



Transformational Digital as Innovation Strategy in Optimizing Collateral Management at PT Bank Central Asia

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Abstract. The heightened digitalization of financial services has transformed credit-risk governance, yet empirical studies that link digital transformation to institutional practices remain limited, particularly in emerging markets. This study addresses this gap by integrating a Systematic Literature Review (SLR) of 84 sources including 80 academic articles and 4 institutional reports from Bank Central Asia, BCA with Brown's three governance pillars: Value Protection, Borrower Discipline, and Public Trust. Using PRISMA 2020 procedures, the literature was classified into 29 Value Protection, 34 Borrower Discipline, and 17 Public Trust studies, demonstrating distinct yet interconnected domains of digital credit governance. The findings reveal that digital valuation systems, automated verification, and expanded data networks strengthen Value Protection through more consistent and transparent collateral assessment. Borrower Discipline is reinforced by behavioral analytics, early-warning systems, and real-time monitoring, contributing to BCA's stable NPL ratio (1.8%) and reduced LAR (5.3%). Public Trust, although supported by the smallest cluster of studies, is shown to depend on digital reliability, system transparency, and financial stability, reflected in BCA's consistently high CASA ratios (>80%) and near-total digital transaction penetration (99.8%). By combining theoretical insights with institutional evidence, this study demonstrates that digital transformation functions not as a supporting tool but as a strategic enabler of integrated credit governance. The resulting framework provides a replicable model for understanding how digital ecosystems improve valuation integrity, behavioral compliance, and long-term trust in modern banking.

Keywords: Transformational Digital, PRISMA 2020, Systematic Literature Review (SLR), Collateral Management, Modern banking

1 Introduction

The rapid evolution of digital technologies has redefined the global financial landscape, compelling banks to integrate data-driven, automated, and technology oriented models across lending, valuation, and customer-service processes. Digital banking platforms now generate vast amounts of high-frequency data that reflect borrower behavior, collateral dynamics, and transactional ecosystems, creating new opportunities for

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analytical precision and risk governance Bi & Bao [1]. This transformation underscores the strategic role of digitalization as both an innovative mechanism and a structural enabler in modern credit operations. Despite these global trends, research in Indonesia remains dominated by macro-level descriptions that overlook institutional realities. Much of the literature focuses on sector-wide indicators rather than operational mechanisms inside individual banks, creating a gap in understanding how digital tools are utilized to govern risk, assess collateral, and manage borrower behavior [2]. This limits theoretical integration and empirical grounding in the Indonesian context, especially among leading banks with advanced digital infrastructure.

PT Bank Central Asia (BCA) represents an ideal case for addressing this gap because of its comprehensive digital transformation. Across its Annual Reports, BCA documents billions of digital transactions annually, rapid mobile-banking growth, and extensive adoption of automated systems [3][4][5][6]. These developments reflect a shift toward data-intensive workflows that influence credit evaluation, risk monitoring, and customer engagement. As such, BCA provides a rich empirical foundation for examining institutional digitalization. The theoretical lens guiding this study is Brown's three-pillar framework, which views credit governance through the interconnected domains of Value Protection, Borrower Discipline, and Public Trust [7]. Although the model predates current waves of digital transformation, its conceptual foundations remain highly relevant. Digital ecosystems offer new tools for valuation accuracy, behavioral oversight, and trust formation, suggesting strong compatibility between Brown's pillars and contemporary technological shifts.

