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Fraud Risk Prediction as a Moderator of the Relationship between Operational Complexity and Audit Report Lag

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Abstract---*This study examines the effect of operational complexity on the likelihood of increased audit completion time and investigates the moderating role of fraud risk prediction. Increased audit completion time may reduce the timeliness and relevance of financial information. Operational complexity expands the scope and difficulty of audit procedures, while potential fraud risk increases audit uncertainty and requires more extensive audit examination. This study employs a quantitative approach using companies listed on the Indonesia Stock Exchange (IDX) as the research population. The sample was selected using a census sampling method based on the availability of complete annual reports and audited financial statements during the 2020–2024 period, resulting in 639 companies with 3,195 firm-year observations. Data were analyzed using logistic regression with Moderated Regression Analysis (MRA) through STATA 17. The increase in audit completion time was measured using a dummy variable, with a value of 1 when the current year's audit completion period was longer than the previous year and 0 otherwise. Operational complexity was used as the independent variable, fraud risk prediction proxied by the Beneish M-Score as the moderating variable, and auditor reputation, firm size, and industry type as control variables. The results indicate that operational complexity has a positive and significant effect on the likelihood of increased audit completion time. Furthermore, fraud risk prediction strengthens the relationship between operational complexity and audit completion time. These findings support agency theory, suggesting that operational complexity and potential fraud increase information asymmetry and audit risk, requiring auditors to perform more extensive audit procedures. This study highlights the importance of considering operational complexity and fraud risk indicators in audit planning and financial reporting practices.*
Keywords---*Audit Completion Time, Audit Report Lag, Operational Complexity, Fraud Risk Prediction, Beneish M-Score, Agency Theory.*

Introduction

Timely financial reporting is an essential aspect of maintaining the relevance and usefulness of financial information for stakeholders. Audited financial statements assure the reliability and credibility of corporate financial information, enabling investors and other stakeholders to make appropriate economic decisions. However, delays in completing audit procedures may reduce the timeliness of financial information and negatively affect market perceptions. Therefore, audit completion time, commonly referred to as audit report lag, has become an important issue in financial reporting practices (Habib, 2011).

Public companies are required to submit audited annual financial statements within the regulatory timeframe. In Indonesia, the Financial Services Authority (Otoritas Jasa Keuangan/OJK) requires listed companies to submit annual financial reports no later than three months after the end of the fiscal year. Despite these requirements, audit delays remain a recurring phenomenon among companies listed on the Indonesia Stock Exchange (IDX). Data from IDX announcements indicate fluctuations in companies experiencing delays in submitting audited financial reports

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during 2020–2024. The proportion of delayed companies increased from 7% in 2022 to 14% in 2023 and remained at 13% in 2024. This condition indicates that audit completion time remains a significant challenge and requires further investigation regarding the factors influencing audit duration.

From an agency theory perspective, audit delay can be explained through the relationship between principals and agents. Agency theory highlights that information asymmetry between management and shareholders may create opportunities for managerial behavior that does not fully align with stakeholder interests (Jensen & Meckling, 1976). Auditors function as monitoring mechanisms to reduce information asymmetry by assuring the fairness of financial statements. However, certain organizational characteristics may increase audit complexity and extend the audit completion process.

One factor that may influence audit completion time is operational complexity. Companies with complex operations generally have multiple subsidiaries, diverse business segments, and broader operational activities. Such complexity increases the difficulty of understanding business processes, evaluating internal controls, assessing risks, and performing audit procedures. From an agency theory perspective, operational complexity may increase information asymmetry because shareholders and auditors face greater challenges in monitoring diverse managerial activities. Consequently, auditors may require additional procedures, broader substantive testing, and more extensive evaluation, potentially increasing audit completion time (Soltani, 2002).

