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How risk oversight committees reduce banking risk: the amplifying role of digital innovation

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ABSTRACT

This study investigates the influence of risk oversight committee characteristics on banking risk. This study also investigates the moderating role of digital innovation between the influence of risk oversight committee characteristics on banking risk. Risk oversight committee effectiveness is measured by five key attributes of committee size, independence, financial expertise, risk management expertise, and meeting frequency. Banking risk is assessed across three critical dimensions which are credit risk, liquidity risk, and operational risk. Digital innovation is operationalized using the Indonesian Digital Innovation Award as a proxy for technological maturity. Samples are 27 publicly listed banks on the Indonesian Stock Exchange from 2017 to 2023. The empirical findings reveal that all risk oversight committee attributes are significantly and negatively associated with banking risk, affirming the importance of governance structures in enhancing risk resilience. Furthermore, digital innovation significantly moderates these relationships, amplifying the risk-reducing effects of each committee attributes of size, independence, financial expertise, risk management expertise, and meeting frequency. These results underscore the synergistic value of integrating governance mechanisms with digital transformation initiatives. The study contributes to the literature by bridging corporate governance and financial technology in a risk management context, and offers practical recommendations for regulators and bank executives to strengthen oversight functions in the digital era.

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1. INTRODUCTION

The financial sector, especially banking, is particularly susceptible to risk exposure. For instance, the 1997 Asian Financial Crisis—triggered by the depreciation of the Indonesian Rupiah—culminated in a loss of trust in domestic banks, leading to the

closure of 68 institutions by Bank Indonesia (Arnold, 2025). More recently, the COVID-19 pandemic significantly heightened banking risk through social mobility restrictions between 2020 and 2022, which disrupted economic activity and escalated default risks among borrowers (Demirgüç-Kunt et al., 2021; Indrawati et al., 2024; Zheng, 2023). Financial crisis and COVID-19 accelerated the adoption of digital tools for risk surveillance, scenario modeling, and early-warning systems (Audretsch et al., 2025).

In this study, banking risk is conceptualized as comprising three primary dimensions including credit risk, liquidity risk, and operational risk. Credit risk, associated with borrower default, is proxied by the non-performing loan (NPL) ratio (Ahn & Gam, 2024; Rehman et al., 2024). Operational risk pertains to failures in internal systems and processes and is measured using the ratio of operating expenses to operating income (OEOI) (Adiatmayani & Panji, 2021; Bungatang & Jumady, 2021). Liquidity risk, defined as a bank's inability to meet short-term obligations, is captured through the loan-to-deposit ratio (LDR) (Boďa & Zimková, 2021). These categories are chosen due to their direct relevance to core banking functions—fund mobilization and distribution—as well as their reflection of internal operational efficiency.

Given the prevalence of risk in banking, effective risk management is paramount. Regulatory frameworks such as Indonesian Law No. 4 of 2023 and Financial Services Authority (OJK) regulations mandate the implementation of comprehensive risk governance structures. These include the formation of a risk oversight committee as stipulated by Bank Indonesia Regulation No. 8/4/PBI/2006 and OJK Regulation No. 55/POJK.03/2016, which outline the role of the risk oversight committee in aligning risk management with their execution and in evaluating the performance of risk management units. Based on Fali et al. (2020), risk oversight committees are entrusted with overseeing risk governance and are central to embedding a strong risk culture within organizations. Their effectiveness hinges on structural characteristics such as member size, independence, financial literacy, risk management competence, and meeting frequency.

The novelty of this research is to be the bridge between corporate governance and financial technology in a risk management context by introducing digital innovation as moderating variable. This study empirically examines how the aforementioned committee characteristics influence bank risk, while also exploring how digital innovation—operationalized through the receipt of digital innovation awards—moderates these relationships. It offers policy implications for banking regulators and practical guidance for banks aiming to design effective risk oversight mechanisms in the digital era. Empirical studies confirm that banks investing in digital technologies tend to have more sophisticated risk management capabilities and demonstrate lower levels of business risk (Barroso & Laborda, 2022; Diener & Špaček, 2021). The Indonesian Digital Innovation Award thus reflects not only technological sophistication but also strategic risk responsiveness.

