Leveraging Expertise for Digitalizing Indonesian Public Sector Performance Audits

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Abstract

Global digital transformation is reshaping audit practices through technologies such as data analytics, artificial intelligence, and automation that enhance accuracy, efficiency, and scope. This study explores Indonesian auditors' perspectives and experiences regarding audit digitalization, particularly in the context of public sector performance audits. This qualitative research employs semi-structured interviews with 8 auditors from audit firms, analyzed using Braun and Clarke's thematic analysis approach. The study examines auditors' understanding of perceived benefits, encountered obstacles, required new skills, and necessary support for integrating digital technologies into audit activities. Findings reveal that audit digitalization offers significant benefits in efficiency, accuracy, and transparency, yet implementation faces challenges including limited human resources, poor data quality, and high costs. Auditors require both technical and non-technical skills, along with training and infrastructure support from audit firms. For the public sector, digitalization holds substantial potential for strengthening accountability and enabling data-driven policymaking. However, challenges such as bureaucratic barriers, inadequate data integration, and limited information systems infrastructure must be addressed. This study provides valuable insights and practical recommendations to support the digitalization of Indonesian public sector performance audits, ultimately enhancing the effectiveness and efficiency of public resource utilization.

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Introduction

Accountability and efficiency are paramount for effective public sector governance, with performance audits playing a crucial role in ensuring their optimal implementation (Ismail et al., 2019; Purnamasari et al., 2024; Virnandes et al., 2024). These audits assess compliance with regulations and evaluate the effectiveness, efficiency, and economy of public resource utilization in achieving organizational objectives (Alqudah et al., 2019; Bini, 2019; Reichborn-Kjennerud et al., 2019). The global digital transformation is reshaping public sector performance audit practices (Bini, 2019; Leng & Zhang, 2024; Nguyen et al., 2020; Pizzi et al., 2021). The adoption of technologies such as big data analytics, artificial intelligence, and workflow automation is increasingly commonplace, enhancing audit accuracy, speed, and scope (Luan et al., 2024; Pizzi et al., 2021). In Indonesia, the drive to digitalize public sector audits is further propelled by the government's initiatives to achieve transparent and accountable governance, as well as the public's demand for quality and efficient public services (Purnamasari et al., 2024; Sabani et al., 2019; Widyaningsih et al., 2019). The use of technology in performance audits is expected to

strengthen oversight, minimize potential irregularities, and promote more effective and results-oriented use of state budgets for the optimal benefit of society.

The digitalization of public sector performance audits has become essential in the modern era, as it enables the utilization of big data for more comprehensive and precise analysis, enhances objectivity in evaluating performance, and increases efficiency throughout the audit process (Lu et al., 2024; Manita et al., 2019). Digital technologies empower auditors to rapidly access and analyze vast amounts of data, thereby identifying patterns and anomalies that may have remained obscured through traditional methods (Leng & Zhang, 2024; Liu et al., 2025; Pham & Vu, 2025; Vitali & Giuliani, 2024). However, the implementation of digitalized performance audits in developing nations often confronts significant obstacles, such as limited resources, inadequate information technology infrastructure, and a shortage of personnel skilled in technology and data analysis (Andrews et al., 2022; Reichborn-Kjennerud et al., 2019; Webb, 2019). Consequently, investing in digital infrastructure and developing human resource capacity represents a crucial step to support the digital transformation of performance audits in developing countries (Lois et al., 2020; Lu et al., 2024; Ruiz et al., 2024; Sabani et al., 2019).

Despite limited research on the digitalization of public sector audits in Indonesia (Marsely, 2020; Purnamasari et al., 2022; Sabani et al., 2019), this study aims to explore the existing knowledge gap in this area. While private sector entities, particularly Audit Firms, tend to be more advanced in adopting audit technologies (Al-Khasawneh, 2022; Ismail et al., 2019), their experiences can offer valuable insights and lessons that can be applied to the public sector. The rationale for using Private Sector Expertise as a sample in this study is based on the assumption that their mature and tested digitalization practices can provide a rich and relevant perspective for understanding the potential, challenges, and implementation strategies of technology in the context of public sector performance audits in Indonesia (Al-Khasawneh, 2022; Apandi et al., 2022; Volodina & Grossi, 2024). Thus, this study is expected to bridge the knowledge gap and provide practical contributions to the ongoing efforts to modernize public audits.

This study seeks to fill a crucial gap in the existing literature by exploring the perspectives and experiences of auditors in public practice regarding the digitalization of audit processes. Previous research has highlighted the broader challenges of digital transformation in the Indonesian public sector, such as low internet penetration, bureaucratic integration issues, and limited digital literacy among civil servants (Aminah & Saksono, 2021; Purnamasari & Hartanto, 2022; Putri & Retnosari, 2023; Saadah et al., 2023; Saifullah et al., 2019; Sudrajat, 2021). However, there is a dearth of in-depth understanding from the auditors' viewpoint on the key benefits, challenges, and skill requirements associated with the implementation of digital technologies in audit practices (Dempsey & Dyk, 2024; Kacanski, 2016; Lois et al., 2020; Nezhyva & Міняйло, 2020; Volodina & Grossi, 2024).

This study aims to address this research gap and provide actionable insights that can inform strategies and policies for enhancing the digitalization of performance audits in the Indonesian public sector. This study addresses this research gap by providing an in-depth understanding of the auditors' experiences, which can inform more targeted and effective policies and initiatives for the digitalization of public sector performance audits in Indonesia.While previous research has highlighted the broader challenges of digital transformation in the Indonesian public sector, such as low internet penetration, bureaucratic integration issues, and limited digital literacy among civil servants (Pratama et al., 2024), this study aims to provide actionable insights from the auditor's viewpoint. By understanding the key benefits, challenges, and skill requirements associated with the implementation of digital technologies in audit practices, this study offer valuable lessons for enhancing the digitalization of performance audits in the Indonesian public sector. The findings are expected to inform strategies and policies that can help bridge the gap between the aspirations of a digital economy and the practical realities faced by government agencies in optimizing their audit processes through technological advancements.

This study looks at how Indonesian auditors see and experience the digital transformation of audit practices. Based on the private sector's experiences, this study examines Auditor’s understanding of the

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benefits, challenges, new skills needed, and support required, to bring digital tech into audit practices. The big goal is to uncover insights and hurdles from Audit Firms' digitalization efforts.

This study explores crucial aspects of audit digitalization in Indonesia. First, this study aims to identify the key benefits and challenges perceived by auditors when implementing digital technologies, such as data analysis or CAATTs, during the audit process, based on their experiences. Secondly, this study seeks to understand the essential skills required for auditors' success in the digital era, and the support needed from companies and from professional organizations. Thirdly, this study aims to identify important lessons from the private sector's experience with audit digitalization, as well as unique challenges that the Indonesian public sector face in adopting similar technologies, to enhance their performance audits.

This study contributes the digitalization of public sector performance audits in Indonesia. Drawing from the perspectives and experiences of private sector auditors, this study offers valuable lessons for improving the effectiveness and efficiency of public sector audits. By examining the benefits, challenges, and essential skills linked to adopting digital technologies in audit practices, this study bridges a critical knowledge gap. The findings of this study also contribute to guide the modernization of public sector audits in developing countries such as Indonesia. Drawing on the mature and proven digitalization practices of private audit firms, this study provides practical recommendations to support ongoing efforts to digitalize public sector audits. These contributions ultimately bolster public sector accountability. Furthermore, this study contributes to public policy decision makers in developing policies regarding the digitalization of audits.

Literature Review

Public Sector Performance Audits

Public sector performance audits are a structured process undertaken to independently examine and assess the performance of government organizations, programs, or functions (Ismail et al., 2019; Mahsun et al., 2021; Sabani et al., 2019; Yasin et al., 2019). While these studies establish the fundamental role of performance audits, they often emphasize the compliance aspect. In contrast, other scholars argue that the primary aim of these audits should extend beyond mere compliance to provide an objective and reliable evaluation of whether public resources have been utilized in an economical, efficient, and effective manner to achieve predefined goals, thereby driving performance improvement (Caiden & Caiden, 1998; Cîmpan et al., 2023; Haliah et al., 2020; Harrell & Barbacci, 2018; Jackson, 1993; Kamara, 2023; Nirupa & Mark, 2012). These audits not only focus on compliance with regulations but also on identifying ways to optimize resource utilization, enhance desired outcomes, and recommend strategies for future performance improvement (Beckmerhagen et al., 2004; Brommelsiek & Tinsley, 1996; Chambers & Rand, 2012; Harrell & Barbacci, 2018; Lee & Novac, 2014; Lombardi et al., 2014; Mihiotis & Konidaris, 2006; Shaikh et al., 2018).

In the context of developing countries, public sector performance audits play a crucial role in fostering public accountability (Caiden & Caiden, 1998; Haliah et al., 2020; Kamara, 2023). Given the often limited resources available, it is essential to ensure that every unit of public funds is used responsibly and delivers maximum benefits to society (Caiden & Caiden, 1998; Igibayeva, 2020). These audits help identify inefficiencies, waste, and ineffective practices, thereby encouraging governments to be more transparent and accountable in managing state finances (Caiden & Caiden, 1998; Cunanan et al., 2022; Navarro et al., 2023). The findings and recommendations from performance audits can serve as a foundation for policy refinements, program enhancements, and ultimately, the improvement of public service quality and societal well-being (Baldwin, 2025; Halai et al., 2021; Haliah et al., 2020; Kwanbo, 2010; Rana et al., 2021).

Fintech and Audit Digitalization

Fintech encompasses a broad range of technological innovations applied to the financial sector, including mobile payment systems, online lending platforms, and advanced algorithms for risk assessment and fraud detection (Crouhy et al., 2021; Jagtiani & John, 2018). While audit digitalization focuses on the use of technology in the audit process, it is closely linked to the fintech revolution(Castri et al., 2018; Udeh et al., 2024). Technologies developed for the financial technology (fintech) industry often have functions that can be adapted for use in audits (Fedyk et al., 2022; Oladejo & Jack, 2020; Rodríguez-Quintero et al., 2021). For example, the advanced data analysis techniques that fintech companies use to analyze transaction patterns for credit assessment can also be valuable in audits to identify irregularities in financial statements.

The rise of financial technology has transformed various aspects of financial services and has the potential to impact audit practices. The use of technologies such as the Quick Response Code Indonesian Standard (QRIS) for non-cash transactions demonstrates how technology can enhance efficiency and user satisfaction, mediated by ease of use and the usage factor itself (Mirza et al., 2023; Tricahyono et al., 2024). In the context of audits, process digitalization is becoming increasingly important (Apandi et al., 2022; Tricahyono et al., 2024; Udeh et al., 2024). Understanding technology acceptance, as described in the Technology Acceptance Model, is relevant to understanding how auditors and audited entities adopt new digital tools (Prastyatini & Galaa, 2023). Audit digitalization can also help in detecting and preventing fraud, given the high incidence of fraud in various industry sectors (Qoshidah et al., 2025).

The rise of financial technology (fintech) has led to a surge in the volume and diversity of digital financial data (Leonov et al., 2020; Sun et al., 2024). Fintech platforms generate data on transactions, payments, investments, and customer behavior, which can provide auditors with a more comprehensive and detailed understanding of an organization's financial health (Ahmadi, 2024; Chu & Yong, 2021; Mhlanga, 2024). Even in cases where companies rely on traditional bank transfer methods, digital recordkeeping has led to increasingly digitalized audit trails (Apandi et al., 2022; Fedyk et al., 2022). The rapid advancements in financial technology have led to a significant growth in digital financial data, both in terms of volume and diversity (Zhong-qing et al., 2019). Fintech applications and platforms generate data on transactions, payments, investments, and customer behavior, which can provide auditors with a more comprehensive and detailed understanding of an organization's financial condition (Sun et al., 2020; Tekaya et al., 2020; Udeh et al., 2024). As a result, auditors must have the ability to access, analyze, and interpret this data, regardless of its source, highlighting the growing interconnection between financial technology and the digitalization of the audit process.

Fintech has also impacted how auditors assess risk (Sun & Qu, 2020; Wang, 2023). Fintech companies utilize advanced algorithms to identify and manage financial risks, such as credit risk and fraud risk. These techniques can inform and enhance audit risk assessment methodologies (Bazarbash, 2019; Roszkowska, 2020). For instance, machine learning algorithms can be employed to analyze large datasets and identify patterns that may indicate potential fraud (Elsayed, 2017; Ikudabo & Kumar, 2024; Xu et al., 2024). These capabilities are highly relevant for auditors seeking to improve the accuracy and efficiency of their risk assessment procedures.

The rapid advancements in financial technology necessitate a dynamic and adaptable regulatory environment. Regulators grapple with issues such as data security and privacy, which have direct implications for the digitalization of the audit process (Batista & Ringe, 2020; Castri et al., 2018). Auditors must be cognizant that the evolving fintech regulatory landscape may shape new standards and procedures they must adhere to when auditing companies utilizing fintech solutions. Auditors need to understand and comply with regulations related to data privacy, information security, and other requirements applicable to the fintech industry (Alam et al., 2019; Vijayagopal et al., 2024). Auditors' knowledge of these regulations will assist them in effectively and compliantly executing their duties.

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The blurring of boundaries between fintech and audit digitalization is a likely future trend. Advancements in fintech will create new opportunities and challenges for auditors. Even organizations currently relying on traditional methods may be influenced by fintech innovations, whether through competitive pressures, changes in customer behavior, or the adoption of new technologies to enhance their own efficiency (Ali et al., 2018; Arner et al., 2017; Kou & Lu, 2025). Consequently, auditors must proactively engage with fintech developments, acquire the necessary skills to audit fintech-driven data and systems, and contribute to the ongoing dialogue about the future of auditing in a fintech-influenced environment.

