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The Mediating Role of Big Data Adoption on the Relationship between Board Governance and Audit Report Lag: Empirical Evidence from Indonesian Listed Companies

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ABSTRACT

Timely audited financial reporting is essential for capital market transparency, especially as companies increasingly operate in a data-intensive business environment. This study examines whether Big Data Adoption (BDA) mediates the relationship between Board Governance and Audit Report Lag (ARL) in companies in the technology, telecommunications, and healthcare sectors listed on the Indonesia Stock Exchange (IDX) during the 2019-2024 period. Using 294 firm-year observations, this study applies panel regression, Structural Equation Modeling (SEM), and Principal Component Analysis (PCA) to test direct and indirect effects among the variables. The results indicate that BDA has a significant negative effect on ARL, suggesting that companies with higher levels of BDA tend to complete audits more quickly. BDA also significantly mediates the relationship between board size and ARL, and between board expertise and ARL. However, BDA was not found to mediate the relationship between board independence and ARL or between Board Diversity and ARL. This study extends the literature on corporate governance, audit timeliness, and digital transformation by demonstrating that board governance can reduce audit delays when supported by data-driven capabilities. These findings also provide practical implications for companies, auditors, and regulators seeking to improve audit readiness, reporting efficiency, and digital governance.

Keywords: Big Data Adoption, Audit Report Lag, Board Governance, Board Expertise, Digital Transformation, Indonesia
JEL Classifications: M42, G34, O33

1. INTRODUCTION

Timely audited financial statements are essential for stakeholders because they provide reliable information for evaluating a company's financial position, performance, and accountability. The usefulness of audited financial information depends not only on its completeness and accuracy but also on whether it is available when users need it for decision-making (Safitri and Rahayu, 2024). Audit report lag (ARL), defined as the number of days between a company's fiscal year-end and the date of the auditor's report, is commonly used to assess the timeliness of audit completion and financial reporting (Nugrahanti et al., 2023). Based on (Habib et al., 2019), generally, investors tend to prefer a short ARL. This happens because a shorter ARL indicates that the auditor's opinion is released sooner, thereby allowing for an earlier assessment of the reliability of the company's financial statements. A longer ARL may reduce the relevance of financial information, increase information asymmetry, and create negative perceptions regarding a company's transparency and governance (Behnampour and Momeni, 2025). Therefore, identifying the factors that influence ARL remains important for improving reporting timeliness and maintaining stakeholder confidence (Lestari et al., 2024; Putra et al., 2023; Tanujaya and Elliany, 2024).

One factor that may affect ARL is board governance. The board is responsible for overseeing management, monitoring the financial reporting process, and ensuring that adequate internal control and governance mechanisms are implemented.

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Effective board governance may reduce ARL by strengthening managerial oversight, facilitating the timely preparation of financial information, and encouraging coordination among management, internal auditors, and external auditors. Board characteristics such as size, independence, expertise, and gender diversity may influence the board's monitoring capacity, access to resources, quality of judgment, and ability to address complex reporting and technological issues. However, prior studies have reported inconsistent findings regarding the relationship between board governance and ARL, indicating that the effect of board characteristics on audit timeliness may depend on additional organizational mechanisms (Maroufkhani et al., 2020).

As digital transformation advances, companies are generating vast, diverse, and complex data sets, necessitating the use of more sophisticated analytical techniques. Big data adoption (BDA) is increasingly recognized as a key mechanism that illustrates how effective board governance leads to improvements in the quality of financial reporting and auditing processes (Ibrahim et al., 2021). In the context of accounting and auditing, BDA may improve the availability, completeness, and accessibility of audit-relevant information. This capability enables more effective execution of processes such as risk identification, internal control assessment, and the collection of audit evidence (Tang and Karim, 2019). The integration of big data enables auditors to process vast and diverse data sets quickly and comprehensively, allowing them to produce more accurate and comprehensive results while shortening the audit period (Haryanto and Setiawan, 2024a; Khaerunnisa et al., 2025; Perera and Abeygunasekera, 2021). As a result, auditors can complete audit procedures more efficiently and minimize audit report lag (ARL) (Ratna Sari and Perwita Sari, 2025).

Board governance may play an important role in encouraging BDA. Boards with diverse capabilities, experiences, and perspectives tend to be more proactive in adopting digital technologies (Lutfi et al., 2022). By encouraging management to develop data-related capabilities, the board may contribute to more integrated information systems and more efficient financial reporting processes. In turn, better access to organized and timely information may reduce the effort required by auditors to obtain and evaluate audit evidence. Accordingly, BDA may function as an intervening mechanism through which board governance affects ARL. In other words, board governance may influence audit timeliness not only directly through its monitoring role but also indirectly by supporting the adoption of technologies that improve information processing and audit efficiency.

Previous research has primarily examined the direct effects of firm characteristics, profitability, auditor reputation, audit complexity, and corporate governance on ARL. While these studies have provided important insights, relatively little attention has been paid to the organizational and technical mechanisms through which board governance influences audit timeliness. (Ahmed et al., 2023) examined BDA as a mediator in the relationship between board governance and ARL in the Egyptian context. However, evidence from a single institutional setting may not be directly applicable to other emerging markets because governance structures, regulatory environments, ownership patterns, and levels of digital development may differ across countries. Therefore, further investigation is necessary to determine whether a similar mediating mechanism exists in other institutional settings.

Indonesia provides a relevant context for examining this issue. Indonesian listed companies operate under a two-tier governance system that separates the supervisory role of the board of commissioners from the managerial role of the board of directors (Tjahjadi et al., 2021). Such structures may influence how governance mechanisms affect corporate decision-making, including investments in digital and data-related capabilities. Furthermore, there are variations in the level of digital technology adoption among Indonesian companies, which may result in differences in the availability and quality of information used for financial reporting and auditing. Given these institutional and technological characteristics, Indonesia is a suitable case study for evaluating whether board governance supports BDA and whether its implementation contributes to shortening the ARL.

Accordingly, this study examines the effects of board governance characteristics on audit report lag and investigates whether big data adoption mediates these relationships among Indonesian listed companies. Specifically, the study focuses on board size, board independence, board expertise, and board gender diversity as dimensions of board governance. By examining these relationships in the Indonesian institutional and digitalization context, this study extends prior research and provides evidence on whether the mediating role of big data adoption is applicable beyond previously examined settings. In doing so, the study contributes to the external validity of earlier findings and deepens understanding of big data adoption as a mechanism linking board governance to audit report lag.

2. THEORETICAL FRAMEWORK, LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

2.1. Theoretical Framework

Agency theory is one of the relevant theoretical foundations for understanding the dynamics between governance mechanisms, technology, and the timeliness of audit reports. Agency theory explains the contractual relationship between principals and agents, whose interests may differ because managers generally possess more information about the company's operations than shareholders (Jensen and Meckling, 1976). Agency theory explains that conflicts of interest between owners and management can lead to information asymmetry, which in turn may result in delays in financial reporting and audit report lag (Yusuf et al., 2025). In this context, the board of commissioners plays an important role in monitoring management, overseeing the financial reporting process, and ensuring the effectiveness of internal controls. Weak board oversight may allow reporting deficiencies to persist, increase audit risk, and require auditors to perform additional procedures, thereby extending audit report lag (Ragab and Saleh, 2025). Conversely, effective board governance may reduce information asymmetry, strengthen reporting discipline, and

improve audit readiness. Agency theory therefore provides a basis for explaining how board governance may contribute to shorter audit report lag, both through direct monitoring and indirectly by supporting information systems that improve the availability and reliability of audit-relevant data.

