Mitigating Financial Statement Fraud through Fraud Heptagon, Digital Forensics, and Risk Management: Evidence from Indonesia's State Owned Enterprises

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Abstract

Financial statement fraud poses a critical threat to organizational integrity and stakeholder trust worldwide, particularly in state-owned enterprises (SOEs) where public accountability is paramount. This study investigates how the Fraud Heptagon framework, digital forensics, and risk management practices mitigate financial statement fraud, providing insights relevant for both national and international contexts. A mixed-methods approach was adopted, combining quantitative analysis of 116 firm-year observations from 68 SOEs listed on the Indonesia Stock Exchange during 2020–2024 with qualitative data from semi-structured interviews with auditors, risk officers, and forensic specialists. The quantitative results reveal that the integrated Fraud Heptagon dimensions, including greed, opportunity, pressure, rationalization, capability, arrogance, and collusion, significantly drive financial statement fraud, while digital forensic tools and risk management mechanisms effectively moderate these effects. Qualitative findings emphasize that systemic pressures, operational demands, and institutional weaknesses foster fraudulent behaviors, whereas technological and risk-based interventions enhance detection, transparency, and organizational accountability. This study underscores that financial statement fraud is primarily a systemic phenomenon rather than an outcome of isolated individual misconduct, highlighting the necessity of integrating behavioral frameworks with technological enforcement and structured governance. By applying the Fraud Heptagon alongside digital forensics and risk management, organizations can implement a comprehensive fraud prevention strategy. The results offer valuable implications for policymakers, regulators, and corporate governance bodies globally, emphasizing-ing the importance of robust fraud detection, prevention mechanisms, and transparency to safeguard financial reporting integrity in public and private sectors.

Keywords: *Financial Statement Fraud; Fraud Heptagon; Digital Forensics; Risk Management; Fraud Detection.*

1. Introduction

Financial statement fraud poses a serious threat to organizational accountability and investor trust, particularly within state-owned enterprises (SOEs) where public confidence is fundamental. When fraud is exposed by regulatory or supervisory authorities, it often triggers negative market reactions such as declining stock prices and heightened volatility, ultimately undermining both market stability and corporate credibility. (Kaur et al., 2023; Lee & Ha, 2021; Shi et al., 2017; Wang et al., 2017). The responsibility for detecting fraud primarily rests on auditors, as emphasized by International Auditing Standard (ISA) 240, which highlights the need for active collaboration between management and auditors in preventing and uncovering fraudulent activities. (Hassan et al., 2023; Rostami & Rezaei, 2022).

The auditor's role has become increasingly critical in light of complex financial transactions and evolving regulatory frameworks. Beyond ensuring compliance, auditors contribute to safeguarding financial integrity and sustaining investor confidence by applying professional skepticism and proactive measures in fraud detection. Auditor competence, independence, and experience are consistently identified as determinants of effective fraud detection. Furthermore, internal audits serve as an additional line of defense, identifying weaknesses in internal controls, reinforcing ethical practices, and strengthening corporate governance structures. (Halbouni et al., 2016). Nevertheless, a persistent expectation gap remains between stakeholders who often assume auditors provide absolute assurance that financial statements are free from fraud and auditors themselves, who define their role as offering reasonable assurance. This gap becomes particularly evident when significant fraud goes undetected. (Hassan et al., 2023; Lefina Boboy et al., 2022; Nasir et al., 2019; Ningsih & Syarief, 2022; Sumbari et al., 2023).

While prior studies have explored fraud detection from various perspectives, such as auditor competence, independence, and psychological factors Rahmatika et al., 2019; Triyanto, 2019), or the role of internal controls in reducing violations Husnawati et al., 2017), Mandal &
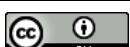
Amilan (2023) highlight that the existing literature on fraud detection remains fragmented. Most studies tend to isolate behavioral, technological, or governance aspects without offering a unified theoretical and operational approach. For instance, research on forensic technology often emphasizes detection tools and digital evidence collection but overlooks their integration with established fraud theories or enterprise risk management frameworks. Similarly, studies grounded in the Fraud Triangle (Cressey, 1953), Fraud Diamond (Wolfe & Hermanson, 2004), Fraud Pentagon (Howarth, 2012), and (Vousinas, 2019) have significantly advanced the understanding of fraud drivers, yet they frequently neglect the dimensions of greed and collusion, which are increasingly prevalent in complex financial statement frauds.

This study addresses these theoretical and empirical gaps by proposing an integrated fraud mitigation model. First, it adopts the Fraud Heptagon framework, which extends prior models by explicitly incorporating greed and collusion, offering a more comprehensive understanding of fraud risk in financial reporting. Second, it examines the role of digital forensics as an operational bridge linking theoretical fraud risk factors to practical detection mechanisms through advanced anomaly detection, pattern recognition, and electronic evidence tracing. Third, it integrates risk management practices to promote organizational resilience and proactive fraud prevention, rather than relying solely on external audits or regulatory oversight.

To provide a balanced synthesis, this study also acknowledges the emergence of machine learning–based fraud detection models, which use predictive analytics and big data to identify irregularities beyond human cognitive limitations. While such approaches enhance detection accuracy, they often lack the theoretical grounding in behavioral and organizational fraud constructs that the Fraud Heptagon offers. Thus, the novelty of this research lies in its holistic integration of behavioral, technological, and managerial dimensions of fraud prevention. Focusing on Indonesia's state-owned enterprises (SOEs), the study contributes both theoretically and practically by offering insights into how the integration of the Fraud Heptagon, digital forensics, and risk management can enhance fraud mitigation strategies and strengthen financial reporting integrity in organizations with high public accountability and strategic economic significance.