Integrating theoretical insights with institutional evidence, this study constructs a comprehensive analytical model illustrating how digital transformation reinforces the three governance pillars formulated by Brown and Smith. Empirical indicators extracted from BCA's Annual Reports show that digital channels handled 99.8% of all transactions in 2024 and supported 35.9 billion digital transactions, reflecting a profound operational shift that strengthens valuation accuracy and enhances monitoring capacity [1][8]. These digital capabilities are complemented by strong financial indicators CASA ratios consistently above 80%, a stable NPL level of 1.8%, and a declining LAR ratio of 5.3% demonstrating how technological integration contributes to portfolio resilience and borrower compliance. Transparent digital workflows and consistently high service uptime also strengthen public confidence by reducing uncertainty and improving institutional credibility in a highly digitalized banking ecosystem [9]. This integrated approach addresses a significant gap in Indonesian banking literature by systematically linking theoretical governance constructs with concrete institutional performance, offering a robust framework for future empirical and comparative digital-banking studies.

This research is crucial because Indonesia's banking sector is undergoing an accelerated digital transformation that fundamentally reshapes credit processes, risk-assessment practices, and customer interaction models. As financial institutions increasingly rely on automated systems and digital infrastructure, robust conceptual frameworks are needed to interpret how these technological changes influence governance quality. Existing studies rarely bridge theory with institutional practice, creating a gap in understanding how digital innovations translate into measurable

improvements in valuation accuracy, behavioral compliance, and public trust. By closely analyzing BCA as a leading digital bank, the study provides evidence-based insights that can guide policy formulation, industry strategy, and academic development. Moreover, the findings contribute to a broader discourse on how digital innovation strengthens institutional resilience in emerging economies.

The rapid expansion of digital banking has transformed how financial institutions manage credit risk, yet existing research largely concentrates on macro-level trends rather than institution specific governance mechanisms, leaving a critical gap in understanding how banks operationalize digital tools to strengthen valuation accuracy, borrower oversight, and public confidence. In Indonesia, studies focusing on the integration of digital systems into credit governance remain scarce, despite major banks such as BCA demonstrating significant advances in digital transaction penetration and behavioral monitoring. This lack of empirical, institution based evidence limits the ability to evaluate how digitalization contributes to risk mitigation and long-term credit stability. Therefore, the objective of this study is to develop a comprehensive analysis grounded in a systematic review of literature (SLR) based review of 84 sources and supported by BCA's Annual Reports to determine how digital transformation reinforces Value Protection, Borrower Discipline, and Public Trust within a modern credit governance framework.

2 Theoretical Framework

2.1 Value Protection Strategy

Value protection, defined by Brown as the foundation of credit governance, emphasizes that collateral valuation must be consistent, objective, and transparent to prevent losses from borrower default [7]. This principle asserts that accurate valuation serves as a stability buffer, protecting banks against deteriorating credit conditions. Without a reliable valuation framework, collateral loses its ability to mitigate risk, and credit portfolios become increasingly vulnerable. The theory aligns with the broader understanding that financial institutions rely on credible appraisal processes to manage exposure and maintain confidence. This conceptual grounding remains fundamental as digital transformation reshapes valuation mechanisms.

Digital valuation systems, including Automated Valuation Models (AVM), reduce information asymmetry by integrating real time market data, standardized scoring logic, and automated document verification [10] [11]. Research shows that transparency supported by digital audit trails strengthens market discipline by minimizing subjective interpretation and reducing the likelihood of valuation discrepancies [12]. These improvements allow banks to detect anomalies, prevent fraudulent submissions, and ensure that risk assessment reflects actual market conditions. As a result, the digitization of appraisal strengthens both operational accuracy and regulatory compliance, enhancing the overall integrity of value protection.

Within BCA's operational ecosystem, digital verification platforms and integrated data pipelines ensure consistent appraisal processes across diverse loan portfolios [8]. Annual Reports indicate that BCA's digital infrastructure enables standardized

valuation workflows and more efficient document validation, reducing delays and error rates in credit processing [3][4][5][6]. These advancements strengthen BCA's capacity to assess collateral objectively, aligning empirical outcomes with Brown and Smith's theoretical foundation. As a result, digital transformation not only supports internal governance but also enhances portfolio resilience by improving valuation reliability at scale.