Concepts of Performance Audit and Audit Digitalization

Performance audits in the public sector are a structured process to independently examine and assess the performance of government organizations, programs, or functions (Bini, 2019; Liu et al., 2025). The main purpose of Performance Audits is to provide an objective and reliable evaluation of how economically, efficiently, and effectively public resources are used to achieve stated goals (Caiden & Caiden, 1998; Harrell & Barbacci, 2018; Ismail et al., 2019). These audits focus not just on compliance with regulations, but also on finding ways to optimize resource use, improve desired outcomes, and recommend strategies for future performance enhancement (Eze & Ibrahim, 2015; Gingerich, 2002). In developing countries, performance audits play a crucial role in promoting public accountability, ensuring responsible use of public funds, and encouraging transparency in public financial management (Caiden & Caiden, 1998; Heinrich, 2008).

Audit digitalization involves incorporating digital technologies into traditional audit practices. This includes using tools like data analytics, artificial intelligence, and automated workflows (Ellul & Buttigieg, 2021; Fedyk et al., 2022). This shift has significantly changed the entire audit process, from planning to reporting. Research shows that this digital transformation offers benefits such as improved efficiency, the ability to analyze large datasets, better risk identification, and deeper insights for decision-making (Al-Khasawneh, 2022; Fedyk et al., 2022; Fotoh & Lorentzon, 2022; Leocádio et al., 2024; Lois et al., 2020). Audit digitalization expands this concept by leveraging technology for more in-depth and efficient data collection, analysis, and reporting. For example, audit delay can be influenced by various internal company factors, including operational complexity, which can be facilitated by digital tools (Al-Faruqi, 2020). In the context of SMEs, the implementation of simple, even manual, accounting practices is a first step towards better accountability, which can then be enhanced through the adoption of accounting technology for business sustainability (Cordery et al., 2023; Gao, 2024). Digitalization also enables more comprehensive and transparent disclosure, such as the disclosure of Environmental, Social, and Governance aspects, whose role is moderated by institutional ownership on firm value (Fauziah et al., 2024; Hu & Yang, 2024). Similarly, charitable non-profit organizations use web platforms for accountability, although there is often a practice of selective disclosure, particularly related to financial data (Cordery et al., 2023; Fauziah et al., 2024; Qoshidah et al., 2025; Mirza et al., 2023; Suandi & Asrimiyanti, 2025).

While the adoption of audit digitalization offers numerous benefits, it also presents a complex array of challenges for auditors. One of the primary obstacles is the limited human resources, as many auditors lack the in-depth understanding or adequate skills required to effectively utilize digital technologies (Fotoh & Lorentzon, 2022; Kokina et al., 2025; Lois et al., 2020). Furthermore, the lack of appropriate training and access to the necessary resources to build digital capacity are significant constraints(Berghout et al., 2022; Leng & Zhang, 2024; Lois et al., 2020). Additionally, data quality and availability pose major challenges, as many financial information systems, particularly in the public sector, are not yet integrated or still rely on manual methods, resulting in data that is often non-standardized, fragmented, and difficult to analyze digitally (Ding et al., 2017; Seyam et al., 2016). Other impediments include limited infrastructure and high costs associated with investments in hardware, software, and the necessary training required for auditors (Lois et al., 2020; Okab, 2013).

The interplay between performance audits and audit digitalization is pivotal in the contemporary landscape. Digitalization empowers auditors to rapidly access and analyze extensive datasets, enabling the identification of patterns and anomalies that may go unnoticed through conventional methods (Fedyk et al., 2022; Fotoh & Lorentzon, 2022; Lois et al., 2020). This directly aligns with the purpose of performance audits, which is to evaluate efficiency and effectiveness. By harnessing digital technology, performance audits can be more comprehensive, precise, objective, and efficient, ultimately enhancing accountability and supporting data-driven policymaking in the public sector (Ellul & Buttigieg, 2021; Loke et al., 2016; Masood & Lodhi, 2015). To overcome these challenges, auditors necessitate a combination of technical and non-technical competencies, as well as ongoing organizational support in the form of adequate training and infrastructure (Apandi et al., 2022; Oladejo & Jack, 2020; Vitali & Giuliani, 2024).

Skills and Support for Audit Digitalization

The adoption of key technologies, such as Computer-Assisted Audit Techniques and Data Analytics, has driven significant changes to traditional auditing practices, transforming the process from planning to reporting (Serpeninova et al., 2019; M. Sun & Qu, 2020; Y. Sun et al., 2024; Teeter et al., 2010). While the literature extensively documents the advantages of this digital transformation, such as enhanced efficiency, the capacity to analyze extensive datasets, more accurate risk identification, and deeper insights to inform decision-making (Fotoh & Lorentzon, 2022; Leocádio et al., 2024; Nwankpa, 2014; The Role of Technology in Auditing, 2024), there is less emphasis on the potential drawbacks and challenges of relying heavily on technology in auditing. This paper will explore both the benefits and challenges.

Nevertheless, this transition also presents a range of challenges, necessitating auditors to acquire new skillsets, initial investments in technological infrastructure, concerns regarding data security, and the need to seamlessly integrate novel digital tools and techniques into existing audit workflows (Friedlich, 2024; Lois et al., 2020; Nwankpa, 2014; Thompson, 2018; Wang, 2023). Audit digitalization requires both auditors and audited entities to possess adequate expertise and receive sufficient support. A strong understanding of finance and technology is crucial for all involved to ensure successful implementation(Apandi et al., 2022; Manita et al., 2019). For instance, research shows that audit quality, often associated with reputable audit firms, positively impacts the extent to which companies disclose their ethical values (Knechel, 2016; Qoshidah et al., 2025; Rakhman & Wijayana, 2024). Furthermore, regulatory support in the form of a clear legal framework, as well as efforts to enhance the capabilities of human resources in the field of sustainable finance, also play a key role in promoting the adoption of digital and sustainable practices across various sectors (Castri et al., 2018; Mirza et al., 2023; Rosalika et al., 2024; Septiana et al., 2024).

The context of audit digitalization in Indonesia reflects an intriguing trend across both the public and private sectors (Harsanto et al., 2022; Meiryani et al., 2021; Purnamasari et al., 2022; Purnamasari & Hartanto, 2022; Yasin et al., 2019). Comprehensive data regarding the extent of technological adoption across all audit firms may not be readily available; however, observations and discourse within the profession indicate a burgeoning awareness and implementation of audit-related technologies (Lamboglia et al., 2020; Lestari et al., 2020; Tysiac, 2022). Large audit firms with multinational clients tend to be at the forefront of adopting technology-based audit tools, such as data analytics and automation (Oldhouser, 2016; Teeter et al., 2010; Tysiac, 2022; Vasarhelyi & Romero, 2014). Similarly, in the public sector, the Supreme Audit Institution of Indonesia, as the country's highest audit body, demonstrates a strong commitment to digitalization (Agustina & Indrayani, 2020; Pratama et al., 2024; Purnamasari & Hartanto, 2022; Sudrajat, 2021; Yasin et al., 2019). SAI Indonesia has initiated various programs and technology-based information systems to enhance the efficiency and effectiveness of audits, including the utilization of big data and other analytical tools in state financial examinations (Giovani et al., 2023; Purnamasari & Hartanto, 2022; Sudrajat, 2021; Yasin et al., 2019). These initiatives indicate a significant drive towards digital transformation in audit practices within Indonesia.

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Vol. 12, No. 1, March 2025, pp. 94-118

Research Method

This study employed a qualitative research methodology with an exploratory design. The rationale for the use of a qualitative methodology with an exploratory design is that it enables a deep and comprehensive understanding of the individual perspectives and experiences pertaining to the phenomenon under investigation (Flick, 1998; Merriam, 2009; Najam & Ghazal, 2022; Perri & Bellamy, 2012). This qualitative methodology enables researchers to gather in-depth and comprehensive insights from participants, thereby providing a profound understanding of the issue of audit digitalization from the practitioners' point of view.

The participants in this study consists of auditors working in Audit Firms located in major cities in Indonesia. The sample size is between 8 auditors, with a minimum criterion of being a Senior Auditor to ensure relevant experience, as presented in Table 1. The eight (8) informants were selected based on their knowledge and experience related to the research topic. The selection began with one key informant and continued on the basis of referral from the initial participant until reaching eight (8) informants in total as the reaching saturation point (Goodman, 1961; Luborsky & Rubinstein, 1995; Robinson, 2014; Shorten & Moorley, 2014). Efforts will be made to involve auditors from various sizes of Audit Firms to obtain diverse perspectives.

Primary data were collected from the informants through online and offline semi-structured interview. Semi-structured interviews were selected as the main data collection method to allow an in-depth exploration of the participants' perspectives while maintaining a degree of structure in the interview process. The interviews will be conducted either face-to-face or virtually via video conferencing.

The research will employ thematic analysis, following the framework developed by Braun & Clarke, (2006). First, the interview transcripts were carefully reviewed multiple times to familiarize the researchers with the data and gain a deep understanding of the participants' perspectives. Next, the data was systematically coded, with relevant text segments identified and labeled. Similar codes were then grouped together to search for broader themes emerging from the data.

To ensure the validity and coherence of the themes, an iterative process of reviewing and refining was undertaken. Finally, the research team clearly defined and named each theme to capture its essence concisely.

Table 1. Summary of Participant Demographics

Participant	Job Level/ Position	Work Experience	Firm Category	Main Digital Audit Technology/Tools Used
P1	Senior Auditor	3 - 5 years	Non-Big Four	Caseware
P2	Junior Auditor	< 3 years	Non-Big Four	Excel
P3	Partner	> 10 years	Non-Big Four	Atlas
P4	Partner	> 10 years	Non-Big Four	ATLAS
P5	Junior Auditor	3 - 5 years	Prefer Not to Disclose	Excel
P6	Partner	6 - 10 years	Non-Big Four	Atlas
P7	Manager	> 10 years	Non-Big Four	Excel
P8	Junior Auditor	3 - 5 years	Non-Big Four	ATLAS

The findings from this rigorous thematic analysis are presented in the report, and any secondary data collected has been integrated into the analysis to provide a richer and more in-depth context to the research findings. This multi-step approach, combined with the consideration of trustworthiness factors such as credibility, transferability, dependability, and confirmability, ensures the reliability and validity of the study's results.

Results and Discussion

Result

The Real Benefits of Audit Digitalization in Audit Firms

Table 2 presents the main themes and benefits of audit digitalization, as identified by participants in this study. The themes are categorized based on the advantages of digitalization in the audit process, including time efficiency, accuracy, data analysis, visualization, documentation, control, transparency, and issue identification. Quotes from participants are included to illustrate each theme and provide insight into their experiences with audit digitalization.

Table 2. Auditor Perspectives on Digitalization in Audit

Main Theme	Brief Theme Description	Quote from Participant (Anonymous)
1. Time Efficiency and Speed.	Audit digitalization significantly speeds up the audit process. This includes accelerating financial statement analysis, determining account materiality, and processing data.	*"Can monitor audit programs and help identify audit risks within one audit cycle*" (P1, Senior Auditor, 3-5 Years)*"Time efficiency, deeper data analysis capabilities, clear data visualization,* (P2, Junior Auditor, < 3 years)
2. Increased Accuracy and Detail	The use of digital audit technology improves data accuracy and enables more detailed analysis.	*"The use of digital audit technology speeds up the audit process, improves data accuracy, and facilitates analysis and team collaboration. Additionally, documentation is neater and audit transparency is increased."* (P8, Junior Auditor, 3-5 years)
3. Deeper Data Analysis Capabilities	Digital technology enables auditors to conduct more in-depth data analysis, including big data analysis.	*"Improving performance, addressing HR and training limitations, utilizing big data analysis, being responsive, and emphasizing the importance of big data access."* (P7, Manager, 7-10 years)
4. Effective Data Visualization	Audit digitalization enhances data visualization clarity, facilitating more accurate understanding and interpretation of audit findings.	"*clear data visualization*" (P2, Junior Auditor, < 3 years)
5. Neat and Reproducible Documentation	Digital technology enables audit documentation to be more systematic, organized, and easily reproducible.r.	*"neat and reproducible documentation, no need for additional software."* (P2, Junior Auditor, < 3 years)
6. Enhanced Control and Compliance Capabilities	Digitalization of audit enhances control and compliance with relevant regulations and audit standards.	"Enables faster workflow and enhances control and compliance mechanisms." (P6, Partner, 6-10 years)
7. Enhanced Transparency and Accountability	Enhance transparency and accountability, particularly in public sector auditing.	*"Yes, there is a specific benefit in terms of increasing transparency and public accountability in real-time."* (P8, Junior Auditor, 3-5 years)
8. Faster Issue Identification	Audit digitalization enables faster identification of issues, particularly in public services. This allows the government to formulate more targeted data-driven policies.	*"Indeed, I firmly believe that leveraging digital technology in government performance audits can yield substantial benefits, including improved budget transparency, expedited issue identification in public services, and more informed, data-driven policy formulation."* (P1, Senior Auditor, 3-5 years)
9. Rapid Inspection Access	Digitalization enables quicker access to audit data and information, removing the wait for physical documents	*"Indeed, The use of a system enhances objectivity, Examination access is expedited, eliminating the need to wait for physical copies."* (P3, Partner, > 10 years)

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Vol. 12, No. 1, March 2025, pp. 94-118

Audit digitalization brings tangible benefits in terms of efficiency and speed of the audit process. Participants in various positions, from junior auditors to partners, acknowledge that the use of digital technology such as data analysis software (e.g., ATLAS and Excel) accelerates financial report analysis, materiality determination, and data processing. Senior auditors even mention that digitalization enables audit program monitoring and risk identification within a single audit cycle. This shows that digital technology helps auditors complete their work faster and more efficiently, without waiting for hard copies or performing time-consuming manual processes.

In addition to efficiency, audit digitalization also enhances data analysis accuracy and depth. Participants, particularly junior auditors, note that digital technology enables more in-depth data analysis, clear data visualization, and well-organized documentation that is reproducible. This deeper analysis capability helps auditors identify patterns and anomalies that might be missed in traditional audit methods. Furthermore, managers with over 10 years of experience mention big data analysis, which enables the government to make more targeted policies based on more comprehensive data. This demonstrates that digitalization not only accelerates the audit process but also improves the quality and thoroughness of audit results.