2. Theoretical Framework and Hypotheses Development

2.1. Fraud heptagon

The Fraud Heptagon theory is an extension of previous fraud models, such as the Fraud Triangle. (Cressey, 1953), Fraud Diamond (Wolfe & Hermanson, 2004), and Fraud Pentagon (Howarth, 2012). (Vousinas, 2019) Advance this framework into the Fraud Hexagon by adding collusion as the sixth dimension. Building on this, the Fraud Heptagon incorporates an additional element, lack of competence, to capture the institutional and managerial weaknesses that often enable fraudulent practices in organizations, particularly in state-owned enterprises (SOEs).

This model is widely recognized through the S.C.C.O.R.E framework, which comprises: (1) Stimulus, referring to external or internal pressures such as financial targets or budget constraints that drive fraudulent intent; (2) Capability, reflecting individual traits and authority that facilitate fraudulent actions; (3) Collusion, denoting cooperation between two or more parties to conceal fraud; (4) Opportunity, arising from weak controls or governance gaps; (5) Rationalization, where individuals justify fraudulent actions as acceptable; (6) Ego (Arrogance), highlighting excessive self-confidence and dominance that disregard organizational rules; and (7) Lack of Competence, emphasizing the role of poor managerial skills, weak internal controls, or inadequate oversight in fostering fraud risks.

By capturing these seven interrelated dimensions, the Fraud Heptagon provides a more comprehensive framework for explaining the complex dynamics of financial statement fraud in SOEs. This theoretical lens also serves as the basis for integrating digital forensics and risk management mechanisms as mitigating factors in the present study.

2.2. Fraud heptagon and financial statement fraud

The Fraud Heptagon theory integrates seven determinants of fraud: greed, opportunity, pressure, rationalization, capability, arrogance, and collusion. These dimensions offer a more comprehensive explanation than the traditional fraud triangle or fraud diamond, as they incorporate both behavioral and organizational perspectives. (Wulandari & Maulana, 2022; Yusrianti et al., 2020). Empirical evidence suggests that greed and pressure drive individuals to financial statement fraud, while opportunity and collusion stem from weak internal controls and ineffective governance. (Lastanti et al., 2022). Meanwhile, rationalization and arrogance allow perpetrators to justify misconduct and underestimate regulatory enforcement. (Arizanda Rahayu et al., 2024; Rohmatin et al., 2021). Capability reflects technical knowledge and access to resources, which enable fraud schemes to remain undetected for longer periods. (Ibrani et al., 2019; Lastanti, 2020).

Prior studies highlight that in state-owned enterprises (SOEs), where political pressure, complex governance, and conflicting objectives exist, the Fraud Heptagon framework is particularly relevant. (Handoko et al., 2022; Handoko & Angelyca, 2023). However, most research has analyzed each dimension separately, while only a few treat the Fraud Heptagon as a higher-order construct capturing multidimensional drivers of fraud. This study addresses that gap by conceptualizing the Fraud Heptagon as an integrated determinant of financial statement fraud in SOEs.

H1: The Fraud Heptagon has a significant positive effect on financial statement fraud in SOEs.

2.3. Fraud heptagon and digital forensics

Digital forensics refers to the application of specialized investigative tools and techniques to collect, preserve, and analyze electronic evidence in financial reporting. (Monteiro et al., 2021). In auditing, digital forensics strengthens fraud detection by identifying anomalies, hidden transactions, and manipulation trails. (Hermiyetti, 2022; Kamal et al., 2016). Recent studies confirm that digital forensic tools, such as forensic data analytics and continuous auditing systems, significantly reduce the opportunity and capability dimensions of the Fraud Heptagon by limiting the ability of perpetrators to conceal misconduct. (Achmad et al., 2023; Evana et al., 2019; Fitriyah & Novita, 2021). Nonetheless, while the adoption of digital forensics is increasing in private companies, its integration into SOEs remains underexplored. Research gaps indicate a limited understanding of how digital forensics moderates behavioral fraud drivers, particularly in environments where collusion and arrogance are embedded in organizational culture. By strengthening evidence-based oversight, digital forensics is expected to mitigate the positive influence of Fraud Heptagon factors on financial statement fraud.

H2: Digital forensics weakens the positive effect of the Fraud Heptagon on financial statement fraud in SOEs.

2.4. Fraud heptagon and risk management

Risk management encompasses systematic processes to identify, evaluate, and mitigate potential risks, including financial statement fraud. Effective risk management frameworks, such as those guided by COSO, integrate internal controls, enterprise risk assessment, and monitoring activities that reduce fraud opportunities. (Andalia et al., 2021; Sawaka K., 2020; Thamlim & Reskino, 2023). In SOEs, risk management is not only a compliance requirement but also a mechanism to ensure accountability to multiple stakeholders, including the public. (Al-Shaer, 2020; Mangala & Soni, 2023).

Empirical evidence shows that organizations with strong risk governance reduce the rationalization and collusion dimensions of fraud, since clear policies and ethical guidelines limit the justification for misconduct. (Lastanti et al., 2022; Nugroho & Diyanty, 2022; Sari & Nugroho, 2021). Furthermore, robust risk management discourages arrogance by imposing transparency and accountability pressures on executives. (Gupta & Gupta, 2015). However, there is still limited empirical research investigating risk management as a moderating factor that directly interacts with behavioral fraud antecedents.

H3: Risk management weakens the positive effect of the Fraud Heptagon on financial statement fraud in SOEs.

