

Analysis of the Impact of Digital Transformation on the Risk Management Effectiveness of Commercial Banks in Vietnam

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Abstract—Digital transformation has fundamentally reshaped the banking industry, creating unprecedented opportunities to strengthen organizational resilience and enhance risk management effectiveness amid increasingly complex financial and technological environments. However, empirical evidence regarding how digital transformation influences risk management effectiveness in commercial banks, particularly in emerging economies such as Vietnam, remains limited. This study investigates the impact of digital transformation on the risk management effectiveness of Vietnamese joint-stock commercial banks, thereby contributing to the growing body of knowledge on digital banking and enterprise risk management. Primary data were collected from 190 employees working at Vietnamese joint-stock commercial banks through a structured questionnaire. The research employed Cronbach's Alpha to assess the reliability of measurement scales, followed by Pearson correlation analysis and multiple linear regression analysis to examine the proposed relationships among the research variables. The empirical findings reveal that digital transformation exerts a positive and statistically significant impact on risk management effectiveness and represents the most influential determinant compared with other organizational and environmental factors. These findings highlight the strategic role of digital transformation in enhancing data integration, decision-making quality, operational transparency, and proactive risk control within commercial banks. Based on the empirical evidence, the study proposes several policy implications aimed at accelerating digital transformation, strengthening digital governance, improving technological infrastructure, and fostering data-driven risk management practices to enhance the effectiveness of risk management in Vietnamese joint-stock commercial banks. The findings also provide valuable insights for banking managers and policymakers in promoting sustainable digital banking development.

Keywords—Digital transformation; Risk measurement effectiveness; Commercial banks; Vietnam.

I. INTRODUCTION

Digital transformation has become one of the most significant structural changes in the global banking industry, fundamentally reshaping banking operations, organizational structures, customer interactions, and risk governance. Beyond the adoption of information technology, it represents a strategic process integrating artificial intelligence (AI), big data analytics, cloud computing, blockchain, and application programming interfaces (APIs) to establish intelligent, data-driven operating models capable of responding to increasingly complex financial risks. At the same time, international regulatory frameworks, particularly Basel II and Basel III, have strengthened requirements for risk governance, capital adequacy, stress testing, and enterprise-wide risk management, making digital transformation a critical enabler of organizational resilience and effective risk management rather than merely a technological initiative (BCBS, 2024; Vial, 2019; Verhoef et al., 2021). The COVID-19 pandemic further accelerated digital banking adoption, prompting commercial banks to integrate AI-based credit assessment, machine learning, predictive analytics, cloud-native infrastructure, and real-time transaction monitoring into risk management. These technologies enhance decision-making, automate risk-control processes, and enable early detection of fraud, cyber threats, liquidity pressures, and credit deterioration, thereby shifting risk management from a reactive compliance function to a predictive, data-centric governance capability. Within this global trend, Vietnam has emerged as one of Southeast Asia's

fastest-growing digital banking markets. Government initiatives, including Decision No. 810/QĐ-NHNN (SBV, 2023) and Resolution No. 57-NQ/TW (CECCPV, 2024), have accelerated investments in digital infrastructure, AI, cloud platforms, data governance, and integrated risk management systems. Despite these advances, existing studies largely examine digital transformation or bank performance separately, while limited empirical evidence explains how digital transformation enhances risk management effectiveness in Vietnamese commercial banks, particularly under ongoing regulatory reforms and rapid digital banking development, thereby motivating this study.

Although digital transformation has received considerable scholarly attention, no universally accepted definition exists because it extends beyond the mere adoption of digital technologies. Recent literature conceptualizes digital transformation as a strategic and organizational process through which firms fundamentally redesign business models, operational processes, decision-making mechanisms, and value creation by integrating digital technologies across organizational activities (Vial, 2019; Verhoef et al., 2021). In the banking sector, this transformation encompasses the adoption of artificial intelligence (AI), big data analytics, cloud computing, blockchain, and digital platforms alongside the restructuring of governance mechanisms, organizational capabilities, and risk-control architectures to enhance responsiveness, resilience, and long-term competitiveness (Bharadwaj et al., 2013; Verhoef et al., 2021; Yan et al., 2026). Accordingly, digital transformation is increasingly