Transparency and accountability are also significant benefits of audit digitalization. Junior and senior auditors emphasize that digitalization produces a strong and objective audit trail, making audit results more accountable to the public. This enhances accountability and transparency, particularly in public sector audits. Participants also mention that digitalization enables faster identification of issues in public services, allowing the government to formulate more targeted data-driven policies. Thus, audit digitalization not only benefits auditors in performing their duties but also has a broader positive impact on society through increased transparency and accountability in the public sector.

Table 2 highlights the various benefits of audit digitalization, from increased efficiency and accuracy to enhanced transparency and accountability. The quotes from participants provide valuable insights into their experiences and perceptions of digitalization in the audit process.The participants' responses indicate that audit digitalization yields substantial benefits, including enhanced efficiency and speed in audit processes, improved data analysis accuracy and depth, and increased transparency and accountability. By leveraging digital tools, auditors can analyze financial reports and process data more quickly, identify patterns and anomalies more effectively, and produce a robust audit trail. This, in turn, enables the government to develop more informed policies and improves accountability in the public sector, ultimately benefiting society as a whole.

Major Barriers to Digitalization Implementation in Firm Audit

Although audit digitalization offers various benefits, such as increased efficiency and accuracy, there are several barriers that need to be overcome for its successful implementation. These barriers include limitations in human resources, issues with data quality, cost constraints, and specific challenges that may be faced in the public sector. To better understand these barriers, Table 3 provides a detailed examination of the key challenges to audit digitalization implementation.

Table 3 outlines the key barriers to implementing audit digitalization, as described by the participants. These include: Limited auditor capabilities and understanding of digital technologies, Issues with data quality and availability, such as non-integrated and non-standardized systems, Infrastructure and cost limitations that hinder the necessary investments, Specific challenges in the public sector, like bureaucratic complexity and budget constraints.

One of the main obstacles in implementing audit digitalization is the limitation of human resources. Many auditors lack a deep understanding or adequate skills in using digital technology. The lack of proper training and access to necessary resources to enhance digital capabilities is also a constraint. This leads to difficulties in adopting and utilizing digital audit tools effectively. Auditors may feel uncomfortable or lack confidence in using new technology, which can hinder the transition process to digitalization.

Table 3. Challenges to Audit Digitalization Implementation

Main Barriers to Audit Digitalization Implementation	Brief Theme Description	Quote from Participant
Limited Auditor Capability and Understanding	Limited auditor capability and understanding of digital technology can hinder the implementation of audit digitalization.	*"Many are not yet familiar with using systems properly and correctly."* - Partner (6-10 years of experience)
Data Quality and Availability	Poor data quality and availability can affect the effectiveness of audit digitalization.	*"Many financial information systems in the regions are still manual, fragmented, and non-standardized. Data formats between agencies differ, making it difficult to analyze digitally."* - Junior Auditor (3-5 years of experience)
Infrastructure and Cost Limitations	Limited infrastructure and cost can be a barrier to implementing audit digitalization.	*"Audit digitalization will face many obstacles, especially in terms of costs and HR that meet the requirements to implement the results of digitalization."* - Junior Auditor (3-5 years of experience)
Specific Challenges in the Public Sector	The public sector has specific challenges that need to be addressed in implementing audit digitalization, such as rigid bureaucracy and digital competency gaps.	*"Additional specific challenges could include rigid bureaucracy, limited technology budgets, and digital competency gaps among auditors in different regions. Furthermore, unintegrated data access between government agencies could also hinder the effectiveness of digital audits."* - Junior Auditor (3-5 years of experience)

Additionally, data quality and availability are also significant issues. Many financial information systems, especially in the public sector, are not yet integrated or still use manual methods. This results in non-standardized, fragmented, and difficult-to-analyze data digitally. Unclean and incomplete data requires a lot of time to process and consolidate before it can be used for audit purposes. As a result, the expected efficiency of audit digitalization is hindered. Limited access to relevant data is also a constraint, especially if the data is scattered across different agencies or systems.

Another significant obstacle is the limitation of infrastructure and costs. Implementing audit digitalization requires significant investment in hardware, software, and training. Many organizations, especially in the public sector with limited budgets, may struggle to meet these needs. Additionally, the availability of adequate IT infrastructure, such as stable internet networks and strong servers, is also a crucial factor. Without adequate infrastructure, the use of digital technology in audit becomes difficult and inefficient. The transition from conventional to digital audit processes also requires adjustments and adaptations that may require additional time and resources. Moreover, there is concern about data security and privacy.

According to the participants, addressing these multifaceted barriers is essential to ensure effective and successful audit digitalization. Overcoming limitations in human resources, data, and infrastructure, as well as navigating public sector-specific hurdles, is crucial to maximize the benefits of this digital transformation.

Key Skills and Essential Support

Audit digitalization requires adequate skills and support to be effectively implemented. Table 4 presents the skills and support needed for audit digitalization, including technical and non-technical skills,

ISSN 2089-6581 (print) | 2614-3720 (online)
Vol. 12, No. 1, March 2025, pp. 94-118

training support, and internal policies that support it. Participant quotes provide insights into their experiences and perceptions of the required skills and support.

Table 4. Required Skills and Support

Category	Sub-Category	Skills/Support	Participant Quote
Key Skills	Technical Skills	Data analysis capability, CAATS tools mastery, SQL basics, accounting information systems knowledge	*"Data analysis capability, CAATS tools mastery, SQL basics, accounting information systems knowledge."* - Junior Auditor (< 3 years of experience)
		Ability to penetrate accounting systems and assess system controls	*"Ability to penetrate accounting systems and perform system control assessments."* - Partner (> 10 years of experience)
		Data Analysis	*"Data Analysis"* - Junior Auditor (3-5 years of experience)
	Non-Technical Skills	Problem-solving and critical thinking	*"Problem-solving and critical thinking because auditors often face complex data or new systems. Critical thinking helps determine appropriate testing, analyze results, and identify hidden risks."* - Junior Auditor (< 3 years of experience)
		Communication, verbal knowledge of technological developments	*"Communication, verbal knowledge of technological developments"* - Partner (> 10 years of experience)
		Communication, adaptation, initiative	*"Communication, adaptation, initiative"* - Partner (6-10 years of experience)
Essential Support	Training & Development	Training on risks of using accounting tools	*"Training on risks of using accounting tools to minimize audit risks and adjust audit procedures."* - Senior Auditor (3-5 years of experience)
		Workshop training on program and technology usage	*"Workshop training on program and technology usage that facilitates both parties."* - Junior Auditor (3-5 years of experience)
		Audit software training (e.g., ATLAS)	*"Audit software training, such as ATLAS"* - Partner (> 10 years of experience)
		Regular technical training	*"Regular technical training, with practical training on audit software, data analytics, and IT systems, makes auditors more technically prepared."* - Junior Auditor (3-5 years of experience)
	Policies & Infrastructure	Internal policies supporting audit digitalization	*"Internal policies supporting audit digitalization, such as allocating time for digital tool exploration and incentives for teams initiating technology-based approaches."* - Junior Auditor (< 3 years of experience)
		IT knowledge for digital data examination	*"IT knowledge to support digital data examination"* - Partner (> 10 years of experience)

Auditors in the digital era require a multifaceted skillset that combines technical and non-technical proficiencies. According to the survey participants, key technical skills encompass data analysis capabilities, mastery of CAATS tools, basic SQL knowledge, and understanding of accounting information systems. Additionally, the ability to navigate and assess the controls within accounting systems is emphasized. Proficiency in utilizing specific audit software, such as data analysis tools (e.g., ACL/IDEA), custom CAATTs, cloud-based audit platforms, and audit process automation software, is also considered crucial.

These findings suggest that auditors must possess a robust understanding of the technology and tools employed in the digital audit process.

In addition to technical proficiencies, non-technical skills are equally crucial for effective audit digitalization. Auditors require problem-solving and critical thinking abilities to navigate complex data and new systems, determine appropriate testing methods, analyze results, and identify hidden risks. Furthermore, communication skills, such as verbal knowledge of technological advancements and the capacity to adapt and demonstrate initiative, are also emphasized as essential for auditors in this digital era. These non-technical competencies, combined with technical skills, form a well-rounded skillset necessary for successful implementation of audit digitalization.

To support the development of these skills, essential support from Audit Firm is needed. This support includes "training on the risks of using accounting tools," "workshop training on program and technology usage," "audit software training such as ATLAS," and "regular technical training." Furthermore, "internal policies supporting audit digitalization," such as allocating time for digital tool exploration and incentives for teams that take initiative, as well as "IT knowledge to support digital data examination" are also crucial.

The participants' responses suggest that successful audit digitalization implementation depends on auditors having a blend of technical and non-technical skills, backed by organizational support. Technical skills like audit software proficiency and data analysis are essential, but auditors also need non-technical skills like critical thinking, problem-solving, and effective communication. To develop these skills, auditors require comprehensive support, including training, infrastructure, and policies that foster digitalization. With the right combination of skills and support, auditors can effectively leverage digital technology and navigate the challenges of audit digitalization.

Learning and Anticipating Challenges for the Public Sector

This section examines key lessons that public sector audit institutions in Indonesia can learn from the digitalization experiences of Audit Firm. It also anticipates specific challenges the public sector may face in implementing digital technology. Table 5 presents the lesson from the private sector.

Table 5. Lesson from Private Sector

Theme	Theme Description	Participant Quote
Important Lessons from Audit Digitalization	The public sector in Indonesia can learn from the private sector's experience by recognizing the need for reliable data infrastructure readiness, auditor capacity building, and adoption of risk-based audit approaches to maximize the benefits of audit digitalization.	*"Public sector audit institutions in Indonesia need to ensure reliable data infrastructure readiness, digital capacity building for auditors, and adoption of risk-based audit approaches to maximize the benefits of audit digitalization. The use of technologies such as data analytics and AI must be accompanied by good data governance, information security policies, and organizational culture change support for effective and sustainable digital transformation."* - Senior Auditor (3-5 years of experience)
Specific Challenges for the Public Sector	In addition to common challenges faced by KAP, specific challenges that may be faced by public sector auditors in Indonesia include limitations of information systems in audited entities.	*"In addition to common challenges such as HR readiness and data infrastructure, public sector auditors in Indonesia are likely to face additional challenges in the form of limitations of information systems in audited entities, which are often not fully digitalized or not standardized."* - Senior Auditor (3-5 years of experience)
Special Benefits for the Public Sector	Audit digitalization provides special benefits to the public sector, such as increased transparency and real-time public accountability.	*"Yes, there are special benefits in the form of increased transparency and real-time public accountability."* - Junior Auditor (3-5 years of experience)

ISSN 2089-6581 (print) | 2614-3720 (online)
Vol. 12, No. 1, March 2025, pp. 94-118

Audit digitalization provides significant benefits in improving the efficiency, accuracy, and transparency of the audit process. However, its implementation faces challenges such as HR limitations, poor data quality, and cost constraints. Auditors need technical and non-technical skills and support from KAP in the form of training and infrastructure. For the public sector, digitalization has the potential to improve accountability and data-driven policies, but challenges such as bureaucracy, lack of data integration, and limitations of information systems must be addressed.

As Table 5 shows, public sector audit institutions in Indonesia can draw several key lessons from the participants' responses. To successfully implement audit digitalization, they need to prioritize data infrastructure readiness, build auditors' digital capacity, and adopt risk-based audit approaches. They must also address specific challenges, including limited digitalization and standardization of information systems, bureaucratic rigidity, budget constraints, and regional digital competency gaps. By overcoming these challenges, audit digitalization can enhance transparency, accountability, and data-driven policymaking in the public sector.

Discussion

Audit digitalization offers various significant benefits, including increased efficiency and speed of the audit process, which accelerates financial report analysis, materiality determination, and data processing. Digital technology also enhances the accuracy and depth of data analysis, enables clearer visualization, and produces a strong and objective audit trail, thereby increasing transparency and accountability. Additionally, digitalization enables faster identification of problems in public services and helps the government formulate data-driven policies. However, implementing audit digitalization faces various challenges, such as limited human resources in terms of understanding and technical skills, poor data quality and availability, cost constraints for IT infrastructure and training, and specific challenges in the public sector such as bureaucracy and data integration.

Overcoming these challenges necessitates a combination of technical and non-technical skills, along with organizational support. Auditors need technical skills, such as proficiency in audit software and data analysis, as well as non-technical skills, such as critical thinking, problem-solving, and effective communication (Volodina & Grossi, 2024). In addition, organizational support, including providing adequate training, infrastructure, and policies that promote digitalization, is essential to develop these skills. By addressing these challenges and providing the necessary skills and support, auditors can leverage digital technology to improve the quality and effectiveness of public sector audits.

To successfully implement audit digitalization, auditors need a combination of technical skills, such as mastery of audit software and data analysis, and non-technical skills, such as problem-solving and communication. Support from Audit Firm is crucial, including ongoing training, supportive internal policies, adequate IT infrastructure, and support from professional organizations such as IAPI. For the public sector, audit digitalization is highly relevant because it has the potential to increase transparency and public accountability in real-time and help the government make more targeted policies. However, the public sector needs to overcome specific challenges such as bureaucracy and data integration to ensure the successful implementation of audit digitalization.

Skills and Support Implications

The findings from the Indonesian audit firms align with the broader global and regional trends in audit digitalization. Studies have consistently emphasized the importance of data governance (Janvrin & Mascha, 2014; Vasarhelyi et al., 2012), change management (Appelbaum et al., 2017), and human capital development (Alles, 2015; Omoteso, 2016) as critical success factors for the effective adoption of digital audit techniques. The challenges observed in the Indonesian context, such as data fragmentation and bureaucratic obstacles, are also consistent with the barriers faced by public sector organizations in other developing economies (Heeks, 2002; Soh & Sia, 2004). However, the Indonesian experience provides

valuable context-specific insights that can inform strategies for successful digital transformation in the public sector, complementing the broader audit digitalization literature (Alles & Gray, 2019; Janvrin & Mascha, 2014). Moreover, Indonesian civil servants still need digital literacy, highlighting the need for urgent skill development (Pratama et al., 2024).