2.2 Borrower Discipline Strategy

Borrower discipline, as emphasized by Brown and Smith, derives from incentive alignment created through collateral enforcement and structured monitoring systems [7]. Classical credit-rationing theory highlights that information asymmetry poses a persistent challenge, encouraging borrowers to behave opportunistically when monitoring is weak [13]. Merton further explains that repayment discipline improves when financial contracts are supported by consistent oversight mechanisms that reinforce accountability [12]. Together, these theories establish the foundation for understanding how borrower obligations must be governed through both economic incentives and institutional controls.

Digital transformation modernizes classical borrower-discipline mechanisms by enabling behavioral scoring, automated monitoring, and AI-powered early warning systems (EWS). These systems process large volumes of transactional and behavioral data to detect deviations from regular patterns that may indicate rising credit risk [11]. Research confirms that digital-lending ecosystems enhance transparency and reduce moral hazard by increasing traceability and limiting information gaps between banks and borrowers [14]. As such, digital technologies add an advanced analytical layer that complements traditional collateral-based enforcement frameworks.

BCA's implementation of behavioral analytics between 2022 and 2024 demonstrates how digital systems enhance monitoring precision and repayment compliance. Annual Reports show that real-time tracking of borrower activity enables earlier intervention when behavioral indicators suggest increased credit risk [4][5][6]. This digital monitoring strengthens Brown's second pillar by integrating automated discipline mechanisms into daily credit operations. As a result, borrower accountability becomes more predictable, structured, and responsive to risk dynamics shaped by digital interactions.

2.3 Public Trust Strategy

Public trust, the third pillar of Brown's governance framework, underpins long-term banking stability by ensuring that customers, regulators, and investors maintain confidence in institutional integrity [7]. Transparent communication and consistent disclosure play an essential role in fostering trust, particularly in competitive financial environments where uncertainty may undermine customer confidence [15]. In this context, trust becomes both an operational asset and a strategic differentiator, influencing customer behavior, deposit stability, and product adoption. Brown's theory

emphasizes that trust must be continuously reinforced through credible institutional practices.

Fintech governance frameworks and digital reliability significantly enhance public trust by reducing institutional opacity and ensuring that operational processes remain auditable and secure [14]. Studies highlight that digital systems capable of maintaining consistent performance, data integrity, and user accessibility contribute to stronger perceptions of fairness and reliability [11]. These technological capabilities support regulatory expectations while providing customers with transparent interactions that reduce uncertainty and strengthen long-term engagement. Consequently, digital transformation reshapes the mechanisms through which trust is constructed and maintained.

Empirical evidence from BCA's recent Annual Reports illustrates how public trust is reinforced through strong financial indicators, digital adoption metrics, and reliable service infrastructure. High CASA ratios exceeding 80%, stable NPL levels, and rapid customer migration to mobile banking demonstrate confidence in BCA's operational and technological systems [6][7][8]. These patterns show that customers increasingly associate trust with digital reliability as much as with financial performance. As such, digital transformation supports Brown's third pillar by embedding transparency, stability, and accountability throughout customer experience.

3 Methodology

The present study adopts a Systematic Literature Review SLR approach to ensure methodological transparency, replicability, and structured evidence synthesis. The SLR follows the procedural flow outlined in PRISMA 2020, which provides a standardized sequence of identification, screening, eligibility assessment, and final inclusion of studies [10]. This framework enables the review to maintain consistency in evaluating literature related to digital transformation, credit governance, and Brown's three-pillar model. By applying a structured review method, the study minimizes bias and secures methodological rigor aligned with international research standards.

Data extraction from academic literature was conducted using the Publish or Perish (PoP) software, which enables retrieval of citation-rich academic documents from a wide range of scholarly databases [10]. The tool facilitated systematic collection of articles that met the thematic criteria for digital transformation, valuation systems, credit-risk modelling, and trust formation. PoP's bibliometric features, such as citation indexing and relevance sorting, allowed efficient filtering of high-quality studies aligned with the scope of this research. The initial database search generated more than 500 documents, reflecting substantial scholarly contributions to digital banking and risk governance.