viewed as a dynamic capability that enables banks to sense emerging risks, seize technological opportunities, and continuously reconfigure organizational resources in rapidly changing financial environments, thereby strengthening strategic renewal and organizational adaptability (Teece, 2007; Yan et al., 2026). Meanwhile, the concept of risk management effectiveness has evolved substantially following the adoption of Enterprise Risk Management (ERM) frameworks and the implementation of Basel II and Basel III. Rather than emphasizing regulatory compliance alone, it refers to an organization's capability to systematically identify, assess, monitor, mitigate, and respond to interconnected risks while maintaining operational stability, financial sustainability, and strategic objectives (Arena et al., 2010; COSO, 2017; Basel Committee on Banking Supervision, 2013). In commercial banks, this capability includes the integrated management of credit risk, operational risk, liquidity risk, market risk, and, increasingly, cyber risk associated with digital platforms and cloud-based infrastructures. As digital banking ecosystems continue to expand, cyberattacks, data breaches, algorithmic failures, and third-party technology risks have become critical challenges that require more sophisticated governance mechanisms combining technological innovation with enterprise-wide risk oversight (Ashta & Herrmann, 2021; Basel Committee on Banking Supervision, 2013). Consequently, contemporary research increasingly recognizes digital transformation and risk management effectiveness as complementary strategic capabilities. Digital technologies enhance real-time monitoring, predictive analytics, and intelligent decision-making through AI-enabled information processing, whereas effective enterprise risk management provides the governance framework required to balance technological innovation, regulatory compliance, organizational resilience, and sustainable value creation, particularly in rapidly digitalizing emerging economies (Vial, 2019; Verhoef et al., 2021; Yan et al., 2026).

Against the backdrop of Vietnam's accelerating digital transformation, understanding how digital transformation enhances risk management effectiveness has become increasingly important for banking practice and public policy. As one of Southeast Asia's fastest-growing digital economies, Vietnam has experienced rapid expansion in digital banking, electronic payments, digital lending, and fintech ecosystems, creating opportunities to improve operational efficiency and customer experience while simultaneously increasing operational, cyber, and systemic risks. Consequently, strengthening risk management capabilities has become a strategic priority for both commercial banks and financial system stability. Digital transformation enables banks to integrate advanced technologies into governance, decision-making, and risk-control processes, thereby enhancing organizational resilience and long-term competitiveness (Vial, 2019). This study is also significant from a regulatory perspective. International banking reforms under Basel III emphasize enterprise-wide risk governance, operational resilience, and sound supervisory practices, requiring financial institutions to adopt advanced digital technologies while maintaining robust governance frameworks (Basel Committee

on Banking Supervision [BCBS], 2024). In Vietnam, these expectations are increasingly reflected in national digital banking strategies and regulatory reforms, encouraging commercial banks to modernize digital infrastructure and strengthen integrated risk management systems. Beyond organizational performance, this study contributes to the sustainability agenda by highlighting digital transformation and effective risk management as complementary drivers of responsible banking. Strong digital risk governance improves transparency, accountability, and stakeholder trust while supporting sustainable financial development. Furthermore, enhanced risk management capabilities contribute to the achievement of the United Nations Sustainable Development Goals (SDGs), particularly SDG 8, SDG 9, SDG 16, and SDG 17, by promoting resilient financial institutions, innovation, and inclusive economic growth (United Nations, 2015). Therefore, the findings are expected to provide evidence-based implications for policymakers, regulators, and banking practitioners seeking to foster a resilient and sustainable digital banking ecosystem in Vietnam.

Against the backdrop of Vietnam's accelerating digital transformation, understanding how digital transformation enhances risk management effectiveness has become increasingly important for banking practice and public policy. As one of Southeast Asia's fastest-growing digital economies, Vietnam has experienced rapid growth in digital banking, electronic payments, digital lending, and fintech ecosystems, creating opportunities to improve financial inclusion, operational efficiency, and customer experience while simultaneously increasing operational, technological, cyber, and systemic risks. Consequently, strengthening risk management capabilities has become essential for safeguarding financial stability and public confidence in the banking system. The growing integration of digital finance and fintech innovations enables banks to enhance decision-making, optimize operational processes, and strengthen risk governance, but also requires more sophisticated management of technology-related risks (Gomber et al., 2017). This study is significant not only from an organizational perspective but also within broader regulatory and sustainability agendas. In Vietnam, ongoing regulatory reforms, including Decree No. 267/2025/NĐ-CP (GSRV, 2025), together with national digital transformation initiatives, encourage commercial banks to modernize digital infrastructure and develop integrated risk management systems that support resilient and compliant banking operations. Furthermore, digital transformation and effective risk management constitute key foundations of sustainable banking by improving transparency, accountability, operational resilience, and stakeholder confidence. Strong governance of digital risks also facilitates the integration of Environmental, Social, and Governance (ESG) principles, which have been shown to be positively associated with corporate financial performance and long-term value creation (Friede et al., 2015). These developments further support the modernization of the banking sector and strengthen its contribution to sustainable economic development through innovation, resilience, and responsible financial services (OECD, 2020). Therefore, this study