3. Research Methodology

This study employs a mixed-methods approach that integrates both quantitative and qualitative techniques to examine how the Fraud Heptagon framework, digital forensics, and risk management contribute to mitigating financial statement fraud in Indonesia's state-owned enterprises (SOEs). Quantitative data were derived from secondary sources, including audit reports, annual financial disclosures, and policy documents of SOEs, while qualitative insights were obtained through semi-structured interviews with auditors, risk officers, and forensic specialists. The combination of methods allows for a comprehensive investigation, ensuring both empirical robustness and contextual depth in understanding fraud mitigation mechanisms.

3.1. Population and sample

The research population consists of State-Owned Enterprises (SOEs) listed on the official government website (bumn.go.id/portfolio/cluster) for the period 2020–2024. Out of 68 enterprises, purposive sampling was employed based on three selection criteria: (1) firms included in the non-financial cluster, (2) availability of complete annual reports, and (3) disclosure of data relevant to fraud-related variables. The sample selection process in this study applied a purposive sampling method to ensure that the selected SOEs met the analytical and data completeness criteria required for empirical testing.

Based on Table 1, Purposive Sampling Criteria, the initial population comprised 68 SOEs listed on the Indonesia Stock Exchange (IDX) during the 2020–2024 observation period. To maintain methodological consistency and ensure comparability across firms, several exclusions were applied. Banking SOEs were excluded due to their unique operational characteristics, specific regulatory frameworks, and distinct financial reporting standards, which differ substantially from non-financial enterprises. In addition, companies with incomplete financial information required for calculating the Beneish M-Score were eliminated to minimize measurement bias and preserve the validity of fraud detection indicators. After applying these exclusion criteria, 48 SOEs were retained as the final sample, producing 116 firm-year observations over the five-year research period. This selection yielded a robust and representative dataset for analyzing financial reporting behavior and identifying potential indicators of fraudulent financial activities within Indonesia's state-owned enterprises.

To complement the quantitative analysis, qualitative data were collected through semi-structured interviews with eight experts comprising four internal auditors, two risk management officers, and two officials from supervisory and regulatory institutions overseeing SOE governance. The informants were purposefully selected to ensure relevance, experience, and professional competence in fraud examination, internal audit, and corporate governance practices. Each interview lasted approximately 45–90 minutes and was conducted either face-to-face or through secure online meetings. The interview guide focused on exploring how digital forensics and risk management mechanisms are applied in fraud detection, prevention, and response within SOEs.

The qualitative data were analyzed using thematic analysis, following Braun and Clarke's (2006) six-phase approach: (1) familiarization with the data, (2) generating initial codes, (3) searching for themes, (4) reviewing themes, (5) defining and naming themes, and (6) producing the final report. To strengthen transparency and replicability, the analysis process involved data triangulation by comparing interview insights with annual reports, audit committee disclosures, and internal control documentation to ensure consistency and validate emerging themes.

Table 1: Purposive Sampling Criteria

No	Description	Total
1	All State-Owned Enterprises (SOEs) listed on the Indonesia Stock Exchange (IDX) during 2020–2024	68
2	Excluded: Banking SOEs and firms without complete data for M-Score calculation	(20)
3	Final SOEs sample	48
4	Research period (years)	5
	Total research data (firm-years)	116

Source: Results of secondary data processing, 2025.

3.2. Data collection procedures

Data collection relied primarily on secondary information obtained through official SOE portals and corporate annual reports. The qualitative strand involved semi-structured interviews designed to explore perceptions regarding fraud risk, the implementation of digital forensic techniques, and the effectiveness of governance mechanisms. To enhance the validity of findings, data triangulation was applied, combining statistical results with expert perspectives for a more reliable and nuanced interpretation.

3.3. Variable operational definition

Operationally, financial statement fraud was designated as the dependent variable and measured using the Fraud Score Model (F-Score) developed by (Dechow et al., 2011). The model incorporates two dimensions: accrual quality, represented by RSST Accrual, and financial performance, measured through changes in receivables, inventories, cash sales, and earnings.

The Fraud Heptagon construct served as the central independent variable, represented by seven dimensions. Stimulus/pressure was proxied by Return on Assets (ROA). (Skousen et al., 2008). Opportunity was captured through ineffective monitoring, measured as the proportion of independent commissioners. (Sari & Nugroho, 2020). Rationalization was proxied by the ratio of related-party transactions to total revenue, as such transactions often justify opportunistic behavior under the guise of business necessity or efficiency. (Ibrani et al., 2019; Syahria, 2019). This proxy reflects managerial attempts to legitimize questionable transactions through formal or structural explanations. To strengthen this operationalization, the study also considers the presence of auditors' notes or disclosures explaining related-party transactions as supplementary qualitative indicators of rationalization. Capability was measured through the CEO's educational background, represented by a dummy variable (1 for a master's degree or higher, 0 otherwise) (Widnyana & Widyawati, 2022). This measure assumes that higher education equips executives with greater analytical and managerial capacity, thereby influencing their ability to design and conceal complex fraudulent schemes. However, given the multifaceted nature of capability, future studies may complement this indicator with additional variables, such as the CEO's tenure, professional certification (e.g., CPA), or prior experience in financial management, to capture a more comprehensive construct of individual capability. Ego or arrogance was operationalized through the frequency of CEO photographs in annual reports (Howarth, 2011). The visibility and prominence of executive imagery have been linked to narcissistic traits and self-enhancing tendencies, which may lead to overconfidence and risk-taking behavior. To provide a more robust assessment, this indicator can be supplemented with narrative analysis of CEO statements or the tone of annual report messages to identify linguistic markers of arrogance or self-importance. Collusion was assessed by the ratio of politically connected commissioners to the total number of commissioners. (Nugroho & Diyanty, 2022).