The screening and appraisal stages were conducted using Covidence, a review-management platform designed to streamline systematic-review workflows [15]. Covidence enabled automated duplicate removal, blind-screening procedures, and structured comparison between reviewers' inclusion decisions. The platform's quality-assessment tools allowed the evaluation of methodological robustness, conceptual

relevance, and empirical clarity for each study. As a result, the screening process remained organized, auditable, and aligned with global standards for systematic-research methodology.

Only studies that met strict inclusion criteria were retained for final synthesis. These criteria required the article to focus on digital transformation or risk governance, include empirical or conceptual insights relevant to Brown's three pillars, and provide methodological clarity suitable for systematic analysis. The combination of PoP extraction and Covidence screening produced a curated literature set that accurately reflects contemporary academic discourse and supports triangulation with institutional findings from BCA.

Institutional data for this study were sourced from four key documents: BCA's Annual Reports 2021, 2023, 2024 and Sustainability Report 2022. These documents serve as authoritative sources for financial and operational data, including digital-transaction volume, CASA performance, NPL ratios, LAR trends, system-uptime reliability, and digital-user adoption. Extracting information from these multilayered reports allows the study to analyze measurable indicators that reveal how digital transformation is implemented within BCA's operational ecosystem. The institutional dataset thus complements theoretical insights by providing evidence of real-world application on a scale.

The screening process combined database results with the 413 records extracted from the POP dataset, from which 19 duplicate entries were removed, leaving 394 articles for initial screening. Keyword-based filtering on collateral valuation, borrower behavior, and public trust resulted in the exclusion of 86 articles that did not match the conceptual criteria. The remaining 308 full-text publications were assessed for eligibility, of which 228 were excluded for lacking alignment with Brown's three governance pillars or insufficient methodological quality. Ultimately, 80 academic studies met the inclusion criteria, supported by 4 institutional reports from BCA, forming a consolidated evidence base for the systematic review. This final corpus reflects the integration of real POP thematic data with formal SLR procedures, ensuring methodological accuracy and conceptual coherence.