Risk theory, as elaborated by Roeser et al. (2012), posits that all entities, including businesses, are inherently exposed to uncertainty and must implement strategies to monitor and mitigate risk. This framework suggests that the presence of risk is not a flaw in business operations, but rather a fundamental condition that must be managed proactively. In the context of banking, where risk exposure is heightened due to financial intermediation activities, the monitoring and mitigation functions become critically important (Bhatt et al., 2023; Harun & Gunadi, 2022; Kedarya et al., 2023).

2. RESEARCH METHOD

The size of the risk oversight committee is a structural attribute that may influence the quality of risk governance. Larger committees are generally associated with a broader range of expertise, perspectives, and networks (Castañer & Oliveira, 2020; Karim et al., 2024; Rahman, 2024). This diversity allows for more robust deliberation and critical

evaluation of risk-related issues. Empirically, studies show that larger committees can lead to better monitoring and advisory roles (Kolev et al., 2025).

H1: Larger risk oversight committees affect bank risk.

Independence is critical to the credibility and objectivity of the risk oversight committee. From an agency theory perspective, independent members serve as a check against managerial opportunism and reduce information asymmetry between the board and stakeholders. Independent members are less likely to be influenced by internal politics or conflicts of interest, allowing them to critically assess risk exposures and enforce mitigation strategies (Odubuasi et al., 2022). Their lack of affiliation with executive management enhances their role in safeguarding the interests of depositors, investors, and regulators.

H2: Higher levels of independence in the risk oversight committee affect bank risk.

Financial expertise among risk oversight committee members is crucial for the comprehension of financial instruments, credit structures, and balance sheet risks. From the perspective of the competence-based view of governance, financial literacy enhances the committee's ability to interpret key financial signals, assess performance, and foresee distress (Fali et al., 2020). Financial experts can contribute to early warning systems by interpreting financial ratios, market trends, and borrower creditworthiness, which is critical for reducing non-performing loans and ensuring asset-liability alignment.

H3: The proportion of members with financial expertise in the risk oversight committee affects bank risk.

Specialized expertise in risk management allows committee members to apply best practices in identifying, assessing, and mitigating various types of risks. According to contingency theory, organizations must align their governance mechanisms with their risk environment. Members with risk management backgrounds are more likely to understand regulatory frameworks, stress-testing protocols, and internal control systems, thus enabling more effective governance (Odubuasi et al., 2022). Their insights are essential in developing forward-looking strategies that respond dynamically to evolving threats.

H4a: The proportion of members with risk management expertise in the committee affects bank risk.

The frequency of committee meetings is a behavioral indicator of governance engagement. More frequent meetings suggest a proactive posture in addressing emerging issues and adapting to market changes. According to stewardship theory, active engagement by oversight bodies contributes to organizational resilience. Regular meetings allow for continuous risk monitoring, timely interventions, and reinforcement of compliance culture (Odubuasi et al., 2022). They also ensure that risk oversight is not merely procedural, but substantive and adaptive.

H5: The frequency of risk oversight committee meetings affects bank risk.

Digital innovation, operationalized through recognition such as the Indonesian Digital Innovation Award, reflects an organization's capacity to adopt and integrate advanced technologies into its operational and strategic processes. Digital transformation enhances the ability to manage risk through real-time monitoring, predictive analytics, and automated control mechanisms. It serves as a complementary factor that enhances the effectiveness of structural governance variables. Digital tools (e.g., dashboards, AI-enabled analytics) improve coordination and knowledge sharing among larger groups, thus overcoming potential inefficiencies due to committee size. Innovation facilitates the aggregation of inputs, making larger committee more effective (Heubeck & Meckl, 2024).

H6: Digital innovation moderates the effect of committee size on bank risk.

