development.

### **Rationale of Research**

Global banking systems are changing due to the quick development of digital technologies, and Pakistan is no exception. However, the nation's banking industry faces particular difficulties, such as limited infrastructure, problems with regulations, and customers' differing degrees of digital literacy. Banks must change to remain competitive as customer expectations move toward quicker, more convenient digital services. Despite this change, not much research has been done expressly on Pakistan's move to digital banking. By investigating current trends, obstacles, and the overall effects of digitalization on banking operations, consumer behavior, and the larger financial ecosystem in Pakistan, this study seeks to close that gap.

### **Research Problem**

Understanding how digital transformation is changing banking services, customer behavior, and operational efficiency is one of the article's main research questions. Issues like cybersecurity risks, a lack of digital literacy, and regulatory barriers still exist despite the increasing use of digital tools. The study aims to investigate the discrepancy between technological development and its successful application in Pakistan's numerous banking institutions. It seeks to evaluate how prepared banks and consumers are to adopt digital platforms, as well as the ways in which these developments affect customer satisfaction, financial inclusion, and the nation's long-term banking viability.

### **Research Questions**

The following important questions, each of which relates to the stated main goals, are the focus of this study:

1. Which digital platforms, technologies, and services are Pakistani banks currently utilizing?
2. What economic, social, and technological elements are supporting the banking industry's digital transformation?
3. In the upcoming years, which new developments and trends, particularly those related to fintech and artificial intelligence, are most likely to completely alter Pakistan's banking industry?
4. What are the primary risks and obstacles impeding the adoption of digital banking, such as infrastructure constraints, cybersecurity threats, and a lack of digital literacy?

5. How much have national programs and regulatory actions (like Raast and Roshan Digital Account) advanced safe, effective, and accessible digital banking in Pakistan?

### **Research Objectives**

The purpose of this study is to look into how the banking industry in Pakistan is changing in terms of digitalization. The following are the main goals driving this study:

1. To examine the general development of digital technologies and current trends in the banking sector of Pakistan during the past ten years.
2. To investigate the primary organizational, technological, and environmental elements propelling the industry's digital transformation.
3. To assess how digital banking improves customer experience, fosters wider financial inclusion, and affects banks' operational efficiency.
4. To determine and evaluate the main risks and obstacles influencing the adoption of digital banking, such as cybersecurity threats, legal restrictions, and infrastructure deficiencies.
5. To investigate how the development and organization of digital financial services in Pakistan are affected by governmental and regulatory frameworks, including programs like Raast and the Roshan Digital Account.

### **LITERATURE REVIEW**

Research on topics including fintech integration, organizational performance, user behavior, cybersecurity, and innovation strategies has focused on the changing digital landscape of Pakistan's banking industry.

#### **Theoretical Foundations of Digital Banking Adoption**

One well-known study by Irum and Akhtar (2021) investigates the factors that encourage First Women Bank of Pakistan staff members to embrace financial technology. According to their research, trust, perceived utility, financial literacy, and ease of use are important factors affecting the adoption of digital tools. These findings align with the Unified Theory of Acceptance and Use of Technology (UTAUT), which identifies performance expectancy, effort expectancy, social influence, and facilitating conditions as key adoption determinants (Venkatesh et al., 2003). Ali et al. (2022) applied this framework specifically to Pakistan during the COVID-19 era, finding that users' intentions to use digital banking services are significantly shaped by perceived risk, social influence, and performance and effort expectancy.

In a related endeavor, Akhtar et al. (2023) assesses how fintech affects the financial performance of fifteen Pakistani banks. Their findings support the performance benefits of digital banking solutions by indicating a positive correlation between increased mobile transaction activity and Return on Equity (ROE) and Return on Assets (ROA). Usability, performance expectations, data privacy, and peer influence are all powerful predictors of e-banking adoption, according to parallel research on Islamic banking clients in Pakistan (Ali et al., 2022).

### **Digital Transformation and Organizational Performance**

The implications of digital transformation for sustainability have also come into focus. Even though infrastructure and regulatory constraints continue to be major obstacles in nations like Pakistan, studies now indicate that fintech-enabled innovation is turning into a strategic enabler of long-term resilience in banking. To elaborate, a quantitative study published in the *Journal of Economic Info* in 2024 indicates that the banking industry benefits from the adoption of fintech in terms of efficiency and competitiveness. To support these conclusions, Iqbal and Fikri (2025) evaluate the effects of globalization, AI, and fintech integration on financial performance and customer satisfaction using panel data from 2010 to 2023. Fintech stands out among these elements as having the greatest impact on achieving these results.

The financial industry now has a rare chance to change its operational frameworks and customer engagement models due to the rapid pace of digital adoption, especially in reaction to global disruptions like the COVID-19 pandemic (Dutta et al., 2025). In addition to improving internal efficiencies and reducing operating costs, this digital transformation transforms how financial institutions engage with their customers through cutting-edge digital interfaces, increasing productivity and competitiveness (Xuan et al., 2025; Bueno et al., 2024). Furthermore, digital tools are now essential for enhancing operational performance and establishing banks as pioneers in industry innovation (Bueno et al., 2024). Better financial outcomes and long-term sector growth are directly impacted by improved resource utilization, cost optimization, and efficient risk management made possible by digital innovations (Bueno et al., 2024). Also, as businesses use digital platforms and cutting-edge technologies to provide innovative and customer-focused financial services, this broad adoption of digital solutions is opening the door for the creation of new business models in the financial sector (Mavlutova et al., 2022).

### **Barriers to Digitalization: Cybersecurity and Infrastructure**

Regarding cybersecurity, a thorough analysis of security threats in online banking settings is carried out by Waliullah et al. (2025). He lists malware, phishing, and illegal access as the main dangers and stresses the importance of countermeasures like blockchain technology, biometric verification, two-factor authentication, and AI-based fraud detection. However, he also cautions that working with outside fintech companies may result in additional security risks (Waliullah et al., 2025). These concerns are particularly salient in developing economies where regulatory frameworks may lag behind technological advancement.

A comparison of Pakistan's public and private banks' responses to digitalization is given by Khan (2022). According to his research, private institutions have adopted digital platforms more quickly, providing services like online portals, mobile banking apps, and AI-powered customer support. To stay competitive, public banks are progressively incorporating digital tools, despite their slower rate of adaptation. This contrast emphasizes how investment capacity and organizational flexibility drive technological change (Khan, 2022).

### **Fintech Innovation and Emerging Technologies**

The financial ecosystem has seen new dynamics as a result of the rise of fintech startups. These businesses are using blockchain technology, cloud infrastructure, and mobile platforms to provide cutting-edge services like digital wallets, peer-to-peer lending, and microinvestment tools. (Zaidi & Shah, 2023). Younger users and small businesses looking for flexible financial options will find these solutions especially appealing. However, the actual adoption of advanced technologies like blockchain in Pakistan's banking sector remains an empirical question that requires investigation.

Comparative research from nations like Kenya and India provides insightful insights. Financial access has been greatly increased by their successful deployment of biometric verification and mobile banking systems. As Pakistan looks to create inclusive and scalable digital financial ecosystems, these models offer helpful frameworks (Demirguc-Kunt et al., 2018). Kenya's M-Pesa, for instance, has achieved over 90% adult penetration, while India's Unified Payments Interface (UPI) processed over 100 billion transactions in 2024, providing benchmarks against which Pakistan's progress can be assessed.

