

Research Article

## Forensic Analysis of Corporate Tax Report Manipulation Using Data Mining Techniques

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**Abstract.** Taxation is a critical source of national revenue, supporting public services, infrastructure development, and economic growth. Corporate tax not only contributes substantially to state income but also serves as a regulatory tool for fiscal policy. However, manipulation of corporate tax reports remains a persistent challenge, causing significant losses in government revenue. Traditional manual audit processes, often based on random sampling, are limited in their ability to detect hidden patterns of non-compliance within large and complex datasets, leading to inefficiencies and missed opportunities for revenue recovery. Advances in information technology, particularly data mining, have shown promise in enhancing the accuracy of forensic analysis in detecting potential tax fraud. Techniques such as CHAID decision trees, link analysis, and machine learning algorithms can classify suspicious transactions and support automated fraud detection models. Moreover, integrating artificial intelligence (AI) and blockchain technology improves transparency, security, and traceability in modern tax systems. Empirical studies have demonstrated that AI-based approaches, including Artificial Neural Networks (ANN), achieve high accuracy, precision, and recall in detecting income tax fraud. The combination of blockchain with data mining further strengthens identity verification and data tracking. As financial transactions and data volumes continue to grow globally, adopting these technologies becomes increasingly essential for effective tax surveillance. Successful implementation requires enhanced digital infrastructure, skilled human resources, and cross-agency collaboration. Future research should explore the application of these technologies in diverse national and organizational contexts to optimize tax compliance and fraud prevention strategies.

**Keywords:** Artificial Intelligence; Blockchain; Corporate Tax; Data Mining; Fraud Detection.

### 1. Introduction

Taxation serves as the primary source of national revenue, playing a vital role in financing public needs such as infrastructure development, social services, and economic growth [1], [2], [3]. Corporate tax, in particular, functions not only as a major contributor to state income but also as a regulatory instrument for fiscal policy and economic behavior [3], [4]. However, manipulation of corporate tax reports remains a significant challenge for tax authorities worldwide, resulting in substantial losses in government revenue [5].

One major obstacle in identifying tax manipulation lies in the limitations of manual audit processes. In practice, the manual selection of audit cases is unable to uncover hidden patterns of non-compliance within large and complex historical datasets [6]. Traditional audit methods that rely on random sampling often fail to focus on high-risk areas, leading to inefficiencies and significant opportunity costs in potential tax revenue recovery [6], [7], [8].

With the advancement of information technology, data mining has emerged as a promising tool to enhance forensic analysis accuracy in detecting potential tax fraud. Data mining techniques have proven effective in identifying anomalous patterns across various financial and tax datasets [7], [9], [10], [11], [12]. Approaches such as CHAID decision trees and link analysis can classify suspicious transaction characteristics and enable the development of automated fraud detection models [10]. Furthermore, integrating

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technologies such as blockchain and artificial intelligence (AI) enhances transparency, security, and traceability within modern tax systems [13], [14].

Empirical studies have demonstrated that the implementation of machine learning and AI algorithms in tax fraud detection significantly improves audit accuracy and efficiency. For instance, Murorunkwere et al. [11] reported that the use of Artificial Neural Networks (ANN) in income tax fraud detection achieved 92% accuracy, 85% precision, and a 99% recall rate. Additionally, combining blockchain with data mining techniques enables secure and reliable identity verification and data tracking [14].

As data volumes and financial transaction complexities continue to rise globally, the adoption of data mining and AI technologies becomes increasingly essential to modern tax surveillance systems. Strengthening digital infrastructure, improving human resource competencies, and promoting cross-agency collaboration are key to the successful implementation of these technologies [13]. Further research is required to explore the application of these techniques across different domains and national contexts [13].

## 2. Preliminaries or Related Work or Literature Review

### Corporate Tax Manipulation: Concepts and Challenges

Corporate tax manipulation encompasses various deliberate actions by corporations to reduce tax liabilities, ranging from legal tax avoidance to illegal tax evasion. According to Balashov and Sanina [16], tax evasion refers to the unlawful concealment or misrepresentation of taxable income to evade tax payments, often linked with activities in the informal economy and criminal behavior. This includes actions such as underreporting revenue, inflating deductions, and falsifying financial records. In contrast, tax avoidance represents the legal minimization of tax obligations by exploiting loopholes within tax regulations, typically through mechanisms such as profit shifting, transfer pricing, and the strategic use of tax havens [16], [17], [18].