Digital systems democratize access to information and empower independent members who may otherwise lack insider knowledge. This reduces information asymmetry and enhances the decision-making capacity of independent directors (Heubeck & Meckl, 2024).

H7: Digital innovation moderates the effect of committee independence on bank risk.

Financial experts can leverage digital systems to deepen analysis, automate modeling, and derive insights from complex financial data. This synergy enhances the ability to detect anomalies, forecast disruptions, and propose corrective measures (Sarto & Saggese, 2022).

H8: Digital innovation moderates the effect of financial expertise on bank risk.

Advanced technologies such as machine learning and early warning systems complement the knowledge of risk management professionals. These tools allow them to move from reactive to predictive risk governance models (Sarto & Saggese, 2022).

H9: Digital innovation moderates the effect of risk management expertise on bank risk.

Digital innovation improves meeting productivity by enabling virtual collaboration, real-time data sharing, and access to performance dashboards. This allows committees to act faster and more decisively (Sierra-Morán et al., 2024).

H10: Digital innovation moderates the effect of committee meeting frequency on bank risk.

The population in this study comprises all commercial banking institutions in Indonesia. To obtain a representative and relevant sample, this research employs a purposive sampling technique, which involves selecting units based on predefined criteria that align with the research objectives. The criteria are as follows: (1) Banks listed on the Indonesia Stock Exchange (IDX), ensuring the availability and transparency of financial and governance data. (2) Banks that remained continuously listed between 2017 and 2023. This period was selected because the Indonesian Digital Innovation Award was first introduced by Warta Ekonomi Group in 2017, allowing for longitudinal analysis of the digital innovation effect. This sampling method ensures that only banks with accessible and consistent data are included, thereby enhancing the relevance of the findings. Total samples are 27 banks with total observations of 189 as in Table 1.

Table 1. Sample

Criteria	Banks	Observations
Banking Companies Listed on IDX 2017-2023	27	189

Since this research uses secondary data, data are collected by using documentation. The data of risk management committee and bank risks are collected from financial statements and annual reports from companies' web page and www.idx.co.id. The digital innovation data are collected from www.wartaekonomi.co.id.

This research involves three dependent variables (types of bank risk), five independent variables (risk oversight committee characteristics), and one moderating variable (digital innovation award). The dependent variables represent the risk profile of a bank, categorized into three main dimensions of credit risk (measured by NPL ratio), liquidity risk (measured by LDR ratio), and operational risk (measured by OEOI ratio) as in Equation 1-3 (Adiatmayani & Panji, 2021; Atichasari et al., 2023).

$$NPL = \frac{Non\ Performing\ Loans}{Total\ Loans} \quad (1)$$

$$LDR = \frac{Total\ Loans}{Third\ Party\ Deposits} \quad (2)$$

$$OEOI = \frac{Operating\ Expenses}{Operating\ Income} \quad (3)$$

In this study, the independent variable is the characteristics of the risk oversight committee, which include committee size, independence, financial expertise, risk management expertise, and meeting frequency. The size of the risk oversight committee is measured by the total number of committee members. The independence of the risk oversight committee is measured by the ratio of independent members to the total number of committee members (Odubuasi et al., 2022). The financial expertise of the risk oversight committee is measured by the ratio of members with financial experience or educational background to the total number of committee members (Odubuasi et al., 2022). The risk management expertise of the risk oversight committee is measured by the ratio of members with risk management experience or educational background to the total number of committee members (Odubuasi et al., 2022). The meeting frequency of the risk oversight committee is measured by the number of meetings held by the committee within one year (Odubuasi et al., 2022).