### **Regulatory Developments and National Initiatives**

Significant strides have been made by the government and State Bank of Pakistan (SBP) to provide a supportive regulatory environment. Aiming to promote innovation while protecting the interests of consumers, initiatives include the implementation of open Application Programming Interfaces (API) policies, digital banking frameworks, and electronic money institution (EMI) licenses. Major digital milestones include the SBP's 2021 launch of Raast, a real-time payment system, and the 2020 launch of Roshan Digital Accounts for Pakistanis living abroad. These programs help achieve more general goals related to digital access and financial inclusion (SBP, 2024). Furthermore, Easypaisa's transformation from a mobile wallet to a fully licensed digital bank by 2025 shows how fintech is still redefining the financial services industry in the nation.

Real-world events in Pakistan closely correspond with these academic discoveries. In July 2025, Pakistan established the Pakistan Virtual Assets Regulatory Authority (PVARA), marking a significant milestone. In order to improve the interbank system, financial inclusion, and payments infrastructure, SBP has selected the Japanese company Soramitsu to assist in the development of a Central Bank Digital Currency (CBDC) pilot. Subject to parliamentary approval, SBP has agreed in principle to grant legal status to digital currencies under the Virtual Assets Bill, 2025 (Kiani, 2025).

### **Digital Literacy and Customer Behavior**

Crucially, in order to fully realize the potential of digital advancements, digital transformation requires a profound shift in organizational mindset and workforce skills, which goes beyond simply implementing new technologies (Shahzad et al., 2025). Research consistently highlights that customer digital literacy is a critical determinant of adoption success. Studies in developing economies demonstrate that without corresponding investments in digital education, technological infrastructure alone cannot achieve inclusive financial growth (Demirguc-Kunt et al., 2018).

### **Research Gaps**

Despite this rich body of literature, several gaps remain. First, while studies have examined adoption factors and performance outcomes separately, few have integrated these analyses to understand the relative importance of various predictors. Second, the discrepancy between the potential of emerging technologies (like blockchain) and their actual implementation in Pakistan's banking sector requires empirical investigation. Third, comparative analysis between public and private sector digitalization efforts remains limited. Fourth, the impact of recent regulatory initiatives (Raast, PVARA, CBDC pilot) on ground-level digital banking outcomes has not been systematically assessed. The present study addresses these gaps through a mixed-method investigation of Pakistan's digital banking transformation from 2015 to 2025.

In summary, the literature paints a vibrant picture of the banking industry's digital transformation in Pakistan. Even though there has been significant progress, more funding is needed for consumer education, regulatory reform, and technology infrastructure in order to fully reap the rewards of digital

finance. The present study contributes to this evolving discourse by providing empirical evidence on the current state of digitalization, the factors that enable or constrain it, and the implications for Pakistan's financial ecosystem.

## **METHODOLOGY**

### **Research Design**

This study employed a mixed-method research design, combining quantitative survey data with qualitative semi-structured interviews. The mixed-method approach was selected to capture both the measurable trends in digital banking adoption and the nuanced experiences of banking professionals implementing these technologies (Creswell & Clark, 2017). This design enables a comprehensive understanding of Pakistan's digital banking transformation by triangulating statistical patterns with stakeholder perspectives.

A priori power analysis using G\*Power 3.1 indicated that a sample of 146 participants would achieve 95% power to detect a medium effect size ( $f^2 = 0.15$ ) with six predictor variables at  $\alpha = 0.05$  (Faul et al., 2009). Our obtained sample of 187 participants exceeds this minimum requirement for the primary regression model (Table 4).

For the secondary regression analysis examining digital literacy impact (Table 10), a post-hoc power analysis was conducted. With 187 participants and four predictor variables, the achieved power to detect a medium effect size ( $f^2 = 0.15$ ) exceeded 0.99, indicating the sample was more than adequate for this analysis as well. For bivariate correlations (Table 3), the sample of 187 provides 95% power to detect a correlation of  $r = 0.20$  at  $\alpha = 0.05$  (two-tailed).

### **Target Population and Sampling**

The target population comprised professionals working in Pakistan's banking sector, including commercial banks, Islamic banks, and fintech firms operating within the country. A purposive sampling strategy was used to select participants with direct involvement in digital banking initiatives, technology implementation, or strategic decision-making.

For the quantitative component, 250 banking professionals were invited to participate, with 187 completed responses received (response rate = 74.8%). The sample included branch managers ( $n = 42$ ), IT and digital banking officers ( $n = 58$ ), operations managers ( $n = 39$ ), and customer relationship managers ( $n = 48$ ).

For the qualitative component, 15 semi-structured interviews were conducted with senior banking executives, digital product managers, and regulatory affairs specialists from both public and private sector banks.

**Table 1**  
*Demographic Characteristics of Survey Respondents (N = 187)*

| Characteristic   | Category                   | n   | %    |
|------------------|----------------------------|-----|------|
| <b>Gender</b>    | Male                       | 124 | 66.3 |
|                  | Female                     | 63  | 33.7 |
| <b>Age Group</b> | 25-34 years                | 58  | 31.0 |
|                  | 35-44 years                | 72  | 38.5 |
|                  | 45-54 years                | 41  | 21.9 |
|                  | 55 years and above         | 16  | 8.6  |
| <b>Bank Type</b> | Private Commercial Bank    | 98  | 52.4 |
|                  | Public Sector Bank         | 47  | 25.1 |
|                  | Islamic Bank               | 28  | 15.0 |
|                  | Fintech Company            | 14  | 7.5  |
| <b>Job Role</b>  | Branch Manager             | 42  | 22.4 |
|                  | IT/Digital Banking Officer | 58  | 31.0 |
|                  | Operations Manager         | 39  | 20.9 |

| Characteristic    | Category                      | n  | %    |
|-------------------|-------------------------------|----|------|
|                   | Customer Relationship Manager | 48 | 25.7 |
| <b>Experience</b> | Less than 5 years             | 41 | 21.9 |
|                   | 5-9 years                     | 67 | 35.8 |
|                   | 10-14 years                   | 52 | 27.8 |
|                   | 15 years and more             | 27 | 14.5 |
|                   |                               |    |      |

## Data Collection Instruments

### Quantitative Survey

A structured questionnaire was developed based on established scales from prior digital banking research (Irum & Akhtar, 2021; Venkatesh et al., 2012). The instrument comprised five sections:

1. Demographic information (5 items)
2. Digital technology adoption (12 items measuring use of mobile banking, AI, blockchain)
3. Perceived barriers to digitalization (10 items covering infrastructure, literacy, cybersecurity)
4. Organizational readiness (8 items)
5. Customer engagement outcomes (6 items)

All items used a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Digital banking usage frequency was measured with a single item: 'On average, how often do you use digital banking services (mobile app, internet banking) for your banking needs?' rated on a 5-point scale: 1 = 'Rarely (less than once per month)', 2 = 'Occasionally (1-3 times per month)', 3 = 'Regularly (once per week)', 4 = 'Frequently (several times per week)', and 5 = 'Daily'.

The questionnaire was pilot tested with 15 banking professionals to assess clarity and relevance, resulting in minor wording modifications.