Previous studies have provided inconsistent findings regarding the relationship between operational complexity and audit report lag. Several studies have demonstrated that operational complexity positively affects audit delay because complex organizational structures require more extensive audit procedures (Naibaho & Dewanti, 2024; Azzahra & Nurcahyono, 2024). However, other studies found that operational complexity does not significantly influence audit completion time, suggesting that professional auditor competence and effective internal control systems may mitigate the impact of complexity (Fitria et al., 2022; Soeparyono & Napisah, 2024). These inconsistent findings indicate the need to examine additional factors that may explain when operational complexity results in longer audit completion periods.

This study introduces fraud risk prediction as a moderating variable in the relationship between operational complexity and audit completion time. Based on agency theory, complex operational structures may increase opportunities for financial manipulation due to greater information asymmetry and weaker monitoring effectiveness. When potential fraud risks are identified, auditors are likely to increase audit effort, expand substantive procedures, and perform more detailed testing, which may further extend audit completion time. Fraud risk prediction measured using the Beneish M-Score provides an analytical approach to identifying potential financial statement manipulation and supporting auditors in risk assessment processes (Adoboe-Mensah et al., 2023).

Therefore, this study aims to examine the effect of operational complexity on the likelihood of increased audit completion time and investigate whether fraud risk prediction strengthens this relationship. This research contributes to the auditing literature by extending previous studies on audit delay through the inclusion of fraud risk prediction as a moderating mechanism.

Literature Review and Hypothesis Development

Operational complexity refers to the degree of complexity in a company's business activities, organizational structure, and operational scope, which is commonly reflected by the number of subsidiaries, business segments, and geographical coverage. From the perspective of Agency Theory, complex organizational structures may increase information asymmetry between managers (agents) and shareholders (principals), as shareholders face greater difficulties in monitoring managerial activities. In this condition, external auditors play an important role as an independent monitoring mechanism to ensure that financial statements are presented fairly and free from material misstatements (Jensen & Meckling, 1976). Higher operational complexity requires auditors to obtain a deeper understanding of business processes, evaluate more complex internal controls, examine intercompany transactions, and perform broader audit procedures. Consequently, the increased audit effort and risk assessment requirements may extend the time required to complete audit procedures.

Previous empirical studies have demonstrated that operational complexity is positively associated with audit report lag. Companies with more complex operational structures generally require longer audit completion periods due to increased audit scope and examination difficulties (Adam et al., 2022; Khamisah et al., 2023; Naibaho & Dewanti, 2024; Azzahra & Nurcahyono, 2024). However, most previous studies examine audit report lag as an absolute measure, while limited studies investigate whether operational complexity increases the likelihood of a longer audit completion period compared with the previous year. Therefore, this study extends previous research by examining the effect of operational complexity on the probability of increased audit completion time. Based on these arguments, the following hypothesis is proposed:

H1: Operational complexity has a positive effect on the likelihood of increased audit completion time.

Agency Theory explains that conflicts between managers and shareholders arise due to differences in objectives and unequal access to information. Managers possess greater knowledge regarding company operations compared with shareholders, creating information asymmetry that may provide opportunities for earnings manipulation or fraudulent activities (Jensen & Meckling, 1976). This condition may become more pronounced when companies have complex operational structures because diversified business activities, multiple subsidiaries, and extensive operational networks make monitoring and verification processes more difficult. Operational complexity not only increases audit difficulties but may also create greater opportunities for financial statement manipulation.

Fraud risk prediction can serve as an important mechanism in identifying potential financial reporting irregularities and influencing auditor responses. The Beneish M-Score model provides an analytical approach to detect potential earnings manipulation based on financial statement indicators (Beneish, 1999). When a company exhibits higher fraud risk indicators, auditors are expected to increase professional skepticism, expand substantive testing, and perform additional audit procedures to obtain sufficient and appropriate audit evidence. Consequently, the presence of potential fraud risk may strengthen the effect of operational complexity on audit completion time because auditors must allocate additional effort to assess and respond to fraud-related risks. Previous research has shown that fraud detection models such as Beneish M-Score can assist auditors in identifying potential manipulation and improving audit risk assessment (Adoboe-Mensah et al., 2023). Therefore, this study proposes that fraud risk prediction strengthens the relationship between operational complexity and increased audit completion time.

