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Public Payment Ecosystem, QRIS Usage Behavior, and Financial Satisfaction Among Manokwari MSMEs

Ekosistem Pembayaran Publik, Perilaku Penggunaan QRIS, dan Kepuasan Keuangan Pada UMKM Manokwari

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Abstract

Uniform national payment standardization by Bank Indonesia has not ensured symmetric utilization across peripheral regions, while Eastern Indonesian evidence remains scarce. This study examined how social influence, facilitating conditions, digital financial literacy, and mental accounting associate with Quick Response Code Indonesian Standard usage and financial satisfaction. Survey data from 180 active micro, small, and medium enterprises in Manokwari Regency were analyzed using Partial Least Squares Structural Equation Modeling. Social influence and facilitating conditions positively associate with usage behavior at comparable magnitudes, where hardware access exceeds technical support, while usage strongly aligns with financial satisfaction and channels significant indirect effects. Conversely, digital financial literacy exhibits no significant direct association, with fraud awareness scoring lowest, and mental accounting moderation remains statistically undetected despite its notable direct contribution to usage variance. Unlike metropolitan studies, this research links public payment infrastructure with behavioral economics, guiding policymakers toward technical support, merchant networks, and fraud safeguards.

Abstrak

Standardisasi pembayaran nasional oleh Bank Indonesia belum menjamin pemanfaatan digital merata di wilayah pinggiran, sedangkan bukti empiris Indonesia Timur masih terbatas. Penelitian ini menguji keterkaitan pengaruh sosial, kondisi fasilitas, literasi keuangan digital, dan akuntansi mental terhadap penggunaan Quick Response Code Indonesian Standard serta kepuasan keuangan. Data survei dari 180 pelaku usaha mikro, kecil, dan menengah aktif di Kabupaten Manokwari dianalisis menggunakan Partial Least Squares Structural Equation Modeling. Pengaruh sosial dan kondisi fasilitas berasosiasi positif terhadap perilaku penggunaan pada besaran setara, dengan akses perangkat melampaui dukungan teknis, sementara penggunaan berasosiasi kuat dengan kepuasan keuangan dan menyalurkan efek tidak langsung signifikan. Sebaliknya, literasi keuangan digital tidak menunjukkan asosiasi langsung signifikan dengan kesadaran penipuan terendah, dan moderasi akuntansi mental tidak terdeteksi secara statistik meskipun jalur langsungnya menyumbang varians penggunaan berarti. Berbeda dari studi metropolitan, riset ini menghubungkan infrastruktur pembayaran publik dengan ekonomi perilaku, mengarahkan kebijakan menuju dukungan teknis, jejaring pedagang, serta perlindungan penipuan.

A. INTRODUCTION

1. Background

Fragmented retail payment ecosystems impose high transaction costs, reinforce cash dependence, and exclude micro and small enterprises from formal financial intermediation. Across emerging economies, central banks have increasingly intervened as regulatory catalysts by building interoperable Digital Public Infrastructure (DPI) and fast payment systems (FPS) to correct private-network fragmentation, lower settlement friction, and expand equitable economic participation.[1] Comparative experiences in Brazil's Pix and India's Unified Payments Interface (UPI) demonstrate that state-mandated payment rails can accelerate merchant formalization, deepen local credit markets, and narrow regional financial divides—yet the micro-level economic gains depend critically on whether local businesses sustain active utilization beyond initial registration.[2]

In Indonesia, Bank Indonesia enacted this institutional intervention through the Quick Response Code Indonesian Standard (QRIS) under Board of Governors Regulation Number 21/18/PADG/2019, launched on August 17, 2019, and effective nationwide on January 1, 2020.[3] By unifying disparate commercial e-wallets and mobile banking applications under a single national QR architecture, QRIS reached 59.53 million users and 42.75 million merchants by the fourth quarter of 2025, recording 139.9% year-on-year transaction volume growth—the fastest expansion among all domestic payment instruments—amid national internet penetration of 221.5 million users, or 79.5% of the population.[4] This state-led payment modernization carries macroeconomic urgency because Indonesia's more than 64 million Micro, Small, and Medium Enterprises (MSMEs) generate roughly 61% of national Gross Domestic Product (approximately IDR 9,580

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[1] Bank for International Settlements (BIS), *Faster Digital Payments: Global and Regional Perspectives*, BIS Papers No. 152 (Basel: Bank for International Settlements, 2024), 5–6, https://www.bis.org/publications/paper-152-faster-digital-payments-global-and-regional-perspectives.pdf.

[2] Adriana Gomes and Thiago Christiano Silva, "Fast Payment, Credit and Bank Diversification: The Impact of Pix Adoption on the Local Credit Market Structure," *EconomiA* 25, no. 2 (2024): 377–392, https://doi.org/10.1108/ECON-11-2023-0199; Peter J. Morgan, "Fintech and Financial Inclusion in Southeast Asia and India," *Asian Economic Policy Review* 17, no. 2 (2022): 183–208, https://doi.org/10.1111/aepr.12379.

[3] Bank Indonesia, *Peraturan Anggota Dewan Gubernur Nomor 21/18/PADG/2019 tentang Implementasi Standar Nasional Quick Response Code untuk Pembayaran* (Jakarta: Bank Indonesia, 2019).

[4] Bank Indonesia, *Laporan Perekonomian Indonesia 2025* (Jakarta: Bank Indonesia, 2025), https://www.bi.go.id/id/publikasi/laporan/Documents/LPI-2025_versi-lengkap.pdf; Asosiasi Penyelenggara Jasa Internet Indonesia (APJII), *Survei Penetrasi Internet Indonesia 2024* (Jakarta: APJII, 2024), https://apjii.or.id/berita/d/apjii-jumlah-pengguna-internet-indonesia-tembus-221-juta-orang.

trillion) and absorb about 97% of the national workforce.[5]

Despite rapid national expansion, uniform supply-side standardization by the central bank has not translated into symmetric utilization across Indonesia's sub-national economies. The 2024 National Survey of Financial Literacy and Inclusion (SNLIK) documented a 9.59-percentage-point gap between national financial inclusion (75.02%) and financial literacy (65.43%), indicating that millions of economic actors hold formal access to digital financial instruments without fully mastering their operational management and risk safeguards.[6] Regional digital asymmetries sharpen this policy tension in Eastern Indonesia: in 2024, West Papua recorded an Indonesia Digital Society Index (IMDI) score of 41.01, trailing the national benchmark of 43.34.[7]

In Manokwari Regency—the administrative and commercial hub of West Papua—preliminary field observations and consultations with the Regency Office of Cooperatives and SMEs (*Dinas Koperasi dan UKM*) and local QRIS-using business operators reveal a nuanced operational landscape. Although Bank Indonesia West Papua, regional banks, and local government agencies actively promote digital onboarding through initiatives such as the West Papua MSME curation program, and smartphones are increasingly widespread among urban traders, persistent institutional and behavioral frictions constrain sustained QRIS intensity.[8] Local retail exchange remains heavily anchored in cash-handling norms, post-onboarding technical assistance is uneven, merchants express apprehension regarding administrative fees and digital fraud, and business revenues are frequently commingled with household funds without systematic bookkeeping.[9]

Scholarly research examining the determinants of digital payment utilization among MSMEs reveals two unresolved theoretical and empirical debates. First, studies rooted in the Unified Theory of Acceptance and Use of Technology (UTAUT) maintain that external

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[5] Kementerian Koordinator Bidang Perekonomian Republik Indonesia, *Laporan Kinerja Kementerian Koordinator Bidang Perekonomian Tahun 2024* (Jakarta: Kementerian Koordinator Bidang Perekonomian, 2024), https://kinerja.ekon.go.id/perencanaan/download/lakip-1660-2024-sHP56.pdf.

[6] Otoritas Jasa Keuangan and Badan Pusat Statistik, *Survei Nasional Literasi dan Inklusi Keuangan (SNLIK) 2024* (Jakarta: Otoritas Jasa Keuangan, 2024), https://ojk.go.id/id/berita-dan-kegiatan/publikasi/Documents/Pages/Survei-Nasional-Literasi-dan-Inklusi-Keuangan-(SNLIK)-2024/Survei%20Nasional%20Literasi%20dan%20Inklusi%20Keuangan%20(SNLIK)%202024.pdf.

[7] Badan Pengembangan Sumber Daya Manusia Komunikasi dan Digital, *Indeks Masyarakat Digital Indonesia 2024* (Jakarta: Kementerian Komunikasi dan Digital, 2024), 92, https://imdi.sdmdigital.id/download-laporan/02122024_Buku%20IMDI_BAB%201-5_V6_compressed.pdf.

[8] Fransiskus Salu Weking, "BI Papua Barat: 28 UMKM Berpotensi Lolos Program Kurasi 2025," *ANTARA News Papua Tengah*, 2025, https://papuatengah.antaranews.com/berita/62157/bi-papua-barat-28-umkm-berpotensi-lolos-program-kurasi-2025.

[9] Preliminary field interviews with the Manokwari Regency Office of Cooperatives and SMEs and active QRIS-using MSME operators conducted prior to survey deployment (2026).

ecosystem pressures (social influence) and enabling technical infrastructure (facilitating conditions) directly shape technology use behavior.[10] Empirical analyses of Indonesian QRIS consumers and mobile payment adopters in western Fiji corroborate this dual ecosystem mechanism, showing that peer and customer expectations alongside technical readiness significantly raise digital payment utilization; yet evidence from micro-enterprises in mature Java and Sumatra markets confirms the salience of facilitating conditions while finding social influence statistically insignificant once habit and trust take hold.[11] Pushing this divergence further, research grounded in the Theory of Interpersonal Behavior finds that neither social influence nor facilitating conditions significantly drives QRIS adoption where entrenched cash habits dominate, while cross-country macroeconomic evidence warns that rapid financial digitalization in developing economies can heighten operational uncertainty when institutional and capability foundations remain weak.[12] Second, a pronounced empirical paradox surrounds digital financial literacy. While recent MSME studies document that digital financial literacy enhances financial well-being and mediates government-support transmission into business performance, empirical investigations of Indonesian QRIS and cashless payment users repeatedly find an insignificant direct link between digital literacy and actual payment usage.[13]

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[10] Viswanath Venkatesh, Michael G. Morris, Gordon B. Davis, and Fred D. Davis, "User Acceptance of Information Technology: Toward a Unified View," *MIS Quarterly* 27, no. 3 (2003): 425–478, https://doi.org/10.2307/30036540.

[11] Evan Hamzah Muchtar, Budi Trianto, Irwan Maulana, Muhammad Nurul Alim, Ruslan Husen Marasabessy, Wahyu Hidayat, Edy Junaedi, and Masrizal, "Quick Response Code Indonesia Standard (QRIS) E-Payment Adoption: Customers Perspective," *Cogent Business & Management* 11, no. 1 (2024): 2316044, https://doi.org/10.1080/23311975.2024.2316044; Rizka Ramayanti, Zubir Azhar, and Nik Hadian Nik Azman, "Factors Influencing Intentions to Use QRIS: A Two-Staged PLS-SEM and ANN Approach," *Telematics and Informatics Reports* 17 (2025): 100185, https://doi.org/10.1016/j.teler.2024.100185; Sailesh Saras Chand and Bimal Aklesh Kumar, "Applying the UTAUT Model to Understand M-Payment Adoption: A Case Study of Western Part of Fiji," *Journal of the Knowledge Economy* 15, no. 4 (2024): 15523–15549, https://doi.org/10.1007/s13132-023-01722-x; Dyah Cahyasari, Hamidah, and Umi Widyastuti, "Digitalization of Micro-Sized Enterprises: Determinants of Quick Response Code Indonesian Standard (QRIS), Fintech Usage Behavior, and Implications for Business Sustainability," *ABAC Journal* 45, no. 3 (2025): 114–137, https://doi.org/10.59865/abacj.2025.18.