### **Qualitative Interview Protocol**

A semi-structured interview guide was developed to explore current digital banking initiatives and technologies implemented, the factors driving or hindering digital transformation, and the impacts of regulations and policies. The guide also addressed future directions and emerging trends, as well as ethical considerations including data privacy and digital inclusion. The protocol included open-ended questions with probes to encourage detailed responses.

### **Construction of the Digital Banking Success Index**

The dependent variable, Digital Banking Success Index, was constructed as a composite measure comprising three indicators from Table 3: operational efficiency, customer satisfaction, and financial inclusion reach. Each indicator was standardized to z-scores, and the index was calculated as the mean of the three standardized values. The index demonstrated acceptable internal consistency (Cronbach's  $\alpha = 0.84$ ).

### **Data Collection Procedures**

Data collection occurred between November 2025 and January 2026. For the quantitative survey, an online questionnaire was distributed via email to banking professionals using professional networks and LinkedIn banking groups. Two follow-up reminders were sent at one-week intervals to improve response rates.

For qualitative interviews, potential participants were contacted directly via email or professional referrals. Interviews were conducted via Zoom or in-person based on participant preference, lasting between 45 and 75 minutes. All interviews were audio-recorded with participants' explicit consent and transcribed verbatim within 48 hours. Field notes were maintained to capture contextual observations and non-verbal cues.

### **Ethical Considerations**

All participants were provided with an information sheet detailing the study's purpose, procedures, and their rights. Informed consent was obtained from all participants prior to data collection.

Key ethical safeguards included anonymity (all identifying information removed), confidentiality (data stored on password-protected servers), voluntary participation (right to withdraw at any time), and data security (encrypted digital files).

## **DATA ANALYSIS TECHNIQUES**

### **Quantitative Analysis**

Survey data were analyzed using SPSS (Version 28). Descriptive statistics (frequencies, means, standard deviations) were calculated to summarize demographic characteristics and technology adoption patterns. Inferential statistics, including Pearson correlation coefficients and multiple regression analysis, were employed to examine relationships between digital technology adoption and perceived organizational outcomes. Statistical significance was set at  $p < 0.05$ .

### **Common Method Bias Test**

To assess the potential for common method bias inherent in self-reported survey data, Harman's single-factor test was conducted. An unrotated exploratory factor analysis on all survey items revealed that a single factor accounted for 28.4% of the total variance, well below the 50% threshold, indicating that common method bias is unlikely to be a significant concern (Podsakoff et al., 2003).

### **Qualitative Analysis**

Interview transcripts were analyzed using thematic analysis following Braun and Clarke (2021) six-phase framework:

1. Data familiarization: Repeated reading of transcripts
2. Initial coding: Systematic coding of meaningful data segments
3. Theme generation: Clustering codes into potential themes
4. Theme review: Checking themes against coded extracts and entire dataset
5. Theme definition: Refining and naming themes
6. Write-up: Selecting vivid examples and relating analysis to research questions

Two researchers independently coded transcripts 1, 2, and 3. Inter-coder reliability was assessed on transcripts 1, 2, and 3 (20% of the sample). Raw percentage agreement was 87%. Chance-corrected agreement using Cohen's  $\kappa$  was 0.73, indicating substantial agreement (Landis & Koch, 1977). Discrepancies were resolved through discussion. The remaining transcripts were coded by the primary researcher.

During interviews, themes were classified as 'spontaneous' if raised by participants without prompting from the interviewer, and 'prompted' if they emerged only after direct questioning. This distinction was recorded immediately following each interview and subsequently verified during transcript review.

### **Saturation Assessment**

Thematic saturation was assessed prospectively by reviewing cumulative themes after each set of three interviews. Saturation was operationally defined as the point at which three consecutive interviews yielded no new themes. This threshold was reached after 12 interviews. New code instances continued to appear in subsequent interviews (e.g., additional examples of fintech partnerships in P13 and P15), which is expected as participants elaborated on established themes. Code frequency distribution is provided in Appendix A.

### **Integration of Methods**

Findings from both data sources were integrated during interpretation using a convergent design (Fetters et al., 2013). Quantitative results were compared and contrasted with qualitative themes to identify areas of convergence, divergence, and complementarity.

### **Validity and Trustworthiness**

#### **Quantitative Validity**

Content validity was ensured by deriving survey items from validated instruments and reviewing them with three banking experts. Construct validity was confirmed through exploratory factor analysis. Reliability was established with Cronbach's alpha coefficients ranging from 0.78 to 0.89 across scales, exceeding the acceptable threshold of 0.70.

#### **Test-Retest Reliability**

Due to the cross-sectional design of the study, test-retest reliability was not assessed. This represents a limitation, as temporal stability of the measures remains unknown.

#### **Qualitative Trustworthiness**

Credibility was enhanced through member checking with five participants who reviewed summary findings. Transferability was supported through detailed descriptions of context and participants. Dependability was established through an audit trail documenting all research decisions. Confirmability was maintained through reflexive journaling to bracket researcher assumptions.

### **RESULTS**

The results are organized into five subsections corresponding to the research objectives: (a) demographic characteristics of respondents, (b) digital technology adoption patterns, (c) relationships between technology adoption and organizational outcomes, (d) barriers to digitalization, and (e) qualitative findings from interviews.

#### **Digital Technology Adoption Patterns**

Respondents rated the extent of digital technology adoption in their institutions on a 5-point Likert scale (1 = *not at all adopted*, 5 = *fully adopted*). Table 2 presents descriptive statistics for eight key technologies.

**Table 2**

*Descriptive Statistics for Digital Technology Adoption*

| Technology Type             | <i>M</i> | <i>SD</i> | % Using Extensively |
|-----------------------------|----------|-----------|---------------------|
| Mobile Banking Applications | 4.32     | 0.67      | 78.6                |
| Internet Banking Platforms  | 4.18     | 0.72      | 74.3                |

| Technology Type                   | <i>M</i> | <i>SD</i> | % Using Extensively |
|-----------------------------------|----------|-----------|---------------------|
| Biometric Authentication          | 3.95     | 0.84      | 68.4                |
| AI-Powered Chatbots               | 3.42     | 1.03      | 52.9                |
| Cloud Computing Services          | 3.38     | 1.12      | 48.7                |
| Data Analytics for CRM            | 3.76     | 0.93      | 61.5                |
| Open APIs for Fintech Integration | 2.87     | 1.18      | 31.6                |
| Blockchain/DLT Solutions          | 2.15     | 1.24      | 18.2                |

*Note:* Mean scores based on 5-point Likert scale. CRM = Customer Relationship Management. DLT = Distributed Ledger Technology.

Mobile banking applications demonstrated the highest adoption rate ( $M = 4.32$ ,  $SD = 0.67$ ), with 78.6% of respondents reporting extensive use. Internet banking platforms followed closely ( $M = 4.18$ ,  $SD = 0.72$ ). Biometric authentication also showed relatively high adoption ( $M = 3.95$ ,  $SD = 0.84$ ), consistent with the State Bank of Pakistan's emphasis on secure digital identity verification.

Conversely, blockchain solutions showed the lowest adoption ( $M = 2.15$ ,  $SD = 1.24$ ), with only 18.2% of respondents indicating extensive use. This finding aligns with the emerging nature of blockchain technology in Pakistan's banking sector, though recent regulatory developments may accelerate future adoption.

### **Technology Adoption and Organizational Outcomes**

To examine relationships between technology adoption and organizational outcomes, Pearson correlation coefficients were calculated. Table 3 presents the correlation matrix.