H2: Fraud risk prediction strengthens the positive relationship between operational complexity and the likelihood of increased audit completion time**.**

Methods

This study employs a quantitative research approach to examine the effect of operational complexity on the likelihood of increased audit completion time and the moderating role of fraud risk prediction. The population consists of companies listed on the Indonesia Stock Exchange (IDX) during the 2020–2024 period. The sample was selected using a census sampling method based on the availability of complete annual reports and audited financial statements throughout the observation period. Based on these criteria, the study obtained 639 companies with a total of 3,195 firm-year observations. The dependent variable, increased audit completion time, was measured using a dummy variable, with a value of 1 if the audit completion period in the current year was longer than the previous year and 0 otherwise. Operational complexity was used as the independent variable, while fraud risk prediction was measured using the Beneish M-Score as a moderating variable. Auditor reputation, firm size, and industry type were included as control variables.

The data were analyzed using logistic regression with Moderated Regression Analysis (MRA) to examine the direct effect of operational complexity and the moderating effect of fraud risk prediction on increased audit completion time. The analysis was conducted using STATA 17. The logistic regression approach was selected because the dependent variable is measured as a binary outcome, indicating whether a company experienced an increase in audit completion time compared with the previous year. The moderation analysis was performed by incorporating the interaction term between operational complexity and fraud risk prediction to determine whether fraud risk indicators strengthen the relationship between operational complexity and audit completion time.

Result and Discussion

Diagnostic Test

Before testing the research hypotheses, diagnostic tests were conducted to evaluate the reliability of the logistic regression model. Since this study employs logistic regression with panel data characteristics, the diagnostic assessment focused on multicollinearity, heteroscedasticity, and autocorrelation. The results are presented in Table 1.

Table 1
Diagnostic Test Results

Test	Measurement	Result	Decision
Multicollinearity	Variance Inflation Factor (VIF)	VIF range = 1.00–1.11	No multicollinearity problem
Heteroscedasticity	Breusch–Pagan Test	Prob > Chi² = 0.021	Corrected using firm-clustered robust standard errors
Autocorrelation	Wooldridge Test	Prob > F = 0.995	No autocorrelation problem

Primary Data, 2026

The multicollinearity test indicates that all variables have VIF values below the recommended threshold of 10, confirming that there is no correlation problem among independent variables. The Breusch–Pagan test indicates the presence of heteroscedasticity; therefore, the regression estimation applies firm-clustered robust standard errors to obtain more reliable statistical inference. Meanwhile, the Wooldridge test confirms that the model does not experience autocorrelation problems.

Moderated Logistic Regression Results

The moderated logistic regression analysis was conducted to examine the effect of operational complexity on the probability of increased audit completion time and the moderating role of fraud risk prediction. The regression model includes operational complexity, fraud risk prediction, interaction between operational complexity and fraud risk prediction, and control variables consisting of auditor reputation, firm size, and industry type.

Table 2
Moderated Logistic Regression Results

Variable	Coefficient	Robust Standard Error	z-value	p-value
Operational Complexity	8.487	0.582	14.59	0.000
Fraud Risk Prediction	0.505	0.048	10.42	0.000
Operational Complexity × Fraud Risk Prediction	4.066	0.683	5.95	0.000
Auditor Reputation	-0.471	0.483	-0.98	0.329
Firm Size	0.073	0.026	2.79	0.005
Industry Type	-0.268	0.111	-2.41	0.016
Constant	-2.454			
Observations	3,195			
Prob > Chi²	0.000			
Pseudo R²	0.133			

Primary Data, 2026

The logistic regression equation is formulated as follows:

$$ln\frac{p}{1-p} = -2{,}454 + 8{,}487X + 0{,}505Z + 4{,}066X.Z - 0{,}471C_1 + 0{,}073C_2 - 0{,}268C_3 + e$$

The results indicate that operational complexity, fraud risk prediction, and the interaction between operational complexity and fraud risk prediction have positive and significant coefficients. These findings suggest that operational complexity increases the probability of longer audit completion time, while fraud risk prediction strengthens this relationship. Among the control variables, firm size has a positive and significant effect, while industry type has a negative and significant effect. Auditor reputation does not show a significant influence on increased audit completion time.