This proxy captures the potential for network-based alliances that may weaken governance independence and facilitate the concealment of irregularities. The inclusion of this measure aligns with prior research highlighting that political ties often reduce the effectiveness of board oversight and increase the tolerance for unethical practices.

Lack of competence was proxied by the presence of reported material weaknesses in internal control disclosures, which reflect the inability of management to design and maintain effective control systems. This indicator is consistent with the notion that internal control deficiencies indicate not only organizational vulnerability but also managerial incompetence that can indirectly enable fraudulent activities.

Furthermore, two moderating variables were incorporated to examine the mechanisms of fraud mitigation. Digital forensics was proxied by the presence and utilization of forensic audit procedures documented in SOE audit reports, representing the organization's capability to detect and analyze anomalies using data-driven techniques. Meanwhile, risk management was measured by the proportion of audit committee members possessing financial or accounting expertise, serving as a proxy for the committee's ability to identify, assess, and mitigate potential fraud risks through informed oversight and internal control monitoring. (Buallay & Al-Ajmi, 2019).

Table 2: Measurement of Variables

Variables	Measurements	Source
Pressure (PRS)	Measured using Leverage Ratio = Total Liabilities / Total Assets	(Handoko & Angelyca, 2023)
Opportunity (OPT)	Measured using the Independent Board of Commissioners, Ratio = (Independent Commissioners / Total Commissioners)	(Mohamed Yusof, 2016)
Rationalization (RTZ)	Measured using a dummy variable: 1 = auditor change occurred during 2019–2022, 0 = otherwise	(Mohamed Yusof, 2016)
Capability (CP)	Measured using a dummy variable: 1 = change of directors during 2019–2022, 0 = otherwise	(Mohamed Yusof, 2016)
Arrogance (ARG)	Measured by the frequency of CEO's photos in the annual reports during 2019–2022	(Mohamed Yusof, 2016)
Ignorance (IG)	Measured using Corporate Governance Courses for Executive and Non-Executive Directors = Total Number of CG Training Programs Attended	(Mohamed Yusof, 2016)
Greed (GR)	Measured using Executive Directors' Remuneration Ratio = Total Executive Compensation / Net Sales	(Mohamed Yusof, 2016)
Digital Forensics (DF)	Measured using the extent of forensic technology adoption, proxied by disclosure of IT-based fraud detection tools in annual/sustainability reports	(Daraojimba et al., 2023)
Risk Management (RM)	Measured using the Enterprise Risk Management (ERM) Index, proxied by the disclosure score of risk oversight, risk committee, and risk mapping in annual reports	(Putra et al., 2022)

Source: Results of secondary data processing, 2025.

Based on Table 2, this study operationalizes the variables in the Fraud Heptagon framework along with the moderating roles of Digital Forensics (DF) and Risk Management (RM). Each construct was measured using well-established proxies adapted from prior empirical studies to ensure validity and comparability. The Pressure variable (PRS) represents the level of financial strain faced by a firm and is measured using the leverage ratio, calculated as total liabilities divided by total assets. (Handoko & Angelyca, 2023). A higher leverage ratio indicates greater external pressure to meet debt obligations, which may increase the likelihood of fraudulent reporting. The Opportunity variable (OPT) captures the extent to which a firm's governance structure allows room for unethical behavior, proxied by the ratio of independent commissioners to total commissioners. (Mohamed Yusof, 2016). A lower ratio implies weaker oversight and thus a higher potential for fraud opportunities.

The Rationalization variable (RTZ) reflects the management's justification for unethical practices and is measured using a dummy variable, where a value of 1 indicates that an auditor change occurred during 2019–2022, and 0 otherwise. (Mohamed Yusof, 2016). Frequent auditor turnover may signal management's attempt to influence audit outcomes or conceal irregularities. Similarly, Capability (CP) is measured through a dummy variable coded as 1 if there was a change in directors during 2019–2022, and 0 otherwise. This indicator reflects the management's ability and authority to manipulate financial statements. (Mohamed Yusof, 2016).

The Arrogance variable (ARG) captures ego-driven behavior or dominance tendencies of top executives, measured by counting the number of times the CEO's photo appears in the firm's annual report. (Mohamed Yusof, 2016). Excessive self-portrayal may imply a lack of humility and overconfidence in leadership, potentially associated with higher fraud risk. The Ignorance variable (IG) represents a lack of awareness or disregard for ethical and governance principles and is measured using the number of corporate governance training programs attended by executive and non-executive directors. (Mohamed Yusof, 2016). A lower frequency of participation in governance training suggests weaker ethical awareness within the organization. Meanwhile, Greed (GR) is measured through the ratio of total executive compensation to net sales, reflecting the extent to which managerial remuneration is disproportionate to firm performance. (Mohamed Yusof, 2016). Excessive compensation may indicate opportunistic behavior that motivates the manipulation of financial outcomes.

Furthermore, two moderating variables, Digital Forensics (DF) and Risk Management (RM), were included to examine their mitigating roles in fraud detection and prevention. Digital Forensics is proxied by the extent of forensic technology adoption, measured through disclosures of IT-based fraud detection tools in annual or sustainability reports. (Daraojimba et al., 2023). This indicator reflects the organization's technological readiness to detect, trace, and prevent fraudulent activities. Risk Management, on the other hand, is measured using the Enterprise Risk Management (ERM) Index, proxied by the disclosure score of risk oversight, the presence of a risk committee, and the comprehensiveness of risk mapping in the firm's annual reports. (I. Putra et al., 2022). A higher ERM disclosure score indicates stronger internal risk control and a proactive approach to fraud prevention.