[12] Apriani Dorkas Rambu Atahau and Devi Nila Himaya, "Adopsi QRIS oleh UMKM dengan Menggunakan Theory of Interpersonal Behavior," *Jurnal Personalia, Financial, Operasional, Marketing dan Sistem Informasi* 29, no. 2 (2022): 125–139, https://doi.org/10.32424/1.jp.2022.29.2.6336; Abd Rahim Md. Jamil, Siong Hook Law, M. S. Mohamad Khair-Afham, and Irwan Trinugroho, "Financial Inclusion and Economic Uncertainty in Developing Countries: The Role of Digitalisation," *Economic Analysis and Policy* 79 (2023): 786–806, https://doi.org/10.1016/j.eap.2023.06.039.

[13] Abdurrahman Abdurrahman and Dimas Adi Nugroho, "The Role of Digital Financial Literacy on Financial Well-Being with Financial Technology, Financial Confidence, Financial Behavior as Intervening and Sociodemography as Moderation," *Jurnal Ekonomi dan Bisnis* 27, no. 2 (2024): 191–220, https://doi.org/10.24914/jeb.v27i2.11891; Charles Tandilino, Grace T. Pontoh, Darmawati, and Aini Indrijawati, "Digital Financial Inclusion as a Mediator of Digital Financial Literacy and Government Support

These conflicting findings expose three interconnected blind spots in the literature. First, existing QRIS scholarship focuses overwhelmingly on densely banked metropolitan corridors in Java and Sumatra and treats digital payments primarily as an individual information-systems adoption choice, leaving underexplored how state-mandated public payment infrastructure operates across geographically peripheral regional economies. Second, prior models rarely examine how internal cognitive budgeting mechanisms—specifically mental accounting in behavioral economics, defined as the cognitive operations through which economic agents categorize, separate, and evaluate funds by source and intended use—interact with external social pressure.[14] Theoretically, mental accounting introduces an unresolved tension: disciplined mental separation of business liquidity from personal consumption may either attenuate uncritical social conformity by promoting autonomous cost-benefit evaluation, or reinforce social influence when customer demand for cashless payment aligns with structured operational tracking. Third, most adoption studies stop at behavioral intention or usage uptake without evaluating whether sustained utilization of public digital payment infrastructure translates into financial satisfaction—the merchant's subjective assessment of financial control, security, and freedom from financial worry—among active MSME users.

Unlike previous studies that analyze initial QRIS adoption in core metropolitan regions of Java and Sumatra without integrating regional public-infrastructure asymmetries or behavioral-economics budgeting mechanisms, this study offers three distinct contributions to state and regional development economics. First, it shifts analytical attention to post-adoption QRIS usage behavior among active MSME merchants in Manokwari Regency, West Papua, providing micro-level empirical evidence on how Bank Indonesia's national payment standardization functions in an underrepresented Eastern Indonesian economy. Second, it integrates UTAUT external ecosystem determinants and self-perceived digital financial literacy with Thaler's mental accounting framework, evaluating both the direct and moderating behavioral pathways shaping sustained digital payment utilization. Third, it extends technology-usage evaluation to an

in MSME Performance," *International Journal of Financial Studies* 13, no. 4 (2025): 199, https://doi.org/10.3390/ijfs13040199; Cahyasari, Hamidah, and Widyastuti, "Digitalization of Micro-Sized Enterprises," 114–137; Ahmad Pudin Syari, Etikah Karyani, Putra Pamungkas, and Aldy Fariz Achsanta, "Digital Literacy and Cashless Payment: Evidence from Indonesia," *The Asian Journal of Technology Management* 17, no. 1 (2024): 51–58, https://doi.org/10.12695/ajtm.2024.17.1.4.

[14] Richard H. Thaler, "Mental Accounting Matters," *Journal of Behavioral Decision Making* 12, no. 3 (1999): 183–206, https://doi.org/10.1002/(SICI)1099-0771(199909)12:3<183::AID-BDM318>3.0.CO;2-F.

economic welfare outcome by examining whether intensive QRIS usage behavior is associated with higher merchant financial satisfaction.

This study advances the central argument that in geographically peripheral regional economies, sustained utilization of state-mandated digital payment infrastructure is closely associated with external market-network pressures, localized enabling technical conditions, and internal financial-organization practices, which in turn strongly align with merchant financial satisfaction—whereas self-perceived digital financial literacy alone exhibits a weak direct association with usage intensity. For economic theory, the study bridges public payment-system governance with behavioral economics by clarifying the boundary conditions under which central bank standardization yields subjective financial welfare gains. For public policymakers—particularly Bank Indonesia, regional governments, and commercial banks—the findings establish an evidence base for reallocating MSME digitalization budgets away from standalone classroom literacy campaigns toward post-onboarding technical support, community-anchored merchant networks, digital fraud safeguards, and integrated practical bookkeeping assistance.

2. Research Questions

The central empirical problem examined in this study is why sustained QRIS usage behavior varies across active MSME operators in Manokwari Regency, West Papua, despite uniform central bank payment standardization, and how external ecosystem determinants, internal financial capabilities, and cognitive budgeting practices jointly associate with usage intensity and merchant financial satisfaction. Because all sampled enterprises are existing QRIS merchants, the study investigates usage behavior (utilization intensity and operational integration) rather than initial adoption decisions between adopters and non-adopters. This problem is formulated into five specific research questions:

a. Does social influence associate positively with QRIS usage behavior among active MSME operators in Manokwari Regency?
b. Do facilitating conditions associate positively with QRIS usage behavior among active MSME operators in Manokwari Regency?
c. Does digital financial literacy associate positively with QRIS usage behavior among active MSME operators in Manokwari Regency?
d. Does QRIS usage behavior associate positively with financial satisfaction among active MSME operators in Manokwari Regency?

e. Does mental accounting moderate the relationship between social influence and QRIS usage behavior among active MSME operators in Manokwari Regency?

To establish a verifiable analytical link between the theoretical framework and the structural estimation in Section B, five hypotheses are specified:

a. H_1**:** Social influence has a positive and significant association with QRIS usage behavior among active MSME operators in Manokwari Regency (reflecting market demand from customers, peer validation, and institutional ecosystem norms).

b. H_2**:** Facilitating conditions have a positive and significant association with QRIS usage behavior among active MSME operators in Manokwari Regency (reflecting device readiness, payment-system compatibility, and accessible technical support).

c. H_3**:** Digital financial literacy has a positive and significant association with QRIS usage behavior among active MSME operators in Manokwari Regency (reflecting self-perceived risk comprehension, fraud-security awareness, and operational confidence).

d. H_4**:** QRIS usage behavior has a positive and significant association with financial satisfaction among active MSME operators in Manokwari Regency (reflecting enhanced transaction traceability, reduced cash-handling friction, and subjective financial control).

e. H_5**:** Mental accounting significantly moderates the relationship between social influence and QRIS usage behavior among active MSME operators in Manokwari Regency (testing whether cognitive separation and budgeting of business funds strengthens or alters merchants' behavioral responsiveness to external social norms)

3. Research Methods

Economic Research Design and Epistemological Framework. This study employs a quantitative, cross-sectional, explanatory-predictive survey design estimated via Partial Least Squares Structural Equation Modeling (PLS-SEM). Positioned within a post-positivist empirical paradigm, the design evaluates the micro-level behavioral transmission of a state-mandated public payment standard (QRIS) into merchant financial satisfaction. PLS-SEM is selected over covariance-based structural equation

modeling (CB-SEM) and consistent PLS (PLSc) on three methodological grounds: the analytical objective combines theoretical extension of UTAUT with behavioral-economics constructs from an out-of-sample predictive perspective; the structural specification incorporates latent variable interaction modeling; and the survey indicators rely on bounded four-point ordinal Likert responses that depart from strict multivariate normality.[15] Epistemologically, because the data are cross-sectional, single-source, and drawn exclusively from existing QRIS users, the structural coefficients represent associative explanatory relationships regarding usage behavior rather than causal identification of initial adoption or longitudinal welfare transitions.

Data Sources, Sampling Strategy, Power Analysis, and Variable Specifications. The study is situated in Manokwari Regency, West Papua, encompassing nine administrative districts. Official secondary registry data from the Manokwari Regency Office of Cooperatives and Small and Medium Enterprises (*Diskopukm Kabupaten Manokwari*) document the registered MSME population from 2020 to 2025 (Table 1). Following a pandemic-era contraction from 1,705 units in 2020 to 1,354 units in 2021, registered MSMEs expanded steadily through 2024 (2,790 units) before surging by 66.6% to 4,649 units in 2025 amid post-pandemic recovery and intensified local business registration.[16] However, official regency statistics do not disaggregate the exact sub-population of active QRIS-registered merchants. Because a complete sampling frame of QRIS-active MSMEs was unavailable, the study applied non-probability purposive sampling targeting three eligibility criteria: operating an MSME in Manokwari Regency for at least six months, utilizing QRIS as a business payment rail, and maintaining a target QRIS usage tenure of at least six months.

Table 1. Number of Registered MSMEs in Manokwari Regency, 2020–2025

Year	Registered MSMEs (Units)	Annual Change (%)
2020	1,705	—
2021	1,354	-20.59
2022	1,620	+19.65
2023	1,834	+13.21
2024	2,790	+52.13
2025	4,649	+66.63

Source: Dinas Koperasi dan Usaha Kecil Menengah Kabupaten Manokwari (2025); annual percentage changes calculated by the authors.

[15] Joseph F. Hair Jr., Jeffrey J. Risher, Marko Sarstedt, and Christian M. Ringle, "When to Use and How to Report the Results of PLS-SEM," *European Business Review* 31, no. 1 (2019): 2–24, https://doi.org/10.1108/EBR-11-2018-0203.

[16] Dinas Koperasi dan Usaha Kecil Menengah Kabupaten Manokwari, *Data Perkembangan Jumlah UMKM Kabupaten Manokwari Tahun 2020–2025* (Manokwari: Dinas Koperasi dan UKM Kabupaten Manokwari, 2025).

Sample size adequacy was evaluated beyond the traditional ten-times heuristic (10 × 18 reflective indicators = 180) using Kock and Hadaya's inverse square root power analysis for PLS-SEM.[17] Under a 5% significance level ($\alpha = 0.05$) and 80% statistical power ($1 - \beta = 0.80$), the minimum required sample size satisfies $N_{\min} > \left(\frac{z_{1-\alpha/2}+z_{1-\beta}}{|\beta_{\min}|}\right)^2$ for two-tailed testing (numerator $= 2.802$) and $N_{\min} > \left(\frac{2.486}{|\beta_{\min}|}\right)^2$ for one-tailed testing. The achieved sample of $n = 180$ exceeds the benchmark of $N_{\min} = 155$ for detecting a minimum standardized path coefficient of $|\beta_{\min}| = 0.20$ (one-tailed) and provides at least 80% power to detect standardized paths of $|\beta_{\min}| \geq 0.186$ (one-tailed) and $|\beta_{\min}| \geq 0.209$ (two-tailed). At the same time, this calculation establishes transparently that $n = 180$ possesses constrained statistical power to detect small moderation effects ($|\beta| < 0.15$), a statistical boundary factored into the interpretation of H_5 in Section B.

