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ADOPTION OF MOBILE PAYMENT SYSTEMS USING TECHNOLOGY ACCEPTANCE MODEL (TAM) AND STRUCTURAL EQUATION MODELING

Asad Javed[*1], Ishtiaq Ahmad Bajwa[2], Dr. Amjad Ur Rehman[3], Talha[4]

[*1]*Business Administration Specialization Finance, Government College University Faisalabad GCUF*
[2]*College of Business, Alyamamah University KSA*
[3]*Department of Management Sciences, Hazara University Mansehra,*
[4]*University of Makran*

[*1]asadjaved657@gmail.com, [2]ibajwa@yu.edu.sa, [3]amjadktk@hu.edu.pk, [4]talha@uomp.edu.pk

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Asad Javed

Abstract

The rapid proliferation of mobile payment (m-payment) systems has transformed the global financial landscape, offering enhanced convenience, speed, and financial inclusion. This study investigates the factors influencing the adoption of mobile payment systems through the lens of the Technology Acceptance Model (TAM) and employs Structural Equation Modeling (SEM) for empirical validation. Grounded in core TAM constructs Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) the research examines how these variables, along with attitude toward use, shape users' behavioral intention to adopt m-payments. The study extends the basic TAM framework by incorporating additional determinants such as trust, perceived risk (financial, privacy, performance, and psychological), social influence, compatibility, and subjective norms. Methodological approaches including covariance-based SEM (CB-SEM) and partial least squares SEM (PLS-SEM), as well as hybrid SEM-ANN techniques, are discussed to address both theory confirmation and predictive accuracy. Regional variations, generational differences, and the perspectives of Small and Medium Enterprises (SMEs) are also analyzed to provide a comprehensive understanding of adoption dynamics across contexts. Findings from existing empirical literature highlight the dominant roles of perceived usefulness, trust, and compatibility, while perceived risk emerges as a significant barrier. The paper underscores the evolving technological trajectory toward AI-driven invisible payments and biometric authentication. This research contributes to a deeper understanding of m-payment adoption and offers practical implications for policymakers, financial institutions, and technology providers aiming to accelerate digital payment ecosystems and promote financial inclusion.

INTRODUCTION

The global financial ecosystem has undergone a transformative shift over the past two decades, primarily driven by the convergence of mobile telecommunications and financial services. By the end of 2010, mobile penetration reached 5 billion

subscriptions globally, yet approximately 2.5 billion adults still lacked access to regulated financial institutions (Demirguc-Kunt & Klapper, 2012). This discrepancy facilitated the rise of mobile payment (m-payment) systems, defined as the use of a mobile device to initiate, authorize, and confirm an exchange of transaction value for products or services (Lin et al., 2022). These systems have evolved from simple SMS-based transfers to sophisticated proximity payments using Near-Field Communication (NFC), Quick Response (QR) codes, and biometric authentication. Understanding the drivers and barriers of this adoption is critical, as it directly impacts financial inclusion, transaction efficiency, and the broader digital economy (Sahi et al., 2021).

Theoretical Foundations of Technology Acceptance

The academic inquiry into why individuals adopt m-payments is anchored in the Technology Acceptance Model (TAM), originally developed. TAM suggests that an individual's behavioral intention to use a system is determined by two primary cognitive beliefs: Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) (Richter, 2024).

Core Constructs and Cognitive Mediators

Perceived Usefulness is defined as the user's subjective probability that using a specific system will increase their performance or enhance their quality of life. In the context of mobile payments, this is expressed through the convenience of making transactions anytime and anywhere, checkout speed, and the ability to manage finances without physical currency. Perceived Ease of Use refers to the degree to which a user expects the target system to be free of physical and mental effort (Schierz et al., 2010).