To explain technology adoption within organizations, this study also adopts the Technology Organization Environment (TOE) theory as another conceptual framework. According to (Tornatzky and Fleischer, 1990), an organization's decision to adopt and implement technology is typically influenced by three factors: technology, organization, and environment. The technological context refers to the characteristics of available technologies, namely the expected benefits of the technology, its data processing capabilities, and the supporting infrastructure. In the context of big data adoption, companies are more likely to implement BDA when they determine that the technology is useful, compatible with existing information systems, and will lead to improvements in data integration, reporting, and auditing processes. The organizational context concerns internal conditions such as firm resources, organizational size, managerial support, employee capabilities, governance structures, and readiness to implement new technologies. Recent research has shown that organizational factors have a significant impact on the adoption of big data in corporate reporting and auditing processes (Ratna Sari and Perwita Sari, 2025). On the other hand, environmental factors refer to external pressures and conditions in the business environment, such as government regulations, competition within industry, stakeholder expectations, market demand, and technological advancements. These external pressures may encourage companies to adopt big data analytics to remain competitive, comply with regulatory requirements, and respond more effectively to changing stakeholders and market expectations. Therefore, TOE theory provides a theoretical basis for the argument that BDA depends not only on technological progress itself but also on organizational governance support and environmental factors that shape corporate decision-making and strategy.

2.2. Corporate Governance and Disclosure in the Indonesia Context

Corporate governance is a topic that has attracted significant attention in the business world. Corporate governance has evolved rapidly over the past 20 years, and its importance has come into focus following the economic crisis, which highlighted the weaknesses in corporate oversight mechanisms, a lack of transparency, and an increase in opportunistic management practices. In Indonesia, the Code of Good Corporate Governance was published in 2006 by the National Committee on Governance and this code adopts an ethics-based approach. While the code itself is not legally binding, it can serve as an important guideline for companies in applying sound governance principles. Furthermore, the Code emphasizes the roles of corporate bodies, such as the Board of Directors, the Board of Commissioner, and the General Meeting of Shareholders in maintaining a balance between oversight and the execution of management responsibilities, as well as in establishing mechanisms for disclosing information relevant to stakeholders (National Committee on Governance, 2006).

In fact, the adoption of corporate governance in Indonesia has shown remarkable progress in recent years, and the improvement in the quality of information disclosure by listed companies. Regulations issued by the OJK (Indonesian Financial Services Authority) and the Indonesia Stock Exchange have also supported this trend by establishing various rules mandating information disclosure and timely financial reporting. (Serly and Susanti, 2021) has shown that the implementation of good corporate governance has a significant impact on the quality of non-financial information disclosure among listed companies in Indonesia. This indicates that corporate boards of commissioners and committees play a crucial role in promoting transparency beyond traditional financial information. Recent research also shows that corporate governance mechanisms, such as independent audit committees, play a key role in improving the quality of disclosure by Indonesian companies as an important means of enhancing corporate transparency and accountability (Anggraini et al., 2025; Putra and Gea, 2022). Digital transformation has increased the volume and complexity of corporate data, creating greater demand for information systems that can collect, integrate, and analyze financial and non-financial information. Big data adoption may strengthen corporate governance by improving data accessibility, supporting risk monitoring, and providing the board with more comprehensive information for decision-making. It may also enhance audit readiness by enabling companies to organize audit-relevant information more efficiently. Therefore, Indonesia provides a relevant institutional setting for examining whether the characteristics of the board of commissioners encourage big data adoption and whether such adoption contributes to shorter audit report lag.

2.3. Literature Review

2.3.1. Big data adoption and audit report lag

Big data adoption refers to the organizational use of technologies and analytical capabilities that enable companies to collect, integrate, process, and analyze large and heterogeneous datasets. In accounting and financial reporting, these capabilities may improve the accessibility, completeness, and timeliness of financial and operational information. Rather than relying on fragmented records and traditional data processing methods, companies that adopt big data technologies have the potential to build more integrated information systems that support reporting, risk assessment, internal controls, and management decision-making (Mukherjee et al., 2025).

At the corporate level, the adoption of big data has the potential to improve audit readiness by providing auditors with organized and easily accessible information. Faster access to financial and operational data can reduce the time spent collecting documents, reconciling inconsistent records, and verifying transactions. Furthermore, integrated data systems may help auditors more efficiently identify suspicious transactions, assess risks, evaluate internal controls, and perform analytical procedures (Tang and Karim, 2019;Ibrahim et al., 2021).

In the Indonesian context, several studies have examined the relationship between big data and audit report lag (ARL), with results generally supporting the role of big data in accelerating

audits, although not always consistently (Ratna Sari and Perwita Sari, 2025; Rozana et al, 2025; sari; 2025). (Haryanto and Setiawan, 2024) reported in his study of fintech companies listed on the Indonesia Stock Exchange (BEI) that big data analytics can significantly reduce audit delay, although it does not always directly improve audit quality In the banking sector, big data analytics contribute to improving audit quality by reducing audit lag, (Ratna Sari and Perwita Sari, 2025) study explain that ARL acts as a significant mediating variable in the relationship between the use of big data and audit quality. Another study in the manufacturing sector also showed that big data has the potential to reduce audit delays, but its implementation has not yet had a significant impact on audit report lag. This is because the adoption of this technology is still in its early stages, and IT infrastructure is not yet evenly distributed (Purwanti et al., 2025).

On the other hand, some studies indicate that the relationship between big data and ARL does not always provide strong empirical evidence. According to (Listya et al., 2023), the implementation of big data analytics regarding audit delay and audit quality remains limited, suggesting that its effectiveness depends on technological readiness, auditor resources, and industry conditions. The use of big data analytics provides auditors with the opportunity to process large amounts of data efficiently (Alrashidi et al., 2022). The positive correlation between BDA and audit completion time suggests the potential for faster audit completion (Abdelwahed et al., 2025).

Nevertheless, the benefits of big data adoption are not automatic. Their realization may depend on data quality, system integration, employee competence, technological readiness, and the ability of auditors to use the information produced by the company. This may explain why previous empirical studies have reported mixed results regarding the relationship between big data adoption and audit timeliness. Overall, the adoption of big data yields results in ARL within a relatively short timeframe, although the strength and consistency of its impact are influenced by contextual factors such as technological readiness, auditor competence, and governance support. These varied findings open the door to further research to examine how big data adoption works within different governance structures.

2.3.2. Board governance, big data adoption and audit report lag

In an increasingly digitized business environment, the role of board governance extend beyond mere monitoring and management to include driving digital transformation and supporting the use of information in strategic decision-making (Verhoef et al., 2021). Based on Agency Theory perspective, an effective board governance has the potential to mitigate conflicts of interest and information asymmetry by strengthening oversight of management, enhancing transparency, and improving the quality of corporate reporting (Ahmed et al., 2023). On the other hand, according to the organizational dimension of the TOE framework, it has been shown that governance support, organizational resources, and strategic commitment can facilitate the adoption of technology. Taken together, it is suggested that board governance may influence audit report lag not only directly through its monitoring function but also indirectly by encouraging big data adoption.

In the Indonesian context, the implementation of board governance is conducted under a two-tier board structure that separates management responsibilities from oversight responsibilities. The board of directors is responsible for managing the company's operations, whereas the board of commissioners performs supervisory and advisory functions (Komite Nasional Kebijakan Governansi, 2021; OJK, 2014). This structure is designed to enhance the effectiveness of oversight and reduce the potential for conflicts. Therefore, the characteristics of the board governance examined in this study refer to the board commissioners. The characteristics of the board of commissioners are believed to influence the board's ability to adopt data-driven technologies, with the aim of improving the quality of corporate information (Wamba et al., 2017).