Overall, the measurement design presented in Table 2 ensures conceptual alignment between the theoretical framework and empirical indicators, enabling a robust assessment of how fraud-related factors and organizational control mechanisms interact within Indonesia's State-Owned Enterprises.

3.4. Data collection procedures

Data analysis was carried out using Partial Least Squares–Structural Equation Modeling (PLS-SEM) with WarpPLS 8.0, which is particularly suited for analyzing complex relationships among latent constructs and handling small to medium sample sizes. Measurement models were tested for validity and reliability using composite reliability, average variance extracted (AVE), and heterotrait-monotrait (HTMT) ratios. Structural testing was then applied to assess both direct effects of the Fraud Heptagon dimensions on financial statement fraud and the moderating roles of digital forensics and risk management. Complementary qualitative data from interviews were analyzed thematically, providing explanatory depth to the quantitative results and offering insights into practical applications of fraud mitigation strategies in the SOE context.

Table 3: Descriptive Statistics

Variable	N	Mean	SD	Min	Max
Financial Statement Fraud (FSF)	116	0.16	0.37	0	1
Pressure (PRS)	116	0.57	0.28	0.10	0.90
Opportunity (OPT)	116	0.42	0.20	0.30	1.40
Rationalization (RTZ)	116	0.07	0.27	0	1
Capability (CP)	116	0.45	0.50	0	1
Arrogance (ARG)	116	7.15	2.28	3	12
Ignorance (IG)	116	12.5	8.65	0.75	35.8
Greed (GR)	116	0.07	0.23	0.10	1.15
Digital Forensics (DF)	116	0.52	0.50	0	1
Risk Management (RM)	116	3.15	1.02	1	5

Source: Results of secondary data processing, 2025.

Based on Table 3, the descriptive statistics provide an overview of the central tendency and variability of all variables used in this study, comprising 116 firm-year observations from State-Owned Enterprises (SOEs) during the 2020–2024 period. The dependent variable, financial statement fraud (FSF), exhibits a mean value of 0.16 with a standard deviation of 0.37, indicating that while the overall occurrence of fraud-related financial misstatements is relatively low, variation across firms remains notable. The minimum and maximum values of 0 and 1 reflect the binary nature of the Beneish M-Score classification used to identify potential fraudulent reporting.

Among the Fraud Heptagon dimensions, Pressure (PRS) records a mean of 0.57 and a standard deviation of 0.28, suggesting moderate leverage levels across the sampled firms, implying that financial strain may influence managerial decision-making. The Opportunity (OPT) variable, proxied by the proportion of independent commissioners, has an average of 0.42 with a standard deviation of 0.20, reflecting variations in board independence and oversight mechanisms among SOEs. Rationalization (RTZ) and Capability (CP) show mean values of 0.07 and 0.45, respectively, indicating that auditor changes are relatively infrequent, whereas director changes occur more commonly, which could influence governance continuity and accountability.

The Arrogance (ARG) variable, measured by the number of CEO photographs in annual reports, has a mean of 7.15 and a standard deviation of 2.28, with values ranging from 3 to 12, suggesting substantial differences in self-representation and leadership visibility across firms. Ignorance (IG), representing the extent of corporate governance training, demonstrates a mean of 12.5 and a relatively high standard deviation of 8.65, indicating disparities in the commitment to ethical training and governance awareness. Meanwhile, Greed (GR) shows a mean of 0.07 with a standard deviation of 0.23, reflecting that, on average, executive remuneration remains proportionate to firm sales, though some firms display significantly higher compensation ratios.

For the moderating variables, Digital Forensics (DF) has a mean value of 0.52 with a standard deviation of 0.50, implying that approximately half of the sampled enterprises disclose the use of IT-based fraud detection tools, while the rest show limited adoption of digital forensic mechanisms. Risk Management (RM) records a mean score of 3.15 (SD = 1.02), ranging between 1 and 5, signifying moderate to high levels of Enterprise Risk Management (ERM) implementation across SOEs. Overall, the descriptive results indicate considerable variability among firms in both fraud risk factors and governance-related practices, justifying the application of multivariate analysis to explore the interactions and moderating effects proposed in this study.

4. Data Analysis and Discussion

4.1. Data analysis

Descriptive statistical analysis was performed to examine the characteristics and distribution of the data, including the minimum, maximum, mean, and standard deviation for all study variables. The dependent variable in this study is Financial Statement Fraud, capability, arrogance, ignorance, and greed. The descriptive analysis aims to provide a clear depiction of the data and highlight potential variability across observations, which is crucial for understanding the risk of financial statement fraud. (Mukhtaruddin et al., 2020).

A comparison between the mean and standard deviation values indicates the level of homogeneity or heterogeneity in the dataset. Specifically, a standard deviation smaller than the mean suggests a relatively homogeneous distribution, while a larger standard deviation implies significant variation among cases. Table 3 presents the descriptive statistics of the study variables.

Based on the results, pressure exhibits a moderate effect on FFR, with variation across firms, reflecting the operational and psychological strain faced by SOEs. Opportunity shows a moderate influence, whereas rationalization and greed appear relatively low in their contribution

to financial statement fraud. Capability and ignorance present moderate effects with considerable variability, suggesting that these factors are context-dependent. Arrogance demonstrates a moderate effect with noticeable differences among observations. Overall, corporate governance mechanisms contribute to reducing FFR risk, as indicated by an acceptable average level, although variability exists across cases. These descriptive insights provide a foundational understanding of the risk landscape and highlight areas requiring governance or technological interventions.