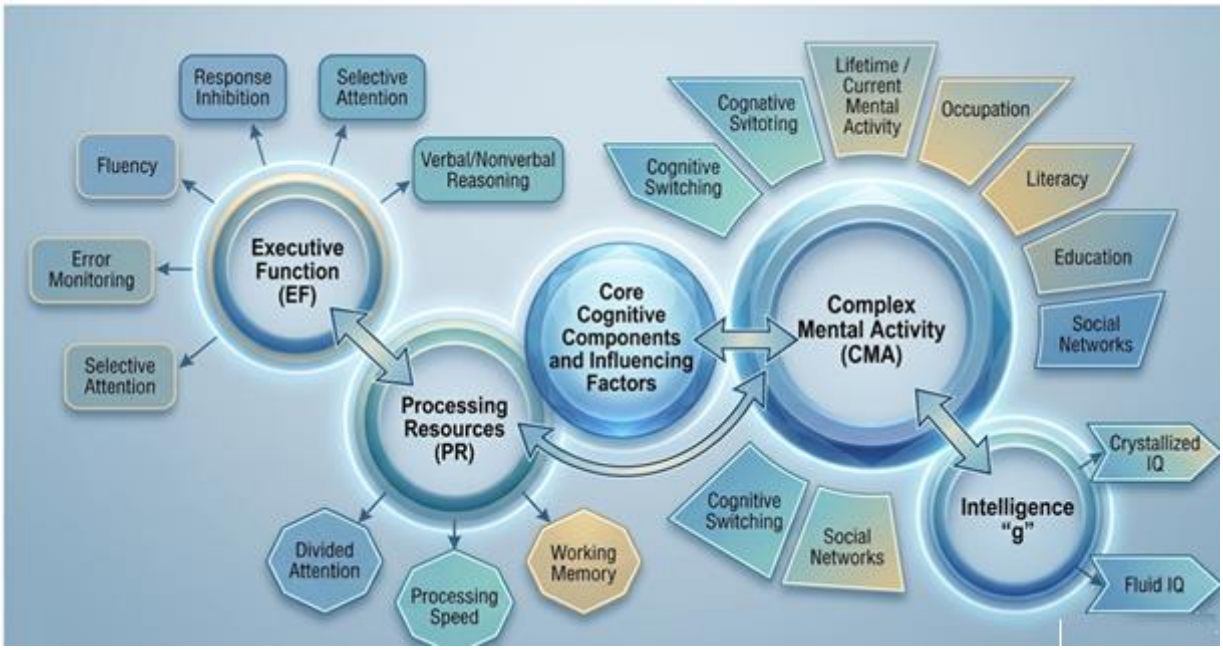


Figure: 1 Hierarchical model of cognitive domains, processing resources, and complex mental activity in relation to general intelligence

The relationship among these constructs is commonly explained through the Technology Acceptance Model (TAM), in which Perceived Ease of Use (PEOU) functions as an antecedent to Perceived Usefulness (PU). According to this model, when a system is intuitive and requires minimal effort to operate, users are more likely to regard it as useful for accomplishing their tasks (Rajanish, 2011). This cognitive mechanism can

be represented using the following structural equations:

$$\text{Attitude} = \beta_1\, PU + \beta_2\, PEOU + \epsilon$$

$$\text{Behavioral Intention} = \beta_3\, \text{Attitude} + \beta_4\, PU + \epsilon$$

where β_1, β_2, β_3, and $\beta_4$are path coefficients that quantify the strength and direction of the relationships among the latent variables, and ϵrepresents the error term capturing unexplained variance. In this framework, attitude toward use defined as the degree of positive or negative evaluation an individual assigns to a technology—serves as a key mediating construct between users' beliefs and their behavioral intentions. Empirical evidence suggests that, for certain populations such as older adults, the influence of attitude on behavioral intention is more substantial than the direct effects of perceived usefulness or perceived ease of use, underscoring the importance of affective evaluations in technology adoption decisions (Chen, 2023).

Comparative Overview of Acceptance Theories

While TAM remains the most parsimonious model, researchers often integrate it with other frameworks (Anwar et al., 2024).

Table 1: Comparison of Theoretical Frameworks for Technology Acceptance and Adoption

Theory	Key Constructs	Domain Focus
Technology Acceptance Model (TAM)	PU, PEOU, Attitude	General IT acceptance
Unified Theory of Acceptance and Use of Technology (UTAUT2)	Performance/Effort Expectancy, Social Influence, Habit, Price Value	Consumer context
Innovation Diffusion Theory (IDT)	Compatibility, Observability, Trialability, Complexity	Rate of innovation spread
Theory of Planned Behavior (TPB)	Attitude, Subjective Norms, Perceived Behavioral Control	Social/cognitive determinants
Mobile Technology Acceptance Model (MTAM)	Mobile Usefulness, Mobile Ease of Use	Mobile environments

The integration of these theories allows for a more holistic view. For example, combining TAM with IDT enables analysis of how "compatibility" influences both the perception of ease and the intention to use (Mujahidin et al., 2025).

Methodological Rigor: Structural Equation Modeling (SEM)

To validate the complex relationships proposed in adoption models, researchers rely on Structural Equation Modeling (SEM), a technique combining factor analysis and path analysis (Dash & Paul, 2021).

Covariance-Based (CB-SEM) vs. Partial Least Squares (PLS-SEM)

CB-SEM is used primarily for theory testing and confirmation, requiring large sample sizes and assuming multivariate normal distribution. In contrast, PLS-SEM is a variance-based approach focusing on prediction and explaining variance in dependent variables (SmartPLS, 2025).