Big Data Adoption (BDA) is becoming increasingly important for organizations in leveraging its capabilities to support data management. As the volume, processing speed, and diversity of corporate data continue to grow, there is an increasing demand for analytical capabilities that go beyond those of traditional data processing systems (Liew et al., 2022). In line with research (Ibrahim et al., 2021), Big data adoption enables companies to collect, integrate, process, and analyze large volumes of financial and operational data more efficiently. These capabilities make it easier to identify suspicious transactions and cases that may involve material misstatements, while also improving the organization and availability of audit evidence (Dagilienė and Klovienė, 2019; Ratna Sari and Perwita Sari, 2025). In this study, BDA represents a company's ability to improve its audit readiness by providing auditors with more timely, integrated, and reliable information.

On the other hand, traditional audit processes may require auditors to spend a significant amount of time collecting documents, reconciling fragmented records, and verifying information from various systems. By improving the integrity and availability of corporate data, BDA may reduce the time auditors need to process data-driven audits, thereby supporting more efficient audit completion (Umar et al., 2020). Nevertheless, the effectiveness of utilizing these advanced BDA tools and techniques naturally depends heavily on oversight from the board governance. Therefore, effective board governance is expected to encourage big data adoption, which in turn may improve audit efficiency and contribute to shorter audit report lag.

2.3.2.1. The relationship between board size and audit report lag

Board size is one of the characteristics of board governance that has been extensively studied in relation to the timeliness of financial reporting, one of which is the ARL. Board size is a governance characteristic that has a significant impact on the effectiveness of oversight functions and the quality of decision-making within an organization (Haryanto and Setiawan, 2024). A larger board may broaden the range of knowledge, professional experience, perspectives, and external networks, which in turn may strengthen the board's oversight functions and its ability to evaluate complex corporate decisions (Jao et al., 2021). In some studies, board size has been found to contribute to faster audit completion through the distribution of oversight tasks. However, the impact of board

size is not necessarily linear. While a larger board can help distribute oversight responsibilities and make it easier to leverage expertise, an excessively large board may give rise to coordination problems, slow decision-making, and a diffusion of responsibility, which could ultimately undermine the effectiveness of oversight (Rahmansyah et al., 2021).

On the other hand, many recent studies argue that the effect of board size on ARL becomes increasingly relevant when considered in relation to BDA. Big data enables auditors and management to process large volumes of data more quickly without reducing their reliance on sampling-based procedures (Huang et al., 2022; Ratna Sari and Perwita Sari, 2025). Study from (Haryanto and Setiawan, 2024) suggests that BDA contributes to improved audit efficiency and quality, although audit delay does not always act as a significant mediator. Consequently, the implementation of big data is expected to function as a mechanism through which the size of the board of commisioners influences the timeliness of audits. Thus, the author formulates the first hypothesis:

- H_1: Big data adoption mediates the relationship between Board Size and Audit Report Lag.

2.3.2.2. The relationship between board expertise and audit report lag

Under Indonesia's two-tier governance system, the Board of Commissioners bears primary responsibility as the supervisory body for ensuring transparency and integrity in the company's strategic decision-making (Tjahjadi et al., 2021). The internal characteristics of the board, one of which is board expertise, have significant influence over the optimization of ARL. Board expertise refers to the knowledge and professional experience that board members possess in fields related to corporate oversight, such as accounting, finance, auditing, information technology, and risk management. Board members who possess relevant professional expertise tend to have a better understanding of business risks and the importance of information efficiency in meeting timely financial reporting requirements (Arifin et al., 2020). These capabilities may strengthen the board's supervisory effectiveness and improve the quality and timeliness of financial reporting.

In an increasingly digitalized business environment, board expertise may influence a company's willingness and ability to adopt data-driven technologies. From the organizational perspective of the TOE framework, board expertise may be in a position to readily recognize the strategic value of big data, which could serve as a catalyst for management to allocate resources to digital infrastructure. Recent research suggests that the adoption of big data audit technology enables auditors to access data more quickly (Said and Usman, 2025). Big data adoption (BDA) enables companies and auditors to obtain more accurate and timely information, thereby improving the efficiency of the audit process (Ahmed et al., 2023). Therefore, board expertise may contribute to shorter audit report lag by encouraging higher big data adoption. In this relationship, big data adoption is expected to serve as an intervening mechanism through which board expertise improves audit timeliness. Thus, the author formulates the second hypothesis:

- H_2: Big data adoption mediates the relationship between Board Expertise and Audit Report Lag.

2.3.2.3. The relationship between board independence and audit report lag

Board independence refers to the presence of board members who come from outside the company and have no affiliation with management (Nurhayadi et al., 2024). In Indonesia, regulations regarding Board Independence are set forth in POJK No. 33/POJK.04/2014 on the Board of Directors and Board of Commissioners of Issuers or Public Companies, which stipulates that independent commissioners must constitute at least 30% of the total number of board members (OJK, 2014). The existence of board independence tends to demand a higher level of transparency and encourages companies to provide timely and accurate information to stakeholders (Nurhayadi et al., 2024). (Nugraheni et al., 2022) states that board independence has a significant positive impact on the level of corporate governance disclosure. This indicates that the presence of objective independent commissioners can encourage management to present more adequate information with big data. These demands are further driving companies to develop adequate data management systems to support oversight and decision-making processes.

Big Data Adoption enables companies to integrate and analyze large volumes of data within a short timeframe to generate comprehensive, high-quality information. BDA can also assist companies in detecting risks, monitoring operational activities, and improving the quality of financial reporting (Ibrahim et al., 2021). Therefore, board independence is expected to provide an incentive to optimally utilize Big Data Adoption, which will contribute to accelerating the completion of audits and thereby reduce Audit Report Lag (ARL). Thus, Big Data Adoption is expected to mediate the relationship between board independence and Audit Report Lag. Thus, the author formulates the third hypothesis:

- H_3: Big Data Adoption mediates the relationship between Board Independence and Audit Report Lag.

2.3.2.4. The relationship between board diversity and audit report lag

Board diversity is a key characteristic of corporate governance that reflects the diversity of a board's composition, particularly in terms of gender. From the perspectives of agency theory and the resource-based view, board diversity may strengthen oversight functions because board members with different backgrounds, experiences, and perspectives tend to foster more comprehensive discussion and decision-making processes. The presence of women on board is also often associated with increased prudence, risk awareness, monitoring quality, and attention to transparency and accountability in corporate reporting. Prior research indicates that gender diversity in governance structures may improve the quality of the audit process and financial reporting (Alkebsee et al., 2022).

Board diversity may also be more receptive to organizational change and technological innovation as broader perspectives and experiences can enhance the board's evaluation of innovation-related opportunities and strategic investments (Chen et al., 2018). From the organizational dimension of the TOE framework, board gender diversity may strengthen strategic support for big data adoption by encouraging more comprehensive discussion and consideration of technology-related decisions. It was found

that audit committee gender diversity has a negative relationship with audit report lag, suggesting that gender diversity on the audit committee can accelerate the completion of audits. At the firm level, big data adoption may improve the integration, accessibility, and timeliness of financial and operational information. board gender diversity may contribute to shorter audit report lag by encouraging greater big data adoption. Therefore, the adoption of big data is expected to function as a mediating variable linking gender diversity on the board of directors and the timeliness of audits. Thus, the author formulates the fourth hypothesis:

- H_4: Big Data Adoption mediates the relationship between Board Diversity and Audit Report Lag.