**Table 3**

*Correlation Matrix: Technology Adoption and Organizational Outcomes*

| Variable                     | 1      | 2      | 3      | 4      | 5     |
|------------------------------|--------|--------|--------|--------|-------|
| 1. Mobile Banking Adoption   | —      |        |        |        |       |
| 2. AI Integration            | 0.48** | —      |        |        |       |
| 3. Operational Efficiency    | 0.62** | 0.51** | —      |        |       |
| 4. Customer Satisfaction     | 0.57** | 0.53** | 0.61** | —      |       |
| 5. Cost Reduction            | 0.44** | 0.39** | 0.58** | 0.43** | —     |
| 6. Financial Inclusion Reach | 0.51** | 0.32*  | 0.46** | 0.49** | 0.38* |

*Note: \* $p < 0.05$ . \*\* $p < 0.01$ .*

All correlations were significant at  $p < 0.01$  except where noted.

Significant positive correlations emerged between all technology adoption variables and organizational outcomes. Mobile banking adoption correlated strongly with operational efficiency ( $r = 0.62, p < 0.01$ ) and customer satisfaction ( $r = 0.57, p < 0.01$ ). AI integration demonstrated moderate to strong correlations with operational efficiency ( $r = 0.51, p < 0.01$ ) and customer satisfaction ( $r = 0.53, p < 0.01$ ). Financial inclusion reach correlated significantly with both mobile banking adoption ( $r = 0.51, p < 0.01$ ) and customer satisfaction ( $r = 0.49, p < 0.01$ ).

### **Predictors of Digital Banking Success**

A multiple regression analysis was conducted to identify significant predictors of digital banking success. The dependent variable was a composite Digital Banking Success Index, comprising measures of operational efficiency, customer satisfaction, and financial inclusion reach. Six predictor variables were entered simultaneously based on theoretical relevance and prior research. Table 4 presents the regression results.

**Table 4**

*Multiple Regression Analysis Predicting Digital Banking Success*

| Predictor Variable            | <i>B</i> | <i>SE</i> | $\beta$ | <i>t</i> | <i>p</i> | VIF  |
|-------------------------------|----------|-----------|---------|----------|----------|------|
| (Constant)                    | 0.87     | 0.24      |         | 3.62     | <0.001   |      |
| Mobile Banking Infrastructure | 0.34     | 0.08      | 0.31    | 4.25     | <0.001   | 1.52 |
| Top Management Commitment     | 0.31     | 0.09      | 0.27    | 3.44     | 0.001    | 1.68 |
| Employee Digital Competency   | 0.28     | 0.07      | 0.26    | 4.00     | <0.001   | 1.44 |
| Regulatory Support            | 0.22     | 0.06      | 0.24    | 3.67     | <0.001   | 1.39 |
| Customer Digital Literacy     | 0.18     | 0.07      | 0.17    | 2.57     | 0.011    | 1.25 |
| Cybersecurity Measures        | 0.15     | 0.08      | 0.12    | 1.88     | 0.062    | 1.31 |

*Note:* The Digital Banking Success Index is a composite measure of operational efficiency, customer satisfaction, and financial inclusion reach.  $R^2 = 0.58$ , Adjusted  $R^2 = 0.56$ ,  $F(6, 180) = 41.23$ ,  $p < 0.001$ . Dependent variable: Digital Banking Success Index. VIF = Variance Inflation Factor. All VIF values are below the conventional threshold of 5 (and well below 2.5), indicating no problematic multicollinearity.

The regression model was significant,  $F(6, 180) = 41.23$ ,  $p < 0.001$ , and explained 58% of the variance in digital banking success ( $R^2 = 0.58$ ). Five of the six predictor variables emerged as significant contributors.

Mobile banking infrastructure was the strongest predictor ( $\beta = 0.31$ ,  $p < 0.001$ ), underscoring the foundational role of robust digital platforms. Top management commitment ( $\beta = 0.27$ ,  $p = 0.001$ ) and employee digital competency ( $\beta = 0.26$ ,  $p < 0.001$ ) also demonstrated substantial effects. Regulatory support ( $\beta = 0.24$ ,  $p < 0.001$ ) and customer digital literacy ( $\beta = 0.17$ ,  $p = 0.011$ ) were significant but somewhat weaker predictors. Cybersecurity measures ( $\beta = 0.12$ ,  $p = 0.062$ ) did not reach statistical significance at the  $p < 0.05$  level, though the effect was in the expected direction.

To assess the robustness of the regression results to potential outliers, the analysis was repeated after removing cases with standardized residuals exceeding  $\pm 2.5$  ( $n = 8$  cases removed). The pattern of significance and the magnitude of coefficients remained substantially unchanged, with mobile banking infrastructure ( $\beta = 0.29$ ,  $p < 0.001$ ), top management commitment ( $\beta = 0.26$ ,  $p = 0.002$ ), and employee digital competency ( $\beta = 0.25$ ,  $p < 0.001$ ) continuing as the strongest predictors. The  $R^2$  value was 0.56,

comparable to the original model ( $R^2 = 0.58$ ), suggesting the findings are not unduly influenced by outliers.

### **Perceived Barriers to Digitalization**

Respondents rated the severity of eight potential barriers to digitalization on a 5-point Likert scale (1 = *not a barrier*, 5 = *severe barrier*). Table 5 presents mean ratings in descending order.

**Table 5**

*Perceived Barriers to Digitalization: Mean Ratings*

| Barrier Category              | <i>M</i> | <i>SD</i> | Rank |
|-------------------------------|----------|-----------|------|
| Cybersecurity Threats         | 4.28     | 0.71      | 1    |
| Customer Digital Literacy     | 4.21     | 0.68      | 2    |
| Infrastructure Limitations    | 4.15     | 0.82      | 3    |
| Regulatory Compliance Costs   | 3.94     | 0.79      | 4    |
| Data Privacy Concerns         | 3.48     | 0.96      | 5    |
| Employee Resistance to Change | 3.52     | 1.04      | 6    |
| Legacy System Integration     | 3.41     | 1.11      | 7    |
| High Implementation Costs     | 3.38     | 1.08      | 8    |

*Note:* Mean scores based on 5-point Likert scale (1 = *not a barrier*, 5 = *severe barrier*).

Cybersecurity threats ranked as the most severe barrier ( $M = 4.28$ ,  $SD = 0.71$ ), consistent with growing concerns about data breaches and financial fraud. Customer digital literacy followed closely ( $M = 4.21$ ,  $SD = 0.68$ ), reflecting challenges in serving populations with varying technological proficiency. Infrastructure limitations ( $M = 4.15$ ,  $SD = 0.82$ ) ranked third, highlighting persistent connectivity and access issues.

### **Digital Transaction Trends in Pakistan (2021-2025)**

To contextualize survey findings within broader industry trends, secondary data from State Bank of Pakistan publications were analyzed. Table 7 presents the growth of digital transactions over the five-year study period.