provides evidence-based implications for policymakers, regulators, and banking practitioners seeking to foster a secure, resilient, and sustainable digital banking ecosystem in Vietnam while enriching the literature on digital transformation and enterprise risk management.

The remainder of this paper is organized as follows. Section 2 reviews the relevant literature on digital transformation, enterprise risk management, and banking risk management effectiveness, while developing the theoretical foundation and research hypotheses. Section 3 presents the research model, variable measurements, data sources, and empirical methodology employed in this study. Section 4 reports and discusses the empirical findings regarding the impact of digital transformation on the risk management effectiveness of Vietnamese commercial banks. Finally, Section 5 concludes the study by summarizing the principal findings, discussing their theoretical and practical implications for policymakers and banking practitioners, acknowledging the study's limitations, and proposing directions for future research.

II. LITERATURE REVIEW

The initial stage of research on digital transformation in the banking industry primarily focused on understanding how emerging digital technologies could improve organizational efficiency, service quality, and competitive advantage rather than directly enhancing risk management effectiveness. During this period, digital transformation was generally regarded as a technology-oriented initiative involving the adoption of internet banking, mobile banking, cloud computing, and big data analytics to modernize banking operations and strengthen customer engagement. Empirical studies were largely based on questionnaire surveys analyzed using regression models or structural equation modeling (SEM), with theoretical foundations derived from the Technology Acceptance Model (TAM), the Unified Theory of Acceptance and Use of Technology (UTAUT), and Innovation Diffusion Theory (IDT). These studies consistently demonstrated that perceived usefulness, trust, technological readiness, and organizational support were critical determinants of successful digital transformation initiatives in commercial banks (Montazemi & Qahri-Saremi, 2015; Bharadwaj et al., 2013).

As digital technologies became increasingly embedded in banking activities, researchers gradually shifted their attention from technology adoption toward organizational capability development. Rather than viewing digital transformation as a simple technological upgrade, scholars argued that it represented a strategic process capable of reshaping business models, governance structures, and organizational decision-making. This transition laid the conceptual foundation for considering digital transformation as a strategic organizational capability rather than merely an information technology investment. Simultaneously, banking studies recognized that digital technologies generated unprecedented volumes of customer and operational data, creating opportunities to improve information quality, managerial responsiveness, and organizational transparency. These developments suggested

that digital transformation could indirectly strengthen risk identification, fraud detection, and decision-making capabilities, although empirical evidence remained limited during this period (Bharadwaj et al., 2013; Vial, 2019).

Meanwhile, research on banking risk management evolved under the influence of Enterprise Risk Management (ERM) and the implementation of Basel II and Basel III principles. Existing studies emphasized integrated risk governance, effective information sharing, and organizational coordination as essential conditions for improving enterprise-wide risk management. Nevertheless, most empirical investigations treated digital transformation and risk management as two separate research streams. Digital transformation was primarily associated with operational performance and customer satisfaction, whereas risk management focused on regulatory compliance and internal control mechanisms. Consequently, limited attention was devoted to examining whether digital transformation could directly enhance the effectiveness of enterprise-wide risk management in commercial banks, leaving an important theoretical and empirical foundation for subsequent studies conducted after 2018.

Between 2019 and 2022, research on digital transformation in the banking sector entered a more mature stage, shifting from technology adoption toward organizational transformation and strategic value creation. The rapid development of artificial intelligence (AI), big data analytics, cloud computing, blockchain, and application programming interfaces (APIs) enabled banks to integrate heterogeneous data sources, automate business processes, and enhance decision-making capabilities. Rather than viewing digital transformation as an isolated technological initiative, scholars increasingly emphasized its role in strengthening organizational capabilities, improving operational resilience, and supporting enterprise-wide risk governance (Vial, 2019; Verhoef et al., 2021; Yan et al., 2026).