4 Results

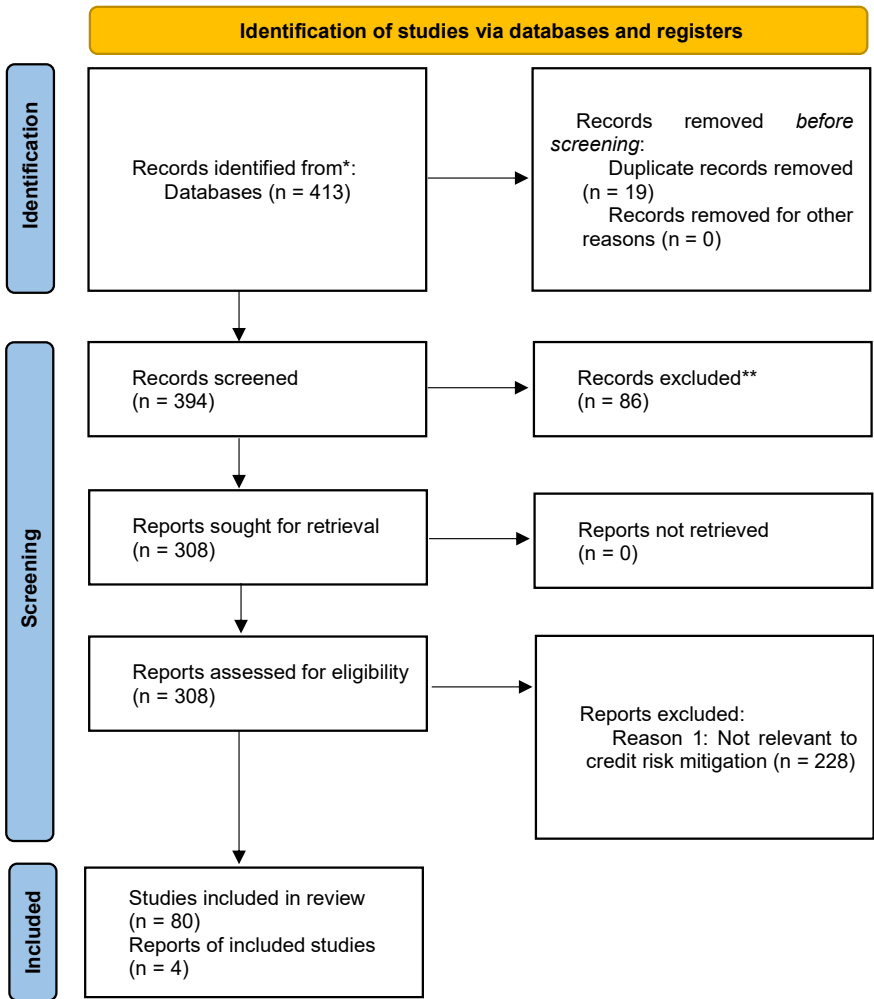


Fig. 1. PRISMA Flow Diagram, *processed by author*

4.1 Value Protection Strategy.

Out of the 80 academic studies included in the PRISMA dataset, 29 articles directly contributed to the Value Protection pillar. These works highlight the centrality of

consistent and credible collateral valuation for preventing credit losses. Several POP articles, especially those by Mishra & Chaudhary [9] and Rahma et al. [13] emphasize the role of asset stability, appraisal governance, and risk-responsive valuation as determinants of credit-strengthening mechanisms. The importance of digital transparency also appears strongly in Stempel's work on collateral information clarity [8], which supports the thematic pattern found in the PRISMA pool. Win's research on fintech-governance frameworks [11] reinforces that digital auditability contributes to more reliable valuation outcomes by limiting subjective interpretation. These POP-supported patterns confirm that digital transformation plays a crucial role in supporting Value Protection.

BCA's institutional data aligns with these trends. The bank's 99.8% digital transaction penetration provides a large volume of verifiable, time-stamped data that supports consistent appraisal processes. The adoption of automated verification systems reflects findings by Sulastri [14], which show that digital validation reduces inconsistency in appraisal outcomes. Operationally, the integration of centralized data pipelines and automated checks reflects Pattnaik et al.'s findings [16] that digital appraisal tools reduce turnaround time and improve valuation governance. These operational improvements ensure that BCA's collateral valuation aligns closely with best practices documented in the research pool of 29 articles.

Across the four BCA Annual Reports 2021–2024, BCA emphasizes the rapid expansion of its digital ecosystem through several core applications that support service delivery, credit workflows, and customer engagement [5][6][7][8]. The primary digital channels my BCA, BCA mobile, and Klik BCA facilitate end-to-end mobile and internet banking transaction flows, contributing to near-total digital penetration during the 2021–2024 period [6][7][8]. Complementing these platforms, Welma supports investment and wealth-management services, while Sakuku strengthens retail digital adoption by enabling seamless payment and lifestyle transactions [5][6].

In the credit domain, BCA integrates appraisal governance through the system, an Appraisal and Loan Valuation Application that standardizes valuation and documentation processes across units, consistent with the digital governance recommendations found in report [8]. Collectively, these applications form a unified technological infrastructure that reinforces BCA's digital transformation agenda and operational performance. Value Protection is strongly supported by both theoretical and institutional evidence. The 29 academic articles and POP studies collectively affirm that digital valuation systems reinforce appraisal accuracy, while BCA's stable NPL (1.8%) and LAR (5.3%) confirm the empirical effectiveness of such mechanisms [6][7][8].