2.3.2.5. The relationship between BDA and audit report lag

Big Data Adoption (BDA) is a technological capability that enables companies to collect, integrate, and analyze large volumes of data in real time, thereby generating accurate, timely, and rapid information to support financial reporting and audit processes (Ibrahim et al., 2021). In the context of auditing, the use of BDA can bring about positive changes in improving audit quality, as the use of visualizations and macro data can be tested more comprehensively, thereby helping auditors conduct more in-depth and accurate testing (Barr-Pulliam et al., 2022; Christ et al., 2021). The use of high-quality information and faster data availability can support audit efficiency by improving the accuracy of evaluations in making audit decisions, thereby minimizing the time required to complete the audit process and shortening the Audit Report Lag (ARL) (Ratna Sari and Perwita Sari, 2025).

This relationship is supported by various empirical findings in recent literature. (Barr-Pulliam et al., 2022) finds that BDA is positively correlated with improved audit quality through rapid analytical capabilities. (Ahmed et al., 2023) suggests that companies with higher levels of BDA tend to experience a reduction in ARL, as big data technology can help auditors accelerate the audit process. Therefore, the higher a company's level of Big Data Adoption, the more efficient the audit process becomes, thereby minimizing the Audit Report Lag. Thus, the author formulates the fifth hypothesis:

- H_5: Big data adoption has a negative effect on audit report lag.

The conceptual framework of the study is presented in Figure 1.

3. RESEARCH DESIGN

3.1. Sample

This study uses a sample of companies operating in the technology, telecommunications, and healthcare sectors that have been listed on the Indonesia Stock Exchange (RW1) (BEI) during the 2019-2024 period as the study population (IDX). These three sectors were selected based on their relatively higher levels of information technology use and digitalization. Additionally, companies in these sectors tend to generate large volumes of data and have a high need for analytical technologies to support business decision-making. The 2019-2024 study period was chosen to examine the development of digital transformation and the increasing adoption of data-driven technologies, which are becoming a trend in today's technological era. The research sample was determined based on several criteria, namely: (1) companies listed on the Indonesia Stock Exchange in the technology, telecommunications, and healthcare sectors; (2) companies that have published their annual reports during the 2019-2024 period; (3) companies with complete data related to the research variables. Of the total 54 listed companies, only 49 consistently published their annual reports during this period. Over the 6-year study period, this research yielded a total of 294 data observations. This study utilized STATA software. The analytical methods included Panel Data Regression, Structural Equation Modeling (SEM), and Principal Component Analysis (PCA) to ensure robust and comprehensive statistical analysis.

The selection of the technology, telecommunications, and healthcare sectors is based on the fact that these three sectors involve a significant amount of data. The technology sector generates massive volumes of data from various heterogeneous sources, such as digital transactions, customer data, online platforms, and Internet of Things (IoT) systems. Big Data Analytics enables companies to integrate, process, and analyze this data in real time, thereby potentially improving the quality of internal control systems and accelerating the audit process (Norena-Chavez, 2023). Meanwhile, in the telecommunications sector, Big Data Analytics plays an important role in managing large volumes of network and operational data, analyzing customer behavior, optimizing network performance, and improving operational efficiency (Wang et al., 2017; Wassouf et al., 2020). This improvement will ultimately lead to greater availability and better processing of organizational information, which can indirectly contribute to more timely financial reporting.

The healthcare sector generates massive volumes of complex and sensitive data from a variety of heterogeneous sources, such as electronic health records, laboratory data, insurance claims, hospital administrative systems, wearable devices, and Internet of Medical Things (IoMT) systems (Dash et al., 2019). Big Data Analytics enables healthcare organizations to integrate clinical and non-clinical information, process both structured and unstructured data, and generate insights more quickly to support more precise clinical decision-making, thereby enabling more personalized healthcare (Batko and Ślęzak, 2022). By improving data processing and organizational information flows, these benefits can support the provision of more accurate and timely information for financial reporting and auditing purposes.

3.2. Variable and Measurements

This study examines audit report lag, board governance characteristics, and big data adoption. Audit report lag serves as the dependent variable, while board size, board expertise, board independence, and board gender diversity represent the independent variables. Big data adoption is included as the mediating variable. ARL is calculated based on the time between the end of the company's fiscal year and the date the audit report is issued by the independent auditor (Puspaningsih and Fabillah, 2024). ARL serves as an indicator of the timeliness of the audit process and is highly relevant in the context of capital markets and investor decision-making. A shorter time to complete an audit indicates that a company can issue audited financial statements

Table 1: Variables, definition and sources

Variables	Type	Definition	Source
Audit report lag (ARL)	Dependent	The company's fiscal year-end date through the date the audit report was issued.	Annual Report
Board size (B.SIZE)	Independent	Number of members of the Board of Commissioners.	BOD Report
Board expertise (B.EXP)	Independent	The proportion of board members with expertise in finance, auditing, information technology, and risk management relative to the total number of board members.	BOD Report
Board independence (B.IND)	Independent	Number of independent members of the board of commissioners as a percentage of the total number of members of the board of commissioners.	BOD Report
Board diversity (B.DIV)	Independent	Measured by the number of female members of the board of commissioners.	BOD Report
Big data adoption (BDA)	Mediation	Measured using an index developed and adopted from (Ahmed et al., 2023).	Annual Report
Firm size F.Size	Control	The natural logarithm of total assets.	Annual Report
Leverage (LEV)	Control	Debt-to-total-assets ratio.	Annual Report
Firm performance (FP)	Control	Performance measurement using ROA or ROE	Annual Report
Auditor type (AUDTYP)	Control	Dummy variable: 1 if the company is audited by a Big Four firm and 0 otherwise	Annual Report
Type of auditor opinion (AOP)	Control	Dummy variable: 1 if the company receives an unqualified opinion and 0 if it receives any opinion other than an unqualified opinion.	Annual Report

Source: Adapted from (Ahmed et al., 2023)

Table 2: Indeks of big data

Big data dimension	Measurement
Social media	The number of social media accounts the company has (Instagram, X, TikTok, YouTube)
Volume of data across Stock Market	Dummy variable: assigned a score of 1 when the number of shares outstanding changes from the previous year, and 0 when no change occurs.
Analysis of Streaming Data	Dummy variable: assigned a score of 1 if the company reports using intelligent software agents, and 0 if not.
Real Time Processing	Compare the dates of the annual report and the annual audit. Assign a score of 1 if real-time reporting is in place with a difference of <2 months.
Financial	Assign a score of 1 if the company is listed on more than one market, and 0 if not.
Numbers	Assign a score of 1 if the company uses percentages to describe year-over-year changes, and 0 if it does not.
Text	Assign a score of 1 if the company uses a different method to present data in its annual report, and 0 if it does not.
Documents	Assign a score of 1 if the company uses other data sources for risk disclosure, and 0 if it does not.
Image	Assign a score of 1 if the company uses images to present data in its annual report, and 0 if it does not.
Video	Assign a score of 1 if the company uses video to present data, and 0 if it does not.
Recordings and voice	Assign a score of 1 if the company's manager uses the recording to share with shareholders, and 0 if not.
Data Quality	Assign a score of 1 if the company uses a general data protection system, and 0 if it does not.
Audited Quality	Assign a score of 1 if the company is audited by one of the world's four major audit firms (the Big 4), and 0 if not.
Business and Financial Data	Assign a score of 1 if the company invests more in cloud-based research and development, and 0 if it does not.
Stock Market	Assign a score of 1 if the company reclassifies its shares from year to year, and 0 if it does not.
Share Price is Changeable	Assign a score of 1 if the company's stock price fluctuates significantly from year to year, and 0 if it remains stable.
Multi dimension and complex Graphs	Assign a score of 1 if the company has complex graphs, and 0 if it does not.