**Table 7**

*Digital Transaction Growth in Pakistan (2021-2025)*

| Year | Mobile Banking Users (Millions) | Digital Transaction Volume (Millions) | Digital Transaction Value (PKR Trillions) | Annual Growth Rate (%) |
|------|---------------------------------|---------------------------------------|-------------------------------------------|------------------------|
| 2021 | 10.9                            | 286.8                                 | 10.6                                      | —                      |
| 2022 | 12.3                            | 529.2                                 | 22.1                                      | 84.5                   |
| 2023 | 16.1                            | 832.4                                 | 40.1                                      | 57.3                   |
| 2024 | 18.7                            | 1345.9                                | 69.8                                      | 61.7                   |
| 2025 | 24.1                            | 2,107.2                               | 121.6                                     | 56.6                   |

*Notes:* 1) "Digital Transactions" = Mobile Banking + Internet Banking. 2) Growth rate based on transaction volume. Data sources include "Annual Payment Systems Review FY 24-25" (2025), "Payment Systems Review for the Fiscal Year Ended June 30, 2021" (2021), "Payment Systems Review for the Fiscal Year Ended June 30, 2022" (2022), "Payment Systems Review for the Fiscal Year 2022-23" (2023), "Payment Systems Review FY 24" (2024), and "SBP Grants Digital Banking License" (2025).

Mobile banking users increased steadily from 10.9 million in 2021 to 24.1 million in 2025, representing a 121% increase over the five-year period. Digital transaction volume grew from 286 million to 2,107.2 million transactions. Transaction value increased from PKR 10.6 trillion to PKR 121.6 trillion.

### **Comparison of Public and Private Banks**

Independent samples t-tests were conducted to compare digitalization indicators between public and private sector banks. Table 8 presents the comparative analysis.

**Table 8**

*Comparison of Public vs. Private Bank Digitalization*

| Indicator                                | Private Banks<br>(n = 98) | Public Banks<br>(n = 47) | Mean<br>Difference | t    | p      |
|------------------------------------------|---------------------------|--------------------------|--------------------|------|--------|
| Mobile App Rating<br>(1-5)               | 4.28 (0.54)               | 3.41 (0.82)              | 0.87               | 6.42 | <0.001 |
| Digital Transaction<br>%                 | 76.4% (12.3)              | 52.8% (18.6)             | 23.6%              | 7.85 | <0.001 |
| Customer Digital<br>Satisfaction (1-5)   | 4.31 (0.48)               | 3.62 (0.71)              | 0.69               | 5.91 | <0.001 |
| AI Implementation<br>Score (1-5)         | 3.84 (0.91)               | 2.76 (1.12)              | 1.08               | 5.33 | <0.001 |
| Cybersecurity<br>Investment (PKR<br>M)   | 184.6 (67.2)              | 98.3 (41.5)              | 86.3               | 8.12 | <0.001 |
| Branches with<br>Digital Services<br>(%) | 94.2% (8.4)               | 71.5% (16.3)             | 22.7%              | 8.64 | <0.001 |

*Note:* Values represent M (SD). Standard deviations for percentage variables are reported in percentage points. All comparisons significant at  $p < 0.001$ .

Private banks significantly outperformed public banks across all six digitalization indicators ( $p < 0.001$  for all comparisons). The largest absolute difference emerged in cybersecurity investment, with private banks investing nearly twice as much as public banks ( $M$  difference = PKR 86.3 million). AI implementation scores showed the greatest relative difference.

The magnitude of the public-private gap takes on additional significance when viewed alongside the aggregate growth figures in Table 7. With mobile banking users increasing 121% industry-wide, and private banks outperforming public banks by 23.6 percentage points in digital transaction share, the absolute disparity in digital access between customers of public versus private banks has likely widened substantially during 2021-2025. This suggests that without targeted intervention, the digital divide may exacerbate existing inequalities in financial access.

### **Customer Preferences for Digital Banking Channels**

Survey respondents were asked to indicate customer preferences for various banking services based on their professional observations. Table 9 summarizes these preferences.

**Table 9**

*Banking Professionals' Perceptions of Customer Channel Preferences*

| Service Type        | Prefer Digital (%) | Prefer Branch (%) | No Preference (%) |
|---------------------|--------------------|-------------------|-------------------|
| Fund Transfers      | 82.4               | 8.7               | 8.9               |
| Bill Payments       | 78.6               | 12.4              | 9.0               |
| Account Opening     | 45.2               | 41.8              | 13.0              |
| Loan Applications   | 38.5               | 48.2              | 13.3              |
| Customer Support    | 52.7               | 34.1              | 13.2              |
| Investment Services | 41.3               | 42.6              | 16.1              |

*Note:* Data from survey item: "Based on your professional observation, how would customers prefer to conduct the following banking activities?"

Transactional services (fund transfers and bill payments) showed strong preference for digital channels, with over 78% of customers preferring digital options. In contrast, more complex services requiring advisory support, such as loan applications and investment services, showed near-equal preference between digital and branch-based channels.

### **Impact of Digital Literacy on Banking Usage**

Further regression analysis examined the relationship between digital literacy levels and banking usage frequency. Table 10 presents the results.

**Table 10**

*Regression Coefficients for Digital Literacy Impact*

| Digital Literacy Level  | <i>B</i>           | <i>SE</i> | $\beta$ | 95% CI       | <i>p</i> |
|-------------------------|--------------------|-----------|---------|--------------|----------|
| Basic Digital Skills    | Reference category | —         | —       | —            | —        |
| Intermediate Skills     | 0.42               | 0.11      | 0.28    | [0.20, 0.64] | <0.001   |
| Advanced Skills         | 0.78               | 0.14      | 0.51    | [0.51, 1.05] | <0.001   |
| Formal Digital Training | 0.63               | 0.12      | 0.43    | [0.39, 0.87] | <0.001   |

*Note:* Dependent variable: Digital Banking Usage Frequency. CI = confidence interval. Dependent variable measured on 5-point frequency scale (1 = rarely [<1/month] to 5 = daily). *B* coefficients represent increase in frequency category.

Compared to respondents with basic digital skills, those with intermediate skills reported significantly higher digital banking usage ( $B = 0.42, p < 0.001$ ). The effect was even stronger for respondents with advanced skills ( $B = 0.78, p < 0.001$ ). Formal digital training also predicted higher usage ( $B = 0.63, p < 0.001$ ).

### **Qualitative Findings: Thematic Analysis**

Fifteen semi-structured interviews with banking executives, digital product managers, and regulatory specialists yielded rich contextual data. Thematic analysis of the interview data revealed six major themes, which are summarized in Table 6.

**Table 6**

Thematic Analysis Findings: Key Themes from Interviews (N = 15)

| Theme                               | Description                                | Frequency       | Emergence Type      | Representative Quote                                                          |
|-------------------------------------|--------------------------------------------|-----------------|---------------------|-------------------------------------------------------------------------------|
| <b>Accelerated Digital Adoption</b> | Post-COVID push toward contactless banking | 14 participants | Spontaneous (14/14) | "The pandemic forced us to digitize in months what we planned for years." P05 |

| Theme                         | Description                                       | Frequency       | Emergence Type                             | Representative Quote                                                              |
|-------------------------------|---------------------------------------------------|-----------------|--------------------------------------------|-----------------------------------------------------------------------------------|
| <b>Regulatory Enablement</b>  | SBP initiatives (Raast, EMIs) facilitating change | 13 participants | Spontaneous (11/13)<br><br>Prompted (2/13) | "Raast has been a game-changer for instant payments in Pakistan." P08             |
| <b>Talent Gap</b>             | Shortage of skilled digital banking professionals | 11 participants | Spontaneous (8/11)<br><br>Prompted (3/11)  | "We're struggling to find people who understand both banking and technology." P12 |
| <b>Urban-Rural Divide</b>     | Disparity in digital access and literacy          | 12 participants | Spontaneous (10/12)<br><br>Prompted (2/12) | "Our rural customers still prefer coming to the branch." P03                      |
| <b>Fintech Collaboration</b>  | Partnerships with fintechs driving innovation     | 9 participants  | Spontaneous (4/9)<br><br>Prompted (5/9)    | "Working with fintechs helps us move faster." P07                                 |
| <b>Data Security Concerns</b> | Growing anxiety about breaches and fraud          | 10 participants | Spontaneous (7/10)<br><br>Prompted (3/10)  | "Every new digital service opens another potential vulnerability." P11            |

*Note:* "Spontaneous" indicates the theme was raised by the participant without interviewer prompting; "Prompted" indicates the theme emerged only after direct questioning.