The empirical model specifies six reflective latent constructs, each operationalized by three indicators adapted from established literature (18 items in total; full item wordings and psychometric diagnostics are reported in Section B):

a. Social Influence (SI): Exogenous construct capturing perceived external endorsement via social recommendations ($SI1$), perceived importance to peers and customers ($SI2$), and social encouragement ($SI3$).
b. Facilitating Conditions (FC): Exogenous construct capturing external enabling infrastructure via supporting device availability ($FC1$), system compatibility ($FC2$), and accessible technical support ($FC3$).
c. Digital Financial Literacy (DFL): Exogenous construct measuring self-perceived internal financial capability via digital risk comprehension ($DFL1$), fraud-security awareness ($DFL2$), and self-confidence in operating digital financial services ($DFL3$).
d. Mental Accounting (MA): Exogenous behavioral-economics moderator capturing cognitive budgeting and fund compartmentalization via mental money management ($MA1$), separation of funds by purpose ($MA2$), and

[17] Ned Kock and Pierre Hadaya, "Minimum Sample Size Estimation in PLS-SEM: The Inverse Square Root and Gamma-Exponential Methods," *Information Systems Journal* 28, no. 1 (2018): 227–261, https://doi.org/10.1111/isj.12131.

differentiated treatment of funds by source ($MA3$).

e. QRIS Usage Behavior (QUB): Endogenous mediating/outcome construct capturing sustained operational utilization among existing adopters via actual business use ($QUB1$), operational acceptance ($QUB2$), and ongoing usage integration ($QUB3$).

f. Financial Satisfaction (FS): Endogenous welfare outcome capturing subjective evaluation of business financial condition ($FS1$), perceived financial security ($FS2$), and absence of financial worry ($FS3$).

All indicators were measured on a four-point forced-choice Likert scale ranging from 1 (*strongly disagree*) to 4 (*strongly agree*). Omitting a neutral midpoint discourages satisficing or socially evasive escape responses in field surveys, though forced-choice scaling can compress item variance and elevate mean agreement levels—a psychometric trade-off monitored explicitly during descriptive and validity diagnostics.[18] Figure 1 maps the conceptual architecture linking H_1–H_5, including the lower-order direct path from mental accounting (MA) to QRIS usage behavior (QUB) required for unbiased moderation estimation.

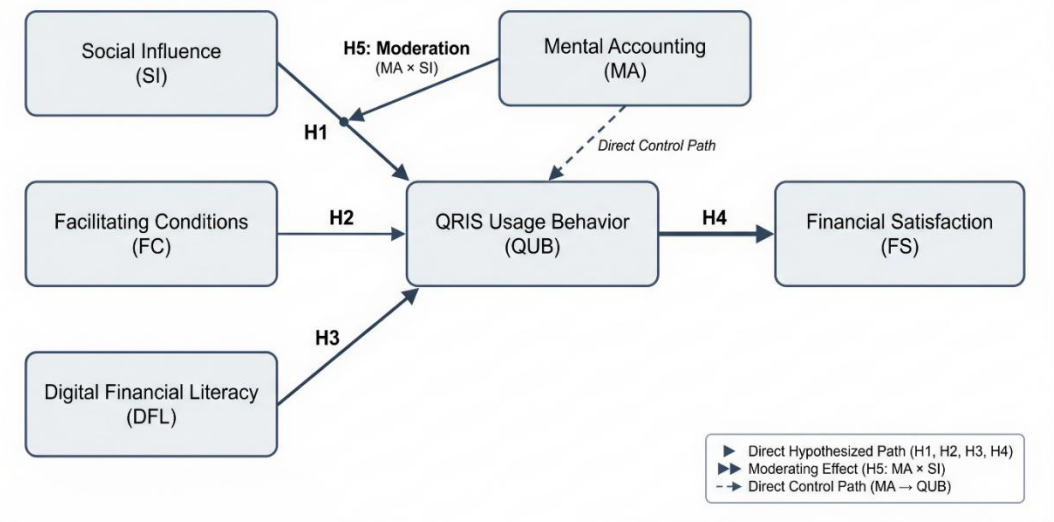


Figure 1. Conceptual and Structural Research Model

Source: Adapted from Venkatesh et al. (2003), Thaler (1999), and Cahyasari et al. (2025); developed by the authors (2026).

Note: Solid arrows denote hypothesized structural paths (H_1–H_5), whereas the dashed arrow denotes the lower-order direct control path ($MA \rightarrow QUB$) required for unbiased latent interaction estimation in PLS-SEM.

[18] Miloš Kankaraš and Stefania Capecchi, "Neither Agree nor Disagree: Use and Misuse of the Neutral Response Category in Likert-Type Scales," *Metron* 83, no. 1 (2025): 111–140, https://doi.org/10.1007/s40300-024-00276-5.

Data Collection, Ethical Protocol, and Pre-Estimation Screening. Prior to full deployment, preliminary qualitative interviews were conducted with officials from the Manokwari Regency Office of Cooperatives and SMEs and local QRIS-using MSME operators to calibrate item phrasing to regional business terminology and verify content validity. Primary survey data were then gathered using a hybrid distribution protocol: electronic Google Forms circulated across Manokwari MSME WhatsApp communities and Instagram channels, complemented by direct in-person visits to merchant premises. Participation was strictly voluntary, informed consent was obtained prior to questionnaire completion, and respondent identities were anonymized. Although the demographic questionnaire adopted standard productive-age intervals starting at 15–30 years, sampling targeted active commercial QRIS merchants whose registration under Indonesian payment-system rules requires legal national identification (KTP) and active business operation.

Pre-estimation data screening verified response completeness across all 18 construct items and checked eligibility against active Manokwari QRIS merchant status, yielding $n = 180$ complete observations with zero missing item values and requiring no imputation or logarithmic transformations (as bounded ordinal Likert indicators are standardized internally within the PLS-SEM estimation routine). Two transparent sampling characteristics are documented from screening: first, while the target recruitment protocol specified six months of QRIS tenure, two completed respondents (1.1%) reported active QRIS operation of less than six months and were retained in the final sample ($n = 180$) to preserve data integrity without post-hoc exclusion; second, hybrid digital recruitment concentrated 76.1% of respondents in West Manokwari, the regency's primary commercial center. Both sample properties are reported explicitly in Section B and incorporated into external validity boundaries.

Data Analysis Techniques, Formal Model Specification, and Validation Criteria. Estimation was executed in SmartPLS 4 in two sequential stages: measurement (outer) model evaluation and structural (inner) model estimation. For each reflective latent construct ξ_j ($j \in \{SI, FC, DFL, MA, QUB, FS\}$) and its $k = 1,2,3$ manifest indicators x_{jk}, the measurement model is specified as:

$$x_{jk} = \lambda_{jk}\xi_j + \delta_{jk}$$

where λ_{jk} denotes the standardized outer loading and δ_{jk} denotes the indicator-specific measurement error. On standardized latent variable scores (zero mean, unit

variance), the structural model is formulated as a recursive two-equation system:

$$QUB_i = \beta_1 SI_i + \beta_2 FC_i + \beta_3 DFL_i + \beta_4 MA_i + \beta_5 (MA_i \times SI_i) + \varepsilon_{1i}$$

$$FS_i = \gamma_1 QUB_i + \varepsilon_{2i}$$

where $i = 1, \ldots, 180$ indexes individual MSME respondents, ε_{1i} and ε_{2i} are structural disturbance terms, and each formal hypothesis maps directly to a specific structural parameter: H_1 tests $\beta_1 > 0$, H_2 tests $\beta_2 > 0$, H_3 tests $\beta_3 > 0$, H_4 tests $\gamma_1 > 0$, and H_5 tests $\beta_5 \neq 0$. In accordance with standard PLS-SEM moderation procedure, Equation (2) explicitly incorporates the main effect $\beta_4 MA_i$ alongside the interaction term $\beta_5 (MA_i \times SI_i)$ so that the estimated moderation slope is not confounded by omitted main-effect variance.[19]

Measurement model validation evaluates indicator reliability (outer loadings $\lambda_{jk} \geq 0.70$), convergent validity (Average Variance Extracted, AVE ≥ 0.50), and internal consistency reliability via Cronbach's α and composite reliability ($\rho_c \geq 0.70$, with ρ_c prioritized where α conservatively underestimates reliability for short three-item scales).[20] Discriminant validity is assessed triangulated across the Fornell–Larcker criterion, indicator cross-loadings, and the Heterotrait–Monotrait Ratio (HTMT), with thresholds fixed *a priori* at HTMT < 0.85 for conceptually distinct constructs and HTMT < 0.90 for conceptually adjacent constructs (specifically facilitating infrastructure and operational usage behavior).[21]

Structural model evaluation examines lateral collinearity via inner Variance Inflation Factors (VIF < 5, ideally < 3), in-sample explanatory power via R^2 and adjusted R^2 (evaluated against 0.25 weak, 0.50 moderate, and 0.75 substantial benchmarks), and relative contribution via effect size f^2.[22] Crucially, while conventional thresholds (0.02 small, 0.15 medium, 0.35 large) are applied to direct main effects, moderation effect sizes in Equation (2) are evaluated against empirically realistic interaction benchmarks established by Aguinis et al., who demonstrated that observed moderating f^2 values average approximately 0.009 (making 0.005, 0.010, and 0.025 more appropriate small,

[19] Hair et al., "When to Use and How to Report the Results of PLS-SEM," 11–14.
[20] Hair et al., "When to Use and How to Report the Results of PLS-SEM," 8–9.
[21] Jörg Henseler, Christian M. Ringle, and Marko Sarstedt, "A New Criterion for Assessing Discriminant Validity in Variance-Based Structural Equation Modeling," *Journal of the Academy of Marketing Science* 43, no. 1 (2015): 115–135, https://doi.org/10.1007/s11747-014-0403-8.
[22] Hair et al., "When to Use and How to Report the Results of PLS-SEM," 11–12.

medium, and large reference points than 0.02).[23] Out-of-sample predictive relevance is assessed through PLSpredict ($Q^2_{\text{predict}} > 0$, RMSE, and MAE).[24] Statistical inference relies on bootstrapping with a conservative two-tailed criterion at the 5% significance level ($|t| > 1.96,\ p < 0.05$): two-tailed testing imposes a stricter threshold on directional hypotheses (H_1–H_4) while remaining theoretically appropriate for the competing behavioral predictions underlying H_5. Economically, standardized coefficients (β and γ) are interpreted in standard-deviation units—indicating the expected standard-deviation shift in QRIS usage behavior or financial satisfaction associated with a one-standard-deviation shift in a given determinant, holding other modeled constructs constant—enabling direct comparison of relative economic salience alongside statistical significance.