Indonesian audit firms' experiences in digitalizing audit offer valuable insights for the public sector. Firms highlight the importance of strategic planning, investing in auditor skills, and prioritizing data security and privacy. Lessons from the private sector emphasize collaboration and effective change management to facilitate adopting new technologies.

Based on this analysis, recommendations for Indonesian public accounting firms include: Continuing to invest in upgrading auditors' data analytics and related technology skills, Strengthening collaborative efforts to share knowledge and best practices, Advocating for a regulatory framework supporting innovation in digital auditing

Key findings from audit firms' experiences adopting digital tools and techniques for performance audits include the importance of robust data governance, effective change management, and strategic investment in human resource development. Firms have seen benefits like enhanced data analysis, but also challenges like bureaucracy, data fragmentation, and the need for specialized skills. Addressing these requires a phased approach, inter-agency cooperation, and a focus on upskilling auditors through training.

The Indonesian experience aligns with broader global and regional trends in audit digitalization, emphasizing data governance, change management, and human capital development as critical success factors(Aswar et al., 2021; Kurniawan & Arti, 2020; Meiryani et al., 2021; Purnamasari & Hartanto, 2022; Yasin et al., 2019). Indonesian context-specific insights can inform strategies for successful digital transformation in the public sector. Innovation will also be a central element in evaluating audit and career progression of collaborators (Manita et al., 2019).

To leverage the expertise of private sector auditors in enhancing Indonesian public sector performance audits through digitalization, several strategies can be employed:

Knowledge Transfer Programs: Develop programs to transfer knowledge and skills from experienced private sector auditors to their public sector counterparts, especially in data analytics, IT governance, and emerging technologies (Manita et al., 2019).

Joint Training Initiatives: Conduct joint training initiatives to enhance auditors' IT skills (Manita et al., 2019; Nguyen et al., 2020; Omoteso, 2016; Popoola et al., 2015).

Collaboration Platforms: Establish platforms for ongoing collaboration between private and public sector auditors to share insights and best practices in audit digitalization (Alles & Gray, 2019; Manita et al., 2019; Omoteso, 2016; Vitali & Giuliani, 2024).

Policy Recommendations: Develop policy recommendations based on the experiences of private sector auditors to support the adoption of digital technologies in the public sector audit process (Al-Khasawneh, 2022; Nezhyva & Міняйло, 2020; Volodina & Grossi, 2024) .

Bridging the Private and Public Sectors

For the Indonesian public sector, the development of a clear and well-funded national strategy to digitize public sector performance audits is critical. Priority should be given to comprehensive training programs to build digital competency among public sector auditors. Challenges related to data quality and interoperability across government systems need to be addressed. A robust data security and privacy framework tailored to the public sector context should be established (Kreuter et al., 2019; Lois et al., 2020; Syahidin, 2021; UNDP Digital Leadership Learning Modules, 2024). Engagement with relevant stakeholders to review and update the regulatory framework to support digital audits is also needed (Bouke et al., 2023; "Digital Public Infrastructure for Digital Governments," 2024; Lois et al., 2020; Wylde et al., 2022). Investment in the necessary IT infrastructure and provision of ongoing technical support to audit

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Vol. 12, No. 1, March 2025, pp. 94-118

bodies across the country is essential. Finally, a culture of innovation and continuous improvement in public sector auditing through the strategic adoption of digital technologies should be fostered.

Conclusion

Audit digitalization provides significant benefits in improving the efficiency, accuracy, and transparency of the audit process. Auditors from various levels of position and experience report that the use of digital technology such as data analysis software (ATLAS, Excel, etc.) accelerates financial report analysis, materiality determination, and data processing. Additionally, digitalization enables more in-depth data analysis and clear data visualization, making it easier to identify patterns and anomalies. Transparency and accountability also increase because digitalization produces a strong and objective audit trail, and enables faster detection of problems, especially in public services. These benefits ultimately support the government in formulating more targeted data-driven policies.

However, implementing audit digitalization also faces various challenges. Limited human resources (HR) in terms of understanding and technical skills, poor data quality and availability, and cost constraints for IT infrastructure investment and training are major obstacles. Additionally, specific challenges in the public sector such as complex bureaucracy, limited information systems that are not yet digitalized, and digital competency gaps among auditors in different regions add layers of difficulty. To overcome these challenges, support from Audit Firms in the form of ongoing training, supportive internal policies, and adequate IT infrastructure is needed.

The development of both technical and non-technical competencies among auditors is equally vital, alongside the need for collaboration and synergy across technology, training, and consistent policy support. The analysis of audit firms' experiences and their implications for the Indonesian public sector suggests several key takeaways. First, while there are significant potential benefits to digitalizing audit, there are also numerous challenges that must be addressed, including the need for strategic planning, investment in skills development, and careful attention to data security and privacy. Second, lessons from the private sector emphasize the value of collaboration and effective change management in facilitating the adoption of new technologies. Finally, for the Indonesian public sector, the development of a clear and well-funded national strategy to digitize public sector performance audits is critical, with priorities including comprehensive training programs, addressing data quality and interoperability issues, establishing a robust data security framework, and fostering a culture of innovation and continuous improvement through the strategic adoption of digital technologies.

The key contributions of this study are its insights into the experiences of Indonesian audit firms in digitalizing audit processes and the implications for the Indonesian public sector. The analysis highlights the critical importance of strategic planning, investment in skills development, and careful attention to data security and privacy. Lessons from the private sector emphasize the value of collaboration and effective change management in facilitating the adoption of new technologies. For the Indonesian public sector, the development of a clear and well-funded national strategy to digitize public sector performance audits is essential, with priorities including comprehensive training programs, addressing data quality and interoperability issues, establishing a robust data security framework, and fostering a culture of innovation and continuous improvement through the strategic adoption of digital technologies. These cross-sector findings and recommendations are crucial for enhancing the performance and efficiency of the Indonesian public sector through the effective leveraging of digital audit tools and capabilities.

This study has some limitations: First, It is based solely on the experiences and perspectives of audit firms, not direct engagement with public sector stakeholders. This means the audit firms' views may not fully capture the public sector's challenges and digitalization needs. Secondly, The reliance on online surveys, rather than in-depth interviews, may have limited the depth and nuance of the data collected. Thirdly, there is potential for sample bias, as the participating firms may not be representative of the broader audit industry in Indonesia.These limitations suggest the need for further research that involves

diverse stakeholders and uses a range of data collection methods to better understand the digitalization of public sector performance audits in Indonesia. Additionally, the focus of this study is on the digital transformation of performance audits, so the insights may not apply to other types of audits. More research is needed to explore digitalization across a broader spectrum of organizations and audit domains.

Future research should address the limitations of this study by conducting comparative studies of audit firms and public sector stakeholders, as well as case studies of public institutions to gain a more comprehensive understanding of digitalization in public sector performance audits in Indonesia. Quantitative assessments could also provide insights into the benefits and challenges of adopting digital audit tools and techniques within the public sector. These investigations would help elucidate cross-sector perspectives and provide robust recommendations for enhancing performance and efficiency of the Indonesian public sector through strategic use of digital technologies.

The findings on the digitalization experiences of Indonesian audit firms have significant relevance for strengthening public audit and accountability in Indonesia and other developing countries. The insights highlight the critical need for comprehensive national strategies to digitize public sector performance audits, focusing on developing digital competencies among auditors, addressing data quality and interoperability challenges, and establishing robust data security frameworks. By leveraging expertise and lessons from the private sector, the public sector can more effectively harness the potential of digital audit tools and techniques to enhance efficiency, transparency, and accountability of government operations. These cross-sector learnings are essential for driving meaningful reform and improving overall public sector performance in Indonesia and other developing economies facing similar digitalization challenges.

The findings from the analysis of audit firm experiences in adopting digital audit processes and their implications for the Indonesian public sector suggest several pragmatic and policy-oriented recommendations. For the Indonesian Institute of Public Accountants (IAPI), the professional body should advocate for regulatory updates that support and facilitate the adoption of digital audit techniques. This could involve developing guidelines and standards for the use of data analytics, artificial intelligence, and other digital tools in the audit process. IAPI should also spearhead collaborative efforts to share knowledge, best practices, and training resources among audit firms, accelerating the development of digital skills within the profession.

Indonesian audit firms should persist in prioritizing investments to upskill their auditors in data analytics, information technology, and the application of digital audit tools. Firms should establish dedicated training programs and provide ongoing professional development opportunities to ensure their workforce remains current with the latest digital audit technologies and techniques. Collaboration between firms to pool resources and expertise can help address the challenges in acquiring digitally skilled talent. Crafting a comprehensive national strategy for digitalizing public sector performance audits is critical for the Audit Board of Indonesia. This strategy should focus on establishing robust data governance frameworks, addressing data quality and interoperability challenges across government systems, and building the necessary IT infrastructure to support digital audit tools. Equipping public sector auditors with targeted training programs to develop their digital competencies should be a key priority. Additionally, engaging with stakeholders to review and update the regulatory environment is essential to enable the adoption of digital audit techniques.

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Uneven Development Principles in Geo-Map Perspective: How Does Infrastructure Play a Role in Crushing the Poverty in the Special Region of Yogyakarta?

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Abstract

The purpose of this study is to determine the relationship between the existence of regional infrastructure and the number of poor people and to know the distribution of infrastructure in each district/city in the Special Region of Yogyakarta (DIY). The data used is a primary data crosssection derived from Village Potential Data Collection (Q-Podes). This study uses two methods, namely, Ordinary Least Square Regression, to determine the relationship between variables and Geo-Map Orange Data Mining to determine the distribution and equitable distribution of infrastructure. Empirical results show that areas with electricity sources from the State Electricity Company (PLN), Information and communication infrastructure, trade and service infrastructure, agricultural infrastructure, and good sanitation can reduce the number of poor people. However, drainage infrastructure, cultural and health education infrastructure, and transportation infrastructure have not been able to reduce the number of poor people in DIY. In addition, the occurrence of uneven development, which is seen in the uneven infrastructure in each region, is also an inhibiting factor in reducing the number of poor people in DIY.

Keywords: Uneven Development, Poverty, Infrastructure, Geo-Map Orange Data Mining, Special Region of Yogyakarta.

JEL classification: C21, H54, R11, R13, R58

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1. INTRODUCTION

Poverty is one of the cliché problems that has not been resolved, especially in developing countries (Saefuddin et al., 2019). The increasing population, which is not accompanied by meeting needs, causes an increase in the number of people with unmet living needs or poor people (Purnomo, 2019). Indonesia is one of the developing countries with the 91st highest number of poor people in the world and 6th in Southeast Asia. According to the Indonesian Central Bureau of Statistics, the poor are people with an average monthly per capita expenditure below the poverty line (Husna, 2020;Karyono et al., 2020)). The population with these criteria in Indonesia in 2023 will reach 25.889 million people, a decrease from 26.161 million people in the previous year. According to World Bank analysis, Indonesia's economic growth over the past decade has succeeded in reducing the percentage of poverty from 11.3 per cent in 2014 to 9.36 per cent in 2023 (Aminda et al., 2024). In line with this, in the last two years, the decline in poverty has experienced a relatively stable pace, 18 per cent. This is a relatively good poverty reduction rate in the last ten years (Fitria, 2023)

The government has provided various poverty reduction programs that have proven to have a positive effect on the community, including family hope programs, school operational assistance, poor student assistance programs, and community health insurance programs (Machmud et al., 2020). In addition, the government also pays special attention to people who are poor, near-poor, and slightly above the poverty line in the form of providing poor certificates as economic support and poverty reduction efforts poverty (Agita & Sailesh, 2024). The number of poor people in Indonesia is spread almost all over the island. BPS data states that the provinces with the highest number of poor people in 2023 are West Java and Central Java, which reach 3.7 thousand people and 3.9 thousand people. However, when analyzed in terms of percentage, the Special Region of Yogyakarta or Daerah Istimewa Yogyakarta (DIY) is the province with the highest poverty rate in Java. Although DIY is famous as a major tourist destination in Indonesia, the problem of poverty remains an issue that cannot be ignored. The poverty rate in DIY is spread over five cities/regencies in the province, as shown in Figure 1 (Niswati, 2014)

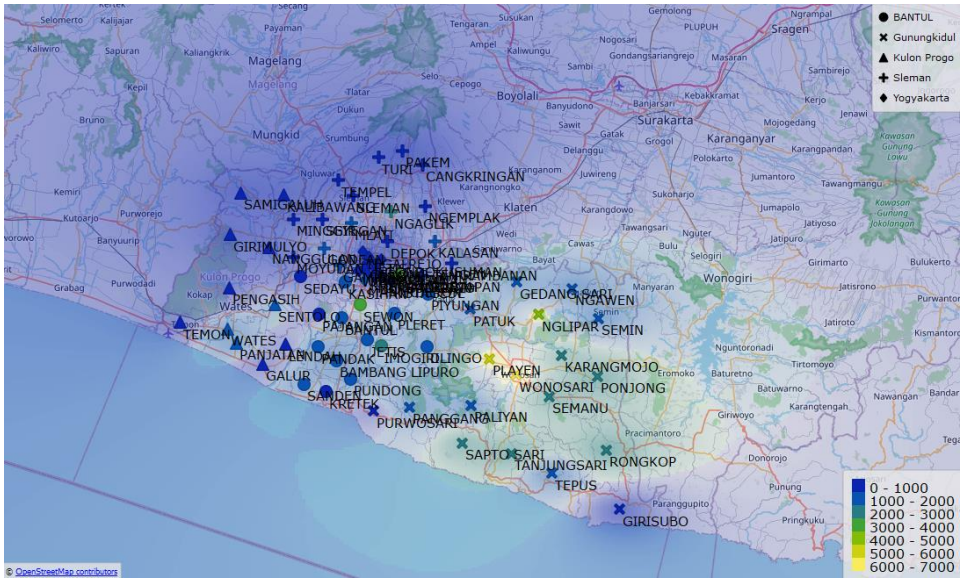


Figure 1. Map of the Distribution of the Number of Poverty in the Special Region of Yogyakarta

Source: BPS Indonesia analyzed using Geo-Map Orange Data Mining, 2024

The average poverty rate in the Special Region of Yogyakarta reaches 13.15 per cent of the total population. Until March 2013, the poverty rate of DIY residents reached 11.04 per cent of the total population in DIY. Of all regencies and cities in DIY, Kulon Progo Regency has the highest poverty rate in 2023 at 15.64 per cent, followed by Gunung Kidul Regency at 15.60 per cent, Bantul Regency at 11.95 per cent, Sleman Regency at 7.52 per cent, and Yogyakarta City at 6.49 per cent. The data can be seen in Figure 1, which shows the number of poor people in 4 districts and one city in DIY. As of March 2023, it was recorded that the percentage of poor people in urban areas reached 10.27 per cent, a decrease of 0.37 percentage points compared to September 2022. Meanwhile, the percentage of poor people in rural areas in March 2023 reached 13.36 per cent, a decrease of 0.64 percentage points compared to September 2022.