The moderating variable used in this study is the Indonesian Digital Innovation Award, organized by the Warta Ekonomi Group. The evaluation process covers several key aspects, including the adoption of new technologies, improvements in digital services, the effectiveness of digital strategies, and their impact on company growth and customer satisfaction (Warta Ekonomi, 2023). The evaluation including the data of investment costs and capacity from mass media and corporate reporting (Warta Ekonomi, 2023). Digital innovation is measured by a dummy variable where score 1 if companies win the Indonesian Digital Innovation Award and score 0 if otherwise. This research uses panel regression analysis to examine the hypotheses. Panel regression can explain dynamic data since it captures multiple banks (cross-section) over multiple years (time-series), while structural equation modelling (SEM) can only capture cross-section data, and generalized method of moments (GMM) suits to lagged dependent variables. Regression model can be seen in Equation 4-6.

$$Y_1 = a_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6Z + b_7X_1Z + b_8X_2Z + b_9X_3Z + b_{10}X_4Z + b_{11}X_5Z + e_4 \quad (4)$$

$$Y_2 = a_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6Z + b_7X_1Z + b_8X_2Z + b_9X_3Z + b_{10}X_4Z + b_{11}X_5Z + e_4 \quad (5)$$

$$Y_3 = a_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6Z + b_7X_1Z + b_8X_2Z + b_9X_3Z + b_{10}X_4Z + b_{11}X_5Z + e_4 \quad (6)$$

Y1 is credit risk. Y2 is liquidity risk. Y3 is operational risk. X1 is the size of risk oversight committee. X2 is the independence of risk oversight committee. X3 is financial expertise of risk oversight committee. X4 is risk management expertise of risk oversight committee. X5 is the meeting frequency of risk oversight committee. Z is digital innovation. Hypotheses are accepted if coefficient values are negative and significant.

3. RESULTS AND DISCUSSIONS

Table 2. Descrptive Statstics

Variable	Min	Max	Mean	Std. Dev.
Credit Risk (NPL)	0.01	10.27	2.49	1.64
Liquidity Risk (LDR)	20.53	527.91	95.77	52.23
Operational Risk (OEOI)	37.10	154.17	83.41	18.41
Committee Size	2.00	13.00	4.87	2.18
Committee Independence	0.30	5.00	0.67	0.64
Financial Expertise	0.25	1.00	0.89	0.20
Risk Management Expertise	0.00	1.00	0.64	0.37
Committee Meeting Frequency	2.00	18.00	6.86	3.70

In table 2, the Non-Performing Loan (NPL) ratio, used to measure credit risk, ranges from 0.01% to 10.27%, with an average value of 2.49% and a standard deviation of 1.64. Liquidity risk, measured by the Loan to Deposit Ratio (LDR), varies widely from 20.53% to 527.91%, with a mean of 95.77% and a standard deviation of 52.23. Operational risk is captured by the ratio of Operating Expenses to Operating Income (OEOI), which ranges from 37.10% to 154.17%, with a mean of 83.41% and a standard deviation of 18.41.

The size of the risk oversight committee ranges from 2 to 13 members, with an average size of 4.87 members and a standard deviation of 2.18. Independence is measured by the ratio of independent members to total committee members, ranging from 0.30 to 5.00, with an average of 0.67 and a standard deviation of 0.64. The proportion of committee members with financial expertise ranges from 0.25 to 1.00, with a high mean of 0.89 and a standard deviation of 0.20. The proportion of members with risk management expertise varies between 0.00 and 1.00, with an average of 0.64 and a standard deviation of 0.37. The number of risk oversight committee meetings per year ranges from 2 to 18, with a mean of 6.86 meetings and a standard deviation of 3.70.

Table 3. Results of Classical Assumption Tests

Test	Result
Kolmogorov-Smirnov	Sig > 0.05
Variance Inflation Factor	VIF < 10, Tolerance > 0.1
Glejser	Sig > 0.05
Run	Sig > 0.05

Based on Table 3, the Kolmogorov-Smirnov test produced a significance value of greater than 0.05, indicating that the data are normally distributed. The multicollinearity test, using the Variance Inflation Factor (VIF) and Tolerance values, showed that all independent variables had VIF values below 10 and Tolerance values above 0.1. The Glejser test revealed p-values greater than 0.05 for all variables across all models (credit risk, liquidity risk, and operational risk), indicating no evidence of heteroscedasticity. The Runs test yielded p-values of greater than 0.05. This suggests no autocorrelation within the regression models. The absence of autocorrelation is important, as its presence can lead to biased and inefficient parameter estimates. Overall, the results of the classical assumption tests indicate that the regression models employed in this study meet all necessary basic assumptions.