The model fit and quality assessment in Table 4 confirm that the structural model employed in this study is suitable for analyzing the relationships among the variables. The Average Path Coefficient (A.P.C.) is 0.072 and significant at $P \leq 0.05$, indicating that the proposed causal paths are meaningful. The Average R-Squared (A.R.S.) of 0.038 and Average Adjusted R-Squared of 0.192 suggest a moderate explanatory power of the independent variables, consistent with expectations in behavioral and organizational studies. Collinearity diagnostics, reflected in the Average Block VIF (3.012) and Average Full Collinearity VIF (3.215), demonstrate no multicollinearity issues, ensuring reliable estimation of the model coefficients.

The Tenenhaus GoF value of 0.478 indicates a large model fit, confirming the overall explanatory capacity of the model. Other indices, including the Simpson's Paradox Ratio (0.801), R-Squared Nonlinear Contribution Index (0.958), Statistical Suppression Ratio (0.372), and Bivariate Causality Direction Ratio (0.987), collectively validate the robustness of the structural model. These results imply that both direct and indirect causal relationships among exogenous and endogenous variables are adequately captured, supporting further hypothesis testing.

In summary, the descriptive and model fit analyses demonstrate that pressure, capability, and ignorance are critical factors influencing FFR in Indonesian SOEs, while corporate governance mechanisms partially mitigate these risks. The validated model provides a reliable framework for integrating Fraud Heptagon factors with digital forensics and risk management practices to effectively predict and prevent financial statement fraud.

Table 4: Results of Model Fit Test

Model Fit and Quality Criteria	Results	Reference/Threshold	Assessment
Average Path Coefficient (A.P.C.)	0.072	$P \leq 0.05$	Meet the Criteria
Average R-Squared (A.R.S.)	0.038	Small ≥ 0.1, Medium ≥ 0.25, Large ≥ 0.36	Fit Model
Average Adjusted R-Squared	0.192	Small ≥ 0.1, Medium ≥ 0.25, Large ≥ 0.36	Medium
Average Block Variance Inflation Factor (A.V.I.F.)	3.012	≤ 5, ideally ≤ 3.3	Fit Model
Average Full Collinearity V.I.F. (A.F.V.I.F.)	3.215	≤ 5, ideally ≤ 3.4	Fit Model
Tenenhaus GoF (GoF)	0.478	Small ≥ 0.1, Medium ≥ 0.25, Large ≥ 0.36	Large
Simpson's Paradox Ratio (S.P.R.)	0.801	Acceptable if ≥ 0.7	Fit Model
R-Squared Nonlinear Contribution Index (R.S.C.R.)	0.958	Acceptable if ≥ 0.9, ideally $= 1$	Fit Model
Statistical Suppression Ratio (S.S.R.)	0.372	Acceptable if ≥ 0.7	Fit Model
Bivariate Causality Direction Ratio (N.L.B.C.D.R.)	0.987	Acceptable if ≥ 0.7	Fit Model

Source: Data calculations with WarpPLS 8.0.

4.1. Discussion

The empirical findings of this study provide a comprehensive understanding of fraudulent financial statement behavior in Indonesia's State-Owned Enterprises (SOEs) by integrating the Fraud Heptagon framework with digital forensics and risk management practices. This mixed-method research combines quantitative data analysis with qualitative insights from in-depth interviews with key stakeholders, including internal auditors, SOE executives, and members of oversight committees, offering a richer and more nuanced understanding of the drivers and mitigation mechanisms of financial statement fraud (FFR).

The analysis confirms that the Fraud Heptagon has a significant positive effect on financial statement fraud in SOEs (H1, $\beta = 0.254$; $p = 0.012$). This demonstrates that the seven dimensions greed, opportunity, pressure, rationalization, capability, arrogance, and collusio interact synergistically to influence financial statement fraud. Among these, financial pressure emerges as the most prominent driver, corroborating prior studies in both public and private sectors. (Ghaisani et al., 2022; Pamungkas & Utomo, 2018; A. N. Putra & Dinarjito, 2021). The mixed-method approach revealed that interviewees consistently cited performance-related incentives, government-set financial targets, and politically influenced operational demands as primary triggers for manipulation. One senior internal auditor noted: "When achieving the target directly impacts bonuses and political evaluations, managers feel compelled to adjust the numbers to meet expectations." This highlights the systemic nature of fraud in SOEs, where institutional and behavioral pressures dominate over individual rationalization or skill.

Interestingly, the proxies for opportunity, rationalization, and capability did not exhibit significant predictive power in this study. Despite the existence of formal monitoring structures, including independent commissioners and internal audit units, the qualitative evidence suggests that autonomy is often constrained by political influence, which limits the effectiveness of conventional oversight mechanisms. (Andalia et al., 2021; Lestari et al., 2020). Similarly, CEO education and technical expertise (capability) were not decisive predictors of misconduct, supporting. (Meidijati & Amin, 2022) That large-scale corporate fraud often requires collusion or systemic weaknesses rather than individual skill. These findings indicate that the Fraud Heptagon operates most prominently through organizational and institutional channels, rather than individual traits, in the SOE context.

Digital forensics demonstrates a significant mitigating effect on the relationship between the Fraud Heptagon and financial statement fraud (H2, $\beta = -0.178$; $p = 0.031$). Quantitative results show that the adoption of forensic data analytics, anomaly detection algorithms, and electronic audit trails reduces both the opportunity and capability dimensions of fraud. Interview findings reinforce this insight, with auditors emphasizing that digital forensics enables early identification of fictitious transactions, inflated revenues, and hidden journal entries, which would otherwise remain undetected. As one audit committee member observed: "Without digital forensic systems, irregularities often surface too late, making corrective action difficult." This supports recent literature that emphasizes the growing importance of technological tools in preventing and detecting corporate fraud (Halbouni et al., 2016; Hassan et al., 2023).