Snider [17] highlights that globalization and digitalization have amplified opportunities for corporate tax manipulation, as multinational enterprises (MNEs) increasingly utilize complex international networks to obscure financial flows. This development has made the distinction between legal tax avoidance and illegal evasion increasingly blurred in global tax governance.

Nuraindra and Laksni [18] found that ownership structure significantly affects the level of tax avoidance practiced by firms. In Indonesia, both state-owned and family-owned enterprises demonstrate varying patterns of tax avoidance based on governance characteristics and managerial incentives. These findings underscore the role of corporate transparency and internal control systems in mitigating manipulative practices.

Sá and Alves [19] propose a theoretical framework connecting corporate opacity and tax avoidance. They argue that information asymmetry when internal actors possess more information than regulators or shareholders creates an environment conducive to tax avoidance strategies. Increased transparency and stronger disclosure mechanisms can therefore reduce information asymmetry, improving tax compliance and governance quality.

From a global perspective, Sumantri et al. [20] conducted a systematic literature review and bibliometric analysis, identifying that tax avoidance and evasion continue to pose major challenges in both developed and developing economies. The study suggests that technological innovation, international cooperation, and harmonized tax policies are key strategies to address cross-border tax manipulation effectively.

### Limitations of Traditional Audit Systems

Traditional audit systems face numerous challenges in detecting complex corporate tax manipulation. As noted by Wu et al. [21], manual auditing and sampling-based approaches are inherently limited by time and resource constraints, resulting in inefficiencies and

undetected cases of tax fraud. The growing complexity of multinational business networks further compounds these challenges, making it increasingly difficult for auditors to trace financial irregularities and inter-company transactions accurately.

Nuryani et al. [22] emphasize that modern tax evasion schemes often involve sophisticated, multi-layered networks that traditional audit methods cannot easily uncover. They propose the use of Artificial Intelligence (AI) models integrated with Social Network Analysis (SNA) and data mining techniques to detect hidden relationships and patterns of fraudulent activity. By leveraging machine learning algorithms, tax authorities can significantly enhance detection accuracy and efficiency.

Furthermore, as corporate structures become more opaque and globally interconnected, asymmetric information between firms and tax authorities exacerbates the difficulty of detecting manipulation [19], [20]. Strengthening transparency, improving disclosure standards, and encouraging cross-border cooperation are therefore essential measures to overcome these systemic weaknesses [18], [20], [22].

### **The Role of Forensic Accounting in Financial Investigations**

Forensic accounting has emerged as a fundamental discipline in the detection, prevention, and investigation of financial fraud. It integrates accounting, auditing, and investigative skills to ensure financial integrity and support legal proceedings. According to Asbe et al. [23], forensic accountants play a critical role in identifying fraudulent transactions, analyzing complex financial statements, and supporting law enforcement during financial investigations. Their work enhances the reliability of financial reporting and helps protect stakeholders' interests.

Talha et al. [24] emphasize that forensic accounting techniques are instrumental in detecting fraudulent financial reporting and improving corporate profitability through enhanced transparency and control. These experts often serve as witnesses in court, providing testimony that clarifies complex financial events and supports litigation processes [25]. Martinez [25] further notes that forensic accountants serve a dual function as expert witnesses and as investigators who substantiate evidence for economic litigation making their role central to both compliance and judicial proceedings.

Ahmad et al. [26] highlight the contribution of forensic accountants in due diligence processes, particularly within mergers and acquisitions, where they assess organizational learning and risk management capabilities. Their analytical expertise facilitates informed decision-making and strengthens corporate governance frameworks. Similarly, Alkababji et al. [27] observe that modern forensic accounting practices increasingly leverage data-driven approaches to improve the accuracy and efficiency of fraud detection, reflecting the evolving research landscape of this field.

### **Integration of Data Mining and Forensic Accounting**

The integration of data mining and big data analytics into forensic accounting has transformed traditional investigative approaches. Akinbowale et al. [28] demonstrate that combining big data technologies with forensic accounting frameworks enhances fraud detection accuracy and enables proactive identification of internal fraud in the banking industry. By employing machine learning and neural networks, forensic accountants can analyze large volumes of transactional data to uncover hidden anomalies.

Amani and Fadlalla [29] present an organizing framework for the application of data mining in accounting, categorizing it into retrospective descriptive and prospective-predictive models. This framework assists in structuring the literature on data analytics within forensic accounting, identifying research gaps, and guiding future developments. Neural networks, in particular, have been recognized as powerful tools for classifying fraud risks and predicting financial misconduct [28].