Model Evaluation

Pseudo R-Square
Because the study uses logistic regression, model explanatory power is evaluated using Pseudo R² rather than conventional R².

Table 3
Pseudo R-Square Result

Measurement	Value
Pseudo R^2	0.133

Primary Data, 2026

The Pseudo R^2 value of 0.133 indicates that the proposed model provides better explanatory power than the null model. This value reflects the improvement of model fit rather than the percentage of variance explained, as in linear regression.

Goodness of Fit Test

The Hosmer–Lemeshow test was conducted to evaluate whether the logistic regression model adequately represents the observed data.

Table 4
Goodness of Fit Test

Test	Prob > Chi^2
Hosmer–Lemeshow	0.389

Primary Data, 2026

The Hosmer–Lemeshow test yields a p-value of 0.389 (>0.05), indicating no significant difference between predicted and observed values. Therefore, the regression model demonstrates adequate goodness of fit.

Robustness Test

To confirm the consistency of the main findings, an additional robustness test was conducted using panel random-effect logistic regression. This approach considers the panel structure of the data and controls for unobserved firm-specific characteristics.

Table 5
Robustness Test Using Random-Effect Logistic Regression

Variable	Model 1 Coefficient	p-value	Model 2 Coefficient	p-value
Operational Complexity	8.593	0.000	8.574	0.000
Fraud Risk Prediction	0.511	0.000	0.510	0.000
Operational Complexity × Fraud Risk Prediction	4.114	0.000	4.102	0.000
Auditor Reputation	-	-	-0.491	0.345
Firm Size	-	-	0.073	0.005
Industry Type	-	-	-0.272	0.015
Observations	3,195		3,195	
Prob > Chi^2	0.000		0.000	

Primary Data, 2026

The robustness analysis confirms that the interaction between operational complexity and fraud risk prediction remains positive and significant after considering firm-specific effects and control variables. Therefore, the main findings remain consistent and robust.

Hypothesis Testing

The hypotheses were tested using the z-statistic and robust standard errors. The decision criteria were based on a significance level of 5%.

Table 6
Hypothesis Testing Results

Hypothesis	Relationship	Coefficient	z-value	p-value	Result
H1	Operational Complexity → Increased Audit Completion Time	8.487	14.59	0.000	Supported
H2	Operational Complexity × Fraud Risk Prediction → Increased Audit Completion Time	4.066	5.95	0.000	Supported

Primary Data, 2026

The results indicate that operational complexity has a positive and significant effect on the likelihood of increased audit completion time, supporting H1. Furthermore, the interaction between operational complexity and fraud risk prediction is positive and significant, indicating that fraud risk prediction strengthens the relationship between operational complexity and increased audit completion time. Therefore, H2 is supported.

The significance of both fraud risk prediction and its interaction term indicates that fraud risk prediction functions as a quasi-moderator, where the moderating variable influences both the dependent variable directly and the relationship between the independent and dependent variables.

Operational Complexity and Increased Audit Completion Time

The hypothesis testing results demonstrate that operational complexity has a positive and significant effect on the probability of increased audit completion time ($\beta = 8.487$; $p < 0.001$). Therefore, H1 is supported. This finding indicates that companies with more complex operational structures are more likely to experience longer audit completion periods compared with previous years.