Source: Adapted from (Ahmed et al., 2023)

more efficiently, which in turn can enhance the transparency and reliability of the financial information presented to the public (Ekaputri and Apriwenni, 2021). A lower ARL tends to indicate that the audit was conducted more efficiently. Audit Report Lag is denoted by ARL, and according to (Zakaria et al., 2018) it is measured as follows.

Audit Report Lag = Audit Report Date - Financial Statement Date

Board governance is represented by the characteristics of the board of commissioners. Unlike countries that implement a one-tier governance system, Indonesia adopts a two-tier system that separates the company's management and oversight functions into two distinct parts. This study uses the characteristics of the board of commissioners as a proxy for board governance because this board plays a more relevant role in carrying out the company's monitoring function. This study will be represented by four proxies: board size, board expertise, board independence, and board diversity. Board Size (BSIZE) is measured by the number of Board of Commissioners members involved in corporate oversight (Muhammad and Wardani, 2025). Board expertise (BEXP) is measured by the proportion of Board of Commissioners members with backgrounds in finance, accounting, information technology, and risk management. This measurement is based on the premise that a board of commissioners with specialized expertise can provide better oversight of business processes (Lee et al., 2024; Zarefar et al., 2026). Board Independence (BIND) is measured based on the proportion of independent board members relative to the total number of board members. A more independent board is often more objective in decision-making and more effective in overseeing management. The presence of independent commissioners enables more transparent oversight of business activities. Board Diversity (BDIV) is measured based on the proportion of female board members in a company (Nurjannah and Oktaryani, 2025). This study also includes firm size, leverage, financial performance, and audit opinion as control variables. These variables were included because previous research has shown that firm characteristics and audit-related factors may influence the delay period in audit reports.

The definitions, measurements, and data sources of the research variables are presented in Table 1.

In this study, BDA was measured using an index adapted from (Ahmed et al., 2023) that encompasses the seven dimensions of BDA itself, namely Volume, Velocity, Variety, Veracity, Variability, Value, and Visualization. These indicators reflect the extent to which companies disclose how they collect, process, integrate, analyze, and utilize large and complex datasets in their business operations. Due to limitations in data access and availability, this study uses only external data available from company annual reports to maintain the consistency and objectivity of the analysis. To measure the extent to which companies have adopted big data, a content analysis method was also applied, enabling researchers to identify and evaluate the level of information usage. Content analysis has been widely applied in research on corporate governance (Endri et al., 2024).

3.3. Research Model

This study uses secondary data obtained from the companies' annual reports. The study covers technology, telecommunications, and healthcare companies over the past 6 years, from 2019 to 2024. The population of companies in this study consists of 49 companies listed on the Indonesia Stock Exchange (IDX). This data was obtained from the official IDX website www.idx.co.id. A multiple regression model was used to test research hypotheses and investigate the individual effects of each explanatory variable on the dependent variable. The regression equation is formulated as follows:

Model: The Relationship between Board Governance, ARL, and Big Data Adoption

$$ARLit = \beta0 + \beta1\ BDA + \beta2\ B.SIZ + \beta3\ B.EXP + \beta4\ B.IND + \beta5\ B.DIV + \beta6\ B.FSIZE + \beta7 B.LEV + \beta8\ B.FP + \beta9\ B.AUDTYP + \beta10\ B.AOP + \epsilon \quad (1)$$

Where:
ARL : Audit Report Lag
BDA : Big Data Adoption
B.SIZ : Board Size
B.EXP : Board Expertise
B.IND : Board Independence
B.DIV : Board Diversity
B.FSIZE: Firm Size
B.LEV : Leverage
B.FP : Firm Performance
B.AUDTYP : Auditor Type
B.AOP : Auditor Opinion
ϵ : Error Term
It : Entity over time

The measurement indicators used to construct the Big Data Adoption index are presented in Table 2.

4. ANALYSIS AND DISCUSSION

4.1. Descriptive and Correlation Analysis

Table 3 presents the descriptive statistics based on 294 company observations during the 2019-2024 period. The ARL variable has a mean of 90.823 days, a median of 88 days, and an interquartile range of 80-98 days, indicating that most companies complete the audit process within approximately 3 months after the end of the fiscal year. The BDA variable has a mean of 0.892 and a median of 0.942, indicating a relatively high level of big data adoption among the sample companies. Regarding the board governance variables, BSIZE, BEXPERT, BIND, and BDIV have means of 1.331, 0.445, 0.444, and 0.578, respectively, indicating variations in board characteristics in terms of size, expertise, independence, and gender diversity. Meanwhile, the control variables also reveal variations in company and auditor characteristics. FSIZE has a mean of 28.459, LEV of 0.447, and FP of 0.033 with a range of values from −2.419 to 1.926, reflecting differences in size, debt financing, and performance across companies. Additionally, AUDTYP has a mean of 0.361, while AUDOPINION is 0.969, indicating that the majority of companies received a Category 1 audit opinion. Overall, these results show that the research variables have sufficient variation to be used in further analysis. The use of descriptive analysis aligns with (Said and Usman, 2025), approach, aimed at providing an overview of the data before statistical testing begins.

Table 4 shows the correlation matrix used to obtain an initial understanding of the relationships among the research variables prior to conducting regression tests. The correlation results show that BDA has a fairly strong negative relationship with ARL of −0.4321, meaning that companies with higher levels of big data adoption tend to have shorter audit completion times. A similar pattern is also observed in the board governance

Table 3: Descriptive statistics

Variable	n	Mean	SD	Min	Max	p25	p50	p75
BDA	294	0.8919568	0.2614042	0.0588235	1.294118	0.7647059	0.9411765	1.058824
LEV	294	0.4465493	0.3222758	−0.018696	2.850724	0.1976701	0.4014313	0.6520735
FSIZE	294	28.45939	2.735056	13.56478	33.33372	27.65227	28.6801	29.89294
BSIZE	294	1.330936	0.4547733	0	2.833213	1.098612	1.386294	1.609438
BIND	294	0.444309	0.1270783	0.25	1	0.3333333	0.4	0.5
BEXPERT	294	0.4453625	0.2725902	0	1	0.25	0.4	0.6666667
BDIV	294	0.5782313	0.7003185	0	3	0	0	1
FP	294	0.0326624	0.2326445	−2.418791	1.926121	0.0023948	0.387118	0.0923307
AUDTYP	294	0.3605442	0.4809771	0	1	0	0	1
AUDOPINION	294	0.9693878	0.1725584	0	1	1	1	1
ARL	294	90.82313	26.8349	36	182	80	88	98

Source: Authors' own work

Table 4: Correlation matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) Arl	1.0000										
(2) Bda	−0.4321*	1.0000									
(3) Bsize	−0.2639	0.4718*	1.0000								
(4) Bexpert	−0.1810	0.2205*	−0.1749*	1.0000							
(5) Bind	−0.0743	0.0511	−0.2257*	0.0632	1.0000						
(6) Bdiv	−0.1046	0.1045	0.2173*	−0.1879*	0.0331	1.0000					
(7) Fsize	−0.1004	0.4525	0.4180*	0.0191	−0.0397	0.1747	1.0000				
(8) Lev	−0.0165	0.1596	0.0523	0.0737	0.1546*	−0.2629*	0.0563	1.0000			
(9) Fp	−0.1045	0.1352	0.0076	0.0359	0.0088	0.1069	0.1814*	−0.2887*	1.0000		
(10) Audtyp	−0.2796	0.5217	0.4408*	0.0041	−0.0866	0.0376	0.3624*	0.0134	0.1384*	1.0000	
(11) Audopinion	−0.2311	0.0199	0.0592	−0.0460	0.0591	0.0622	0.0397	−0.2598	0.1562*	0.0923	1.0000

Source: Authors' own work. * Is significant at 0.05

variables, where BSIZE, BEXPERT, BIND, and BDIV each correlate negatively with ARL, albeit with varying strengths of relationship. Meanwhile, BSIZE and BEXPERT are positively correlated with BDA, indicating that board size and expertise may be associated with increased big data adoption. All correlation values among the independent variables remain below the critical threshold of 0.80, suggesting no initial indication of serious multicollinearity and that the data is suitable for further analysis.