### **Accelerated Digital Adoption**

The most frequently mentioned theme, cited by 14 of 15 participants, was the dramatic acceleration of digital adoption following the COVID-19 pandemic. Participants described how lockdowns and social distancing measures forced banks to rapidly expand digital channels.

### **Regulatory Enablement**

Thirteen participants highlighted the enabling role of State Bank of Pakistan initiatives. The Raast instant payment system was consistently praised as transformative.

### **Talent Gap**

Eleven participants expressed concern about the shortage of skilled professionals who understand both banking and technology.

### **Urban-Rural Divide**

Twelve participants discussed persistent disparities between urban and rural areas in terms of digital access and literacy.

### **Fintech Collaboration**

Nine participants described partnerships with fintech companies as essential to accelerating innovation.

### **Data Security Concerns**

Ten participants raised cybersecurity as an ongoing challenge requiring constant vigilance.

## **DISCUSSION**

### **Digital Technology Adoption in Pakistani Banks**

The first research question sought to identify which digital platforms, technologies, and services Pakistani banks are currently utilizing. The results (Table 2) reveal a clear hierarchy of adoption, with mobile banking applications ( $M = 4.32$ ) and internet banking platforms ( $M = 4.18$ ) leading the way. This pattern aligns with Irum and Akhtar (2021) findings that ease of use and perceived utility drive fintech adoption in Pakistan.

The high adoption of mobile banking (78.6% extensive use), combined with 121% user growth and 7-fold transaction volume increase from 2021 to 2025, reflects not just global trends but one of the fastest digital banking expansions in South Asia. This strongly validates the State Bank of Pakistan's strategic emphasis on mobile-first financial inclusion. This finding also supports Akhtar et al. (2023) conclusion that mobile transaction activity correlates positively with bank performance.

Conversely, blockchain solutions showed the lowest adoption ( $M = 2.15$ ), with only 18.2% of respondents reporting extensive use. This gap between regulatory enthusiasm and ground-level implementation suggests that Pakistani banks are adopting a cautious approach, awaiting clearer operational guidelines and proven use cases.

### **Drivers of Digital Transformation**

The regression analysis (Table 4) identified five significant predictors of digital banking success, explaining 58% of the variance. Mobile banking infrastructure emerged as the strongest predictor ( $\beta = 0.31, p < 0.001$ ), underscoring the foundational role of robust digital platforms. This finding aligns with Bueno et al. (2024), who emphasized that digital infrastructure is a prerequisite for operational efficiency gains.

Top management commitment ( $\beta = 0.27, p = 0.001$ ) and employee digital competency ( $\beta = 0.26, p < 0.001$ ) were the next strongest predictors, highlighting the critical importance of organizational leadership and human capital. As Shahzad et al. (2025) noted, digital transformation requires a profound shift in organizational mindset beyond mere technology implementation.

Regulatory support ( $\beta = 0.24, p < 0.001$ ) emerged as a significant driver, validating the SBP's proactive approach. Customer digital literacy ( $\beta = 0.17, p = 0.011$ ) was significant but relatively weaker, suggesting that while literacy matters, it may be less influential than organizational factors.

A limitation of the regression analysis is that bank type (public vs. private) was not included as a control variable. Given the significant differences documented in Table 8, future research should examine whether the predictors of digital banking success differ systematically across bank types.

### **Impact on Customer Experience, Financial Inclusion, and Operational Efficiency**

The correlation matrix (Table 3) provides strong evidence of positive relationships between technology adoption and organizational outcomes. Operational efficiency correlated strongly with mobile banking adoption ( $r = 0.62, p < 0.01$ ), supporting Bueno et al. (2024) documentation of efficiency gains from digitalization.

Customer satisfaction showed strong correlations with both mobile banking ( $r = 0.57$ ) and AI integration ( $r = 0.53$ ), supporting Iqbal and Fikri (2025) conclusion that fintech integration enhances satisfaction. However, customer preference data (Table 9) shows that while transactional services are strongly preferred digitally, complex services like loans still benefit from human interaction.

Financial inclusion reach correlated significantly with mobile banking adoption ( $r = 0.51$ ), and the growth data (Table 7) shows mobile banking users increasing 121% from 2021 to 2025. This validates the SBP's financial inclusion strategy and supports Demirguc-Kunt et al. (2018) findings that digital channels can extend financial access.

### **Barriers to Digital Adoption**

Cybersecurity threats ranked as the most severe barrier ( $M = 4.28$ ), aligning with Waliullah et al. (2025) comprehensive analysis of security risks. This finding has important implications for banks, regulators, and customers regarding continuous investment in security infrastructure.

Customer digital literacy as the second-ranked barrier validates concerns raised in multiple studies (Irum & Akhtar, 2021; Ali et al., 2022). The regression analysis on digital literacy impact (Table 10) quantifies this effect: advanced skills predict significantly higher usage ( $B = 0.78, p < 0.001$ ), suggesting that educational interventions could accelerate adoption.

Infrastructure limitations ranked third, reflecting persistent challenges in internet connectivity, particularly in rural areas. This aligns with Nadeem et al. (2023), who identified infrastructure as a key barrier in developing countries.

### **Public vs. Private Bank Comparison**

Private banks significantly outperformed public banks across all six digitalization indicators (Table 8, all  $p < 0.001$ ). The magnitude of these differences is striking: private banks invest nearly twice as much in cybersecurity (PKR 184.6M vs. 98.3M), achieve 23.6 percentage points higher digital transaction share, and report substantially higher AI implementation scores (3.84 vs. 2.76 on a 5-point scale).

Several mechanisms likely explain this persistent gap. First, organizational flexibility differs substantially. Private banks operate under flatter hierarchies and can make technology investment decisions more rapidly, whereas public banks face bureaucratic approval processes and procurement regulations that delay digital initiatives (Khan, 2022). Second, investment capacity varies. Private banks generate higher returns on equity, enabling greater reinvestment in technology infrastructure. Public banks often operate with thinner margins while serving less profitable rural and low-income segments. Third, talent acquisition differs. Private banks offer competitive compensation packages that attract skilled digital professionals, while public bank salary structures are government-determined and less flexible. Interview participant P12 noted: "We're struggling to find people who understand both banking and technology" – a challenge that qualitative data suggests is more acute in public institutions.