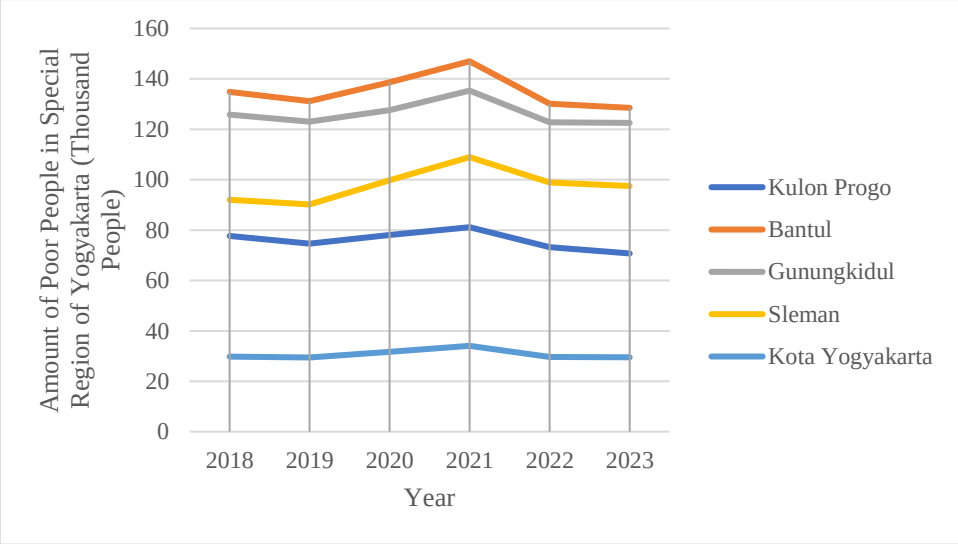


Figure 2. Number of Poor People in Regencies and Cities in the Special Region of Yogyakarta in 2018 – 2023
Source: BPS Indonesia, 2024

The high poverty rate in DIY is caused by several factors, both on a macro scale, such as inflation and unemployment, which are also influenced by the transition season, which causes many farmers to experience crop failure. In addition to these factors, rising fuel prices and high open unemployment rates are also suspected to be factors that play a major role in increasing the number of poor people in DIY(Salsabilla et al., 2022). Another cause that affects the amount of poverty in DIY is the side effects of uneven development(Samudro, 2015). Uneven development is one of the four principles in political economy, meaning that persistent differences in the level and development of the economy between different sectors of the economy characterize a state. This principle can be used as a perspective in assessing uneven development in a region. Development inequality is suspected to be one of the cliché factors that caused the increase in the number of poor people in DIY. The government has also provided several solutions to overcome the increasing number of poor people in DIY, one of which is the provision of facilities and infrastructure to support daily life. The infrastructure provided also varies according to the needs of the community. Some of the infrastructures provided by the government in DIY as shown in Figure 3 are electricity delivery by the State Electricity Company, Drainage Facilities and Infrastructure, Information and Communication Infrastructure, Health Culture Education Infrastructure, Trade and Services Infrastructure, Agricultural Infrastructure and small village industries, sanitation and clean water infrastructure, and transportation infrastructure.

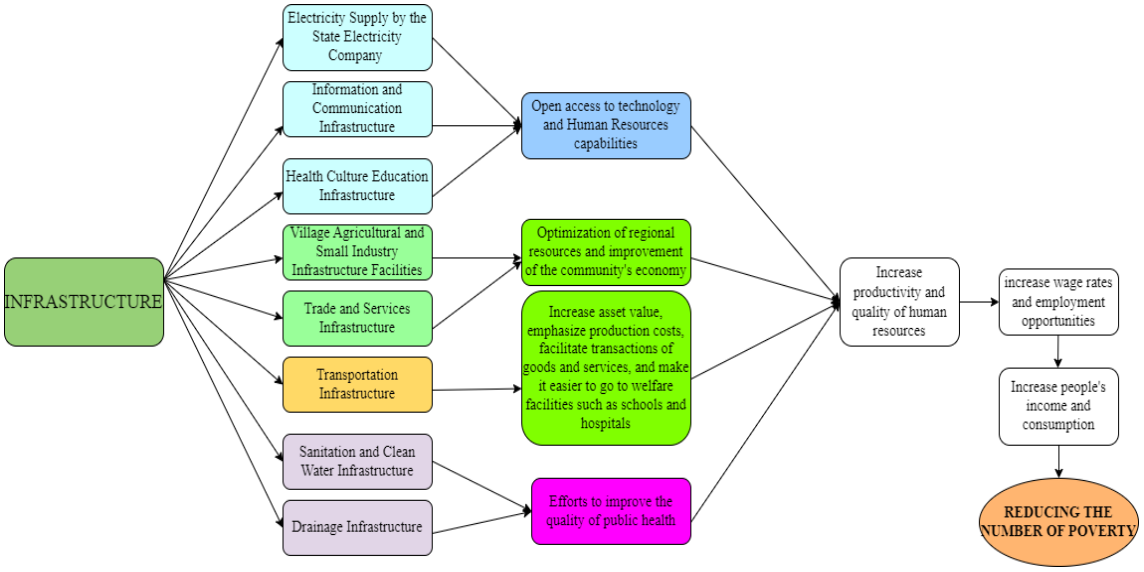


Figure 3. Mechanism of Flow of Infrastructure Influence on Reducing the Number of Poverty

Source: Authors's own work, 2024

The existence of infrastructure provided by the government and private sector (with government permission) is intended to reduce poverty in the Special Region of Yogyakarta. Moreover, DIY has been decentralized into five regional parts, namely four regencies and one municipality consisting of Sleman Regency, Kulon Progo Regency, Bantul Regency, Gunungkidul Regency, and Yogyakarta City. However, some of these problems arise due to uneven development. This is evidenced by the uneven distribution of regional infrastructure provided as can be seen in the figure 4.

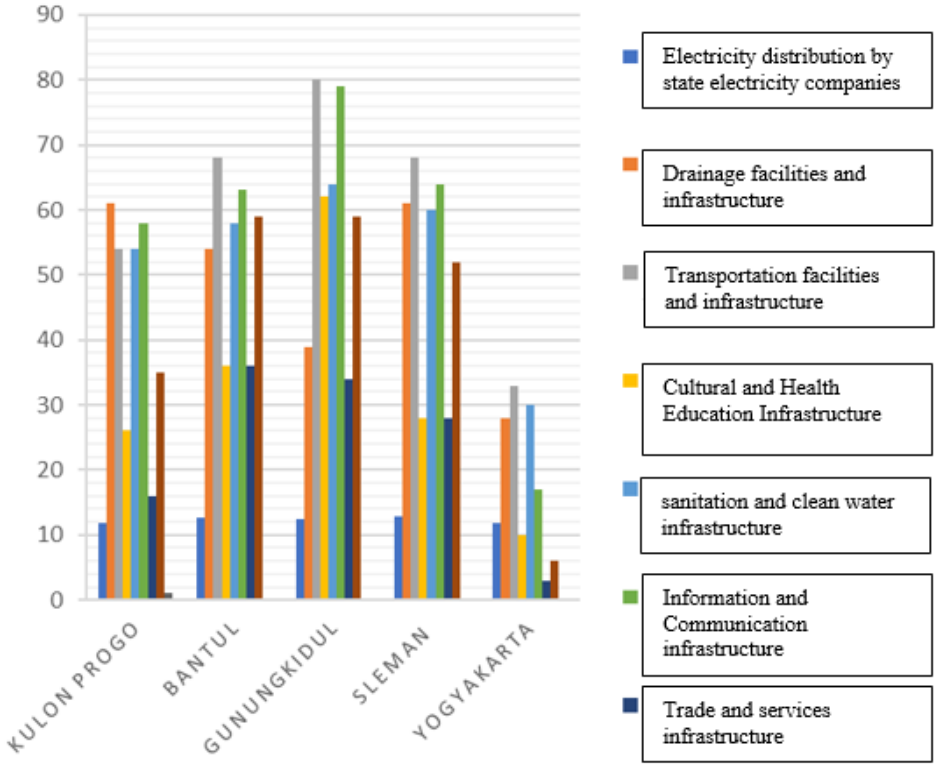


Figure 4. Distribution of Infrastructure in Regencies and Cities in Yogyakarta Regional Province

Source: BPS Indonesia, 2024

Figure 4 shows that the existence of infrastructure in each district or city shows a different amount. The difference in availability results in differences in the number of poor people and poverty levels in each region, as can be seen in Figure 2. This is in accordance with Andrianus and Alfatih's (2023) research, which shows that the ability to produce proper electricity, sanitation, and road infrastructure has a significant negative relationship with poverty rates in Indonesia. In line with the results of this study, research conducted by Putra and Yasa (2023) said that infrastructure and education factors were proven to reduce the number of poor people—another study conducted by Widiyasari et al., (2021) found that good health infrastructure, trade, and drainage systems are considered to be able to cross poverty, especially in urban areas. Some other research related to infrastructure and regional poverty.

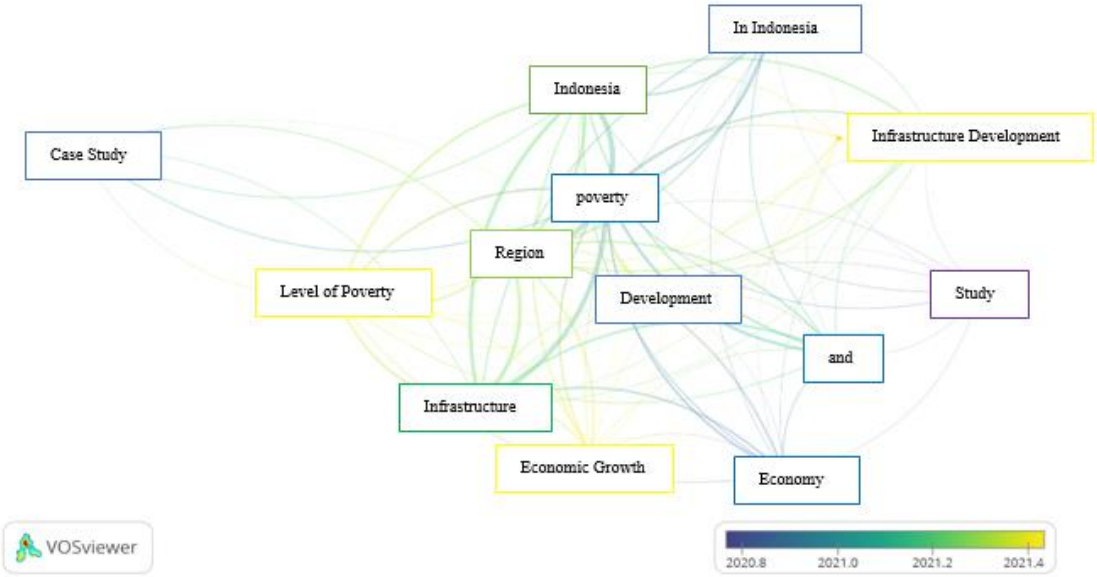


Figure 5. Previous Research on the Relationship Between Poverty and Infrastructure
Source: Authors' Own Work using VosViewer, 2024

Figure 5 shows that there have been many studies on the effect of poverty and infrastructure development in Indonesia. The results show that one of the direct influences, namely the existence of infrastructure, has a significant negative effect on poverty. The majority of these studies were conducted in the 2020-2021 period. However, no deeper studies have been carried out on the classification of infrastructure that directly affects and is able to reduce the number of poor people in the context of the principle of uneven development. In addition, research on the relationship between infrastructure and the number of poor people has rarely conducted in the Special Region of Yogyakarta. Therefore, this study aims to determine the relationship between regional infrastructure consisting of electricity delivery by the State Electricity Company, Drainage Facilities and Infrastructure, Information and Communication Infrastructure, Health Culture Education Infrastructure, Trade and Services Infrastructure, Agricultural Infrastructure and small village industries, sanitation and clean water infrastructure, and transportation infrastructure to the number of poor people in DIY. The indicator is taken based on the results of processing topics and keywords that have not appeared much in national and international articles. In addition, these indicators are influential indicators to reduce poverty rates based on the Sustainable Development Goals (Khamjalas, 2024; Ley, 2023; Okuputra, 2022)

2. RESEARCH METHOD

This research was conducted in 438 villages throughout the Special Region of Yogyakarta Province and was conducted through Village Potential Data Collection (Q-Podes) In the latest data period, namely the 2018 edition. The method used in this study is mixed,

namely quantitative using Ordinary Least Square Regression analysis and qualitative using description with spatial data collection Geo-Map Orange Data Mining. The use of Geo-Map using the Orange Data Mining tool helps to classify the spatial distribution in the analysis results. The advantage of this method is that it can be used flexibly by inputting analysis data, latitude, and longitude. This study uses eight independent variables consisting of electricity delivery by the State Electricity Company, Drainage Facilities and Infrastructure, Information and Communication Infrastructure, Health Culture Education Infrastructure, Trade and Services Infrastructure, Agricultural Infrastructure and small village industries, sanitation and clean water infrastructure, and transportation infrastructure. The dependent variable used is the number of poor people calculated from residents who have a poor certificate. The variables in this study were analyzed using the following equation:

$$lnPoverty_i = \alpha_i + \beta_1 PLN_i + \beta_2 Drainage_i + \beta_3 Information_i + \beta_4 Penbudkes_i + \beta_5 Perdagjasa_i + \beta_6 agriculture_i + \beta_7 Sanitation_i + \beta_8 Transportation_i + e_i \quad (1)$$

Equation (1) shows that the variable lnPoverty is the number of inhabitants who have a certificate of poverty in one village, PLN is the number of households that have electricity sourced from the State Electricity Company, Drainage is dummy variables regarding the presence or absence of infrastructure facilities regarding drainage infrastructure in each village, Information is a dummy variable Regarding the presence or absence of Information and communication infrastructure in each village, Penbudkes dummy variabel regarding the availability of educational, cultural, and health infrastructure in each village/kelurahan, Perdagjasa dummy variables regarding the availability of trade infrastructure and services in each village, Agriculture Dummy variables related to the existence of infrastructure supporting agricultural activities and regional small industries, sanitation dummy variables regarding availability of sanitation and clean water infrastructure in each village, and transportation dummy variable of the availability of transportation infrastructure in villages. Each dummy variable in equation (1) indicates that the numbers 1 are for availability and 0 for unavailable.