4.2. Multivariate Regression Analyses

Table 5 presents the results of the regression analysis using three panel data estimation models: Pooled OLS, Fixed Effects (FE), and Random Effects (RE). These models were selected to test the effects of BDA, board governance characteristics, and control variables on ARL. The results show that the panel data regression yielded a chi-square value of 20.07 for the Hausman test, with a probability of 0.0286. Since the probability value is less than 0.05, the Fixed Effects model was selected; thus, the main hypothesis testing was conducted using the Fixed Effects model with cluster-robust standard errors at the firm level. The regression results show that BDA has a coefficient of −46.158 with a significance level of 0.021. The negative sign of the coefficient indicates that an increase in big data adoption leads to a decrease in audit report lag. Since the significance level is less than 0.05, BDA is proven to directly accelerate audit reporting. Board Size has a positive coefficient of 12.554 with a significance level of 0.070, meaning it is only significant at the 10% level; thus, its effect on audit report lag is still considered weak. The larger the board, the longer the coordination and decision-making processes may become, potentially slowing down the completion of the audit. Board expertise has a negative and significant effect on audit report lag, with a coefficient of −19.198 and a significance level of 0.025. This indicates that the more board members who possess expertise in finance, accounting, or auditing, the faster the audit process tends to be completed.

4.3. Structure Equation Model

The use of path analysis in this study is based on the mediation analysis approach within the framework of Structural Equation Modeling (SEM). Path analysis is used to identify direct and indirect relationships among variables, specifically to determine whether BDA acts as a mediator in the relationship between board governance and ARL. This mediation approach refers to

Table 5: Pooled, fixed and random effects for our model

Variables	Pooled	FE	RE
BDA	−41.081***	−46.158***	−43.692***
BSIZE	−4.380	12.554	0.422
BEXPERT	−11.672**	−19.196**	−14.979**
BIND	−0.128	−2.100	−7.066
BDIV	−3.697*	−2.566	−2.405
FSIZE	2.047***	1.112	1.419**
LEV	−0.355	2.814	0.283
FP	−8.969	6.515	1.981
AUDTYP	−3.224	−11.505	−5.793
AUDOPINION	−32.691***	−24.009***	−27.378***
Year-effect	Yes	Yes	Yes
Industry-effect	Yes	Absorbed	No
Firm effect	No	Yes	Random
Constant	121.347***	124.800***	132.550***
Observations	294	294	294
R-squared	0.379	0.314	0.339
P-value	0.000	0.000	0.000
Chow/F test		0.000	
LM Test			0.000
Hausman test		0.0286	

Source: Authors' own work. Standard errors in parentheses. ***P<0.01, **P<0.05, *P<0.1

(Baron and Kenny, 1986), who argues that a variable can act as a mediator if the independent variable influences the mediator, and the mediator subsequently influences the dependent variable. This approach is also consistent with (Sarstedt and Moisescu, 2024) that mediation analysis is used to identify the mechanisms through which an effect occurs via an intervening variable. The path relationships among the variables are illustrated in Figure 2.

Table 6 presents the results of path analysis using Structural Equation Modeling (SEM). The results indicate that BSIZE has a significant positive effect on BDA (b = 0.170; s.e. = 0.053; Z = 3.21; P = 0.001 < 0.05). These results indicate that the larger the size of the board of commissioners, the higher a company's level of big data adoption. Furthermore, BEXPERT also has a significant positive effect on BDA (b = 0.268; s.e. = 0.074; z = 3.64; P = 0.000 < 0.05), meaning that the board's expertise is a key factor in driving big data adoption. These findings suggest that boards of commissioners with a larger number of members and greater competence tend to have a stronger capacity to support technology-based strategic decisions. Conversely, BIND does not have a significant effect on BDA (b = 0.179; s.e. = 0.111; z = 1.62; P = 0.106 > 0.05), nor does BDIV (b = −0.008; s.e. = 0.025; Z = −0.32; P = 0.752 > 0.05). Thus, when examining the board

Table 6: Path analysis

Variables	Coefficient	Standard error	Z	P>z	(95% Confidence interval)
BDA ←					
BSIZE	0.1702034	0.0530801	3.21	0.001	(0.0661683, 0.2742385)
BEXPERT	0.2682295	0.0736915	3.64	0.000	(0.1237968, 0.4126621)
BIND	0.1791651	0.1108610	1.62	0.106	(−0.0381185, 0.3964488)
BDIV	−0.0078873	0.0249401	−0.32	0.752	(−0.0567690, 0.0409943)
Cons	−0.0131686	0.2888547	−0.05	0.964	(−0.5793134, 0.5529762)
ARL ←					
BDA	−41.01817	10.72837	−3.82	0.000	(−62.04539, −19.99096)
BSIZE	−4.380353	5.569495	−0.79	0.432	(−15.29636, 6.535656)
BEXPERT	−11.67226	6.808896	−1.71	0.086	(−25.01745, 1.672937)
BIND	−0.1276161	11.77349	−0.01	0.991	(−23.20323, 22.94800)
BDIV	−3.696621	3.190687	−1.16	0.247	(−9.950253, 2.557012)
Cons	121.3470	17.63618	6.88	0.000	(86.78077, 155.9133)
Var (e.BDA)	0.0310028	0.0049102			(0.0227295, 0.0422876)
Var (e.ARL)	445.8252	50.6850			(356.7740, 557.1038)

Source: Authors' own work. Robust standard errors are reported. *** P<0.01, ** P<0.05, * P<0.10

governance pathway to BDA, BSIZE and BEXPERT were found to have a significant effect, whereas BIND, although it has a positive direction toward BDA, does not have a strong enough effect to be considered significant. BDIV has a very small and negative coefficient, so its contribution to an increase in BDA is almost imperceptible in the model.

Regarding the relationship with ARL, BDA has a significant negative effect on ARL (b = −41.018; s.e. = 10.728; z = −3.82; P = 0.000 < 0.05). These results indicate that the higher the level of BDA, the shorter the company's ARL. Thus, H_5 is accepted. This finding is consistent with previous research conducted by (Al-Ateeq et al., 2022; Ratna Sari and Perwita Sari, 2025), which also found that the implementation of big data has had a positive and significant impact on audit quality. Meanwhile, the direct effect of BSIZE on ARL is not significant (b = −4.380; s.e. = 5.569; Z = −0.79; P = 0.432 > 0.05). BIND also had no significant effect on ARL (b = −0.128; s.e. = 11.773; z = −0.01; P = 0.991 > 0.05), nor did BDIV (b = −3.697; s.e. = 3.191; z = −1.16; P = 0.247 > 0.05). Meanwhile, BEXPERT showed a negative effect on ARL at the 10% significance level (b = −11.672; s.e. = 6.809; Z = −1.71; P = 0.086 < 0.10). This indicates that the expertise of the board of commissioners tends to shorten ARL, although its direct effect is not as strong as that of BDA.