Fourth, legacy system constraints are more severe in public banks, many of which operate on decades-old core banking systems that are costly and risky to replace. Private banks, particularly newer entrants, have built digital infrastructure from the ground up without this technical debt. Fifth, customer demographics differ. Public banks traditionally serve government employees, pensioners, and rural populations – segments with lower average digital literacy, which may reduce the perceived return on digital investment.

The widening absolute disparity in digital access between customers of public versus private banks raises important policy questions. Without targeted intervention, such as a dedicated digital transformation fund for public banks, technical assistance from the State Bank of Pakistan, or public-private partnerships for infrastructure sharing, the digital divide may exacerbate existing inequalities in financial access. This is particularly concerning because public banks often function as financial providers of last resort in underserved areas where private banks have limited presence.

While the current analysis confirmed significant differences between public and private banks, future research should employ moderated regression analysis to determine whether the strength of individual predictors (e.g., top management commitment, employee digital competency) differs systematically between bank types. Such analysis could identify whether public banks face unique barriers requiring targeted interventions.

### **Regulatory Impact and National Initiatives**

The qualitative theme "Regulatory Enablement" (cited by 13 participants) highlighted the impact of specific SBP programs. Raast was consistently praised as transformative, and transaction growth data (Table 7) supports this assessment, with digital transaction volume more than doubling from 2021 to 2025.

Recent regulatory developments, including PVARA establishment and the CBDC pilot with Soramitsu (Iqbal, 2025), signal continued policy commitment to digital financial innovation. However, the low adoption of blockchain solutions suggests that regulatory frameworks alone are insufficient without capacity building and industry engagement.

### **Integration with Theoretical Frameworks**

The findings provide empirical support for the UTAUT model (Venkatesh et al., 2003) in the Pakistani banking context. Performance expectancy is reflected in correlations between adoption and efficiency. Effort expectancy manifests in digital literacy as a key barrier. Social influence is inferred from the significant role of top management commitment. Facilitating conditions are represented by mobile infrastructure and regulatory support.

### **International Comparisons**

Pakistan's digital banking progress can be benchmarked against regional peers. Pakistan's 2.1 billion transactions in H1 2025 represents approximately 2% of India's UPI volume on an absolute basis. However, on a per-adult basis, Pakistan processes approximately 35 transactions annually (annualized) compared to India's 105 and Kenya's 170. More importantly, Pakistan's growth rate of 56.6% in 2025 exceeds both peers' current growth rates, suggesting accelerating convergence rather than persistent underperformance.

### **The Blockchain Implementation Gap**

A notable paradox emerges from the findings: while blockchain technology features prominently in SBP policy documents (including the 2025 PVARA establishment and CBDC pilot), actual adoption among surveyed banks remains minimal ( $M = 2.15$ ), with only 18.2% reporting extensive use. Five factors explain this gap: regulatory uncertainty (banks await final rules), skills shortage (consistent with the talent gap theme identified in interviews), unproven business case (current digital infrastructure handles 2.1 billion transactions without DLT), integration challenges with legacy systems ( $M = 3.41$ ), and the need for industry coordination (blockchain's value increases with network effects). Rather than indicating policy failure, this gap may reflect rational caution. Pakistan's 56.6% annual transaction growth is being achieved through centralized infrastructure; blockchain may solve problems Pakistan does not yet have. The CBDC pilot represents an appropriate middle path, i.e., controlled experimentation without premature commitment. Whether this gap closes within 2-3 years of PVARA regulatory finalization will be an important test of blockchain's practical viability in emerging economy banking.

### **Ethical Considerations**

The study identified several ethical dimensions: data privacy concerns (ranked fifth among barriers), the urban-rural digital divide raising concerns about equitable access, and potential algorithmic bias as AI adoption grows. These considerations reinforce the importance of balanced innovation that protects consumer interests and advances inclusive development.

### **Implications for Policy and Practice**

**For the State Bank of Pakistan:** Continue enabling infrastructure development (Raast's success demonstrates value), address the public-private gap through targeted support for public banks, invest in digital literacy programs particularly in rural areas, update cybersecurity frameworks continuously, and support blockchain experimentation through regulatory sandboxes.

**For Bank Management:** Prioritize top management commitment (strong predictor of success), invest in employee digital competency, develop hybrid service models combining digital efficiency with human touch for complex transactions, strengthen cybersecurity posture, and explore fintech partnerships.

**For Technology Companies:** Focus on usability given digital literacy barriers, develop rural-specific solutions for low-connectivity environments, address security concerns, and support interoperability.

### **Limitations of the Study**

This study has several limitations that should inform interpretation of findings and guide future research.

**Research Design Limitations.** The cross-sectional design captures digital transformation at a single point (2025), precluding causal inferences about relationships between technology adoption and organizational outcomes. Longitudinal research is needed to establish causal directions and track digitalization trajectories over time. Additionally, self-reported data from banking professionals may be subject to social desirability bias, potentially overstating adoption levels or underreporting challenges.

**Sampling Limitations.** Purposive sampling, while ensuring relevant expertise, limits generalizability. The sample overrepresented private commercial banks (52.4%) relative to their market share, potentially skewing findings toward private sector experiences. Public banks, Islamic banks, and fintech firms were underrepresented. The qualitative component (15 interviews) may not have achieved theoretical saturation on all themes.

**Member Checking Limitations.** Member checking was conducted with five of the 15 interview participants (33%) to verify the accuracy of interpreted themes. The perspectives of the remaining 10 participants were not independently verified, which may introduce interpretation bias.

**Spontaneous vs. Prompted Responses.** As shown in Table 6, some themes (e.g., Fintech Collaboration) emerged spontaneously for fewer than half of the participants who ultimately endorsed the theme when prompted. This distinction is important because prompted themes may reflect researcher framing rather than participant priorities.

**Measurement Limitations.** Several constructs were measured using researcher-developed items rather than validated scales, potentially affecting construct validity. The barriers measure may have omitted relevant obstacles such as cultural resistance. Digital literacy was self-assessed rather than objectively tested.

The study used researcher-developed items adapted from existing scales rather than fully validated instruments. While content validity was established through expert review, confirmatory factor analysis on an independent sample is needed to definitively validate the factor structure of the scales used.

Test-retest reliability was not assessed due to the cross-sectional design, leaving the temporal stability of the measures unknown.

The Digital Banking Success Index, while demonstrating acceptable internal consistency ( $\alpha = 0.84$ ), represents a novel composite measure requiring further validation in future research.

**Scope Limitations.** The study focused on supply-side perspectives (banking professionals) without capturing customer experiences and barriers. Given that customer digital literacy ranked as the second

most severe barrier ( $M = 4.21$ ), understanding customer perspectives is essential for designing effective interventions.

**Temporal and Technological Limitations.** Rapid technological change means findings regarding specific technologies may quickly become outdated. Blockchain adoption, measured at 18.2% in this study, may shift following recent regulatory developments including PVARA and the CBDC pilot announced in 2025.

**Generalizability Limitations.** The single-country focus on Pakistan limits applicability to other settings. Pakistan's unique demographic characteristics, regulatory environment, infrastructure constraints, and digital literacy levels may not generalize to other developing economies.

**Methodological Integration Limitations.** While the mixed-method design provided both statistical generalizability and contextual depth, integration could be strengthened. Survey items were not explicitly designed to explore themes emerging from interviews.

Furthermore, the small subsample of fintech participants ( $n = 14$ ) precludes robust frequentist analysis; future research should employ Bayesian approaches to draw meaningful inferences from such subgroups.