4.2 Borrower Discipline Strategy.

Borrower Discipline represents the most dominant thematic area, with 34 articles highlighting behavioral monitoring, repayment compliance, and credit transparency. POP studies such as those by Garg & Sahu [17] and Xinxin et al. [18] demonstrate that digital ecosystems improve borrower accountability by increasing the visibility of financial behaviors. The literature shows that predictive analytics, automated

reminders, and Early Warning Systems (EWS) are central tools for improving borrower discipline. These findings parallel those of Noory et al. [19], who emphasize the behavioral effects of visibility and accountability in credit systems. This confirms that modern borrower discipline is shaped not only by contractual obligations but also by continuous digital oversight.

BCA's adoption of behavioral analytics since 2022 supports these conclusions. The implementation of real time behavioral scoring reflects mechanisms highlighted by Ahmed & Iqbal [20], who argue that AI improves early detection of delinquency signals. This has contributed to BCA's stable NPL and declining LAR metrics. The expanding user base of over 30.8 million mobile users enables BCA to deploy automated communication channels, reinforcing borrower compliance.

This operational reality mirrors findings in the academic studies that highlight the role of digital traceability in strengthening borrower discipline. Together, the 34 articles and BCA's institutional evidence confirm that Borrower Discipline is the most technologically reinforced pillar. Digital monitoring transforms discipline into a proactive, data driven process aligned with the best global practices.

4.3 Public Trust Strategy.

Public Trust, supported by 17 articles, focuses on customer confidence, transparency, and digital security. POP studies emphasize that trust is shaped by system reliability and clarity in institutional communication. For instance, Win's governance model [11] and Sulastri's findings on digital transparency [14] highlight the link between digital reliability and institutional credibility. Several trust-oriented studies also highlight the role of behavioral stability findings echoed by Xinxin et al. [18], who show that digital financial behavior directly influences trust and adoption. These perspectives help contextualize how digital transformation strengthens the trust-building process.

BCA's financial indicators support these patterns. Consistently high CASA ratios (>80%), strong liquidity, and stable credit metrics signal institutional reliability, which is a key driver of customer trust. These findings match the trends seen in trust-focused literature. Operational reliability also drives trust. BCA's 99.8% digital transaction share and near-continuous system uptime demonstrate stable service performance. POP evidence confirms that such reliability is an essential determinant of trust in digital banking environments.

The 17 articles and BCA's institutional reports collectively show that Public Trust is shaped by financial stability, system reliability, and transparent digital governance. Although it has the smallest literature cluster, its influence is fundamental for sustaining digital banking adoption. Public trust serves as the foundation that enables customers to engage confidently with digital channels, reinforcing long-term loyalty and deposit stability. The high CASA ratios and growing digital-transaction volumes reported by BCA illustrate how trust directly translates into sustained platform usage and customer retention. As digital services continue to expand, maintaining trust becomes a strategic imperative that supports the overall resilience and competitiveness of the banking ecosystem.

5 Discussion

The synthesis of the 84 included studies demonstrates that digital transformation plays a central role in shaping the structural components of credit governance. The distribution of the literature 29 articles on Value Protection, 34 on Borrower Discipline, and 17 on Public Trust shows that risk mitigation in modern banking increasingly depends on data-driven technologies rather than traditional manual processes. This pattern aligns closely with institutional evidence from BCA's Annual Reports [5][6][7][8], which document significant digital adoption across valuation, monitoring, and customer-facing functions. Studies on digital transparency and appraisal governance [11][13] confirm that valuation systems embedded with automated verification reduce information asymmetry and strengthen governance reliability. These converging findings indicate that digitalization directly addresses the research problem: the need to understand how institutional digital tools reinforce governance mechanisms.