The results of the indirect effect test show that BDA mediates the relationship between BSIZE and ARL (b = −6.981; s.e. = 2.598; Z = −2.69; P = 0.007 < 0.05), thus accepting H_1. The negative coefficient on this path indicates that BSIZE can contribute to a reduction in ARL through an increase in BDA. In other words, a larger board size can provide greater oversight capacity, resources, and a broader perspective in driving big data adoption, thereby making the information provision and audit completion processes more efficient. Furthermore, BDA was also found to mediate the relationship between BEXPERT and ARL (b = −11.002; s.e. = 4.026; Z = −2.73; P = 0.006 < 0.05), thus H_2 is accepted. These results indicate that board expertise—particularly in finance, accounting, auditing, or related professional fields—can encourage companies to adopt big data, which ultimately helps accelerate the audit process and shorten ARL.

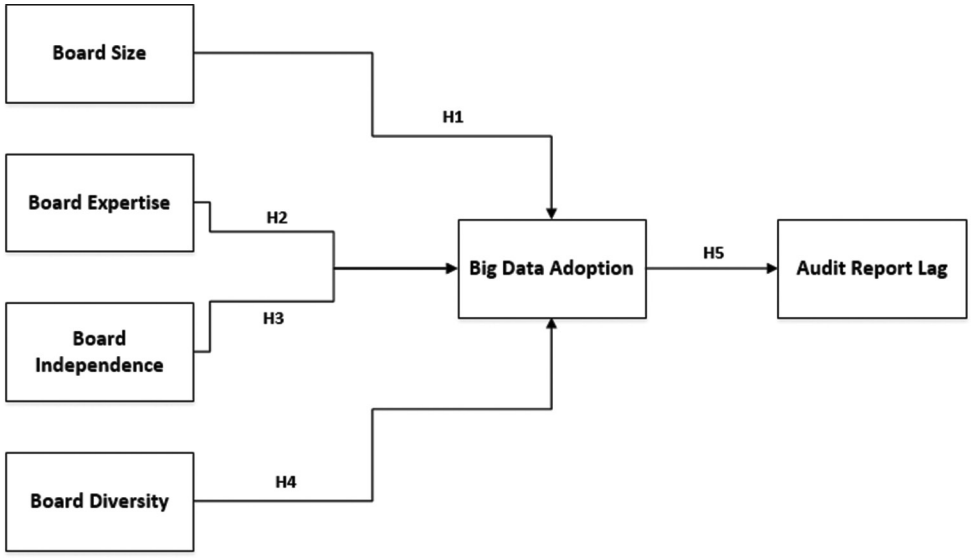
Table 7: Regression of PCA Internal Governance, BDA and ARL

Variables	(1)	(2)	(3)
	BG indices on ARL	BG indices on BDA	BDA, BG indices on ARL
BDA			−47.738***
			(10.056)
BG	0.117	−0.012	−0.438
	(1.921)	(0.019)	(1.608)
Leverage	−4.267	0.122	1.563
	(7.042)	(0.086)	(5.911)
Firm size	0.634	0.026*	1.876***
	(0.680)	(0.015)	(0.586)
FP	−12.064**	0.065	−8.946
	(5.644)	(0.085)	(6.411)
AUDTYP	−12.697***	0.212***	−2.582
	(4.632)	(0.041)	(3.832)
AUDOPINION	−31.922***	−0.005	−32.158***
	(11.370)	(0.074)	(9.404)
Constant	111.085***	0.136	117.600***
	(24.048)	(0.405)	(18.894)
Year-effect	Yes	Yes	Yes
Industry-effect	Yes	Yes	Yes
Observations	294.000	294.000	294.000
R-squared	0.240	0.442	0.361

Source: Authors' own work. Standard errors in parentheses *P<0.10, **P<0.05, ***P<0.01

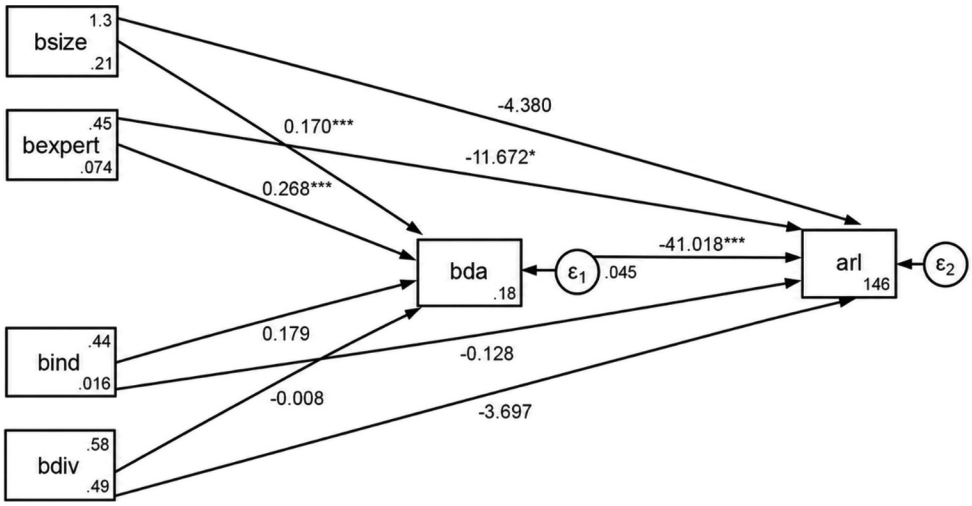
Conversely, BDA was not found to mediate the relationship between BIND and ARL (b = −7.349; s.e. = 4.718; Z = −1.56; P = 0.119 > 0.05), so H_3 is rejected. This suggests that board independence is not yet strong enough to drive BDA to the point of reducing ARL. BDA also does not mediate the relationship between BDIV and ARL (b = 0.324; s.e. = 1.039; Z = 0.31; P = 0.755 > 0.05), so H_4 is rejected. The lack of significance in this path indicates that board diversity is not directly related to BDA decisions in the sample companies. Thus, the SEM results show that H_1, H_2, and H_5 are accepted, while H_3 and H_4 are rejected. From these results, it can be concluded that BDA acts as a mediator for BSIZE and BEXPERT in relation to ARL, but not for BIND and BDIV. Consequently, the capacity and expertise of the board of commissioners play a greater role in driving the use of big data.