During this period, empirical studies increasingly adopted questionnaire-based survey methods combined with multiple regression, covariance-based SEM, or Partial Least Squares Structural Equation Modeling (PLS-SEM) to examine the organizational consequences of digital transformation. Most studies reported that digital technologies significantly enhanced information quality, organizational agility, innovation capability, and managerial decision-making, thereby indirectly improving risk identification, operational control, and organizational resilience. In particular, AI and big data analytics enabled commercial banks to process massive volumes of structured and unstructured data in real time, while cloud computing improved information accessibility, operational flexibility, and business continuity. These technologies collectively strengthened banks' abilities to detect abnormal transactions, assess creditworthiness, predict operational risks, and support more timely managerial responses under uncertain business environments (Verhoef et al., 2021; Hanelt et al., 2021).

Nevertheless, the empirical findings were not entirely consistent. While many studies confirmed the positive relationship between digital transformation and organizational

performance, innovation capability, and risk governance, others argued that technological investment alone did not automatically improve organizational outcomes. Instead, the effectiveness of digital transformation depended on complementary organizational factors, including leadership commitment, digital culture, employee capabilities, governance quality, and dynamic capabilities. Scholars increasingly recognized that digital technologies created value only when they were integrated with organizational resources and supported by appropriate governance mechanisms. Consequently, the literature gradually shifted from investigating the direct effects of technology adoption to exploring mediating and moderating mechanisms explaining how digital transformation contributes to sustainable organizational performance and effective risk management. Despite these advances, empirical evidence specifically examining the direct impact of digital transformation on risk management effectiveness in commercial banks remained limited. Existing studies generally treated risk management as one component of organizational performance rather than as a distinct strategic capability, particularly in emerging economies where banking digitalization, regulatory reforms, and institutional environments differ substantially from those of developed countries. This limitation provides an important theoretical foundation for further investigation into the relationship between digital transformation and risk management effectiveness within Vietnamese commercial banks.

Recent studies have increasingly shifted their attention from examining the operational benefits of digital transformation toward evaluating its contribution to enterprise-wide risk management, organizational resilience, and sustainable banking development, particularly in emerging economies. Advances in artificial intelligence (AI), machine learning, cloud computing, and big data analytics have enabled commercial banks to establish integrated risk management systems capable of supporting real-time monitoring, early risk detection, predictive analytics, and intelligent decision-making. Consequently, digital transformation is no longer viewed merely as a technological initiative but as a strategic capability that enhances banks' resilience against financial and non-financial risks under rapidly changing business environments (Hoque et al., 2024; Verhoef et al., 2021; Hanelt et al., 2021).

Within emerging economies, empirical evidence has generally supported the positive role of digital transformation in improving banking stability and reducing risk exposure, although the magnitude and mechanisms of these effects remain heterogeneous. In Vietnam, Hoque et al. (2024) demonstrated that digital transformation significantly reduces credit and insolvency risks by improving information processing capacity and mitigating information asymmetry, whereas its influence on liquidity risk remains statistically insignificant due to the expansion of both lending and deposit activities. More recently, survey-based studies conducted in Vietnamese commercial banks have emphasized that digital transformation contributes to effective risk control primarily through enhanced governance quality, organizational

coordination, and regulatory compliance rather than through technology adoption alone. These findings suggest that organizational capabilities, governance mechanisms, and managerial commitment play complementary roles in translating digital technologies into effective risk management practices.

Despite these important advances, several research gaps remain. Methodologically, existing banking studies in Vietnam predominantly rely on secondary panel data or focus on organizational performance, while relatively few employ primary survey data to investigate the causal relationship between digital transformation and risk management effectiveness using regression or structural equation modeling (SEM). Contextually, most international evidence originates from developed countries or large emerging markets, whereas empirical studies focusing on Vietnamese commercial banks remain scarce despite Vietnam's rapid digital banking development and ongoing regulatory reforms. Practically, prior studies mainly evaluate specific risk dimensions, such as credit or insolvency risk, rather than examining risk management effectiveness as an integrated organizational capability encompassing risk identification, assessment, monitoring, response, and governance. Therefore, this study addresses these methodological, contextual, and practical gaps by investigating how digital transformation influences the effectiveness of enterprise-wide risk management in Vietnamese commercial banks using primary survey data, thereby providing evidence-based implications for managers, regulators, and policymakers in accelerating sustainable digital banking development.