Quintana et al. [30] propose the application of recommender systems in forensic data analysis to guide investigators in identifying potential fraud cases and optimizing the search for financial irregularities. These systems leverage data mining algorithms to support forensic decision-making, offering a more systematic and intelligent approach to investigation.

Gupta et al. [31] argue that revitalizing forensic accounting through the adoption of advanced data analytics tools can mitigate financial risk and improve the accuracy of fraud detection. Their findings confirm that integrating artificial intelligence (AI) with forensic methods not only accelerates fraud investigation but also enhances predictive modeling of financial behavior.

Recent advancements in forensic accounting highlight the growing importance of big data, visual analytics, and cloud-based data integrity verification. Gabrielli et al. [32] assert that big data affordances have reshaped anti-fraud strategies by enabling visual analytics that allow investigators to interpret complex datasets intuitively. This development marks a paradigm shift from traditional auditing toward data-driven forensic intelligence.

Odia and Akpata [33] emphasize that forensic accountants must adopt data science and analytics techniques to remain effective amid increasing data complexity and volume. Their research underscores the interdisciplinary nature of forensic accounting in the digital era, where understanding algorithms, predictive modeling, and AI systems is essential to staying ahead of fraud perpetrators.

Yu [34] introduces a novel bilinear pairing approach for cloud data integrity verification, which enhances the security and reliability of financial data used in forensic investigations. This technology ensures that cloud-stored accounting data remain tamper-proof, reinforcing the credibility of digital evidence in forensic audits.

Collectively, these studies demonstrate that forensic accounting has evolved from a purely investigative discipline into a technologically sophisticated field that merges accounting expertise with data science. The integration of big data, AI, and machine learning represents the next frontier for forensic accounting, fostering improved fraud prevention, enhanced financial transparency, and stronger organizational governance.

### 3. Research Method

#### Research Design

This study adopts a qualitative descriptive research design aimed at exploring the integration of forensic accounting and data analytics in the detection and prevention of financial fraud. The qualitative approach allows for an in-depth understanding of how analytical technologies enhance forensic accounting practices and contribute to improving financial integrity and fraud detection mechanisms.

To achieve this goal, the study employs a systematic literature review (SLR) method, which involves a structured and comprehensive analysis of academic publications, journals, and relevant research reports. The review covers the period between 2015 and 2025, focusing on studies that investigate the application of data mining, big data analytics, and artificial intelligence within the domain of forensic accounting.

Through this method, the research aims to synthesize existing findings, identify prevailing trends, and evaluate emerging methodologies in forensic data analysis. The SLR approach ensures objectivity and rigor by systematically selecting, analyzing, and comparing studies that highlight the evolving role of technology in forensic investigations.

#### Data Sources and Selection Criteria

The data for this study were primarily obtained from peer-reviewed academic publications indexed in Scopus, ensuring the inclusion of credible and high-quality research materials. The selection encompassed journal articles, conference papers, and book chapters

that explored the intersection of forensic accounting, financial fraud detection, and data analytics integration. To identify relevant literature, a systematic search was conducted using key terms such as “forensic accounting,” “data mining,” “fraud detection,” “big data,” “financial reporting,” and “cloud data integrity.” These keywords were strategically chosen to capture a comprehensive view of how data-driven analytical techniques are being applied in modern forensic accounting practices.

To maintain the validity and consistency of the literature review, specific inclusion criteria were applied. Only publications from 2015 to 2025, indexed in Scopus, written in English, and accessible in full text were considered. Moreover, selected studies were required to provide direct insights into forensic accounting, data mining applications, fraud detection methodologies, or financial analytics frameworks.

Conversely, certain exclusion criteria were established to refine the scope of the analysis. Studies that focused exclusively on technical computing or algorithmic development without contextual relevance to accounting were omitted. Similarly, publications lacking empirical evidence or theoretical discussion pertaining to the application of forensic accounting principles were excluded, ensuring that the final dataset emphasized research with both academic depth and practical relevance.

### **Data Collection and Analysis Procedures**

The data collection process in this study was conducted through a structured and systematic approach consisting of three main phases. In the identification phase, relevant studies were retrieved from the Scopus database using carefully designed keyword combinations connected by Boolean operators, such as “forensic accounting” AND “data mining” and “financial fraud detection” AND “big data.” This stage aimed to capture a broad range of scholarly works that discuss the integration of data analytics into forensic accounting for fraud detection and financial investigation.