This result supports Agency Theory, which explains that differences in information access between management (agent) and shareholders (principal) create information asymmetry (Jensen & Meckling, 1976). Operational complexity, characterized by multiple subsidiaries, diverse business segments, and broader geographical operations, increases information asymmetry because external parties face greater difficulty in monitoring managerial activities.

For auditors, complex operations increase audit scope and effort. Auditors must evaluate additional entities, examine intercompany transactions, assess consolidation procedures, and perform more extensive substantive testing. Consequently, the increased complexity of audit procedures requires additional time to obtain sufficient and appropriate audit evidence (Mahayani & Sisdyani, 2025).

The finding is consistent with previous studies showing that operational complexity increases audit report lag because complex organizational structures require broader audit procedures and greater audit effort (Adam et al., 2022; Khamisah et al., 2023; Naibaho & Dewanti, 2024; Azzahra & Nurcahyono, 2024). This study extends previous research by demonstrating that operational complexity not only affects absolute audit delay but also increases the probability of longer audit completion time compared with the previous period.

Fraud Risk Prediction as a Moderator between Operational Complexity and Increased Audit Completion Time

The results indicate that fraud risk prediction strengthens the relationship between operational complexity and increased audit completion time ($\beta = 4.066$; $p < 0.001$). Therefore, H2 is supported. The findings demonstrate that operational complexity has a stronger impact on audit completion time when companies exhibit higher fraud risk indicators.

According to Agency Theory, information asymmetry between managers and shareholders creates opportunities for opportunistic behavior, including financial statement manipulation. This risk becomes more significant when companies have complex operational structures because monitoring and verification become more difficult. Fraud risk prediction measured using the Beneish M-Score provides additional information regarding potential financial statement manipulation, allowing auditors to identify higher-risk areas.

When operational complexity is accompanied by higher fraud risk indicators, auditors are expected to increase professional skepticism and expand audit procedures. Additional procedures such as extended substantive testing, transaction verification, and deeper evaluation of financial statement accounts require more time, resulting in longer audit completion periods (Shahab et al., 2023).

This finding contributes to previous audit delay literature by introducing fraud risk prediction as a moderating mechanism. Previous studies primarily examined operational complexity as a direct determinant of audit delay, whereas this study demonstrates that the effect of operational complexity becomes stronger under conditions of

higher fraud risk. The result is also consistent with Adoboe-Mensah et al. (2023), who highlighted the usefulness of the Beneish M-Score in identifying potential financial statement manipulation and supporting audit risk assessment.

Conclusion

This study examines the effect of operational complexity on the likelihood of increased audit completion time and investigates the moderating role of fraud risk prediction in this relationship. The findings provide empirical evidence that operational complexity is an important determinant of audit completion time, where companies with more complex operational structures tend to experience longer audit completion periods. Furthermore, fraud risk prediction strengthens the relationship between operational complexity and increased audit completion time, indicating that operational complexity accompanied by higher fraud risk indicators creates greater audit challenges and requires more extensive audit procedures.

This study contributes to the auditing literature by introducing fraud risk prediction as a moderating mechanism in explaining the relationship between operational complexity and audit completion time. Unlike previous studies that primarily examine operational complexity as a direct determinant of audit delay, this research demonstrates that the effect of operational complexity depends on the level of potential financial statement manipulation risk. The findings support Agency Theory by showing that increased information asymmetry arising from complex operations and potential fraud risks requires stronger auditor monitoring efforts. Therefore, audit completion time is not only determined by the complexity of company operations but also by the level of risk associated with the reliability of financial reporting.

Managerial Implications

The findings provide practical implications for company management, auditors, and regulators. For company management, operational complexity should be accompanied by stronger internal control systems, effective financial reporting processes, and adequate documentation mechanisms to reduce audit difficulties. Companies with multiple subsidiaries, diverse business segments, or extensive operational activities should anticipate longer audit processes by improving coordination between business units and ensuring the availability of audit evidence before the audit period begins. Furthermore, management should strengthen fraud prevention and detection mechanisms because potential fraud indicators may increase auditor skepticism and extend audit procedures.