Furthermore, digital forensics fosters a culture of transparency and accountability, as staff are aware that transactions can be analyzed and traced electronically. This preventative effect highlights the importance of integrating behavioral theory with technological enforcement, aligning with (Arora & Dharwadkar, 2011; Ghozali et al., 2019), who argue that technological interventions can directly constrain behavioral drivers of fraud in complex organizational environments.

Risk management also shows a significant moderating effect on the influence of the Fraud Heptagon on FFR (H3, $\beta = -0.142$; $p = 0.045$). Quantitative evidence indicates that enterprises with well-structured risk management frameworks experience lower levels of misreporting. Qualitative insights from interviews suggest that risk-based monitoring frameworks compel managers to justify deviations transparently,

reducing the rationalization and collusion potential. One SOE executive explained: "Systematic risk registers make it clear where deviations occur and why, which discourages manipulative behavior." This supports recent studies highlighting the critical role of enterprise risk management in mitigating fraud risk by strengthening accountability, aligning incentives, and institutionalizing ethical oversight (Irwandi et al., 2020; Mangala & Soni, 2023; I. Putra et al., 2022; Vanini et al., 2023).

The integration of risk management with the Fraud Heptagon framework emphasizes both preventive and detective dimensions of governance. Preventive mechanisms include establishing clear fraud policies, ethical guidelines, and risk-based internal audits, while detective mechanisms rely on systematic monitoring and reporting to identify anomalies before they escalate into material misstatements.

The interviews further highlight that embedding risk awareness into daily operations creates a culture of compliance, where managers are conscious of both organizational rules and broader ethical considerations. Beyond the roles of the audit committee and internal risk management, the study also recognizes the importance of external governance mechanisms. External auditors play a crucial role in providing independent assurance and in detecting red flags that internal mechanisms may overlook. Meanwhile, regulatory oversight bodies, such as the Financial and Development Supervisory Agency (BPKP) and the Supreme Audit Agency (BPK), strengthen accountability through compliance reviews, enforcement of audit standards, and public transparency requirements.

This broader governance perspective reinforces the multidimensional nature of fraud prevention and detection within SOEs, where internal and external mechanisms interact to safeguard integrity, strengthen oversight, and enhance the overall effectiveness of anti-fraud systems. The integration of quantitative data and interview insights reveals that financial statement fraud in SOEs is predominantly systemic, driven by structural pressures, political influence, and institutional weaknesses, rather than isolated individual attributes. The Fraud Heptagon provides a robust theoretical framework to understand the multidimensional drivers of fraud, while digital forensics and risk management function as operational instruments to disrupt fraudulent pathways. Internal auditors emphasized the importance of continuous digital monitoring, while executives highlighted risk awareness and internal communication as critical for compliance. Together, these findings suggest that effective mitigation requires coordinated efforts, combining governance, technology, and risk frameworks to address both behavioral and structural drivers of fraud.

From a theoretical perspective, this study extends the Fraud Heptagon literature by demonstrating its applicability in public-sector enterprises, particularly SOEs, where collusion and systemic pressures are prominent. It also provides empirical support for the role of digital forensics and risk management as moderators of behavioral and organizational fraud drivers, bridging behavioral theory with practical enforcement mechanisms. Practically, the findings imply that SOEs must adopt integrated anti-fraud strategies, embedding digital forensic tools to monitor and detect anomalies continuously, strengthening risk management frameworks to institutionalize accountability, and recognizing that systemic pressures, especially performance and political expectations, are primary drivers of fraud requiring organizational and cultural interventions.

In conclusion, this study demonstrates that financial statement fraud in SOEs is primarily a systemic phenomenon, shaped by financial and political pressures, rather than individual rationalizations or capabilities. Effective mitigation demands a multi-pronged approach, embedding digital forensic technologies, institutionalizing risk management, and reinforcing governance mechanisms to safeguard the integrity of financial statements from fraud. By combining quantitative modeling with qualitative interviews, this research offers a holistic understanding of fraud dynamics, providing both theoretical advancement and actionable insights for practitioners and policymakers in state-owned enterprises.

Table 5: Hypothesis Summary

Hypothesis	Relationship	Coefficient (β)	Significance (p-value)	Decision	Notes
H1	Fraud Heptagon → FFR	0.254	0.012	Accepted	Integrated Fraud Heptagon factors significantly influence FFR in SOEs.
H2	Digital Forensics × Fraud Heptagon → FFR	-0.178	0.031	Accepted	Digital forensics reduces the positive effect of Fraud Heptagon on FFR.
H3	Risk Management × Fraud Heptagon → FFR	-0.142	0.045	Accepted	Risk management mitigates the influence of Fraud Heptagon on FFR.

Source: Results of secondary data processing, 2025.

Based on Table 5, the results of the hypothesis testing confirm that the Fraud Heptagon framework has a significant and positive relationship with fraudulent financial reporting (FFR) in Indonesia's State-Owned Enterprises (SOEs). The first hypothesis (H1) shows a standardized path coefficient (β) of 0.254 with a significance level of 0.012, indicating that the integrated dimensions of the Fraud Heptagon, comprising pressure, opportunity, rationalization, capability, arrogance, ignorance, and greed, jointly exert a measurable influence on the likelihood of financial misreporting. This finding validates the theoretical proposition that fraud in SOEs is not merely the result of individual misconduct but rather emerges from interconnected behavioral and structural determinants embedded within organizational and institutional contexts. The second hypothesis (H2) tests the moderating effect of digital forensics on the relationship between the Fraud Heptagon variables and FFR. The coefficient value of −0.178 (p = 0.031) indicates a statistically significant negative moderation, suggesting that the implementation of digital forensic mechanisms weakens the positive association between fraud drivers and financial misstatements. This implies that the adoption of advanced data analytics, continuous monitoring systems, and technology-assisted audit trails enables organizations to detect irregularities earlier and reduce the opportunity for manipulation. Consequently, digital forensics serves not only as a reactive investigative tool but also as a preventive control that strengthens transparency and operational integrity.