B. RESULT

1. Urban, Young, and Experienced Merchants Dominate the Active QRIS Sample with Compressed Positive Perceptions

The achieved sample comprises $n = 180$ active QRIS-using MSME operators across Manokwari Regency, exhibiting pronounced demographic, sectoral, and spatial concentration (Table 2). Female entrepreneurs represent 60.0% of respondents, while younger business operators aged 15–40 years account for 87.2% ($n = 157$), including 53.9% in the 15–30 cohort. Nearly half of the sample holds a bachelor's degree (47.8%) and operates in the culinary sector (49.4%), followed by fashion (18.3%), services (15.6%), and trade (14.4%). Regarding operational maturity, 46.1% of enterprises have operated for more than three years, and 160 respondents (88.9%) have actively transacted with QRIS for more than one year (54.4% for over two years). Two sample properties directly bound statistical inference.

First, although the recruitment protocol targeted merchants with at least six months of QRIS tenure, two completed respondents (1.1%) reported less than six months of active use and were retained to preserve raw-sample integrity. Second, respondents reside in only four of Manokwari Regency's nine districts, with 76.1% concentrated in West

[23] Herman Aguinis, James C. Beaty, Robert J. Boik, and Charles A. Pierce, "Effect Size and Power in Assessing Moderating Effects of Categorical Variables Using Multiple Regression: A 30-Year Review," *Journal of Applied Psychology* 90, no. 1 (2005): 94–107, https://doi.org/10.1037/0021-9010.90.1.94.
[24] Galit Shmueli, Marko Sarstedt, Joseph F. Hair, Jun-Hwa Cheah, Hiram Ting, Santha Vaithilingam, and Christian M. Ringle, "Predictive Model Assessment in PLS-SEM: Guidelines for Using PLSpredict," *European Journal of Marketing* 53, no. 11 (2019): 2322–2347, https://doi.org/10.1108/EJM-02-2019-0189.

Manokwari—the regency's central commercial zone—confirming that the empirical evidence captures predominantly urban, digitally active existing QRIS users rather than unbanked rural non-adopters.

Table 2. Demographic, Operational, and Spatial Profile of Respondents ($n = 180$)

Characteristic	Category	Frequency (n)	Share (%)
Gender	Male	72	40.0
	Female	108	60.0
Age (years)	15–30	97	53.9
	31–40	60	33.3
	41–55	21	11.7
	> 55	2	1.1
Education	< Senior high school	8	4.4
	Senior high school	62	34.4
	Diploma	15	8.3
	Bachelor's	86	47.8
	Postgraduate	9	5.0
QRIS usage duration	< 6 months	2	1.1
	6–12 months	18	10.0
	> 1 year	62	34.4
	> 2 years	98	54.4
Business age	< 1 year	16	8.9
	1–3 years	81	45.0
	> 3 years	83	46.1
Business type	Culinary	89	49.4
	Fashion	33	18.3
	Services	28	15.6
	Trade	26	14.4
	Health	2	1.1
	Souvenirs	1	0.6
	Automotive	1	0.6
District	West Manokwari	137	76.1
	South Manokwari	30	16.7
	East Manokwari	11	6.1
	North Manokwari	2	1.1

Source: Authors' calculation based on primary survey data (2026).
Note: Percentages may not sum to exactly 100.0% in every category due to one-decimal rounding. Two respondents (1.1%) reporting under six months of QRIS operation were retained without post-hoc deletion.

Descriptive statistics across the six reflective constructs reveal consistently elevated agreement levels and narrow dispersion across item means (Table 3). Every construct mean exceeds 3.00 on the four-point forced-choice Likert scale, ranging from 3.05 for social influence (SI) and 3.06 for digital financial literacy (DFL) to 3.38 for financial satisfaction (FS). Two item-level contrasts merit direct empirical attention. Within facilitating conditions (FC, mean $= 3.29$), device availability ($FC1$, mean $= 3.41$) achieves

the highest score in the entire survey, whereas technical support when resolving operational difficulties ($FC3$, mean $= 3.14$) records the lowest score within the construct—indicating that hardware access is already widespread among sampled merchants while post-onboarding technical support lags behind. Within digital financial literacy (DFL, indicator range $= 3.01–3.09$), fraud-security awareness ($DFL2$, mean $= 3.01$) sits at the bottom of the capability profile. Methodologically, the uniform clustering of construct means above 3.00 with compressed indicator-mean spreads reflects potential ceiling effects and acquiescence bias characteristic of forced-choice ordinal scales lacking a neutral midpoint;[25] furthermore, because predictive power in structural modeling depends on inter-construct covariance rather than mean levels, lower descriptive averages cannot by themselves explain path insignificance.

Table 3. Descriptive Statistics of Latent Constructs (1–4 Scale, $n = 180$)

Variable	Indicator Mean Range (Points)	Construct Mean (Points)
Social influence (SI)	2.96–3.11	3.05
Facilitating conditions (FC)	3.14–3.41	3.29
Digital financial literacy (DFL)	3.01–3.09	3.06
Mental accounting (MA)	3.14–3.35	3.25
QRIS usage behavior (QUB)	3.27–3.33	3.30
Financial satisfaction (FS)	3.36–3.39	3.38

Source: Authors' calculation based on primary survey data (2026).
Note: Measured on a four-point forced-choice Likert scale (1 = strongly disagree to 4 = strongly agree). Item-level standard deviations were not retained in the archived descriptive summary output.

2. Construct Validity Holds Despite Mild Reliability Attenuation and Adjacent-Construct Proximity

Outer model diagnostics confirm indicator reliability and convergent validity across all six reflective constructs without requiring item elimination (Table 4). Standardized outer loadings span from 0.706 ($FC1$) to 0.919 ($SI3$), surpassing the 0.70 retention threshold. Average Variance Extracted (AVE) values range from 0.600 for facilitating conditions to 0.837 for social influence, exceeding the 0.50 convergent validity benchmark across every construct. Internal consistency evaluated via composite reliability (ρ_c) spans 0.818 (FC) to 0.939 (SI), satisfying the ≥ 0.70 standard. Five constructs likewise meet or exceed Cronbach's $\alpha \geq 0.70$ (0.716 to 0.903), whereas facilitating conditions records a mildly attenuated $\alpha = 0.665$. Because Cronbach's α assumes equal indicator loadings (tau-equivalence) and penalizes short three-item

[25] Kankaraš and Capecchi, "Neither Agree nor Disagree," 114–118.

scales—particularly when hardware availability ($FC1$, $\lambda = 0.706$) exhibits greater heterogeneity relative to system compatibility ($FC2$, $\lambda = 0.827$) and technical support ($FC3$, $\lambda = 0.786$)—composite reliability ($\rho_c = 0.818$) and AVE (0.600) establish acceptable internal consistency for structural estimation.[26]

Table 4. Measurement Model: Indicator Loadings, Reliability, and Convergent Validity

Construct	Code	Indicator	Outer Loading (λ)	Cronbach's α	Composite Reliability (ρc)	AVE
Social influence (SI)	SI1	Social recommendation	0.916	0.903	0.939	0.837
	SI2	Perceived importance	0.910			
	SI3	Social encouragement	0.919			
Facilitating conditions (FC)	FC1	Device availability	0.706	0.665	0.818	0.600
	FC2	System compatibility	0.827			
	FC3	Technical support	0.786			
Digital financial literacy (DFL)	DFL1	Risk understanding	0.723	0.716	0.831	0.623
	DFL2	Security awareness	0.775			
	DFL3	Self-confidence	0.863			
Mental accounting (MA)	MA1	Money management (mental budgeting)	0.727	0.749	0.857	0.666
	MA2	Separation by purpose	0.848			
	MA3	Treatment by source	0.867			
QRIS usage behavior (QUB)	QUB1	Actual use	0.837	0.802	0.883	0.716
	QUB2	Acceptance	0.863			
	QUB3	Usage support	0.838			
Financial satisfaction (FS)	FS1	Satisfaction with financial condition	0.840	0.752	0.857	0.667
	FS2	Sense of financial security	0.812			
	FS3	No financial worry	0.798			

Source: Authors' estimation using SmartPLS 4 (2026).
Note: AVE equals the arithmetic mean of squared standardized outer loadings; Dijkstra–Henseler's ρ_A was not extracted in the archived output.

Discriminant validity is corroborated under both the Fornell–Larcker criterion[27] and the Heterotrait–Monotrait Ratio (HTMT), with one boundary caveat (Table 5). The square roots of AVE—0.915 (SI), 0.775 (FC), 0.789 (DFL), 0.816 (MA), 0.846 (QUB), and 0.817 (FS)—uniformly exceed the maximum inter-construct latent correlation observed in the model ($r = 0.624$ between FC and QUB), and each manifest item loads highest on its designated construct. Across all 15 construct pairs in Table 5, HTMT values range from

[26] Hair et al., "When to Use and How to Report the Results of PLS-SEM," 8–9.
[27] Claes Fornell and David F. Larcker, "Evaluating Structural Equation Models with Unobservable Variables and Measurement Error," *Journal of Marketing Research* 18, no. 1 (1981): 45–46, https://doi.org/10.1177/002224378101800104.

0.440 ($SI–DFL$) to 0.852 ($FC–QUB$). Fourteen pairs fall comfortably below the conservative 0.85 cutoff, whereas the $FC–QUB$ pair (0.852) breaches 0.85 by 0.002 while remaining below the 0.90 *a priori* threshold designated for conceptually adjacent constructs.[28] This empirical proximity aligns with the operational overlap between technical support ($FC3$) and ongoing usage support ($QUB3$) among active merchants, warranting cautious interpretation of the $FC \rightarrow QUB$ slope.

Table 5. Discriminant Validity Matrix: Heterotrait–Monotrait Ratio (HTMT)

Construct	SI	FC	DFL	MA	QUB	FS
Social influence (SI)	—					
Facilitating conditions (FC)	0.711	—				
Digital financial literacy (DFL)	0.440	0.536	—			
Mental accounting (MA)	0.564	0.788	0.589	—		
QRIS usage behavior (QUB)	0.683	0.852	0.487	0.735	—	
Financial satisfaction (FS)	0.623	0.775	0.493	0.699	0.747	—

Source: Authors' estimation using SmartPLS 4 (2026).
Note: Square roots of AVE (Fornell–Larcker diagonal) range from 0.775 (FC) to 0.915 (SI), exceeding the highest inter-construct correlation ($r_{FC,QUB} = 0.624$). Full off-diagonal Fornell–Larcker correlations and bootstrapped HTMT confidence intervals were not archived in the original estimation output.

3. Structural Diagnostics Confirm Absence of Severe Collinearity, Moderate Usage Explanatory Power, and Weak Satisfaction Variance Share

Structural collinearity diagnostics rule out severe predictor redundancy across all modeled paths: inner Variance Inflation Factor (VIF) values span 1.000 to 1.792, remaining well below both the strict 3.0 guideline and the standard 5.0 cutoff.[29] In-sample explanatory power and out-of-sample predictive accuracy diverge meaningfully across the two endogenous equations (Table 6). For QRIS usage behavior (QUB), the five-predictor structural specification (SI, FC, DFL, MA, and $MA \times SI$) accounts for 52.3% of total variance ($R^2 = 0.523$; adjusted $R^2 = 0.510$), classifying as moderate explanatory power under Hair et al.'s 0.25/0.50/0.75 benchmarks.[30] For financial satisfaction (FS), the single-predictor specification explains 34.4% of total variance ($R^2 = 0.344$; adjusted $R^2 = 0.340$), which corresponds to weak explanatory power—reflecting that merchant financial satisfaction also depends on unmodeled economic determinants such as household income, firm revenue, and macroeconomic conditions.