Table 4. Regression Analysis

Independent Variable	Credit Risk		Liquidity Risk		Operational Risk	
	t	Sig.	t	Sig.	t	Sig.
Constant	2.534	0.006	5.295	0.000	8.960	0.000
X1 (Committee Size)	-7.256	0.000	-5.505	0.000	-3.859	0.000
X2 (Committee Independence)	-3.724	0.000	-4.186	0.000	-5.698	0.000
X3 (Financial Expertise)	-4.316	0.000	-5.367	0.000	-3.555	0.000
X4 (Risk Management Expertise)	-3.121	0.001	-4.400	0.000	-3.670	0.000
X5 (Meeting Frequency)	-8.070	0.000	-3.267	0.000	-3.436	0.000
Z (Digital Innovation Award)	-4.603	0.000	-5.737	0.000	-6.756	0.000
X1 x Z (Size × Innovation)	-4.002	0.000	-5.408	0.000	-3.211	0.000
X2 x Z (Independence × Innovation)	-3.372	0.000	-6.795	0.000	-3.742	0.000
X3 x Z (Financial Expertise × Innovation)	-6.069	0.000	-3.069	0.010	-7.026	0.000
X4 x Z (Risk Expertise × Innovation)	-3.837	0.000	-5.243	0.000	-4.507	0.000
X5 x Z (Meeting Frequency × Innovation)	-6.725	0.000	-3.611	0.000	-3.189	0.000
Adjusted R-Square		0.269		0.347		0.453

Based on Table 4, the size of the committee, committee independence, financial expertise, risk management expertise, and meeting frequency all exhibit a significant negative relationship with credit risk, liquidity risk, and operational risk as indicated by the negative t-values and significance levels (Sig. = 0.000). This finding suggests that increases in these governance factors are associated with a reduction in bank risks. In

other words, a larger board size, greater independence, enhanced financial expertise, stronger risk management expertise, and higher meeting frequency are all linked to lower levels of risks in banks. These results confirm the acceptance of hypotheses H1, H2, H3, H4, and H5.

For moderating role, the interaction terms committee characteristics (the size of the committee, committee independence, financial expertise, risk management expertise, and meeting frequency) and digital innovation all show negative t-values and significance levels of 0.000. This finding confirms the acceptance of hypotheses H6, H7, H8, H9, and H10, indicating that digital innovation awards strengthen the negative relationships between governance factors of risk oversight committee and bank risk (credit risk, liquidity risk, and operational risk). In other words, the presence of innovation awards amplifies the negative effects of board size, independence, financial expertise, risk management expertise, and meeting frequency on bank risks.

The results of this study offer compelling evidence for the role of governance structures—specifically the risk oversight committee—in shaping the risk profile of banks. All five core dimensions of committee characteristics (size, independence, financial expertise, risk management expertise, and meeting frequency) demonstrate a statistically significant and negative association with three categories of bank risk including credit risk, liquidity risk, and operational risk. Furthermore, the moderating variable—recognition through the Indonesian Digital Innovation Award—is shown to amplify the effect of these committee attributes, underscoring the synergistic potential of governance and technology in enhancing risk resilience.

The finding that larger committee size is associated with lower risk supports the idea that greater diversity in expertise, experience, and perspective facilitates more comprehensive oversight. Larger committees are likely to possess a richer pool of knowledge, enabling nuanced discussions around credit underwriting standards, liquidity buffers, and operational risk controls. The balancing effect of digital innovation tools (e.g., meeting platforms, real-time dashboards) that help overcome logistical barriers in large group settings is supported.

The results confirm that higher proportions of independent members on the risk oversight committee lead to lower levels of bank risk across all categories. Their presence fosters greater transparency and accountability in the risk management process, particularly in contexts where information asymmetry between management and oversight bodies is high. The moderating role of digital innovation further enhances the effectiveness of independent members. As outsiders with limited access to real-time data, independent members benefit greatly from digital systems that deliver timely, accurate, and interpretable risk metrics—thus elevating their decision-making capacity (Heubeck & Meckl, 2024).