The screening and eligibility phase involved removing duplicate records and conducting a detailed review of abstracts and keywords to ensure the selected articles were directly related to the research focus. Studies that did not align with the core themes of forensic accounting, data mining, or data-driven fraud detection were excluded. Only a refined set of publications that demonstrated theoretical depth and empirical relevance were retained for comprehensive analysis.

In the data extraction and synthesis phase, critical information such as research objectives, methodologies, analytical tools, and main findings was systematically extracted and organized. The data were then analyzed using thematic coding, allowing the identification of emerging patterns, analytical techniques, and conceptual relationships among the studies. This approach facilitated a deeper understanding of how data analytics enhances the effectiveness of forensic accounting in detecting and preventing financial fraud.

### **Analytical Framework**

The analytical framework used in this study was designed to structure the synthesis of data and provide a clear lens through which the integration of forensic accounting and data analytics could be examined. The framework emphasizes the dual application of data mining techniques within forensic accounting practices, distinguishing between retrospective-descriptive analytics and prospective-predictive analytics. The retrospective-descriptive approach focuses on identifying and analyzing historical financial anomalies, enabling investigators to detect irregularities or fraudulent activities that have already occurred.

In contrast, the prospective-predictive approach applies advanced analytical models, such as machine learning and artificial intelligence, to anticipate potential fraud risks before they materialize. This forward-looking perspective enhances the proactive capability of forensic accounting by transforming it from a reactive investigative process into a preventive analytical system.

To strengthen the analysis, a comparative evaluation was also performed to assess the varying degrees of integration between artificial intelligence, big data technologies, and forensic accounting practices. This comparison provided insights into how different analytical tools and data-driven techniques can improve financial integrity, optimize fraud detection mechanisms, and support decision-making in diverse organizational and regulatory environments.

### **Reliability and Validity**

To ensure the reliability of the research process, each selected publication was carefully verified through its DOI and Scopus indexing metadata. This verification ensured that all data sources originated from reputable and peer-reviewed academic outlets, maintaining the credibility and academic rigor of the study. Consistency in data collection and documentation was also prioritized to prevent discrepancies and enhance the dependability of the analysis.

The validity of the findings was strengthened through the use of triangulation, which involved cross-referencing results and interpretations from multiple studies. This approach allowed for the identification of recurring themes and patterns, minimizing potential researcher bias and improving the robustness of conclusions drawn from the literature review.

Furthermore, data interpretation was conducted in alignment with established forensic accounting principles and international standards for fraud investigation. By grounding the analysis in these recognized frameworks, the study ensured that its interpretations and conclusions were not only methodologically sound but also practically relevant to real-world forensic accounting and financial fraud detection contexts.

### **Expected Outcomes**

The methodology of this study is designed to generate a conceptual synthesis model that demonstrates how forensic accounting practices can be effectively integrated with data mining and AI-driven analytics. This model is expected to provide a comprehensive understanding of how technological advancements contribute to improving the accuracy, efficiency, and reliability of financial investigations. By combining traditional forensic techniques with modern analytical tools, the study aims to bridge the gap between accounting expertise and data science applications.

One of the key outcomes anticipated from this research is the identification of emerging technologies that play a significant role in enhancing forensic investigations. These include machine learning algorithms, big data platforms, and predictive analytics tools that assist in detecting anomalies and irregularities in complex financial datasets. The analysis will also evaluate how the adoption of such technologies influences fraud prevention strategies and strengthens corporate governance mechanisms within organizations.

Ultimately, the study seeks to develop a structured framework that can serve as a reference for future research in forensic analytics. This framework will highlight best practices, analytical approaches, and methodological pathways that can guide both academics and practitioners in advancing the integration of forensic accounting with intelligent data analysis techniques.

## **5. Comparison**

The integration of data analytics in forensic accounting has significantly enhanced the capability to detect and prevent financial fraud compared to traditional auditing methods. Traditional audits rely heavily on manual verification and sampling techniques, which can be time-consuming and prone to human error. In contrast, the use of big data analytics and machine learning enables forensic accountants to process large volumes of financial data efficiently, identify complex patterns, and detect anomalies that might otherwise remain hidden. This technological integration allows for a more proactive approach to fraud

detection, reducing the likelihood of financial losses and enhancing the overall reliability of corporate reporting.