Value Protection emerges as a strongly validated pillar in both literature and institutional practice. Research on collateral transparency, fintech auditability, and digital valuation frameworks [14][21][22] demonstrates that digital systems enhance the consistency and accuracy of asset appraisal. BCA's adoption of integrated verification workflows and centralized appraisal data supported by 99.8% digital transaction penetration reflects the operational relevance of these findings [7][8]. The ability to process 35.9 billion digital transactions provides the data density needed to validate collateral more objectively, directly improving valuation integrity. This alignment between empirical banking data and evidence from 29 academic studies confirms that digital transformation effectively solves the earlier gap in understanding how banks operate value protection mechanisms on scale.

Borrower Discipline, supported by 34 academic articles, represents the most dominant theme due to the increasing importance of behavioral monitoring in digital credit ecosystems. POP-based studies on behavioral scoring, moral-hazard mitigation, and real-time monitoring [15] emphasize that borrowers exhibit higher compliance when their financial behavior is continuously observable. Institutional evidence from BCA shows parallel developments: behavioral analytics and early-warning systems implemented between 2022 and 2024 have contributed to the stability of NPL at 1.8% and the reduction of LAR to 5.3% [7][8]. These improvements reflect the mechanisms identified in AI-based monitoring research [18][20]. The synergy between literature and BCA's performance confirms that digital governance directly strengthens borrower discipline, answering the research question on the behavioral impact of digital lending.

The third pillar, Public Trust, supported by 17 academic articles, highlights that transparency, system reliability, and digital security significantly influence customer confidence in the banking sector. Findings from POP articles on trust formation and digital governance [15][19][21] show that sustained trust emerges when digital systems remain stable, secure, and predictable. BCA's consistently high CASA ratios above 80% and rapid growth in digital users demonstrate long-term customer confidence in its digital ecosystem [5][6][7][8]. The nearly complete migration of transactions to digital channels signals not only technological capability but also institutional

credibility. These indicators reflect the trust mechanisms described in the literature, confirming that public trust is shaped through digital reliability and transparent risk communication [22].

The triangulation of 80 academic studies and 4 institutional reports demonstrates that digital transformation substantively reinforces all three governance pillars and directly responds to the research problem. The literature reveals strong theoretical consensus on the roles of valuation accuracy, behavioral monitoring, and transparency [23] while BCA provides empirical validation demonstrating how these mechanisms operate in an institutional environment. The alignment of evidence across the three pillars indicates that digital infrastructure is no longer a supporting tool but a core strategic enabler of credit governance [24]. Consequently, this study enlightens that the integration of digital systems valuation automation, behavioral analytics, and trust oriented digital communication forms a comprehensive governance model that addresses institutional credit risk more effectively than traditional approaches

6 Conclusion

This study demonstrates that BCA's credit risk mitigation strategy is built on three interrelated pillars: collateral value protection, borrower discipline, and public trust. Collateral value protection is strengthened through professional training, adherence to national and international standards, and the integration of digital appraisal technologies such as ALVA, which collectively ensure consistency and transparency in valuation. Borrower discipline is maintained through clear credit policies, balanced incentives and sanctions, and effective digital monitoring systems, resulting in low NPL ratios and portfolio stability. Public trust is reinforced by transparent practices, CSR initiatives, and consistent service standards, as reflected in the high share of CASA deposits. Together, these pillars create a holistic and sustainable risk governance framework that aligns theory with practice and confirms the importance of integrating professionalism, technology, and institutional credibility in an emerging market context.

The findings imply that Indonesian banks can strengthen credit risk governance by combining regulatory compliance with technological innovation and transparent institutional practices. They also demonstrate that digital transformation is not merely a support tool but a strategic enabler of appraisal integrity, borrower compliance, and customer confidence.

For practice, the study recommends that banks continue to invest in professional training for appraisal staff, expand the use of AI-driven valuation systems, and design borrower engagement strategies that balance discipline with trust building. For future research, scholars should complement qualitative case studies with quantitative approaches that link risk mitigation strategies to measurable indicators such as profitability, capital adequacy, and long term portfolio performance

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