III. RESEARCH MODEL AND DATA

Qualitative research: The authors analyze, reason, and synthesize relevant concepts from previous studies, thereby adjusting and proposing an appropriate research model for the topic.

Quantitative research: The survey was designed with 30 observed variables, using a 5-point Likert scale. A convenient sampling method was used. A suitable sample size requires the number of responses to be five times the number of observed variables, corresponding to a minimum sample size of 150 as confirmed by Hair et al. (2006). The authors also used nominal scales for questions related to demographics (gender, education level, etc.). Data collected from the survey were analyzed using IBM SPSS Statistics 20.0 software to check the reliability of the scales using Cronbach's Alpha, perform Exploratory Factor Analysis (EFA) to check convergent and discriminant validity, and conduct correlation and regression analysis to test hypotheses. To ensure the preliminary scale was appropriate for the context and research requirements of joint-stock commercial banks in Vietnam, before conducting the official survey, the author held a focus group discussion with 30 bank employees and 15 managers, and consulted with 6 experts with many years of experience in the banking and finance sector. The results showed that all participants agreed with the elements of the proposed research model and retained the observed variables in the preliminary scale. However, some observed variables in the scales needed

adjustment to better suit the Vietnamese writing style, clearly express the content, and avoid duplication that could cause confusion.

Based on the hypotheses derived from previous studies and those presented by the authors above, the authors have refined and proposed a research model, including five influencing factors: Digital transformation, management policies, employee capabilities, customer financial capacity, and the economic environment. The five research hypotheses are as follows:

H1: Digital transformation has a positive impact on the effectiveness of risk management in joint-stock commercial banks.

H2: Management policies have a positive impact on the effectiveness of risk management in joint-stock commercial banks.

H3: Employee competence has a positive impact on the effectiveness of risk management in joint-stock commercial banks.

H4: Customers' financial capacity has a positive impact on the effectiveness of risk management in joint-stock commercial banks.

H5: The economic environment has a positive impact on the effectiveness of risk management in joint-stock commercial banks.

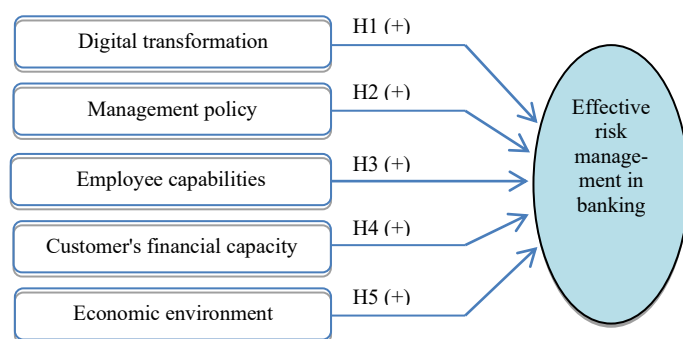


Fig. 1. Research model proposed by the authors.

Source: The author

The research model is defined in the form of an equation:

$$RME = \beta_0 + \beta_1 * DT + \beta_2 * MP + \beta_3 * EC + \beta_4 * CFC + \beta_5 * EE + e$$

In which:

RME (dependent factor): Risk management effectiveness in the Bank

Independent factors include (X_i): Digital transformation (DT); Management policy (MP); Employee capabilities (EC); Customer's financial capacity (CFC); Economic environment (EE).

β_k : Regression coefficient ($k = 0, 1, 2, \dots, 5$).

e: Remainder

IV. RESEARCH RESULTS

Data was compiled from a sample of 190 valid survey responses (collected via online survey) and analyzed using SPSS 20.0. The results are as follows:

The reliability assessment of the scale for the independent and dependent variables using Cronbach's Alpha coefficients is shown in Table 1 below.

TABLE I. Reliability of the scale

Potential variables	Number of Observed variables	Cronbach's Alpha coefficient
DT	5	0.820
MP	5	0.802
EC	5	0.835
CFC	5	0.818
EE	5	0.866
RME	5	0.897

Source: Compiled by the author

The Cronbach's Alpha coefficients, representing the reliability of the variables, are all greater than 0.6; the correlation coefficients with the total variable are also all greater than 0.3. Therefore, it can be concluded that the scales in this study meet the reliability criteria.