[28] Henseler, Ringle, and Sarstedt, "A New Criterion for Assessing Discriminant Validity," 121–123.
[29] Hair et al., "When to Use and How to Report the Results of PLS-SEM," 11.
[30] Hair et al., "When to Use and How to Report the Results of PLS-SEM," 11–12.

Out-of-sample predictive testing via PLSpredict yields strictly positive Q^2_{predict} statistics for both QRIS usage behavior (0.464, RMSE = 0.743, MAE = 0.547) and financial satisfaction (0.334, RMSE = 0.836, MAE = 0.619), confirming that the structural model outperforms naïve indicator-mean benchmarks.[31] Two diagnostic boundaries apply transparently to Table 6. First, indicator-level linear-model (LM) prediction errors and standardized root mean square residual (SRMR) were not extracted in the archived SmartPLS 4 output, preventing formal comparison against linear regression prediction benchmarks. Second, although low inner VIFs (≤ 1.792) exclude severe predictor multicollinearity, a formal full-collinearity test for single-source common method bias[32] was not conducted, meaning that shared-method variance may modestly inflate the single-predictor R^2 for FS.

Table 6. Structural Model Quality: Explanatory Power and Out-of-Sample Predictive Relevance

Endogenous construct	R^2	Adj. R^2	Explanatory Benchmark	Q^2predict	RMSE	MAE
QRIS usage behavior (QUB)	0.523	0.510	Moderate	0.464	0.743	0.547
Financial satisfaction (FS)	0.344	0.340	Weak	0.334	0.836	0.619

Source: Authors' estimation using SmartPLS 4 (2026).

Note: Inner VIF values range from 1.000 to 1.792 across all structural predictors. Benchmarks follow Hair et al. (2019): 0.25 = weak, 0.50 = moderate, 0.75 = substantial. Indicator-level linear-model (LM) PLSpredict errors and SRMR were not archived in the original output.

4. Social Influence and Facilitating Conditions Associate Equally with Usage Behavior, While Usage Strongly Tracks Financial Satisfaction

Bootstrapped structural estimates (two-tailed, $\alpha = 0.05$) establish explicit empirical verdicts for all five hypotheses formulated in Section A.2: H_1, H_2, and H_4 are supported, whereas H_3 and H_5 are not supported (Table 7, Panel A).

First, social influence (H_1 is supported) exhibits a positive, statistically significant association with QRIS usage behavior ($\beta_1 = 0.285$, $SE = 0.086$, $t = 3.310$, $p = 0.001$, 95% CI [0.116,0.454], $f^2 = 0.105$). Economically, a one-standard-deviation increase in perceived customer, peer, and community endorsement corresponds to a 0.285-standard-deviation increase in sustained QRIS utilization intensity, holding other predictors constant—a small-to-approaching-medium unique variance contribution

[31] Shmueli et al., "Predictive Model Assessment in PLS-SEM," 2327–2331.
[32] Ned Kock, "Common Method Bias in PLS-SEM: A Full Collinearity Assessment Approach," *International Journal of e-Collaboration* 11, no. 4 (2015): 6–8, https://doi.org/10.4018/ijec.2015100101.

($f^2 = 0.105$) under Cohen's main-effect standards.[33] Second, facilitating conditions (H_2 is supported) likewise displays a positive, highly significant association with QRIS usage behavior ($\beta_2 = 0.301$, $SE = 0.073$, $t = 4.150$, $p < 0.001$, 95% CI [0.159,0.443], $f^2 = 0.106$). A one-standard-deviation improvement in supporting devices, system compatibility, and technical assistance aligns with a 0.301-standard-deviation increase in usage behavior. Crucially, although the point estimate for FC (0.301) slightly exceeds that of SI (0.285) by 0.016 standard-deviation units, their substantial confidence-interval overlap ([0.159,0.443] vs. [0.116,0.454]) and nearly identical effect sizes ($f^2 = 0.106$ vs. 0.105) demonstrate that the two external ecosystem determinants are statistically indistinguishable in magnitude.

Third, digital financial literacy (H_3 is not supported) shows a small positive point estimate that does not reach statistical significance ($\beta_3 = 0.083$, $SE = 0.061$, $t = 1.358$, $p = 0.175$, 95% CI $[-0.037,0.203]$, $f^2 = 0.011$). Because the confidence interval spans zero up to $+0.203$, this null result indicates insufficient statistical evidence of a direct linear association between self-perceived digital literacy and usage intensity at $n = 180$, rather than definitive proof that literacy is economically irrelevant.

Fourth, QRIS usage behavior (H_4 is supported) registers the strongest structural relationship in the model, associating positively and substantially with merchant financial satisfaction ($\gamma_1 = 0.586$, $SE = 0.064$, $t = 9.087$, $p < 0.001$, 95% CI [0.460,0.712], $f^2 = 0.524$). In economic-magnitude terms, a one-standard-deviation shift in active QRIS usage behavior corresponds to a 0.586-standard-deviation gain in subjective financial satisfaction, representing a large effect size ($f^2 = 0.524 > 0.35$).

Fifth, mental accounting moderation (H_5 is not supported) does not reach statistical significance ($\beta_5 = 0.062$, $SE = 0.067$, $t = 0.928$, $p = 0.354$, 95% CI $[-0.069,0.193]$, $f^2 = 0.010$). However, evaluating $f^2 = 0.010$ against Aguinis et al.'s empirically calibrated interaction benchmarks (0.005 small, 0.010 medium, 0.025 large) rather than Cohen's main-effect cutoff (0.02) indicates that the point estimate sits near a medium real-world moderation magnitude.[34] Combined with the power boundary documented in Section A.3—where $n = 180$ lacks 80% power to detect effects below $|\beta| = 0.209$ (two-tailed)—the non-significant p-value reflects a failure to detect moderation reliably rather than

[33] Jacob Cohen, *Statistical Power Analysis for the Behavioral Sciences*, 2nd ed. (Hillsdale, NJ: Lawrence Erlbaum Associates, 1988), 413–414.
[34] Aguinis et al., "Effect Size and Power in Assessing Moderating Effects," 98–101.

conclusive proof of zero moderation. Equally important, the lower-order direct control path from mental accounting to QRIS usage behavior ($MA \rightarrow QUB$), included in Equation (2) and verified by the five-predictor adjusted R^2 (0.510), records an effect size of $f^2 = 0.088$. Although its standardized slope, t-statistic, and p-value were not archived in the original SmartPLS table, an f^2 of 0.088 represents over four-fifths of the variance contribution of social influence ($f^2 = 0.105$) and facilitating conditions ($f^2 = 0.106$). This internal behavioral-economics variable therefore accounts for a nontrivial share of usage variance, directly precluding any sweeping claim that external factors unilaterally dominate internal factors.

Table 7. Structural Path Estimates, Hypothesis Verdicts, and Implied Recursive Indirect Effects

Hypothesis / Path	Structural Relationship	β	SE	t / z	p	95% CI	f²	Verdict / Role
Panel A: Direct, Control, and Moderation Paths								
H_1	$SI \rightarrow QUB$	0.285	0.086	3.310	0.001	[0.116, 0.454]	0.105	Supported
H_2	$FC \rightarrow QUB$	0.301	0.073	4.150	< 0.001	[0.159, 0.443]	0.106	Supported
H_3	$DFL \rightarrow QUB$	0.083	0.061	1.358	0.175	$[-0.037, 0.203]$	0.011	Not supported
H_4	$QUB \rightarrow FS$	0.586	0.064	9.087	< 0.001	[0.460, 0.712]	0.524	Supported
H_5	$MA \times SI \rightarrow QUB$	0.062	0.067	0.928	0.354	$[-0.069, 0.193]$	0.010	Not supported
Control	$MA \rightarrow QUB$	NR	NR	NR	NR	NR	0.088	Unhypothesized direct control
Panel B: Implied Specific Indirect Transmission (Sobel Delta-Method Approximation)								
Indirect 1	$SI \rightarrow QUB \rightarrow FS$	0.167	0.054	3.110	0.002	[0.062, 0.272]	—	Significant implied channel
Indirect 2	$FC \rightarrow QUB \rightarrow FS$	0.176	0.047	3.775	< 0.001	[0.085, 0.268]	—	Significant implied channel
Indirect 3	$DFL \rightarrow QUB \rightarrow FS$	0.049	0.036	1.343	0.179	$[-0.022, 0.120]$	—	Not significant
Indirect 4	$MA \times SI \rightarrow QUB \rightarrow FS$	0.036	0.039	0.923	0.356	$[-0.041, 0.113]$	—	Not significant

Source: Panel A based on primary data processed in SmartPLS 4 (2026) using two-tailed bootstrapping ($\alpha = 0.05$); Panel B calculated analytically by the authors.
Notes: In Panel A, bootstrap standard errors are recovered algebraically from reported coefficients and t-statistics ($SE = |\beta|/t$), and 95% confidence intervals reflect symmetric normal approximations ($\beta \pm 1.96 \times SE$) because bias-corrected accelerated (BCa) bounds, bootstrap resample counts, and interaction-construction settings were not retained in the archived output. NR = not reported in archived estimation output (confirmed present in the QUB equation via five-predictor adjusted $R^2 = 0.510$ and $f^2 = 0.088$). In Panel B, implied indirect paths equal $\beta_a \times \gamma_1$, with standard errors and z-statistics computed via Sobel's (1982) first-order delta method ($SE_{\text{Sobel}} = \sqrt{\gamma_1^2 SE_a^2 + \beta_a^2 SE_{\gamma_1}^2}$). Because direct paths from exogenous constructs to FS were not specified in Equations (2)–(3), Panel B characterizes conditional recursive transmission rather than a formal test of full versus partial mediation.

Panel B of Table 7 quantifies the implied recursive transmission from external ecosystem conditions through QRIS usage behavior to merchant financial satisfaction

using Sobel's first-order delta-method approximation.[35] Conditional on the specified two-equation recursive chain, both social influence ($\beta_{\text{ind}} = 0.167, SE = 0.054, z = 3.110, p = 0.002$, 95% CI [0.062,0.272]) and facilitating conditions ($\beta_{\text{ind}} = 0.176$, $SE = 0.047$, $z = 3.775$, $p < 0.001$, 95% CI [0.085,0.268]) exhibit statistically significant, economically comparable indirect associations with financial satisfaction via active QRIS utilization. Specifically, a one-standard-deviation improvement in facilitating conditions or social influence transmits roughly a 0.17–0.18-standard-deviation indirect shift in subjective financial satisfaction through usage intensity. Conversely, the implied indirect channels from digital financial literacy ($\beta_{\text{ind}} = 0.049$, $p = 0.179$) and the mental-accounting interaction ($\beta_{\text{ind}} = 0.036, p = 0.356$) remain statistically indistinguishable from zero.