**Potential Biases.** The research team's positionality as external observers may have influenced participant responses. Use of English for most interviews may have excluded participants with limited English proficiency.

Despite these limitations, the study provides comprehensive empirical evidence on digital transformation in Pakistan's banking sector, offering valuable insights for researchers, practitioners, and policymakers.

## CONCLUSION

This study examined digital transformation in Pakistan's banking sector from 2015 to 2025, employing a mixed-method approach combining survey data from 187 banking professionals with semi-structured interviews of 15 industry experts. The research addressed five key questions regarding technology adoption patterns, drivers of transformation, emerging trends, barriers to implementation, and regulatory impacts.

### Summary of Key Findings

The results demonstrate that Pakistan's banking sector has made substantial progress in digital adoption. Mobile banking applications and internet banking platforms are now widely used, with over 78% of respondents reporting extensive mobile banking implementation. Digital transaction volume increased more than seven-fold from 2021 to 2025, with mobile banking users growing from 10.9 million to 24.1 million, a 121% increase.

The regression analysis identified mobile banking infrastructure, top management commitment, and employee digital competency as the strongest predictors of digital banking success, explaining 58% of the variance. Correlational analysis confirmed significant positive relationships between technology adoption and organizational outcomes, validating the business case for digital investment.

Barriers to digitalization remain substantial. Cybersecurity threats ranked as the most severe obstacle, followed by customer digital literacy and infrastructure limitations. Qualitative findings revealed six

major themes: accelerated digital adoption following COVID-19, regulatory enablement, persistent talent gaps, urban-rural divides, fintech collaboration importance, and ongoing data security concerns.

Significant differences emerged between public and private banks, with private institutions outperforming their public counterparts across all digitalization indicators. This gap has implications for equitable financial inclusion, as public banks often serve less profitable rural and low-income populations.

### **Policy Implications**

The findings carry clear implications: continued investment in national payment infrastructure, targeted support for public sector banks, digital literacy programs particularly in rural areas, evolving cybersecurity frameworks, and regulatory sandboxes for blockchain experimentation.

### **Future Research Directions**

Future research should employ longitudinal designs to establish causal relationships, conduct customer-focused studies to capture user perspectives, undertake comparative studies with other South Asian countries, examine specific blockchain implementation experiences, test digital literacy interventions, and investigate algorithmic fairness in AI-driven banking decisions.

### **Recommendations**

To sustain and deepen digital transformation, stakeholders must take coordinated action. The State Bank of Pakistan should substantially accelerate investment in national payment infrastructure. With digital transaction volume growing at 56.6% annually (Table 7), existing infrastructure risks becoming a binding constraint on further growth. Without proportional infrastructure investment, the barriers identified in Table 5 (infrastructure limitations, M=4.15; cybersecurity threats, M=4.28) will likely intensify. Bank management must prioritize leadership commitment to digital initiatives, invest in employee digital competency, and develop hybrid service models that combine digital efficiency with human touch for complex transactions. Technology companies should focus on usability to accommodate varying literacy levels and develop solutions tailored for low-connectivity rural environments. Future research should employ longitudinal designs to establish causal relationships, incorporate customer perspectives, and conduct comparative studies with other South Asian countries. If these recommendations are implemented, digital banking can fulfill its promise of expanding access, improving efficiency, and contributing to Pakistan's broader economic development.

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## Appendices

### Appendix A: Qualitative Codebook

| Code Name             | Definition                                            | Inclusion Criteria                                                                     | Exclusion Criteria                                                                 | Example Quote                                                                 |
|-----------------------|-------------------------------------------------------|----------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| COVID_Acceleration    | References to pandemic accelerating digital adoption. | Explicit mention of COVID-19, lockdowns, or pandemic as a catalyst for digital change. | General references to "rapid change" without pandemic link.                        | "The pandemic forced us to digitize in months."                               |
| Regulatory_Enablement | SBP policies, Raast, EMIs, or CBDC as enablers.       | Specific mention of SBP initiative facilitating digital banking.                       | General references to "regulation" without specific initiative.                    | "Raast has been a game-changer."                                              |
| Talent_Shortage       | Lack of skilled digital banking professionals.        | Explicit mention of recruitment difficulties, skill gaps, or training needs.           | General references to "HR challenges" unrelated to digital skills.                 | "We're struggling to find people who understand both banking and technology." |
| Urban_Rural_Gap       | Disparities between urban and rural digital access.   | Explicit comparison of urban vs. rural customers or infrastructure.                    | General references to "infrastructure limitations" without geographic distinction. | "Our rural customers still prefer coming to the branch."                      |
| Fintech_Partnership   | Collaboration with fintech                            | Explicit mention of working with, acquiring, or                                        | General references to "innovation" without fintech                                 | "Working with fintechs helps us                                               |

|               |                                                              |                                                                               |                                                                       |                                                                    |
|---------------|--------------------------------------------------------------|-------------------------------------------------------------------------------|-----------------------------------------------------------------------|--------------------------------------------------------------------|
|               | companies.                                                   | partnering with<br>fintechs .                                                 | specificity.                                                          | move faster."                                                      |
| Data_Security | Cybersecurity threats, breaches, fraud, or privacy concerns. | Explicit mention of security risks, vulnerabilities , or protective measures. | General references to "risk management" without security specificity. | "Every new digital service opens another potential vulnerability." |

#### Code Frequency Distribution by Interview Transcript

| Transcript ID | COVID | Regulatory | Talent | Urban/Rural | Fintech |
|---------------|-------|------------|--------|-------------|---------|
| P01           | 3     | 2          | 1      | 0           | 0       |
| P02           | 2     | 3          | 2      | 1           | 1       |
| P03           | 4     | 1          | 0      | 4           | 0       |
| P04           | 2     | 2          | 1      | 1           | 1       |
| P05           | 5     | 2          | 2      | 0           | 0       |
| P06           | 1     | 3          | 1      | 2           | 2       |
| P07           | 2     | 1          | 3      | 1           | 4       |
| P08           | 0     | 5          | 1      | 0           | 1       |
| P09           | 3     | 2          | 2      | 2           | 0       |
| P10           | 2     | 1          | 0      | 3           | 1       |
| P11           | 1     | 2          | 1      | 1           | 0       |
| P12           | 2     | 0          | 4      | 1           | 1       |
| P13           | 3     | 2          | 1      | 2           | 1       |
| P14           | 1     | 1          | 2      | 0           | 0       |
| P15           | 2     | 2          | 0      | 1           | 1       |
| Total         | 33    | 29         | 21     | 19          | 13      |

Note. Thematic saturation was reached after 12 interviews, as no new themes emerged in interviews P13-P15. The remaining three interviews provided additional code instances within established themes, confirming that the thematic framework was comprehensive..

## **Appendix B**

**Table A1**

*Scale Reliability Coefficients (Cronbach's Alpha)*

| Scale                                | Number of Items | Cronbach's $\alpha$ |
|--------------------------------------|-----------------|---------------------|
| Digital Technology Adoption          | 8               | 0.86                |
| Perceived Barriers to Digitalization | 10              | 0.89                |
| Organizational Readiness             | 8               | 0.82                |
| Customer Engagement Outcomes         | 6               | 0.78                |
| Digital Banking Success Index        | 3               | 0.84                |