Factor analysis was performed on 25 observed variables of the independent variables affecting the effectiveness of risk management in banks, as shown in Table 2.

TABLE III. KMO and Barlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.826
Approx. Chi-Square		2053.850
Bartlett's Test of Sphericity		df 300
Sig.		0.000

Source: Compiled by the author

The results in Table 2 show that the KMO coefficient reached 0.826 (greater than 0.5) with a very small significance level Sig. = 0.000 (less than 0.05), confirming that the factor analysis is appropriate. The Eigenvalues are 7.734, 2.825, 2.251, 1.793, and 1.303 (all greater than 1), and the total variance extracted is 63.629% (greater than 50%), demonstrating that the 5 extracted factors can explain 63.629% of the variation in risk management effectiveness in banks.

After rotating the factors, the discriminant values of all observed variables exceeded the minimum standard of 0.5. Therefore, 25 observed variables were retained, forming 5 official factors for the research model. The rotated matrix results are shown in Table 3.

TABLE IIIII. Rotated Component Matrix^a

	Component				
	1	2	3	4	5
EE4	0.827				
EE3	0.822				
EE5	0.802				
EE2	0.775				
EE1	0.719				
EC4		0.793			
EC3		0.782			
EC2		0.741			
EC5		0.710			
EC1		0.695			
CFC4			0.845		
CFC3			0.760		
CFC1			0.696		
CFC5			0.689		
CFC2			0.647		
DT5				0.746	
DT4				0.743	
DT1				0.735	
DT3				0.693	

DT2				0.653	
MP2					0.760
MP5					0.758
MP4					0.686
MP1					0.674
MP3					0.670

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

^a. Rotation converged in 6 iterations.

Source: Compiled by the author

Before performing regression analysis, correlation analysis was conducted, and the results are presented in Table 4 below.

TABLE IVV. Linear correlation between independent and dependent variables

	EE	EC	CFC	DT	MP
Pearson Correlation	0.435*	0.556*	0.431*	0.616*	0.456*
Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000
N	190	190	190	190	190

*. Correlation is significant at the 0.01 level (2-tailed).

Source: Compiled by the author

The correlation analysis results in Table 4 show that all independent variables have a positive linear correlation with the independent variable at the 1% significance level, supporting the continued use of regression analysis.

TABLE V. Model summary

Model	R	R ²	R ² adjustment	Estimate error	Durbin-Watson
1	0.765	0.586	0.574	0.54137	1.949

Source: Compiled by the author

The analysis results in Table 5 show that the adjusted R² is 57.4%, indicating that the model explains 57.4% of the variation in the dependent variable.

TABLE VI. ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	76.199	5	15.240	51.998	.000 ^b
	Residual	53.927	184	.293		
	Total	130.127	189			

^a. Dependent Variable: RME

^b. Predictors: (Constant), MP, EE, EC, CFC, DT

Source: Compiled by the author

ANOVA testing with Sig. = 0.000 (less than 0.01) and F = 51.531 confirms that the model fits the actual data. Correlation matrix analysis shows that some independent variables are correlated with each other, which should be noted to avoid multicollinearity in regression analysis, checked through the variance inflation factor (VIF).

According to Table 7, the Variance Inflation Factor (VIF) of each variable is less than 2, indicating that multicollinearity does not affect the model's explanatory results. The regression analysis shows that the Sig. values of the independent variables are all less than 0.05, confirming that these variables are statistically significant at the 5% significance level. The Beta coefficients are 0.243; 0.297; 0.136; 0.402 and 0.132, all

positive, indicating a positive influence of each factor on the effectiveness of risk management in banks (RME).

TABLE VII. Linear regression results of the dependent variable, risk management effectiveness in banks

Management Practices in Banks								
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-.866	.294		-2.944	.004		
	EE	.243	.050	.244	4.824	.000	.882	1.134
	EC	.297	.055	.289	5.358	.000	.777	1.288
	CFC	.136	.059	.124	2.300	.023	.770	1.299
	DT	.402	.067	.342	6.021	.000	.697	1.435
	MP	.132	.060	.120	2.188	.030	.752	1.330

Source: Compiled by the author

Both graphs in Figure 2 below support the hypothesis that the residuals of the model have a normal distribution.