Finally, in the interest of empirical transparency regarding model identification and heterogeneity, the archived primary dataset did not retain disaggregated respondent-level covariates necessary to estimate auxiliary robustness regressions with demographic controls (gender, age, education, sector, business age, and QRIS tenure), multi-group heterogeneity splits across districts or sectors, or instrumental-variable endogeneity corrections. Consequently, the empirical findings reported in Tables 2–7 establish cross-sectional associative magnitudes within an urban-concentrated cohort of existing Manokwari QRIS merchants; their theoretical mechanisms, international comparators, institutional policy implications, and identification boundaries are analyzed in Section C

C. DISCUSSION

1. Two-Sided Network Coordination and Post-Onboarding Infrastructure Jointly Anchor Regional QRIS Utilization

Viewing Quick Response Code Indonesian Standard (QRIS) utilization through the lens of state and public economics reframes technology acceptance as the micro-level behavioral transmission of central-bank-mandated Digital Public Infrastructure (DPI). Under Board of Governors Regulation Number 21/18/PADG/2019, Bank Indonesia resolved a classic private-market coordination failure—proprietary e-wallet fragmentation—by imposing universal QR interoperability nationwide.[36] Yet the Manokwari findings reveal that uniform national payment regulation is a necessary

[35] Michael E. Sobel, "Asymptotic Confidence Intervals for Indirect Effects in Structural Equation Models," *Sociological Methodology* 13 (1982): 290–321, https://doi.org/10.2307/270723.
[36] Bank Indonesia, *Peraturan Anggota Dewan Gubernur Nomor 21/18/PADG/2019* (Jakarta: Bank Indonesia, 2019).

rather than sufficient condition for deep regional utilization. Consistent with the recursive transmission mechanism of regulatory shock (QRIS standardization) → localized market-infrastructure channels (SI and FC) → sustained merchant utilization (QUB), active usage intensity responds with virtually identical magnitude to social influence ($\beta_1 = 0.285$, $f^2 = 0.105$) and facilitating conditions ($\beta_2 = 0.301$, $f^2 = 0.106$), whose overlapping confidence intervals confirm statistical equivalence.

The positive association between social influence and usage behavior (H_1) requires distinguishing analytically between two distinct economic mechanisms often conflated in Unified Theory of Acceptance and Use of Technology (UTAUT) applications: *normative social conformity* and *two-sided market demand*. In retail payment markets characterized by cross-side network externalities, a merchant's return from actively maintaining QRIS rises with the share of local customers and peer businesses transacting digitally.[37] Thus, social endorsement ($SI1$–$SI3$) operates not merely as psychological compliance with peer opinions, but as an economic signal of local demand density and commercial legitimacy. This mechanism resolves an apparent tension between the preliminary qualitative observations—which highlighted persistent cash-handling norms across Manokwari—and the positive survey mean (3.05). Because the survey sampled active urban QRIS merchants who had already cleared initial adoption barriers, their positive baseline reflects an emerging digital commercial enclave in West Manokwari, while marginal variation in usage intensity remains highly elastic to whether surrounding customers and peers actively reinforce cashless exchange.

Adjudicating between competing theoretical frameworks illuminates why social influence remains salient in Manokwari when it vanishes in core Indonesian markets. Whereas Atahau and Himaya—applying the Theory of Interpersonal Behavior—found that entrenched habits overshadowed social norms in shaping QRIS intention, and Cahyasari, Hamidah, and Widyastuti similarly reported insignificant social influence among micro-enterprises in mature Java and Sumatra markets (where routine habit and trust dominate), the Manokwari evidence aligns with UTAUT's direct ecosystem-pressure pathway documented among Indonesian consumers and bottom-of-the-pyramid Indian Unified Payments Interface (UPI) users.[38] In peripheral regional economies where formal

[37] Bank for International Settlements (BIS), *Faster Digital Payments: Global and Regional Perspectives*, BIS Papers No. 152 (Basel: Bank for International Settlements, 2024), 5–6.
[38] Apriani Dorkas Rambu Atahau and Devi Nila Himaya, "Adopsi QRIS oleh UMKM dengan Menggunakan Theory of Interpersonal Behavior," *Jurnal Personalia, Financial, Operasional, Marketing dan Sistem Informasi*

commercial information channels are thinner and cash remains the default fallback, peer validation and visible customer demand carry disproportionate informational weight in lowering adoption uncertainty.

Equally decisive is the disaggregated economic interpretation of facilitating conditions (H_2). Treating FC as a monolithic infrastructure variable obscures the binding public-policy constraint. Item-level descriptive profiles show that hardware ownership ($FC1$, device availability $= 3.41$) is already the highest-scoring dimension in the survey, whereas post-onboarding technical assistance ($FC3 = 3.14$) lags substantially behind. Consequently, the structural slope of facilitating conditions among active Manokwari merchants is driven primarily by *operational continuity*—system compatibility ($FC2, \lambda = 0.827$) and troubleshooting support ($FC3$, $\lambda = 0.786$)—rather than basic smartphone scarcity. From a regional development perspective, this distinction prevents misallocated public spending: in secondary Eastern Indonesian urban centers, the digital divide manifests less as an absence of mobile devices than as thin institutional support density when settlement failures, QR print errors, or application glitches disrupt daily trade. At the same time, this mechanism must be interpreted alongside the measurement caveat documented in Section B.2 ($\text{HTMT}_{FC,QUB} = 0.852$), as technical assistance ($FC3$) and operational usage support ($QUB3$) are closely intertwined in day-to-day merchant workflows.

2. Why Self-Perceived Digital Financial Literacy Fails to Drive Usage Directly—and Why Internal Mental Accounting Still Matters

The empirical null result for digital financial literacy (H_3: $\beta_3 = 0.083$, $p = 0.175$, 95% CI $[-0.037, 0.203]$) must not be attributed to its relatively low descriptive mean (3.06). As shown in Section B, social influence exhibits a marginally lower mean (3.05) yet exerts a highly significant structural effect; in variance-based modeling, predictive salience depends on inter-construct covariance rather than mean levels. Instead, three

29, no. 2 (2022): 125–139, https://doi.org/10.32424/1.jp.2022.29.2.6336; Dyah Cahyasari, Hamidah, and Umi Widyastuti, "Digitalization of Micro-Sized Enterprises: Determinants of Quick Response Code Indonesian Standard (QRIS), Fintech Usage Behavior, and Implications for Business Sustainability," *ABAC Journal* 45, no. 3 (2025): 114–137, https://doi.org/10.59865/abacj.2025.18; Evan Hamzah Muchtar et al., "Quick Response Code Indonesia Standard (QRIS) E-Payment Adoption: Customers Perspective," *Cogent Business & Management* 11, no. 1 (2024): 2316044, https://doi.org/10.1080/23311975.2024.2316044; Rohit Joshi, "A Mixed Methods UTAUT2-Based Approach to Understanding Unified Payments Interface Adoption in BOP Users," *International Journal of Electronic Banking* 4, no. 3 (2024): 235–254, https://doi.org/10.1504/IJEBANK.2024.139219.

rigorous economic and psychometric mechanisms account for the insignificant direct path.

First, digital financial literacy likely operates indirectly rather than directly on transaction volume. Consistent with empirical mediation evidence from Indonesia by Abdurrahman and Nugroho and international household evidence from Choung, Chatterjee, and Pak, financial literacy primarily strengthens perceived security, fraud resilience, and financial confidence—channels that govern *safe* financial management rather than sheer payment scan frequency.[39] Because the current parsimonious specification omits trust and perceived risk, any indirect literacy pathway operating through risk reduction remains unobserved in β_3.

Second, operational payment use can decouple from conceptual financial literacy. As Lo Prete demonstrates cross-nationally, simplified digital payment interfaces allow economic agents with basic smartphone fluency to transact cashlessly even when deeper financial and risk-management literacy remains weak—a pattern mirrored in Indonesian cashless payment evidence by Syari et al. and Cahyasari, Hamidah, and Widyastuti.[40]

Third, selection on active users and subjective measurement attenuate variance: because all respondents already operate QRIS (88.9% for over a year) and items $DFL1$–$DFL3$ measure self-perceived confidence rather than objectively tested financial numeracy, the sample lacks the unbanked lower tail where basic literacy barriers bind most sharply. Notably, the lowest literacy score belongs to fraud-security awareness ($DFL2 = 3.01$), signaling a latent consumer-protection vulnerability rather than a direct brake on current usage.

A parallel theoretical recalibration is essential for mental accounting (H_5 and its direct control pathway). Grounded in Thaler's behavioral economics rather than narrow managerial accounting, mental accounting describes how economic agents cognitively

[39] Abdurrahman Abdurrahman and Dimas Adi Nugroho, "The Role of Digital Financial Literacy on Financial Well-Being with Financial Technology, Financial Confidence, Financial Behavior as Intervening and Sociodemography as Moderation," *Jurnal Ekonomi dan Bisnis* 27, no. 2 (2024): 191–220, https://doi.org/10.24914/jeb.v27i2.11891; Youngjoo Choung, Swarn Chatterjee, and Tae-Young Pak, "Digital Financial Literacy and Financial Well-Being," *Finance Research Letters* 58, Part B (2023): 104438, https://doi.org/10.1016/j.frl.2023.104438.

[40] Anna Lo Prete, "Digital and Financial Literacy as Determinants of Digital Payments and Personal Finance," *Economics Letters* 213 (2022): 110378, https://doi.org/10.1016/j.econlet.2022.110378; Ahmad Pudin Syari, Etikah Karyani, Putra Pamungkas, and Aldy Fariz Achsanta, "Digital Literacy and Cashless Payment: Evidence from Indonesia," *The Asian Journal of Technology Management* 17, no. 1 (2024): 51–58, https://doi.org/10.12695/ajtm.2024.17.1.4; Cahyasari, Hamidah, and Widyastuti, "Digitalization of Micro-Sized Enterprises," 114–137.

partition funds into separate non-fungible accounts by source and purpose.[41] In Equation (2), the interaction between mental accounting and social influence (H_5: $\beta_5 = 0.062$, $p = 0.354$, $f^2 = 0.010$) is not statistically supported. However, unlike standard main-effect benchmarks (0.02), Aguinis et al.'s empirical review establishes $f^2 = 0.010$ as a near-medium interaction magnitude in applied behavioral research.[42] Paired with the inverse square root power boundary ($n = 180$ lacks 80% power for slopes below $|\beta| = 0.209$), the data indicate that moderation was *not statistically detected* rather than proven non-existent. Contextually, preliminary Manokwari interviews also show that many micro-traders still commingle household and enterprise cash informally, suggesting that informal mental budgeting may not yet be institutionalized enough to systematically amplify or dampen external social norms.

Most importantly, these estimates overturn any simplistic claim that external ecosystem factors unilaterally dominate internal merchant capabilities. As documented in Table 7, the lower-order direct control path from mental accounting to QRIS usage behavior ($MA \rightarrow QUB$) accounts for a unique effect size of $f^2 = 0.088$—more than four-fifths the explanatory contribution of social influence ($f^2 = 0.105$) and facilitating conditions ($f^2 = 0.106$). Even though the archived SmartPLS output did not retain its exact standardized slope and p-value, the magnitude of $f^2 = 0.088$ demonstrates that internal cognitive fund-compartmentalization co-moves substantially with sustained QRIS utilization. Economic intuition supports this direct channel: merchants who mentally separate business liquidity from personal consumption value QRIS directly as an external commitment device that isolates digital sales receipts from pocket cash. Rather than an external-versus-internal dichotomy, sustained payment utilization in Manokwari reflects a dual-anchor equilibrium combining external ecosystem pull/support (SI, FC) with internal behavioral fund management (MA).