The method for visualizing geospatial data regarding the distribution of maps of the number of poor people and infrastructure in each village in the Special Region of Yogyakarta Province is carried out using maps (Putri & Wijayanto, 2024; Saefuddin et al., 2019). This approach is effective for analyzing data containing latitude and longitude information in the WGS 84 format EPSG: 4326, which in this study is used to analyze infrastructure that has not had a significant effect on reducing the number of poor people in DIY (Sundari et al., 2019). The Information required includes geographical coordinate data for each village, the number of people registered as poor, and the amount of infrastructure in each village.

3. RESULTS AND DISCUSSION

The principle of uneven development is a complicated phenomenon. Several factors, such as geographical location, economic conditions, gender differences, and the history of a region, cause development inequality in the Special Region of Yogyakarta. The government has

made policy interventions in an effort to reduce development inequality in DIY. One of the outcomes of such policy interventions is the improvement of economic development, especially through infrastructure development. However, the success of such interventions still varies. Inequality in DIY is also related to the problem of poverty, namely the increase in the number of poor people, which can be seen from the existence of vulnerable and not vulnerable groups of poverty. Development in all fields, especially in the infrastructure sector, is one of the programs in the series of DIY Regional Long-Term Development Plans for 2022-2027. This is coupled with the government's focus on reducing the poverty rate in DIY. One way is to equalize infrastructure in various sectors. These sectors include electricity delivery by the State Electricity Company, Drainage Facilities and Infrastructure, Information and Communication Infrastructure, Health Culture Education Infrastructure, Trade and Services Infrastructure, Agricultural Infrastructure and small village industries, sanitation and clean water infrastructure, and transportation infrastructure.

The results of this study show that some infrastructures have shown results that can cross the number of poor people in districts/cities in DIY, as can be seen in Table 1.

Table 1. OLS Regression Results

Variable	Coefficient	Probability
C	0.469	0.391
PLN	-0.614	0.000
DRAINAGE	-0.193	0.043
INFORMATION	-0.134	0.170
PENBUDKES	-0.022	0.832
PERDAGJASA	-0.278	0.015
AGRICULTURE	-0.188	0.067
SANITATION	-0.412	0.000
TRANSPORTATION	-0.010	0.929
R-Squared	0.344	

Source: Primary Data processed, 2024

Table 1 shows that regional infrastructure consisting of electricity delivery by the State Electricity Company, Drainage Facilities and Infrastructure, Information and Communication Infrastructure, Trade and Services Infrastructure, Agricultural Infrastructure and small village industries, and sanitation and clean water infrastructure have a significant negative effect on the number of poor people in DIY, as seen from the probability values of less than 0.05 and 0.1. While the Information and Communication Infrastructure, Health Culture Education Infrastructure, and transportation infrastructure show negative and insignificant values. The results of Table 1 show that if the number of households that get access to electricity sources from the State Electricity Company (PLN) increases by 1%, it will reduce the number of poor people by 0.61%. Electricity resources are one of the primary needs that each individual must meet. The existence of electricity resources in Indonesia today is still mostly dependent on supplies provided by PLN. This is in accordance with Christiani and Nsinupu (2021), which shows that one of the

infrastructures that can cross the number of poor people is the electricity provider infrastructure. This fact is also supported by research by Saputri et al. (2019), which, according to SUSENAS data for 2015-2019, shows that economic development in Indonesia is influenced by the affordability of electricity in each region. The second influential infrastructure is the drainage infrastructure, which shows that areas with good drainage access will have 0.193 per cent fewer poor people than areas that do not have it.

Drainage refers to a water management system or process that aims to regulate the flow of water from a certain area or surface. This approach is used to control rainwater, surface water, and groundwater so as not to interfere with human activities, infrastructure, or the environment (Arjosari et al., 2019). Drainage systems are important to maintain ecosystem balance and prevent flooding and environmental damage due to waterlogging (Paramita et al., 2018). Infrastructure that supports a good drainage system will lead to improved quality of public health. This can affect productivity and have an impact on the economic condition of the community (Agita & Sailesh, 2024; Febrian & Burhanudin, 2023). The majority of DIY areas are used to dump household waste in manholes or drainage streams before it is drained into nearby rivers (Paseru et al., 2022). Therefore, good drainage channels that are not clogged with garbage or wild plants will make the flow of water smoother so as to minimize puddles that can cause disease (Ghosh et al., 2023; Gonçalves et al., 2024). The third factor is the existence of trade and service infrastructure, which shows that village or kelurahan areas in DIY with access to trade and services facilities have a relatively smaller number of poor people, as much as 0.278 percent.

Trade, both goods and services, is one of the sectors that is able to support the economy in Indonesia, especially the regional economy (Saefuddin et al., 2019). Yogyakarta Special Region is one of the provinces with high and diverse natural and human resources (Noviyanti, 2019). This is one of the advantages or potential benefits of the region. One of them is through the procurement of infrastructure facilities for access to trade in goods and services. Several government programs related to trade have begun to be built evenly, one of which is revitalizing traditional markets into more hygienic and visitor-friendly markets (Bayu, 2018). Other programs have succeeded in improving the economy of the community, especially the regions, one of which is the procurement of tourism villages through the role of the local tourism office (Ariyani et al., 2020; Utami et al., 2023; Widhianingsih et al., 2023). Tourism Villages are proven to be able to explore the potential of the area to be used as jobs by the local community (Savitri et al., 2023). Related to previous infrastructure factors, agricultural infrastructure and small rural industries also contribute to the reduction of the number of poor people in DIY. Areas with access to infrastructure for agriculture and small industries have a lower number of poor people, 0.412 per cent.

Data from the Central Bureau of Statistics DIY in 2023 states that the number of farmers in DIY in 2023 will reach 495,781, with 37,141 of them being farmers aged 19-39 years or millennial farmers (Wiradhani et al., 2023). This proves that some districts in DIY still rely on the agricultural sector as one of the main livelihoods (Obeidat & Hamadneh, 2022). The agricultural products are then sold in the city. Still, due to the infrastructure related to agriculture and small industries of villages or villages, these results can increase

through efforts to provide fertilizer and technology subsidies. In addition, the role of tourism villages and the creation of online sales facilities are also able to expand the market in small industries with regional potential (Heliany, 2019). The last influential infrastructure to reduce the number of poor people in DIY is sanitation and clean water infrastructure (Yesi & Juairiyah, 2021). Sanitation and clean water are important factors in supporting the quality of life of human resources in the region (Purwaningsih et al., 2021). The majority of villages in DIY already have access to sanitation and clean water. This is supported by facilities provided by the government in the form of clean water flow from the Regional Drinking Water Company (Monoarfa et al., 2022). Table 1 shows that villages with adequate infrastructure have 0.41 per cent fewer poor people compared to areas that do not have.

In addition to infrastructure that has been proven to be able to reduce the number of poor people in DIY, several infrastructures in this study have not been able to affect the number of poor people in DIY, namely Information and communication infrastructure, cultural and health education infrastructure, and transportation infrastructure. This is evidenced by the probability value of the variable Penbudkes,\ Information,\ dan\ Transportation has significance values above 0.05 and 0.1.Information and communication infrastructure has a negative but not significant influence, which means that many villages or villages in DIY do not yet have Information and communication infrastructure in the form of telephone access, internet, radio and television frequencies, and the availability of newspapers/magazines/bulletins.

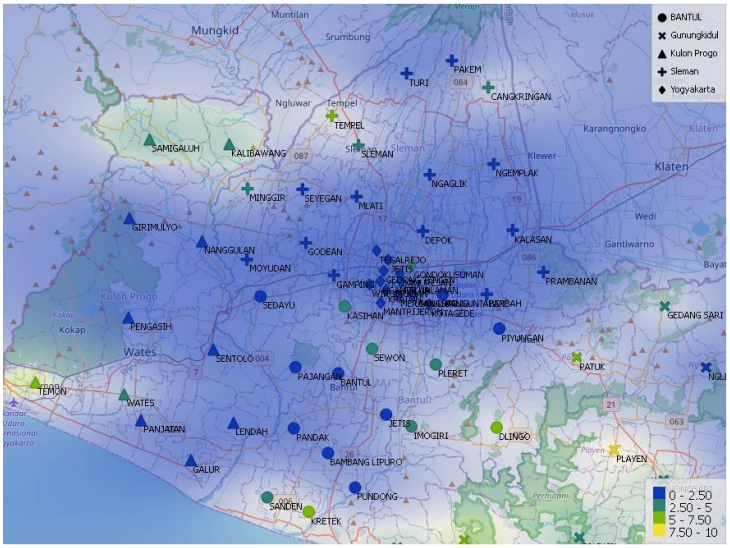


Figure 6. Map of Distribution of Information and Communication Infrastructure Facilities of the Special Region of Yogyakarta.

Source: Primary Data processed using Geo-Map Orange Data Mining, 2024

Regional infrastructure consisting of electricity delivery by the State Electricity Company, Drainage Facilities and Infrastructure, Information and Communication Infrastructure, Health Culture Education Infrastructure, Trade and Services Infrastructure,

Agricultural Infrastructure and small village industries, sanitation and clean water infrastructure, and transportation infrastructure

Figure 6 is a map of the distribution of each sub-district in DIY on Information and communication infrastructure facilities, which shows that areas with a high number of poor people, such as Bantul Regency and Kulon Progo Regency, have not been met by the need for Information and communication infrastructure (Masjhoer et al., 2022; Nilawati, 2019; Warsito, 2020). This is one of the impacts of uneven Development or uneven regional Development, which has side effects on the level of community productivity. Variable coefficients Information shows a value of -0.134, which means that if Information and communication infrastructure are fulfilled in each region, the number of poor people can be reduced by 0.134 per cent. The majority of information and communication infrastructure facilities that have not been reached are internet service access and cellular operators. The same is true of education, culture, and health infrastructure, which have not shown efforts to contribute to the reduction of people experiencing poverty.

Similarly, with information and communication infrastructure, the amount of educational, cultural, and health infrastructure infrastructure is not evenly distributed in every region in DIY. These infrastructure facilities include access to proper schools, cultural support facilities, and nearby health places. Variable Penbudkes which represents the number of villages that have educational, cultural, and health infrastructure has a coefficient of -0.022 which means that if the infrastructure is fulfilled it can reduce the number of poor people by 0.022 in each region. However, the facts show that the infrastructure is not yet available evenly.

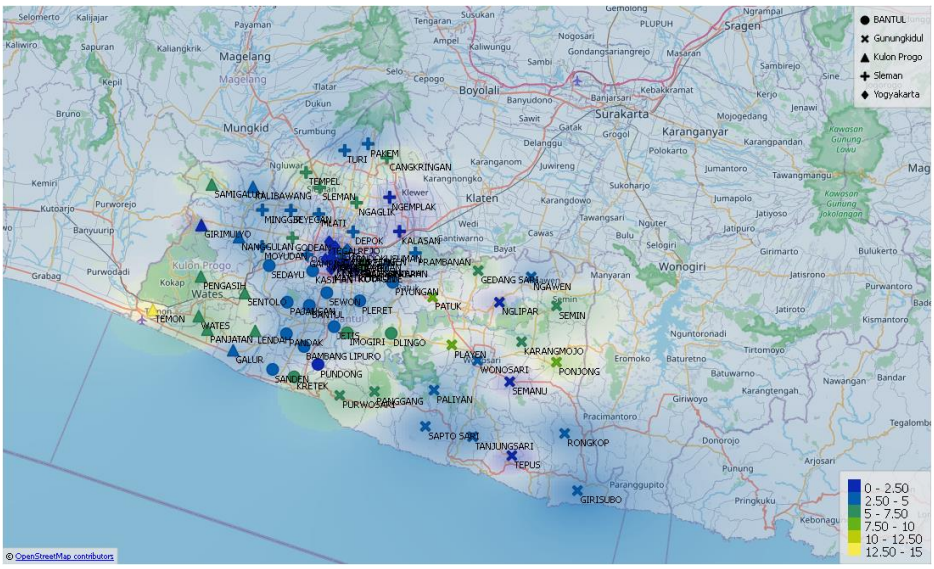


Figure 7 Map of Infrastructure Distribution of Education, Culture, and Health Infrastructure in the Special Region of Yogyakarta.