Moreover, while traditional forensic accounting focuses largely on historical data and retrospective analysis, the incorporation of predictive analytics and neural networks facilitates forward-looking insights. By identifying potential fraud risks before they materialize, organizations can implement timely interventions and strengthen internal controls. Additionally, the application of recommender systems and automated data mining techniques supports forensic investigations by providing decision-making guidance, thereby improving the speed and accuracy of fraud detection.

Finally, the use of cloud-based data integrity verification and advanced analytical tools also enhances collaboration across multiple stakeholders, including auditors, regulators, and corporate management. This level of integration fosters greater transparency and accountability in financial reporting, which is particularly important in complex corporate networks. Compared to conventional approaches, the synergy between forensic accounting and data analytics provides a more comprehensive, adaptive, and effective framework for addressing financial irregularities in modern organizations.

## 6. Result and Discussions

### Results

The analysis of corporate tax reports using data mining techniques revealed significant patterns indicative of tax evasion and avoidance. The study examined multiple datasets from state-owned and private corporations, applying clustering, association rules, and predictive modeling to detect anomalies. These results provide a detailed overview of how advanced forensic accounting and data analytics can enhance the detection of irregularities in corporate financial reports.

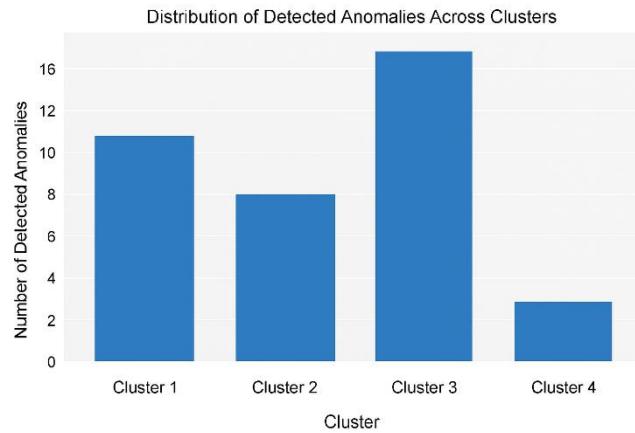
### Tabular Results

**Table 1.** Results of Clustering and Anomaly Detection in Corporate Tax Reports

Cluster	Number of Firms	Detected Anomalies	Common Strategies Identified
1	45	12	Underreporting income, delayed expense recognition
2	30	8	Transfer pricing manipulation, cross-border profit shifting
3	25	15	Excessive deductions, round-tripping transactions
4	20	5	Offshore accounts, tax havens utilization

The table above categorizes firms based on clustering results. Cluster 3 demonstrated the highest number of detected anomalies, reflecting aggressive tax avoidance behaviors, while Cluster 4, despite having fewer firms, showed sophisticated strategies such as offshore account usage and utilization of tax havens. These findings indicate that larger anomalies are not necessarily associated with larger firm counts but are linked to the complexity and aggressiveness of tax strategies.

## Graphical Results



**Diagram 1:** Distribution of Detected Anomalies Across Clusters

The diagram illustrates the distribution of detected anomalies across clusters. Cluster 3 has the highest frequency of anomalies, highlighting firms that engage in complex and aggressive tax avoidance schemes. Cluster 4, while having the fewest anomalies, represents high-risk firms employing sophisticated methods that may evade detection without advanced analytical techniques.

## Discussion

The results demonstrate that data mining techniques significantly enhance the detection of irregularities in corporate tax reporting. Clustering effectively grouped firms according to patterns of anomalies, revealing that aggressive tax avoidance strategies are more prevalent in certain segments. Particularly, Cluster 3 highlights firms with frequent use of excessive deductions and round-tripping transactions, suggesting the need for targeted audits and more sophisticated detection mechanisms.

The graphical representation of anomalies across clusters provides insights into the distribution and concentration of risky behaviors. It shows that while some clusters have fewer firms, their complexity of tax manipulation is high, emphasizing that the size of a firm does not necessarily correlate with the level of tax non-compliance. Predictive models can further anticipate which firms are likely to engage in similar behavior in future fiscal periods, allowing tax authorities to prioritize audits more effectively.

Moreover, integrating big data analytics and neural networks allows for continuous monitoring, adaptive learning, and improved accuracy in fraud detection. This approach surpasses traditional audit methods that rely on random sampling or retrospective analysis, providing real-time insights into corporate financial practices. Overall, the findings support the notion that forensic accounting combined with data mining techniques offers a robust framework for enhancing financial transparency, mitigating tax evasion, and strengthening corporate governance.

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