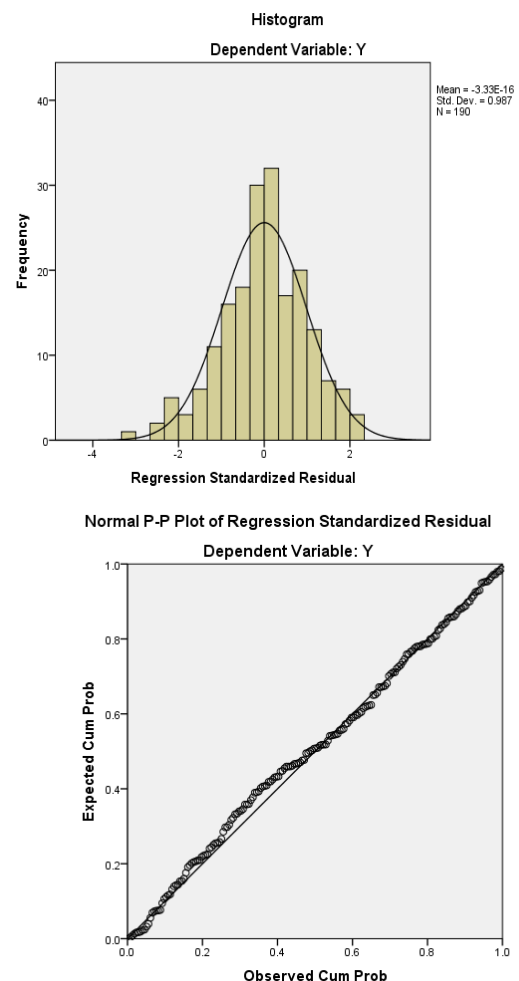


Fig. 2. Graph illustrating the normal distribution of residuals in the regression model

Source: Compiled by the author

All necessary tests confirm that the above regression model is entirely appropriate and can be used to analyze the impact of digital transformation on risk management effectiveness in commercial banks in Vietnam.

V. CONCLUSION AND IMPLICATIONS

Thus, the regression analysis results show that if digital transformation increases by 1 unit, the effectiveness of risk management in commercial banks in Vietnam increases by an average of 0.402 points. In addition, the standardized regression coefficient of digital transformation is also the largest among the standardized regression coefficients (0.342) compared to the standardized regression coefficients of EE (0.244), EC (0.289), CFC (0.124) and MP (0.120), demonstrating that digital transformation is the strongest factor impacting the effectiveness of risk management in commercial banks in Vietnam compared to the factors of management policy, employee capabilities, customer financial capacity, and economic environment.

The research results show that digital transformation has the strongest and most positive impact on the risk management effectiveness of commercial banks in Vietnam, surpassing factors such as management policies, employee capabilities, customer financial capacity, and the economic environment. This result reflects the central role of digital transformation as a strategic capability, not only supporting the digitization of business processes but also fundamentally changing the way risks are identified, measured, monitored, and controlled throughout the entire banking system. Through the integration of centralized data, the application of artificial intelligence (AI), big data, cloud computing, and intelligent analytical platforms, banks can improve data quality, reduce information asymmetry, increase real-time monitoring capabilities, and predict early signs of risk. As a result, management decisions are made faster, more accurately, and more proactively, contributing to improved risk management efficiency across the entire bank, instead of just dealing with each risk type in isolation.

The greater impact of digital transformation compared to other factors can be explained by the fundamental nature and pervasive influence of digital technology on all banking operations. While management policies primarily serve as guidance and establish the legal framework, employee capabilities reflect operational performance, customer financial capacity directly impacts credit quality, and the economic environment is an external factor difficult to control, digital transformation simultaneously impacts all core banking activities through data connectivity, process automation, enhanced information transparency, and data-driven decision-making support. In other words, digital transformation not only directly improves risk management efficiency but also amplifies the effectiveness of other management factors by improving information quality and coordination among departments. This result is consistent with the study by Hoque et al. (2024), where the authors demonstrated that digital transformation helps reduce credit risk and insolvency risk of Vietnamese commercial banks by improving risk management capacity and reducing information asymmetry; however, the impact on liquidity risk is not yet clear because digital transformation simultaneously promotes both deposit and lending activities. In addition, the study by Dien Vy & Thanh Tam (2026) also shows that digital transformation has a positive impact on operational risk management, but this

effectiveness is only maximized when linked to the internal control environment and the maturity level of the enterprise risk management (ERM) framework, in which awareness and operation of ERM play a crucial mediating role.