3. Sustained Payment Formalization Aligns with Financial Satisfaction, Subject to Identification Caveats

The strongest empirical association in the structural model links QRIS usage behavior to merchant financial satisfaction (H_4: $\gamma_1 = 0.586$, $p < 0.001$, $f^2 = 0.524$),

[41] Richard H. Thaler, "Mental Accounting Matters," *Journal of Behavioral Decision Making* 12, no. 3 (1999): 183–206, https://doi.org/10.1002/(SICI)1099-0771(199909)12:3<183::AID-BDM318>3.0.CO;2-F.
[42] Herman Aguinis, James C. Beaty, Robert J. Boik, and Charles A. Pierce, "Effect Size and Power in Assessing Moderating Effects of Categorical Variables Using Multiple Regression: A 30-Year Review," *Journal of Applied Psychology* 90, no. 1 (2005): 94–107, https://doi.org/10.1037/0021-9010.90.1.94.

accompanied by statistically significant implied recursive transmission from both facilitating conditions ($\beta_{\text{ind}} = 0.176$, $p < 0.001$) and social influence ($\beta_{\text{ind}} = 0.167$, $p = 0.002$) through usage behavior to financial satisfaction (Table 7, Panel B). Within a public-economics framework, this link illustrates why central bank payment modernization matters beyond operational checkout speed: shifting micro-enterprise transactions from opaque cash to standardized digital rails aligns with measurable gains in merchants' subjective financial control, perceived financial security, and freedom from financial worry ($FS1$–$FS3$, construct mean $= 3.38$).

Analytically, however, theoretical transmission channels must be distinguished rigorously from empirically measured indicators. Because the survey measured subjective financial satisfaction rather than objective settlement speed, theft incidence, or accounting error rates, the underlying channels—such as automated digital transaction histories that lower mental bookkeeping burdens, elimination of small-change shortages, reduced physical cash-handling risk, and progressive formalization of merchant cash-flow footprints—represent *theoretically grounded economic mechanisms* consistent with broader MSME digitalization evidence from Indonesia and India, rather than directly observed mediators in this dataset.[43] Moreover, the weak overall explanatory power for financial satisfaction ($R^2 = 0.344$; adjusted $R^2 = 0.340$) reinforces economic realism: payment-rail usage is one institutional lever among many, leaving roughly two-thirds of satisfaction variance governed by unmodeled fundamentals including net business profit, household wealth, input-cost inflation, and credit access.

Two identification boundaries further qualify the magnitude of $\gamma_1 = 0.586$. First, reverse causality and omitted-variable bias cannot be excluded in a cross-sectional design: merchants who already enjoy stronger sales turnover, steadier liquidity, and higher baseline financial satisfaction possess greater capacity and willingness to sustain multi-channel QRIS integration. Second, because both QUB and FS were collected from the same respondents via a single forced-choice instrument without a formal full-

[43] Yoga Affandi, Masagus M. Ridhwan, Irwan Trinugroho, and Danny Hermawan Adiwibowo, "Digital Adoption, Business Performance, and Financial Literacy in Ultra-Micro, Micro, and Small Enterprises in Indonesia," *Research in International Business and Finance* 70, Part B (2024): 102376, https://doi.org/10.1016/j.ribaf.2024.102376; Anirban Adhikary, Krishna Sundar Diatha, Sourav Bikash Borah, and Amalesh Sharma, "How Does the Adoption of Digital Payment Technologies Influence Unorganized Retailers' Performance? An Investigation in an Emerging Market," *Journal of the Academy of Marketing Science* 49, no. 5 (2021): 882–902, https://doi.org/10.1007/s11747-021-00778-y.

collinearity diagnostic, common method variance may inflate both γ_1 and R^2_{FS}.[44] Consequently, H_4 establishes a robust, economically meaningful cross-sectional association—not an identified causal treatment effect—between digital payment formalization and subjective financial welfare.

4. Comparative Empirical Dialogue, Global Elevation, and External Validity Boundary Conditions

Situating Manokwari within national and international empirical research prevents the local-context trap and clarifies where findings converge or diverge across institutional environments. Table 8 synthesizes eight peer-reviewed empirical studies spanning Indonesia and four structurally comparable emerging economies—Fiji, India, Brazil, and Kenya—comparing estimator choices, sample scopes, and substantive magnitudes against the present Manokwari results.

Table 8. Comparative Synthesis of Empirical Evidence Across Domestic and Developing-Economy Payment Ecosystems

Study	Economy & Payment Rail	Sample & Method	Key Empirical Findings & Magnitudes	Relation to Manokwari Findings
Present Study (2026)	Indonesia (Manokwari, West Papua) — QRIS	$n = 180$ active QRIS MSMEs; PLS-SEM (UTAUT + Behavioral Economics)	$SI \rightarrow QUB$ ($\beta = 0.285$, $f^2 = 0.105$); $FC \rightarrow QUB$ ($\beta = 0.301$, $f^2 = 0.106$); $DFL \rightarrow QUB$ ($\beta = 0.083$, ns); $QUB \rightarrow FS$ ($\beta = 0.586$, $f^2 = 0.524$); $MA \rightarrow QUB$ ($f^2 = 0.088$); $MA \times SI$ ($\beta = 0.062$, ns)	Baseline peripheral Eastern Indonesian merchant evidence linking public payment rail use to subjective welfare.
Cahyasari, Hamidah, & Widyastuti (2025)[45]	Indonesia (Java & Sumatra) — QRIS	Micro-entrepreneurs; PLS-SEM (UTAUT + Behavioral Finance)	Facilitating conditions, habit, trust, and continuance intention significantly raise QRIS usage and sustainability; **social influence and DFL insignificant**	**Confirms** *FC* salience and null direct *DFL*; **diverges** on *SI*, showing peer/market pressure remains stronger in less-saturated Eastern Indonesia than in mature Java–Sumatra markets.
Muchtar et al. (2024)[46]	Indonesia (National) — QRIS	$n = 195$ QRIS consumers; PLS-SEM (UTAUT)	*SI* and *FC* significantly drive QRIS adoption intention; performance and effort expectancy positive but insignificant	**Confirms** dual *SI* and *FC* dominance from the demand side, reinforcing the two-sided network externality linking customers to Manokwari merchants.
Atahau & Himaya (2022)[47]	Indonesia — QRIS	MSME actors; SEM (Theory of Interpersonal Behavior)	Social influence does not increase QRIS intention; facilitating conditions (as moderator) insignificant	**Refutes/contrasts**: divergence stems from theoretical specification (habit-centric TIB vs. direct-path UTAUT) and testing *FC* as a direct enabler rather than a moderator.
Affandi et al. (2024)[48]	Indonesia (17 major regions) — Digital adoption	$n = 5{,}035$ ultra-micro, micro, and small enterprises; Econometric survey analysis	Digital adoption improves enterprise performance, conditioned by financial literacy and targeted policy support	**Extends** macro-survey performance evidence to micro-level subjective financial satisfaction in an

[44] Ned Kock, "Common Method Bias in PLS-SEM: A Full Collinearity Assessment Approach," *International Journal of e-Collaboration* 11, no. 4 (2015): 1–10, https://doi.org/10.4018/ijec.2015100101.
[45] Cahyasari, Hamidah, and Widyastuti, "Digitalization of Micro-Sized Enterprises," 114–137.
[46] Muchtar et al., "Quick Response Code Indonesia Standard (QRIS) E-Payment Adoption," 2316044.
[47] Atahau and Himaya, "Adopsi QRIS oleh UMKM," 125–139.
[48] Affandi et al., "Digital Adoption, Business Performance, and Financial Literacy," 102376.

				underrepresented Eastern Indonesian province.
Chand & Kumar (2024)[49]	Fiji (Western Division) — Mobile payments	$n = 301$ m-payment users; PLS-SEM (UTAUT)	All UTAUT predictors significant; performance expectancy and **facilitating conditions** exert the strongest influence	**Confirms** strong *FC* salience across geographically dispersed island economies with uneven telecom/service infrastructure.
Adhikary et al. (2021)[50] & Joshi (2024)[51]	India — Digital payments / Unified Payments Interface (UPI)	Emerging-market unorganized retailers (econometric); bottom-of-the-pyramid UPI users (mixed-methods UTAUT2)	Digital payment adoption lifts unorganized retailer economic performance by **9.6%** on average; social influence carries outsized weight where formal information is scarce, alongside fraud concerns	**Extends & corroborates**: parallels Manokwari's strong *SI* effect in information-thin local markets, merchant welfare gains, and persistent fraud-security anxiety (*DFL2*).
Gomes & Silva (2024)[52] & Duarte (2025)[53]	Brazil — Pix (Central Bank instant payment)	Brazilian municipalities (event-study/econometric) & institutional regulatory analysis	Pix reached > 61% of adults within a year and diversified local credit markets; mandatory participation and low fees boost inclusion, yet territorial infrastructure gaps sustain functional disparities	**Contextualizes** QRIS within global central-bank DPI: confirms that supply-side standardization must be paired with localized technical support to close regional inclusion gaps.
Suri & Jack (2016)[54]	Kenya — M-Pesa (Mobile money)	Longitudinal household panel (2008–2014); Difference-in-differences	Mobile money agent access lifted ~194,000 households (**2%**) out of poverty via savings resilience and enterprise shifts, with largest gains for **female-headed** units	**Illuminates welfare channel**: reinforces why QRIS usage strongly aligns with financial satisfaction in a predominantly female merchant cohort (60.0%), conditional on local support-infrastructure density.

Source: Authors' comparative synthesis of verified peer-reviewed literature (2016–2025).
Note: ns = statistically not significant at the 5% level.

Three overarching global insights emerge from this comparative synthesis. First, Brazil's Pix and India's UPI corroborate the institutional economics of central-bank DPI: when monetary authorities mandate open interoperability and subsidize small-value merchant fees, adoption scales rapidly—yet functional utilization in peripheral regions remains constrained by local technical support, cash-preference norms, and fraud apprehension.[55]

[49] Sailesh Saras Chand and Bimal Aklesh Kumar, "Applying the UTAUT Model to Understand M-Payment Adoption: A Case Study of Western Part of Fiji," *Journal of the Knowledge Economy* 15, no. 4 (2024): 15523–15549, https://doi.org/10.1007/s13132-023-01722-x.
[50] Adhikary et al., "How Does the Adoption of Digital Payment Technologies Influence Unorganized Retailers' Performance?," 882–902.
[51] Joshi, "A Mixed Methods UTAUT2-Based Approach," 235–254.
[52] Adriana Gomes and Thiago Christiano Silva, "Fast Payment, Credit and Bank Diversification: The Impact of Pix Adoption on the Local Credit Market Structure," *EconomiA* 25, no. 2 (2024): 377–392, https://doi.org/10.1108/ECON-11-2023-0199.
[53] Paula da Cunha Duarte, "Digital Financial Inclusion and Women: A Case Study of Pix, the Brazilian Instant Payment System," *Eurasian Economic Review* 15, no. 2 (2025): 379–400, https://doi.org/10.1007/s40822-024-00300-z.
[54] Tavneet Suri and William Jack, "The Long-Run Poverty and Gender Impacts of Mobile Money," *Science* 354, no. 6317 (2016): 1288–1292, https://doi.org/10.1126/science.aah5309.
[55] Gomes and Silva, "Fast Payment, Credit and Bank Diversification," 377–392; Duarte, "Digital Financial Inclusion and Women," 379–400; Adhikary et al., "How Does the Adoption of Digital Payment Technologies Influence Unorganized Retailers' Performance?," 882–902.