This study provides robust evidence that financial expertise within the risk oversight committee significantly mitigates credit, liquidity, and operational risks. Financially competent members can interpret key financial ratios, understand balance sheet vulnerabilities, and assess risk exposure through a technical lens. This finding echoes the competence-based view of governance, which suggests that effectiveness in oversight is a function of knowledge and experience (Fali et al., 2020). Moreover, digital innovation amplifies the utility of financial expertise by providing tools such as advanced analytics, forecasting models, and scenario simulations, enabling risk oversight committee members to not just detect but anticipate risk events.

Specialized expertise in risk management enables committee members to identify systemic weaknesses, assess risk maturity models, and ensure regulatory compliance. The study finds a significant negative relationship between risk management expertise and all forms of bank risk, underscoring the importance of having domain-specific knowledge within the committee. As banks face evolving risks (e.g., cyber threats, regulatory changes), the presence of risk management professionals becomes

indispensable. Digital innovation acts as an enabler of proactive governance—by providing these experts with real-time dashboards, automated alerts, and integrated risk frameworks, they are empowered to intervene more swiftly and effectively (Kalogiannidis et al., 2024; Sarto & Saggese, 2022).

The study validates that the frequency of committee meetings is positively associated with risk mitigation outcomes. This result confirms prior literature indicating that frequent meetings foster continual risk monitoring, timely identification of emerging threats, and a culture of responsiveness (Odubuasi et al., 2022). From a stewardship theory lens, such behavior reflects a high level of commitment and engagement by board members in protecting organizational assets. What distinguishes this study is the finding that digital innovation strengthens the effectiveness of these meetings. Technologies such as virtual meeting platforms, collaborative tools, and shared data environments increase the productivity of each session, enabling data-informed discussions and faster decision cycles (Sierra-Morán et al., 2024). Further studies can consider business models, market segments, or economic conditions to facilitate high variability in loan to deposits ration (LDR) as in table 2.

4. CONCLUSION

This study highlights the pivotal role of risk oversight committee in managing and mitigating banking risks. Using a panel dataset of publicly listed Indonesian banks from 2017 to 2023, it empirically demonstrates that five key characteristics of risk oversight committee—size, independence, financial expertise, risk management expertise, and meeting frequency—exert a statistically significant and negative influence on three categories of bank risk: credit risk, liquidity risk, and operational risk. Furthermore, the study introduces digital innovation as a moderating variable. The results clearly show that banks recognized for their digital innovation capabilities experience stronger reductions in risk, suggesting that technology and governance are complementary forces. Digital innovation enhances real-time monitoring, predictive analytics, and data-driven decision-making, thereby enabling risk oversight committee to fulfill their oversight functions with greater precision and responsiveness.

The findings offer several practical takeaways for bank boards, executives, and regulators. Boards should prioritize diversity and expertise in forming risk oversight committees, ensuring a balanced composition of independent members, financial professionals, and risk management specialists. Executives can also do digital transformation into governance strategy. Regulators should formulate regulation to promote technology and innovation in risk governance.

Despite providing important insights, this study is not without limitations. First, the study focuses exclusively on banks listed on the Indonesia Stock Exchange. As a result, the findings may not be fully generalizable to non-listed banks, rural banks, or cooperative banks. Future studies could examine the same relationships across different types of financial institutions (e.g., fintech firms, rural banks, microfinance institutions) to test the generalizability of the findings. Second, digital innovation was operationalized using the Indonesian Digital Innovation Award as a proxy. Although awards reflect a degree of external recognition, they may not capture the full extent, depth, or internal effectiveness of digital transformation initiatives. Future researches are encouraged to develop composite indices of digital innovation based on objective internal metrics (e.g., IT investment ratios, number of digital services launched, cybersecurity maturity levels).

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