Table 2: Distinctive Characteristics of CB-SEM and PLS-SEM Methodologies

Feature	CB-SEM	PLS-SEM
Primary Objective	Theory confirmation	Prediction/Exploration
Data Assumptions	Multivariate normality	Robust to non-normality

Sample Size	High (typically > 200)	Low to moderate
Model Fit Indices	Established (CFI, RMSEA)	Evolving (SRMR)

Advanced Analytical Approaches: SEM-ANN

Recent studies employ a hybrid approach combining SEM with Artificial Neural Networks (ANN). While SEM tests linear hypotheses, feeding significant constructs into an ANN algorithm allows researchers to rank predictor importance and account for non-linear influences (Ooi & Tan, 2016).

Determinants of Adoption: Extending the Basic TAM

Empirical research demonstrates that basic TAM constructs are insufficient for explaining adoption, as financial transactions carry inherent risks and social implications (Alalwan et al., 2017).

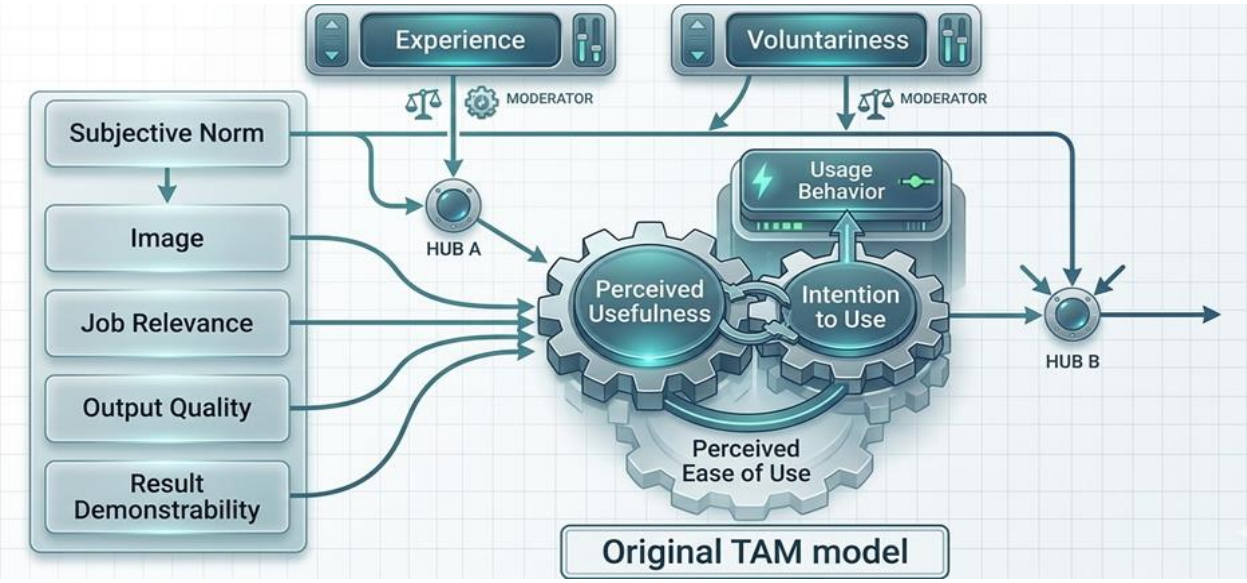


Figure:1 conceptual Framework of the Extended Technology Acceptance Model (TAM)

The Centrality of Trust and Perceived Risk

Trust acts as a cognitive bridge reducing uncertainty in virtual transactions. Conversely, perceived risk acts as a significant inhibitor (Mittal & Sharma, 2025).

Table 3: Taxonomy of Perceived Risk Dimensions and Their Impact on User Behavior

Risk Dimension	Description	Behavioral Impact
Financial Risk	Potential for monetary loss	Strongest detractor from trust
Privacy Risk	Concern over data disclosure	Reduces adoption intention
Performance Risk	Fear of technology malfunction	Influences satisfaction
Psychological Risk	Stress or anxiety stemming from use	Affects user well-being
Time Risk	Loss of time due to learning curves	Barrier for efficiency

For older adults in Taiwan, performance and financial risks are the most significant detractors from trust, whereas privacy and time risks show weaker effects (Chen, 2023).

Social Influence and Subjective Norms

Subjective norms perceived pressure from important others play a pivotal role in acceptance. In many Asian contexts, using mobile payment is

a social imperative as merchants move toward cashless environments (Sahi et al., 2021).