Figure 1: Theoritical framework



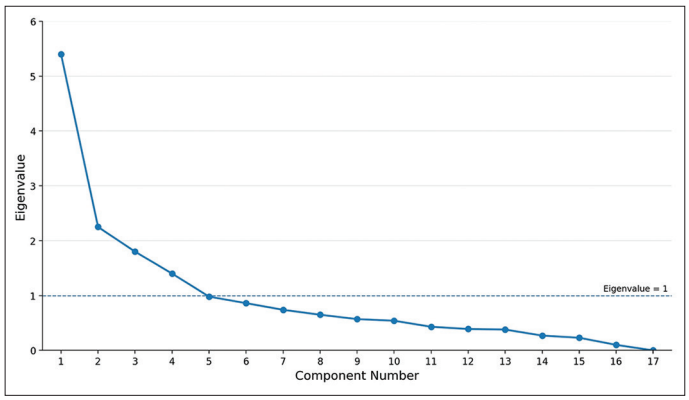
Source: Authors' own work

Figure 2: Diagram research line



Source: Authors' own work

Figure 3: Scree plot of eigenvalues after PCA



Source: Authors' own work

4.4. Robustness Test

Table 7 shows the results of the PCA analysis to combine the board governance variables. Figure 3 shows a plot of the eigenvalues after PCA, which indicates that the eigenvalues of the PCA board governance model have a positive but insignificant effect on ARL Model 1 (b = 0.117, P > 0.05). The second BG index model also did not significantly influence BDA, with a coefficient of (b = −0.012, P > 0.05); thus, the PCA-based internal governance index is not a significant factor in big data adoption. The results for BDA in Model 3 showed a negative and significant effect on ARL (b = −47.738, P > 0.01), with an R-squared value of 0.361. These results indicate that a higher level of big data adoption is associated with shorter audit report delays; companies with stronger big data adoption tend to complete the audit process more quickly. Meanwhile, after incorporating BDA into the board governance index model, the results were not significant, with a coefficient of (b = −438, P > 0.05). Overall, the regression test shows that BDA plays a significant role in reducing audit reporting delays, whereas the PCA-based BG index does not significantly affect either ARL or BDA.

Table 8: Regression analysis for early and late adoption of big data on ARL

Variables	Early adoption 2019-2020	Late adoption 2021-2024
BDA	−70.956*** (20.345)	−27.238*** (9.462)
BDIV	−8.081 (5.004)	−3.757 (3.029)
BSIZE	5.285 (9.857)	−6.962 (5.236)
BIND	−13.189 (38.006)	3.527 (9.981)
BEXPERT	−15.714 (14.748)	−10.867* (5.659)
FSIZE	2.095* (1.124)	1.640*** (0.537)
LEV	−9.385 (17.458)	−2.042 (4.778)
FP	−74.802* (42.902)	−5.826 (4.791)
AUDTYP	−4.380 (7.140)	−2.819 (3.446)
AUDOPINION	−10.249 (22.086)	−41.388*** (12.948)
Industry-effect	Yes	Yes
Constant	131.967** (50.425)	124.425*** (16.854)
Observations	98	196
R-squared	0.384	0.386

Source: Authors' own work. Standard errors are in parentheses. ***, **, and * indicate significance at 1%, 5%, and 10%

4.5. Early Versus Late Adoption of Big Data

In the following section, we divided the sample into two groups based on different time periods: Early adoption and late adoption. This two-period analysis was conducted to determine whether the effect of BDA on ARL differs between the early and later stages of BDA adoption. The period was divided into two groups based on years: (1) Early adoption during the 2019-2020 period; (2) late adoption during the 2021-2024 period.

Based on the test results presented in Table 8, it can be seen that BDA has a significant negative effect on ARL in both the early adoption and late adoption periods. In the early adoption period, BDA has a coefficient of −70.956 at the 1% significance level, while in the late adoption period, BDA has a coefficient of −27.238 at the 1% significance level. These results indicate that BDA is consistently associated with a decrease in ARL in both periods. Comparing the two periods, it is evident that BDA has a larger coefficient in early adoption than in late adoption, suggesting that in the initial stage, the implementation of big data has a greater impact on audit process efficiency. Meanwhile, during the late adoption phase, the effect remains significant, but the value is smaller—likely because the use of big data has become more stable and its impact on ARL is not as substantial as in the early stages. From the perspective of board governance, BDIV, BSIZE, and BIND have not been shown to have a significant effect on ARL during the early adoption phase. In contrast, during late adoption, BEXPERT was found to have a significant negative effect at the 10% level, indicating that board expertise begins to play a role in shortening the audit report lag once big data adoption has become more established.

In examining findings related to the speed of technology adoption, the results of (Dagilienė and Klovienė, 2019) study align with the perspective that the decision to adopt big data early is a response to environmental pressures. Furthermore, the findings of this study also support the argument from (AL Lawati et al., 2024) that the transition to big data is not merely a technological trend but a crucial necessity for improving audit quality. Therefore, the difference in the impact of BDA in the early and late stages can be understood as a result of differences in companies' readiness to optimally utilize big data technology.

5. CONCLUSION, IMPLICATIONS AND ROAD MAP FOR FUTURE RESEARCH

This study examines the role of big data adoption (BDA) in the relationship between board governance characteristics and audit report lag (ARL) among Indonesian listed companies in the technology, telecommunications, and healthcare sectors. The results indicate that BDA has a negative and significant effect on Audit Report Lag (ARL), indicating that companies with higher levels of disclosed big data adoption tend to complete their audits within a shorter period. These findings reinforce previous research emphasizing that big data can help improve audit quality and that BDA can serve as a solution for auditors not only to meet regulatory requirements but also to provide added value by conducting more efficient, data-driven audit processes (Ahmed et al., 2023; Dagilienė and Klovienė, 2019; Said and Usman, 2025). Thus, these findings are consistent with prior literature that views big data as a key instrument in enhancing audit effectiveness. Furthermore, BDA was found to mediate the relationship between BEXP and BSIZE, indicating that board size and expertise can contribute to a reduction in ARL if both factors effectively promote the adoption of big data within the company. In contrast, BDA does not serve as a mediating variable in the relationship between board independence and gender diversity on the board and ARL. These findings suggest that formal independence and gender diversity alone may be insufficient to promote BDA unless directors possess the authority, expertise, and substantive involvement necessary to influence technology-related decision-making.

This study contributes to theory in two ways. From an agency theory perspective, the results suggest that BDA may strengthen the board's oversight function by improving access to timely and comprehensive corporate information, thereby reducing information asymmetry and supporting a more efficient financial reporting process. From the Technology–Organization–Environment (TOE) framework, the findings suggest that board size and expertise are organizational conditions that can facilitate technology adoption through resource allocation, strategic support, and informed decision-making. Therefore, BDA provides an organizational mechanism through which specific characteristics of the board may influence the timeliness of audits. The findings also have practical implications. For organizations, the findings highlight the need to strengthen data infrastructure and ensure that boards with adequate resources and relevant expertise actively support big data adoption to improve audit readiness and reduce audit report lag. For investors, the findings suggest that companies with stronger big data adoption may provide audited financial information more promptly, enabling more timely evaluation of firm performance and better-informed investment decisions. For auditors and regulators, these results underscore the importance of promoting companies' digital readiness, data governance, and transparency as part of efforts to enhance the timeliness and quality of financial reporting.

This study is subject to several limitations that also provide opportunities for future research. First, the sample is limited to companies in the technology, telecommunications, and healthcare sectors, which may restrict the generalizability of the findings to other industries. Future research could expand the sample scope by including more industry sectors or by comparing companies with high and low levels of technology adoption to examine the role of BDA in different business contexts. Second, the BDA is measured based on information disclosed in annual reports and may reflect only the disclosed initiatives rather than the full scope, maturity, or effectiveness of actual implementation. Therefore, interviews and surveys are considered effective methods for gaining a more direct understanding of an organization's actual practices. There are limitations to drawing causal conclusions because this study still employs observational research design. Future research could employ a longitudinal or mixed-methods approach to capture not only the statistical relationships among variables but also the organizational processes involved in applying big data in financial reporting and auditing practices. Future research could also incorporate additional mediating or moderating variables, such as auditors' technological competence or the quality of information systems, to provide a more in-depth explanation of the relationship between governance, technology, and timeliness.

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