Source: Primary data processed using Geo-Map Orange Data Mining, 2024

Figure 7 shows that Bantul Regency and Gunungkidul Regency have an uneven distribution of educational, cultural, and health infrastructure compared to other regions in DIY. Areas with severe inequality conditions are mostly located in the southern area of DIY or along the southern seafront. Another case with one of the sub-districts in Kulon Progo Regency that has good infrastructure, namely Temon District, one of them is due to the effect of the existence of the new airport, New Yogyakarta International Airport in Temon, Kulon Progo (Nurkholidah &; Pratiwi, 2017). The existence of the airport can lead to better affordability of infrastructure facilities compared to other regions in the same district (Fatimah & Rahayu, 2023). The last infrastructure that is considered unevenly distributed so that it has not been able to reduce the number of poor people in DIY is transportation infrastructure. The infrastructure of transportation facilities in equation (2) is shown through variables Transportation with a coefficient of -0.01 with the meaning that if transportation infrastructure is fulfilled, it will reduce the number of poor people in DIY by 0.01 per cent. Figure 8 shows a map of equitable distribution of transportation infrastructure in DIY.

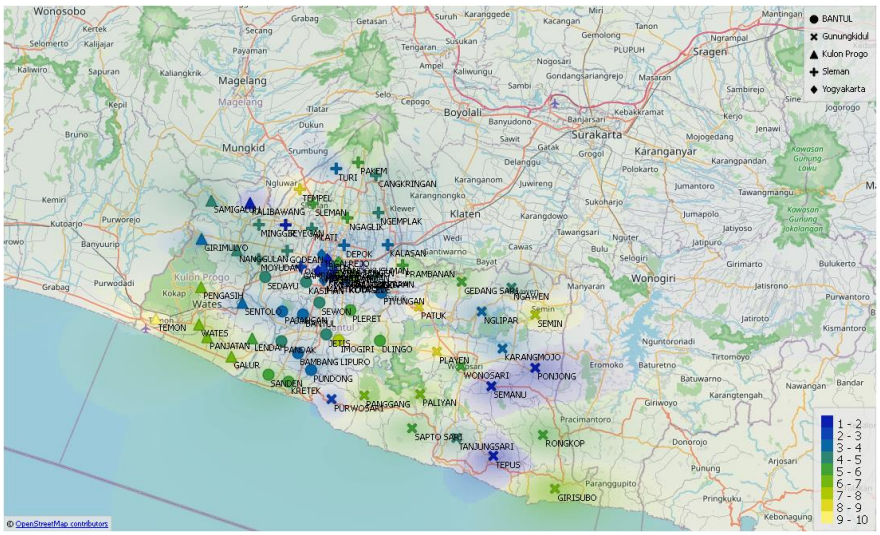


Figure 8 Map of Distribution of Transportation Infrastructure Facilities in the Special Region of Yogyakarta.

Source: Primary data processed using Geo-Map Orange Data Mining, 2024

Transportation infrastructure in DIY has begun to be evenly distributed, one of which is in the area of New Yogyakarta International Airport (NYIA). Various accessibility began to be provided by the government in the form of procurement of airport fire flats and also the Prambanan Express train line with the final destination of Kutoarjo Station (Fatimah & Rahayu, 2023). The facilitation has only been inaugurated in line with the inauguration of the airport so that the community cannot feel the impact. However, areas with a high number of poor people, such as the Bantul Regency, have not received equitable transportation infrastructure from the government. Third, infrastructure that has not been able to reduce

the number of poor people in DIY is one of them caused by uneven development. The inequality of development affects the quality of human resources and has an impact on the lack of productivity, reducing the level of income and consumption of the community.

The development of infrastructure is essential for fostering economic growth; however, it does not invariably lead to a reduction in poverty levels. Several factors contribute to the inadequacy of infrastructure alone in alleviating poverty (Hangli & Xinnan, 2024). First, there is often inequitable access to infrastructure projects, which may fail to reach the most disadvantaged or remote communities, thereby excluding vulnerable populations from the advantages of enhanced transportation, electricity, and water services. Furthermore, for infrastructure to yield significant benefits, it must be integrated with essential services such as education, healthcare, and social safety nets; without these complementary services, the positive impacts of infrastructure can be severely constrained (Mangal et al., 2024). Additionally, large-scale infrastructure initiatives can inadvertently displace local communities, disrupt existing economic activities, and result in the loss of livelihoods if not implemented with an inclusive approach. Moreover, such projects may pose environmental risks, including deforestation and pollution, which can adversely affect local communities and their means of subsistence (Yin et al., 2024). It is also noteworthy that infrastructure development often prioritizes urban areas, thereby overlooking rural regions where poverty is more acute. To effectively combat poverty, infrastructure development must be incorporated into a comprehensive strategy that encompasses social policies, economic opportunities, and a commitment to environmental sustainability (Wan et al., 2024).

4. CONCLUSION

Infrastructure is one of the means of supporting the economy of an area characterized by a decrease in the number of poor people. The high number of poor people in Yogyakarta Special Region (DIY) Province can be reduced, one of which is through equity and alleviation of uneven development. The results obtained are infrastructure in the form of electricity by the State Electricity Company, Drainage Facilities and Infrastructure, Trade and Services Infrastructure, Agricultural Infrastructure Facilities and small village industries, and sanitation and clean water infrastructure facilities proven to be able to reduce the number of poor people in DIY. However, the information and communication infrastructure, health culture education infrastructure, and transportation infrastructure have not shown an influence on overcoming poverty.

Thus, this requires better synergy from the DIY Government through related agencies and Regional Apparatus Organizations such as educational supporting facilities and cultural stages to be able to flatten the infrastructure of the area. Improving quality and adequate infrastructure has a very important role in overcoming the problem of poverty. One of the steps that can be taken is to provide a public transportation fleet that can cover DIY areas, especially areas adjacent to the coast that are still difficult to reach, such as Gunungkidul Regency and Bantul Regency. In addition, it is also important to improve accessibility to health facilities, as this will help improve people's welfare and reduce the burden of poverty.

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The Role of Forensic Accounting and Non-Financial Measurement for the Financial Audit

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ABSTRACT
Due to a lack of competency, including knowledge and experience, non-financial measurement skills are now required by auditors in order to prove fraud. As a result, this research aims to identify the gap between the practice requirements and the output of the audit training centre and the role of the forensic accounting curriculum in filling that gap. This research examines the best strategies for establishing competent and reliable auditing practice results. The non-participatory observation data mining method is used in this study. The study discovered that the auditing education and training centre had not taught and did not have a fraud prevention and detection curriculum based on non-financial measurement. As a result, this study recommends that Training Centre develop the audit curriculum in accordance with The International Education Standard. Furthermore, this study suggests that auditing education and training centres involve forensic accounting practitioners in team-teaching, particularly investigative audit topics.

Keyword: Education, Core Competencies, Skill, Objectivity, Forensic Accounting, Financial Criminology, Non-Financial Measurement.

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1. INTRODUCTION

Auditor knowledge and experience are essential factors in audit quality. According to Knechel (2016), auditor independence and objectivity and expertise (knowledge and experience) influence audit quality. Meanwhile, audit standards assess the quality of audit work, so auditors who follow an audit standard will produce higher-quality audit reports (Mahsun et al., 2020). Standardised auditing practises, in other words, can improve control over governance and risk management processes (Narayanaswamy et al., 2019; Steinbart et al., 2018). On the other hand, financial reporting must meet market demands for real-time reporting by utilising various constantly evolving technologies (Kueppers & Sullivan, 2010). As a result, auditors require effective and efficient audit procedures to provide assurance on financial statement presentation (Kueppers & Sullivan, 2010). Combining financial and non-financial measurements will make the audit procedure more effective (Ames et al., 2012; PCAOB, 2004). Today, financial measurement is a common method for detecting red flags. In the meantime, non-financial measurement collects evidence that forensic accountants can use to investigate suspected fraud cases. Non-financial measurements are typically taken in qualitative measurements using the interview method.

The learning outcomes of education and training centres (Pusdiklat) in the accounting field are frequently criticised for failing to meet the demand for labour market competencies (Adler et al., 2000; Suryawathy & Putra, 2014). However, various auditing education and training centres have not included sufficient material in their curricula for practise needs, primarily related to non-financial methods of measurement. In this case, the Students' Learning Outcomes may fall short of meeting the stakeholders' expectations for investigative audit services. The scope of standard accounting competencies for accounting graduates to meet future accounting profession expectations is still being debated. In preparing professional expectations for future accountants, Blix et al. (2021) emphasise the importance of including data analysis skills and understanding the logic behind data analysis. Some researchers advocate for including forensic accounting skills (Mahsun et al., 2021; Prabowo, 2021). Another argument might be that forensic accounting should only be taught within the scope of the primary accounting curriculum because the field of forensic accounting is considered too broad and more comprehensive than basic accounting for a single major.

This study aims to identify the gap between current auditing practice competency requirements and the audit education and training centre graduates' competency. Furthermore, this research aims to determine the role of the forensic accounting curriculum in filling this void. The study's data collection method is a non-participatory observation, which aims to learn more about the case being studied without actively involving the object of study. Based on previous research, this study also investigates the best possible strategies for developing competent and ready-to-work Learning Outcomes.

This study helps Audit Education and Training Centers and Universities develop their curricula, learning methods and assess the gaps between the curriculum and the needs of current auditing practises. Furthermore, this study suggests that auditing education and training centres involve forensic accounting practitioners in team-teaching, particularly in investigative audit topics. Furthermore, this study benefits Audit Education and Training Centers and Universities by providing material for consideration when developing strategic plans and learning programmes. Finally, by providing various competency recommendations that match current auditing practices' competency needs, this study can help prospective auditors consider alternative audit training curricula.

Because auditors frequently encounter problems with supporting evidence of Audit Reports, the current labour market necessitates that young auditors master evidence collection in Investigative Audits. This study advocates for a qualitative evidence-gathering approach or non-financial measurement methods in investigative audits. The current financial measurement approach, known as Computer Based Audit, cannot be used to detect specific fraud cases. Instead, computer-based auditing (CbA) looks for evidence of fraud in financial statements. As a result, auditors frequently suspect fraud based on complaints or public reports, even when the computer system has not raised any red flags.

2. LITERATURE REVIEW AND HYPOTHESIS

Graduate Skill Gap and Audit Practice Requirements

Accounting education researchers have recently emphasised the importance of developing an accounting curriculum and developing students' competence (M. Bhasin, 2016; Kramer et al., 2017; Weil et al., 2004). Currently, the accounting labour market in Indonesia requires graduates to be fluent in English, audit, and tax, as well as can create a simple accounting system and communicate financial ratios and position to managers (Suryawathy & Putra, 2014). However, essential accounting competencies are insufficient for auditors to deal with various practical challenges, so auditors now need forensic accounting competencies (Mahsun et al., 2021). Because of various financial statement publication scandals, various accounting profession leaders began to call on scholars to provide forensic accounting education over a decade ago (Melancon, 2002). This statement demonstrates that every company requires auditors with forensic accounting competency to analyse problems, problem-solve, gather and evaluate evidence, and provide opinions for more than a decade. Auditors are currently in need of litigation support for claims based on published opinions.

In various countries such as the United Kingdom (Herbert et al., 2020), New Zealand (Jackson et al., 2013), and the United States, there is a gap between training institution expectations and labour market expectations in terms of intellectual, technical, and work readiness of graduates (Webb & Chaffer, 2016). (Bolt-Lee & Foster, 2003). Ideally, an accounting firm would prefer candidates with more accounting expertise, particularly technical and forensic accounting (Nsengiyumva & Bokka, 2020). Auditors require forensic accounting expertise because the audit scope includes financial statements, assets, and transactions with specific values that necessitate communication and legal skills (Wankel, 2009).

Gap in Audit Expectations

The gap arises due to differences in beliefs and expectations between the auditor and stakeholders regarding the auditor's assumption of duties and responsibilities in relation to the opinion on the financial statements he examines (Monroe & Woodliff, 1993). The public expects every auditor to detect fraud in any situation. On the other hand, auditors believe that they are only responsible for determining the fairness of a financial statement. This expectation gap will undoubtedly be exacerbated if the auditor lacks expertise in forensic accounting.

Curriculum in Forensic Accounting Makes a Difference

Forensic accounting is defined as "the application of financial and investigative skills and mental abilities to solve financial problems with fraud indications in the context of regulations and the gathering of specific evidence" (Bhasin, 2016). Due to the rise in fraud, embezzlement, and other financial crimes in today's society, professional accountants and auditors must receive forensic accounting skills training to detect and identify these

crimes (Houck et al., 2006; Kramer et al., 2017). Forensic accounting education is multidisciplinary training that focuses on developing technical and soft skills. Forensic accounting can cover various disciplines depending on the auditee type and the need to gather audit evidence. Auditing, accounting, statistics (Tiwari & Debnath, 2017), information systems, law, communication, and investigative skills are all part of forensic accounting (Van Akkeren et al., 2013). As a result, the demand for candidates with forensic accounting skills is growing (Kramer et al., 2017; Ramadhan, 2021). Academics in Indonesia agree that teaching forensic accounting skills to accounting students is critical to supplement the needs of future audit investigations (Prabowo, 2021). Other empirical evidence suggests that candidates who have completed forensic accounting courses are more likely to be hired than candidates who have not completed forensic accounting courses (Mounce & Frazier, 2002). Indeed, forensic accounting skills can help professionals pursue careers as consultants, managers, and auditors, according to (Kramer et al., 2017).