While sharing many similarities with previous studies, this research also reveals some notable differences. Most recent international studies focus on assessing the impact of digital transformation on individual risk categories, such as credit risk, liquidity risk, or operational risk, or on the impact of digital transformation on banks' risk-taking behavior. In contrast, this study approaches risk management effectiveness as a holistic management capability, encompassing the identification, assessment, monitoring, control, and response to various risks within the framework of corporate risk management. Therefore, digital transformation is demonstrated to play a more comprehensive and influential role than traditional management factors. This finding also differs from some previous studies on the Vietnamese banking system, which primarily emphasized the role of management policies, internal controls, or human resource capabilities in improving risk management effectiveness. In the context of ongoing digital transformation, digital technology is no longer merely a supporting tool but has become a strategic infrastructure that determines the ability to integrate data, enhance analytical capabilities, and improve governance quality across the entire organization. This implies that Vietnamese commercial banks need to continue prioritizing investment in digital infrastructure, centralized data platforms, AI, and big data analytics, while simultaneously perfecting the ERM framework, developing digital human resources, and strengthening technology governance to build a proactive, flexible, and sustainable risk management system in the context of increasingly profound digital transformation.

Based on the above analysis, several solutions can be proposed to improve the effectiveness of risk management in Vietnamese joint-stock commercial banks through digital transformation, as follows:

Solution 1: Completing Digital Infrastructure and Building an Integrated Data Platform for Risk Management

Commercial joint-stock banks need to prioritize synchronized investment in digital technology infrastructure and build a centralized data system to form a real-time risk management platform. Integrating data from credit, payment, deposit, customer management, and internal control activities will help improve information quality, reduce data fragmentation, and support comprehensive risk identification. Simultaneously, standardizing databases and enhancing connectivity between systems will facilitate faster and more accurate analysis, monitoring, and decision-making, contributing to improved risk management efficiency in the context of digital transformation.

Solution 2: Promoting the Application of Artificial Intelligence and Big Data Analytics in Risk Management

Banks need to strengthen the application of artificial intelligence (AI), big data, and machine learning in risk identification, forecasting, and early warning activities. These technologies allow for the processing of large volumes of data at high speed, the detection of anomalous patterns, and the

prediction of risk trends before losses occur. Besides improving the accuracy of credit assessments, AI also supports fraud detection, monitoring of unusual transactions, and evaluating customer compliance. As a result, banks can shift from reactive risk management to proactive, data-driven management.

Solution 3: Developing Digital Human Resources in conjunction with a Risk Management Culture

Digital transformation is only effective when coupled with enhancing the digital capabilities of bank staff. Therefore, joint-stock commercial banks need to develop regular training programs on digital technology, data analytics, cybersecurity, and digital risk management for staff at all management levels. Simultaneously, a data-driven risk management culture needs to be fostered, encouraging employees to proactively utilize digital tools in decision-making and business processes. Combining professional expertise, digital thinking, and risk management awareness will contribute to improved operational efficiency and increased adaptability of the bank to new risks.

Solution 4: Completing the Digital Risk Management Framework According to International Standards

Banks need to continue improving their risk management systems by integrating digital transformation with international standards such as Basel III and Enterprise Risk Management (ERM). This requires building a unified management process, connecting data between lines of defense, and applying digital monitoring tools to continuously track risks. Simultaneously, mechanisms for managing new types of risks arising from the digital environment, such as cybersecurity risks, data risks, model risks, and third-party risks, need to be added. A modern management framework will help enhance the proactiveness, resilience, and effectiveness of risk control within banks.

Solution 5: Strengthening Coordination Between Banks, Regulatory Agencies, and Technology Businesses

To enhance risk management effectiveness in the context of digital transformation, it is necessary to build a close coordination mechanism between joint-stock commercial banks, the State Bank of Vietnam, technology businesses, and data service providers. This coordination will contribute to the formation of a secure digital ecosystem, promote data sharing, standardize technical standards, and improve risk monitoring capabilities across the entire system. At the same time, regulatory agencies need to continue improving the legal framework on data, cybersecurity, artificial intelligence, and digital banking to create a favorable environment for innovation while ensuring financial safety and long-term stability of the banking system.

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