For auditors and regulators, the results highlight the importance of incorporating operational complexity and fraud risk indicators into audit planning and risk assessment processes. Auditors should consider the Beneish M-Score or similar analytical tools as additional information to identify potential financial reporting risks, particularly in companies with complex operational structures. Regulators may also encourage listed companies to improve transparency, internal governance, and risk management practices to support timely financial reporting. By integrating operational complexity assessment and fraud risk prediction into audit strategies, audit effectiveness can be improved while maintaining the reliability and timeliness of financial information.

References

Adam, W. B., Purnamasari, P., & Hartanto, R. (2022). Pengaruh kondisi keuangan, kompleksitas operasi dan umur perusahaan terhadap audit report lag. *Jurnal Riset Akuntansi, 2*(2), 143–152.

Adoboe-Mensah, N., Salia, H., & Addo, E. B. (2023). Using the Beneish M-score model to detect financial statement fraud in the microfinance industry in Ghana. *International Journal of Economics and Financial Issues, 13*(4), 47–57.

Ashton, R. H., Graul, P. R., & Newton, E. (1989). Audit delay and the timeliness of corporate reporting. *Contemporary Accounting Research, 5*(2), 657–673.

Azzahra, N., & Nurcahyono, N. (2024). The influence of auditor characteristics on audit report lag in property and real estate sector companies. *Economics and Business International Conference Proceeding,1*(2), 348–361.

Beneish, M. D. (1999). The detection of earnings manipulation. *Financial Analysts Journal, 55*(5), 24–36.

Fitria, S., Widianingsih, R., Purwati, A. S., Restianto, Y. E., & Sunarmo, A. (2022). The effect of audit committee characteristics, operating complexity, and company age on audit report lag. *International Students' Conference on Accounting & Business*, 14, 66–78.

Habib, A. (2011). Audit firm industry specialization and audit outcomes: Insights from academic literature. *Research in Accounting Regulation*, *23*(2), 114-129. https://doi.org/10.1016/j.racreg.2011.06.008

Hosmer Jr, D. W., Lemeshow, S., & Sturdivant, R. X. (2013). *Applied logistic regression*. John Wiley & Sons.

Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics, 3*(4), 305–360.

Khamisah, N., Nurullah, A., & Kesuma, N. (2023). Pengaruh agresivitas penghindaran pajak, kompleksitas operasi perusahaan, audit fee, dan financial distress terhadap audit report lag. *Reviu Akuntansi dan Bisnis Indonesia, 7*(1), 232–247.

Mahayani, N. K. R., & Sisdyani, E. A. (2025). Fraud hexagon indicators and audit committee in detecting financial statement fraud. *International Journal of Business, Economics and Management*, *8*(3), 214-228. https://doi.org/10.21744/ijbem.v8n3.2422

Naibaho, E. A., & Dewanti. (2024). The Effect of Firm Performance, Financial Distress, and Operational Complexity on Audit Report Lag with Corporate Governance Mechanism and Audit Quality as Moderation. In *Proceedings of the International Conference on Entrepreneurship (IConEnt)* (Vol. 4, pp. 37-52).

Napisah, N., & Soeparyono, R. D. (2024). Pengaruh financial distress, kompleksitas operasi dan auditor switching terhadap audit report lag dengan ukuran perusahaan sebagai pemoderasi. *Owner: Riset dan Jurnal Akuntansi*, *8*(3), 2546-2564.

Shahab, Y., Tianzi, W., Hussain, T., & Kumar, S. (2023). Foreign experience and audit report lag. *Finance Research Letters*, *57*, 104239. https://doi.org/10.1016/j.frl.2023.104239

Soltani, B. (2002). Timeliness of corporate and audit reports: Some empirical evidence in the French context. *The International Journal of Accounting*, *37*(2), 215-246. https://doi.org/10.1016/S0020-7063(02)00152-8