Second, Kenya's M-Pesa evidence underscores the gendered welfare potential of digital payment rails: Suri and Jack's finding that digital payment infrastructure yields disproportionately strong financial resilience and business-transition gains for women directly resonates with Manokwari's 60.0% female MSME merchant composition, suggesting that strengthening QRIS operational reliability serves simultaneously as an inclusive regional gender-empowerment lever.[56]

Third, the findings map directly onto the United Nations 2030 Agenda for Sustainable Development, specifically advancing SDG Target 8.10 (strengthening domestic financial institutions to expand universal access to financial services) and SDG Target 9.3 (expanding small-scale enterprises' access to affordable financial services and formal market integration).[57]

At the same time, external validity rests on explicit boundary conditions. Because 76.1% of sampled merchants reside in urban West Manokwari, 49.4% operate in culinary retail, 47.8% hold bachelor's degrees, and 100% are already registered QRIS merchants, these structural magnitudes generalize primarily to urban and peri-urban, digitally connected micro-and-small consumer-facing enterprises in secondary Eastern Indonesian or comparable developing-economy towns that have already cleared initial onboarding. They should *not* be extrapolated mechanically to unbanked rural districts lacking stable mobile broadband, to initial non-adopters facing registration or documentation hurdles, or to capital-intensive medium enterprises where B2B invoicing supersedes retail QR transactions.

5. Theoretical Contributions, Institutional Policy Implications, and Research Boundaries

Theoretical Contributions. This study advances three specific contributions to state economic research, regional development economics, and behavioral technology analysis. First, it extends UTAUT beyond individual information-systems acceptance by embedding social influence and facilitating conditions within the institutional economics of central-bank Digital Public Infrastructure, demonstrating how supply-side payment standardization transmits asymmetrically across sub-national regions through localized network externalities and post-onboarding service density. Second, it integrates Thaler's

[56] Suri and Jack, "The Long-Run Poverty and Gender Impacts of Mobile Money," 1288–1292.
[57] United Nations, *Transforming Our World: The 2030 Agenda for Sustainable Development*, A/RES/70/1 (New York: United Nations, 2015), 20–21, https://sdgs.un.org/2030agenda.

behavioral-economics mental accounting framework into digital payment scholarship, revealing that internal cognitive fund-compartmentalization operates primarily as a substantive parallel correlate of sustained usage ($f^2 = 0.088$) rather than solely as a statistically detectable moderator of social norms. Third, it refines the theoretical boundary between *digital payment utilization* and *digital financial capability*, showing that active payment usage can co-exist with low fraud-security literacy while still associating closely with subjective merchant financial satisfaction.

Actionable Institutional Policy and Managerial Implications. Translating these verified mechanisms—while respecting both measured item bottlenecks and unmeasured institutional variables—yields targeted, non-generic recommendations across four stakeholder groups:

a. Bank Indonesia (West Papua Representative Office): Preserve and clearly communicate the tiered Merchant Discount Rate (MDR) structure—specifically the 0% MDR exemption for Micro Enterprises (UMI) on transactions up to IDR 500,000 (0.3% above IDR 500,000, compared to 0.7% for small, medium, and large merchants)[58]—to neutralize merchant fee objections documented during preliminary fieldwork and curb unlawful consumer surcharging. Simultaneously, reorient QRIS outreach from generic awareness seminars toward practical cybersecurity and anti-fraud advisories targeting the lowest-scoring literacy item ($DFL2 = 3.01$), such as verifying real-time settlement notifications to prevent fabricated payment-screenshot scams.

b. Local Government (*Pemerintah Kabupaten Manokwari* and *Diskopukm*): Avoid expending scarce regional fiscal budgets on subsidized smartphone or hardware distribution for urban merchants, as device availability ($FC1 = 3.41$) is already high among active operators. Instead, anchor the planned Manokwari integrated MSME service center around a dedicated post-onboarding technical troubleshooting desk to directly close the technical-support deficit ($FC3 = 3.14$), and expand institutional facilitation

[58] Bank Indonesia, "Quick Response Code Indonesian Standard (QRIS): Skema Harga QRIS (MDR)," accessed November 2026, https://www.bi.go.id/id/fungsi-utama/sistem-pembayaran/ritel/kanal-layanan/QRIS/default.aspx.

geographically beyond West Manokwari (76.1% of current respondents) into underserved rural districts.

c. Commercial Banks, Regional Development Banks (*Bank Papua*), and Payment Service Providers (PSPs): Compete on transaction reliability, rapid settlement reconciliation, and accessible Bahasa Indonesia / local-office merchant helpdesks. To bridge informal mental accounting (MA) into formal enterprise resilience, PSPs should embed zero-friction automated daily settlement summaries and optional business-versus-personal sub-wallet partitioning directly within QRIS merchant applications—turning routine digital payment flows into auditable cash-flow records suitable for micro-credit underwriting.

d. MSME Operators and Local Business Associations: Capitalize on proven peer-network and market-demand dynamics (H_1) through culinary and neighborhood merchant clusters that normalize cashless checkout signage, while disciplining internal cash management by routing QRIS settlements into a dedicated enterprise account separate from household spending.

Limitations and Concrete Future Research Agenda. Six methodological limitations bound the present analysis and define concrete empirical priorities for subsequent research:

a. Cross-sectional endogeneity and common method bias: Single-source, cross-sectional survey data cannot rule out reverse causality (financially satisfied or higher-revenue merchants adopting QRIS more intensively) or shared-method inflation of γ_1 and R^2_{FS}. Future studies should link merchant survey responses to anonymized acquirer QRIS transaction logs (monthly transaction counts and values) and deploy longitudinal panel or difference-in-differences (DiD) designs exploiting staggered merchant exposure to Bank Indonesia curation programs or regional technical helpdesk rollouts.

b. Selection on existing users: Sampling solely active QRIS merchants isolates post-adoption usage intensity and precludes inference on initial adoption barriers. Future work should survey matched samples of QRIS adopters and non-adopters across both urban and remote rural districts in West Papua to evaluate extensive-margin adoption alongside intensive-margin utilization.

c. Omitted theoretical and economic controls: Excluding core UTAUT predictors (performance expectancy, effort expectancy, perceived trust, perceived fraud

risk, and MDR price sensitivity) and firm financials (monthly revenue, profit margins, and household income) risks omitted-variable bias and prevented direct testing of indirect $DFL \rightarrow$ Trust/Risk $\rightarrow QUB$ pathways. Future specifications should measure objective financial literacy alongside perceived risk and firm turnover.

d. Measurement refinement: Mild reliability attenuation in facilitating conditions ($\alpha = 0.665$), adjacent-construct proximity ($\text{HTMT}_{FC,QUB} = 0.852$), and forced-choice four-point Likert ceiling effects (all means > 3.00) indicate room for sharper psychometric separation between infrastructure support ($FC3$) and operational usage ($QUB3$), ideally using five- or seven-point anchored frequency scales combined with objective behavioral metrics.

e. Spatial concentration and statistical power: Heavy concentration in West Manokwari (76.1%), retention of two sub-six-month users (1.1%), and moderate sample size ($n = 180$) constrain rural representativeness and moderation detection power. Future designs should implement stratified district sampling powered explicitly for interaction detection ($n \geq 400$) and randomized field experiments (RCTs) comparing standalone classroom literacy workshops against hands-on post-onboarding technical support and anti-fraud coaching.

f. Archived estimation diagnostics: Because raw respondent-level microdata were not retained for supplementary re-estimation, auxiliary demographic control regressions, multi-group heterogeneity analyses (e.g., by gender, culinary vs. non-culinary sector, and age band), full $MA \rightarrow QUB$ slope reporting, bias-corrected accelerated (BCa) confidence intervals, SRMR, and indicator-level linear-model (LM) PLSpredict comparisons could not be executed retroactively. Future empirical replications should archive de-identified replication datasets and estimation scripts openly to enable full robustness verification.

D. CONCLUSIONS

Among active micro, small, and medium enterprise merchants in Manokwari Regency, sustained Quick Response Code Indonesian Standard usage behavior associates positively and at comparable magnitudes with social influence (H_1 supported) and

facilitating conditions (H_2 supported), whereas self-perceived digital financial literacy shows no significant direct association (H_3 not supported) and mental accounting moderation remains statistically undetected (H_5 not supported) despite its notable direct variance contribution. Sustained usage behavior exhibits the strongest positive cross-sectional association with merchant financial satisfaction (H_4 supported) while transmitting significant indirect ecosystem effects from both social networks and enabling technical infrastructure. Theoretically, these findings extend technology acceptance research into state and regional development economics by demonstrating that uniform central bank payment standardization operates in peripheral economies through a dual anchor of localized market-infrastructure conditions and internal behavioral fund management rather than unilateral external dominance or standalone literacy. Consequently, Bank Indonesia, the Manokwari Regency government, and payment service providers should reallocate digitalization efforts away from urban hardware subsidies toward post-onboarding technical troubleshooting desks, peer-anchored merchant networks, micro-enterprise fee transparency, and practical antifraud coaching integrated with simple digital bookkeeping.

REQUIRED STATEMENTS

CRediT authorship contribution statement. A.A.S.L.: Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Visualization, Writing – original draft. I.G.K.A.U.: Conceptualization, Methodology, Supervision, Validation, Writing – review & editing. A.D.B.: Methodology, Supervision, Validation, Writing – review & editing.

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Data availability. Aggregate descriptive summaries, structural equation modeling outputs, and secondary municipal registry figures supporting the findings of this study are reported within the article. Individual-level primary questionnaire responses

generated during the current study are not publicly available due to respondent confidentiality commitments, but de-identified summary datasets are available from the corresponding author upon reasonable academic request.

Ethics statement. This study involved an anonymous, non-interventional primary survey of active micro, small, and medium enterprise (MSME) operators in Manokwari Regency conducted under academic supervision at the Faculty of Economics and Business, Universitas Negeri Jakarta. Because the survey collected non-sensitive commercial and behavioral perceptions without clinical procedures, psychological risks, or personally identifiable records, formal Institutional Review Board (IRB) approval was waived in accordance with institutional social-science research protocols, while all field procedures adhered to established ethical standards for human-participant research, including the principles of the Declaration of Helsinki. Prior to completing the questionnaire, all participants were informed of the research objectives, confidentiality and anonymity protections, and their unconditional right to decline or withdraw at any time, and each provided voluntary informed consent. Although the demographic questionnaire applied the standard Indonesian productive-age category starting at 15–30 years, recruitment targeted registered commercial QRIS merchants—whose payment-system onboarding requires valid Indonesian national identification (KTP) and active business operation—ensuring participation by legally eligible commercial actors rather than unconsented minors.

Declaration of generative AI and AI-assisted technologies in the writing process. The authors did not use generative AI or AI-assisted technologies in the preparation of this manuscript.

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