The third hypothesis (H3) examines the moderating role of risk management, which yields a coefficient of −0.142 with a p-value of 0.045. This result confirms that strong risk management practices can significantly mitigate the influence of fraud risk factors on financial reporting irregularities. Specifically, well-structured risk governance, regular risk mapping, and the existence of a dedicated risk oversight committee contribute to creating a more controlled environment that limits the escalation of financial misrepresentation. Together, these findings underscore the importance of embedding both technological and governance-based safeguards within the organizational infrastructure of SOEs.

Overall, the hypothesis testing results highlight that while systemic and behavioral pressures continue to drive fraudulent tendencies, integrating digital forensics and risk management frameworks provides effective countermeasures. These moderating mechanisms enhance early detection, accountability, and compliance culture, transforming fraud prevention from a reactive stance into a proactive, data-driven governance practice within Indonesia's public-sector enterprises.

5. Conclusion, Limitations, and Suggestions

The present study reinforces the limited explanatory capacity of the Fraud Hexagon framework when applied to Indonesia's State-Owned Enterprises (SOEs). Empirical analysis indicates that financial pressure, representing the stimulus element, stands as the sole significant determinant of fraudulent financial reporting. In contrast, other dimensions, capability, collusion, opportunity, rationalization, and ego exhibit negligible effects. Similarly, the moderating role of the audit committee appears constrained: while it slightly reduces the influence of collusion on fraud occurrence, it lacks comprehensive preventive capacity. These findings underscore that the institutional rigidity, hierarchical governance, and bureaucratic culture inherent to SOEs amplify the effect of financial pressure, whereas existing control mechanisms remain only partially effective in mitigating fraud risk. By integrating both quantitative evidence and qualitative interpretation, the study provides a more nuanced understanding of how structural and behavioral factors interact in shaping fraud dynamics within state-owned enterprises.

Several limitations should be considered in interpreting these results. The exclusive focus on SOEs limits generalizability, as private sector organizations operate under distinct governance logics, ownership incentives, and performance pressures. Moreover, the study's reliance on archival and secondary data constrains its ability to capture behavioral and cultural nuances that shape fraudulent intent. Governance in this research is represented solely through the audit committee, thereby excluding other critical oversight mechanisms such as the board of commissioners, external auditors, regulatory bodies, and ownership configurations, all of which may interactively influence fraud risk and mitigation effectiveness.

Future research directions should pursue broader and more comparative perspectives to enrich the theoretical and contextual understanding of fraud. Cross-sector and cross-country analyses could reveal how institutional environments and governance architectures shape fraud dynamics in different regulatory and cultural settings. The proposed theoretical evolution from the Fraud Hexagon to the Fraud Heptagon, incorporating digital forensics and risk management, represents a meaningful refinement that aligns with the increasing complexity of contemporary fraud ecosystems. Additionally, adopting mixed-method approaches, integrating forensic interviews, ethnographic observation, and digital trace analytics, could yield deeper behavioral and organizational insights that purely quantitative models may fail to capture. Such methodological diversification ensures that fraud research remains contextually sensitive while advancing toward more holistic models of explanation.

From a practical standpoint, embedding risk management systems and digital forensic tools within governance structures can transform fraud prevention from a reactive to a proactive function, enabling real-time anomaly detection and predictive monitoring. Empirical evidence from several ASEAN state enterprises provides encouraging examples. Petronas in Malaysia has implemented AI-driven continuous auditing systems that flag irregular transactions with real-time dashboards. Singapore's Temasek Holdings integrates blockchain-based transparency mechanisms to enhance traceability and accountability in financial reporting. Similarly, Thailand's PTT Group utilizes digital forensic analytics to strengthen its internal investigation processes and early fraud detection protocols. These successful implementations demonstrate that technology-enabled integrity systems, when integrated with robust governance and risk management frameworks, substantially enhance transparency, accountability, and operational resilience.

Beyond Indonesia, the findings of this study also hold implications for the broader international context. The demonstrated interplay between financial pressure, institutional rigidity, and governance effectiveness provides valuable insights for countries with similar state ownership structures or developing economies undergoing governance reform. Lessons from Indonesia's SOEs could inform the refinement of global anti-fraud standards, such as those promoted by the International Organization of Supreme Audit Institutions (INTOSAI) and the OECD Guidelines on Corporate Governance of State-Owned Enterprises. Integrating digital forensics, data analytics, and risk management within these frameworks may serve as a universal model for enhancing public accountability and fraud resilience worldwide. By positioning financial pressure as the dominant explanatory variable and acknowledging the institutional inertia of SOE governance, this study contributes to the refinement of fraud theory in public-sector contexts. It also underscores the systemic nature of fraud and the necessity of multi-pronged interventions that combine behavioral, technological, and managerial strategies. In doing so, the study advances theoretical understanding while providing actionable insights for policymakers, regulators, and practitioners seeking to foster a sustainable, fraud-resistant organizational ecosystem within and beyond Indonesia's state-owned enterprises.

Acknowledgement

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