Compatibility and Lifestyle Integration

Compatibility refers to the degree an innovation is consistent with existing values and needs. Studies have found that compatibility is one of the strongest predictors of attitude toward m-payments (Schierz et al., 2010).

Regional Variations and the Digital Divide

The drivers of adoption are not uniform globally, showing stark differences between developed and developing economies (Monno & Xiao, 2014).

Asia vs. Europe and North America

The Asia-Pacific region, particularly China, leads the world in mobile wallet adoption. In 2021, 44% of point-of-sale transactions and 69% of online payments in the region were mobile-based. In contrast, US and European adoption remains lower (e.g., US at 25%, Sweden at 30%) due to entrenched credit card infrastructures (Statista, 2024).

The Generational Gap

While Gen Z consumers are digital natives, with 70% utilizing mobile wallets, older adults often find these applications difficult to navigate. For older populations, observability seeing others use the tech successfully is crucial (Chen, 2023).

Organizational Adoption: The SME Perspective

Adoption by Small and Medium Enterprises (SMEs) is vital for the digital ecosystem. For SMEs, m-payments are driven by the need to increase transaction volume and reduce cash-handling costs (Lin et al., 2022).

Psychological Consequences: Spending and Anxiety

Frictionless digital payments reduce the psychological "pain of payment," potentially leading to impulse purchases and buyer's remorse. A study of 18,584 US consumers used SEM to show that m-payment usage is positively associated with financial anxiety, mediated by overspending and over-indebtedness (An et al., 2025).

Technological Trajectory: 2016 to 2026

The evolution of m-payment technology is categorized into distinct phases.

- **2016–2018:** Launch of international services like Apple Pay and Samsung Pay. In Taiwan, usage grew from 26.8% in 2016 to 50.3% in 2018 (Cheng & Lei, 2026).
- **2024–2026:** Focus shifting to AI-driven "invisible payments" and real-time compliance (Thunes, 2026). Biometric authentication is expected to grow to a 34.71 billion market by 2032 (ThoughtFocus, 2025).

Synthesis of Challenges and Future Directions

Despite literature maturity, gaps persist. A primary critique of TAM is its focus on "behavioral intention" rather than "actual usage". Furthermore, the field is shifting from "sufficiency arguments" provided by SEM to "necessity arguments" provided by Necessary Condition Analysis (NCA) (Richter et al., 2024).

Conclusions

This study has examined the adoption of mobile payment systems through the robust theoretical framework of the Technology Acceptance Model (TAM) and advanced statistical techniques such as Structural Equation Modeling (SEM). The analysis confirms that Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) remain foundational determinants of users' attitude and behavioral intention toward m-payments. However, the basic TAM model requires extension to fully capture the complexities of financial technology adoption. Factors such as trust, perceived risk (particularly financial and privacy risks), social influence, subjective norms, and compatibility with users' lifestyles and values play critical roles in shaping adoption decisions. The integration of TAM with complementary theories including the Unified Theory of Acceptance and Use of Technology (UTAUT2), Innovation Diffusion Theory (IDT), and elements of the Theory of Planned Behavior (TPB) provides a more holistic understanding of m-payment acceptance. Methodologically, the complementary strengths of CB-SEM for theory testing and PLS-SEM for prediction, along with hybrid SEM-ANN

approaches, offer powerful tools for uncovering both linear and non-linear relationships in adoption behavior. Significant contextual variations exist across regions, generations, and user groups. While the Asia-Pacific region demonstrates high adoption rates driven by convenience and social norms, Western markets continue to face competition from established credit card infrastructures. Generational gaps, particularly among older adults, highlight the need for user-friendly designs and targeted interventions to bridge the digital divide. For Small and Medium Enterprises (SMEs), mobile payments represent an opportunity to reduce costs and expand transaction volumes, further accelerating the shift toward a cashless economy. Despite notable progress, challenges persist. Perceived risks continue to inhibit widespread adoption, while the psychological consequences of frictionless payments such as increased impulse spending and financial anxiety warrant careful consideration. Looking forward to 2026 and beyond, the technological trajectory points toward more seamless, AI-enabled "invisible" payments and enhanced biometric security solutions. Future research should address key limitations of current TAM-based studies by shifting focus from behavioral intention to actual usage behavior, incorporating longitudinal designs, and applying Necessary Condition Analysis (NCA) alongside traditional SEM approaches. Policymakers and industry stakeholders must prioritize building consumer trust, enhance data security, and ensuring inclusive design to maximize the benefits of mobile payments for financial inclusion and economic efficiency

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