Auditors typically require non-financial measurement competencies from the various skill sets in the forensic accounting curriculum, as data and evidence in investigative audits are collected using qualitative approaches. Non-financial measurement/non-technical skills are commonly found in communication and interpersonal skills (Suryawathy & Putra, 2014; Weil et al., 2004), which are extremely useful and advantageous in collecting and evaluating fraud evidence. Weil et al. (2004) divided the primary attributes of persons in auditing, reporting, reconstruction and bankruptcy, accounting management, and taxation into three skill sets: communication skills, problem-solving skills, and presentation skills. Communication skills are related to asking probing questions in interviews in order to identify problems. Problem-solving is the process of making decisions based on all available information, both complete and incomplete. Finally, presentation skills are associated with expressing ideas, making judgments, and presenting problems and solutions to managers and stakeholders from various points of view. In general, auditors must be able to analyse data (McMullen & Sanchez, 2010), simplify complex problems, solve problems (M. Bhasin, 2016), and present opinions that can be legally accounted for (Kramer et al., 2017).

The forensic accounting services department is present in all financial firms, most of which are medium-sized. Furthermore, some may be in charge of insurance claim service and fraud detection (M. L. Bhasin, 2015). Because of the fraud risks that the auditee could not face, the provision of forensic accounting services began to emerge. Poor governance can lead to decreased performance, financial statement manipulation, and decreased stakeholder confidence and trust levels for a company. As a result, forensic accountants play an important role in every business, particularly in reducing fraud.

Theory of Stakeholders

A stakeholder is any group or individual who can influence or is influenced by an organisation's goals being met (Freeman, 2015). A stakeholder is any individual or group interested in an organisation or events within an organisation, either directly or indirectly (Wibisono, 2007). Creditors, investors, the government, the Audit Standards Board, and the general public are all interested in auditing. In terms of audit service user satisfaction, stakeholders are more satisfied with audit opinions from forensic accountants because they can provide legal considerations and financial accounting considerations (Mahsun et al., 2021). To complete an investigative audit, auditors must be proficient in forensic accounting (Mahsun et al., 2021; Yudhiyati, 2020). Based on the level of satisfaction among stakeholders and the current demand for accounting professionals in forensic accounting,

forensic accounting competence can help bridge the expectation gap between various stakeholders, such as the Audit Standards Board and the Auditor. The audit standards board has established a standard for implementing Fraud Risk Assessment (FRA), but not all auditors recognise FRA as audit procedures required by SAS 99 and ISA 240.

Criminology of Finance

Financial crime is defined as any illegal activity carried out by a person or organisation without the use of direct violence in order to obtain financial gain through deception, embezzlement, or concealment (Pickett & Pickett, 2002). Financial criminology investigates financial crimes from an accounting, legal, and behavioural standpoint. The definitive explanation of the categories used in the white-collar crime domain underpins the criminological analysis of financial crime (Ruggiero, 2015).

Auditors should understand financial criminology as a profession that stakeholders expect to uncover a variety of irregularities. Furthermore, in investigative assignments, auditors must investigate the occurrence of fraud and calculate losses due to fraud. As a result, financial criminology knowledge is relevant to the auditor profession, mainly when performing investigative audit assignments.

3. METHODS

This study employs the non-participatory observation data collection technique. Non-participatory observation, as defined by Lavia et al. (2018), is a scientific investigation or experiment in which research participants are unaware of the observation and do not actively participate. The interview technique was used in this study, along with direct non-structural questions. The data collected include accounting and auditing teachers' educational backgrounds, accounting and auditing education curriculum, students' learning experiences in audit education and training centres, employee self-development needs in specific accounting and auditing competencies, and various literature that may be a solution to the gap between auditor competency needs and learning outcomes from audit education and training centres.

4. RESULTS AND DISCUSSION

The results based on research objectives are set out in subsections 4.1 – 4.4.

ROI: To identify the gap between current auditing practice competency requirements and the competency of audit education and training centre graduates.

RO2: To determine the role of the forensic accounting curriculum in filling this void.

RO3: To examine the best strategies for establishing competent and reliable auditing practice results.

Experiential Learning

The learning experience provided to students in this research is intended to help them develop technical skills such as audit planning, audit techniques and procedures, substantive and control testing techniques, and financial statement preparation techniques. Participants in this study are generally required to practise Computer-Based Audit (CbA). In other words, participants in this study were not taught about qualitative evidence collection (non-financial measurement) methods such as in-depth interviews in detecting red flags. Furthermore, participants with teacher characteristics in this study did not prioritise teaching forensic accounting in financial audits. The majority of participants in this study with student and teacher attributes stated that the learning method used was the lecture method. The majority of student activity is listening to the teacher and working on the financial measurement procedures. Table 1 presents the demographics and profile of respondents.

Table 1. **Demographics and Profile of Respondents**

		Frequency	%	Valid %	Cumulative %
1. Training Participants					
	Male	13	43.33	43.33	43.33
	Female	17	56.67	56.67	100
	Total	30	100.00	100	
2. Training Instructor					
	Male	7	100.00	100.00	100.00
	Female	0	0	0	100
	Total	7	100	100	
3. Internal Auditor					
	Male	24	80.00	80.00	80.00
	Female	6	20.00	20.00	100.00
	Total	30	100.00	100.00	
4. External Auditor					
	Male	9	30.00	30.00	30.00
	Female	21	70.00	70.00	100
	Total	30	100.00	100.00	
5. Apprenticeship					
	Male	8	53.33	53.33	53.33
	Female	7	46.67	46.67	100
	Total	15	100.00	100.00	
6. Audit Service User					
	Male	9	100.00	100.00	100.00
	Female	0	0	0	100
	Total	9	100	100	
7. Audit Training Centre Manager					
	Male	3	100.00	100.00	100.00
	Female	0	0	0	100
	Total	3	100	100	
8. Audit Lecturer					
	Male	1	33.33	33.33	33.33
	Female	2	66.67	66.67	100
	Total	3	100	100	

Source : Data Processed

Only computer-based auditing was taught at the audit training institutions in this study. This means that no one teaches all students to collect qualitative data or evidence. Students are only taught to investigate quantitative data through analytical procedures, control testing, and substantive testing. Analytical procedures compare data over time and/or with a certain level of expectation. Control testing is a method of determining the effectiveness of an internal control system. Substantive testing evaluates the fairness of account presentation in financial statements. Demand for investigative audit services is increasing these days. Many audit service users prefer investigative audits performed by auditors with forensic accounting expertise, focusing on accounting, law, and behaviour. Behavioural science is beneficial

for auditors in detecting potential fraud or diagnosing improper behaviour as a result of a legal deviation. Legal knowledge is advantageous for auditors in order to support investigations into deviations from applicable regulations.

Graduate Competency Expectations in the Labour Market

Due to the prevalence of fraud in the business and public sectors, auditors must develop forensic accounting skills. In addition to these essentials, the auditor must analyse the qualitative non-financial measurement data collected. Financial measurement or computer-based auditing (CbA) is less reliable in investigative auditing. The growing demand for investigative audit services requires auditors to analyse illegal acts, calculate fraud losses, and analyse company resilience to fraud. This phenomenon demonstrates that today's labour market competency requirements for graduates and competency development for auditors and undergraduates in forensic accounting are increasing. Forensic accountants in the United States can begin their careers with the Federal Bureau of Investigation (FBI). Currently, police in Indonesia frequently rely on forensic accounting experts to assist them in uncovering financial crimes and calculating fraud losses. Audit and forensic accounting experts are frequently called to assist the judicial process as expert witnesses in several trials at the Corruption Court. Unfortunately, because this study did not include participants from the police and prosecutor's offices, it cannot reveal their specific needs regarding forensic accounting competency and their job requirements and recruitment.

Auditor Competency Requirements

Auditors today require forensic accounting expertise in order to collect qualitative evidence and prepare accurate and reliable audit reports. The non-financial measurement approach plays an essential role in developing audit conclusions. The more evidence and witnesses auditors have, the more confident they are in the Audit Report. Furthermore, because most of a company's transactions are conducted online, today's auditors must be IT-savvy in big data and data security.

Non-Financial Metrics

Non-financial measurements were not considered by audit participants in this study as part of audit procedures and data analysis. On the other hand, auditors frequently encounter issues with audit evidence, which underpins the construction of audit reports. They must maintain professional scepticism in responding to indications of outrageous behaviour and including them in an objective and independent audit report in accordance with auditing standards and professional ethics codes. The auditor must be able to convert audit evidence into legal evidence that may be required in the litigation process during the investigative audit assignment.

Non-financial measurement is based on non-financial qualitative data, so data collection methods such as in-depth interviews and observation are required. When fraud indicators are discovered, auditors who only look at non-financial data will miss important clues. Non-financial data can be as crucial as financial statements, but auditors frequently overlook qualitative data. Auditors in this study have access to non-financial information but do not always pay attention. Non-financial information includes family background, employee number and workload, organisational culture, customer accounts, overtime hours, family relationships, social information, and public complaints.

In this study, the audit report users expect the auditor to uncover the fraud. On the other hand, common auditors believe that the audit of financial statements is limited to assessing the fairness of financial statement presentation and compliance with generally accepted accounting principles or financial accounting standards. In this case, an auditor with forensic accounting expertise

bridges the gap between the audit report user and the auditor because forensic accountants' professional judgement includes additional factors such as legal, psychology, information technology systems, and other relevant non-financial measurement variables.

DISCUSSION

Auditors are currently required to learn a variety of disciplines, particularly forensic accounting, due to its broad scope and the diversity and growth of financial crimes committed by auditees. Clients now require auditors with forensic accounting expertise, particularly for investigative assignments. Only a few Audit Education and Training Centers and Universities have responded to this occurrence. Even the quality of accounting and audit training institutions has come under fire for failing to provide the necessary professional skills (Murphy & O'Connell, 2017; Suryawathy & Putra, 2014). According to Wells et al. (2009), orientation to client needs is an effective strategy for achieving company goals. This argument demonstrates the importance of including forensic accounting in audit curriculum development to meet labour market demands for auditor competence. Auditors and audit learning instructors must also be proficient in forensic accounting and non-financial measurement. Students nowadays rely on audit instructors to provide them with new information about practical accounting issues (Suryawathy & Putra, 2014). As a result, this study recommends that all parties associated with Audit Education and Training Centers include elements of forensic accounting in the development of audit curriculum to prepare learning outcomes that give credence to the labour market.

Curriculum for Audit and Forensic Accounting

Several strategies that may be able to assist audit education and training centres and universities in developing audit curricula in order to prepare the learning outcomes can be summarised based on the study's findings and various related literature: 1) using and adapting the International Education Standard (IES) as a benchmark for accounting and auditing curriculum preparation; and 2) involving audit practitioners as a teaching team who introduce auditing practises (Bridgstock, 2009; Jackson & Chapman, 2012). (Mahsun et al., 2021). 3) Involve law and behaviour professionals in the investigative audit teaching team; 4) Use learning methods that make it easier for students to acquire technical and soft skills, such as case simulation and role play.

With the rapid competition of training institutions and the labour market and changes in regulations and technology, training institutions should guide their students based on practical needs (Adler et al., 2000; Mah'd & Mardini, 2020). The balance between the current curriculum and the need for labour market competency attributes must be improved regularly (Bautista-Mesa et al., 2018; Boyce et al., 2019; Mourshed et al., 2013). IES is currently an alternative accounting education standard that can address the quality challenges of training institutions (Mah'd & Mardini, 2020; Sugahara & Wilson, 2013). According to the International Education Standard (IES), aspiring accountants should have diverse complex skills. Technical abilities alone may not be sufficient to assist auditors in dealing with business challenges (Dolce et al., 2020; Moore & Morton, 2017). Technical skills, individual skills, interpersonal skills, communication skills, and management skills are all necessary for prospective accountants and auditors to develop (IAESB, 2017). As a result, implementing IES is also not easy for Training Centers (Karreman et al., 2007).

Auditors typically work to uncover financial inaccuracies. On the other hand, a forensic accountant works to identify deviations from the applicable law (Rezaee et al., 2016). Accounting manipulation, loss assessment, corruption, employee negligence and management are all discovered by forensic accountants,

according to Tiwari and Debnath (2017). Auditors must be proficient in auditing, accounting, information technology systems, law, and behaviour. As a result, this study recommends that auditors acquire more comprehensive skills to meet today's business challenges.

Methods/Approach to Learning

The most common learning method participants use in this study is lecture and working on financial measurement procedures. The best accounting learning approach, on the other hand, is still being debated. Several scholars have proposed case study learning (Agrawal et al., 2021; Baldauf et al., 2020; Hassall et al., 1998; Plant et al., 2019; Weil et al., 2004), experimental learning (Butler et al., 2019), phenomenological learning (Healy & McCutcheon, 2010; Weil et al., 2004), seminars, and guest lectures (Suryawathy & Putra, 2014). Case studies assist students in evaluating a problem from various perspectives and considering alternative solutions to a case (Weil et al., 2004). Students benefit from the case studies learning approach in terms of increasing their ability to question underlying assumptions and listen to arguments (Hassall et al., 1998), developing critical thinking (Beattie et al., 2012; Mihret et al., 2017; Weil et al., 2004), preparing for dealing with real-life practical problems and developing scepticism towards material misstatements, data analysis, risk measurement, developing problem-solving skills; sharpen (Weil et al., 2004; Wines et al., 1994).

5. CONCLUSION

This study's Audit Educations and Training Centres do not yet focus on forensic accounting and non-financial measurement learning to prepare labour market demands on financial criminology learning outcomes. The Audit Education and Training Center focuses on audit technical skills such as computer-based auditing (CbA) as a professional development entity. On the other hand, the public anticipates that the audit results will reveal the accuracy and validity of fraud-related losses. The International Education Standard (IES) can be adopted and adapted by audit education and training centres and accounting colleges to benchmark accounting and auditing curriculum development materials. Audit practitioners, forensic accounting practitioners, and professionals in law and behaviour should all be involved in the audit learning process, according to the Training Centre supervisor (psychology). Audit and accounting instructors must also use a case study approach to learning, phenomenology, experimental, seminar, and guest lecture.

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