ARTIFICIAL INTELLIGENCE IN AUDITING: OPPORTUNITIES, CHALLENGES, AND FUTURE DIRECTIONS[*]

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ABSTRACT

Amid growing data complexity, artificial intelligence (AI) holds transformative potential for auditing. This study explores AI's role in enhancing audit efficiency and effectiveness, employing a qualitative research design based on secondary sources. It delves into the impacts of AI-driven technologies, like machine learning, on risk assessment, anomaly detection, and continuous auditing. While AI offers substantial benefits such as improved speed and accuracy, challenges related to data privacy, skills adaptation, and ethics persist. The paper calls for regulatory frameworks and skill sets to address them, providing practical guidelines for professionals and regulators and contributes to understanding AI's transformative role in auditing.

Keywords: Artificial Intelligence, Auditing, Risk Assessment, Ethical Issues

JEL Classification: M42, M15, O33

DENETİMDE YAPAY ZEKA: FIRSATLAR, ZORLUKLAR VE GELECEK PERSPEKTİFLERİ

ÖZ

Artan veri karmaşıklığı çağında, Yapay Zekâ (YZ) denetim için dönüştürücü bir potansiyele sahiptir. Bu çalışmada, ikincil kaynaklara dayanan nitel bir araştırma yöntemi kullanılarak YZ'nin denetim verimliliği ve etkinliğini artırmadaki rolü incelenmiştir. Makine öğrenmesi gibi YZ destekli

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teknolojilerin risk değerlendirmesi, anormallik tespiti ve sürekli denetim üzerindeki etkilerine odaklanılmıştır. YZ, hız ve doğruluk gibi önemli faydalar sağlarken, veri gizliliği, yetkinliklerin uyarlanması ve etik konularla ilgili zorluklar devam etmektedir. Bu çalışmada, bu sorunları ele almak için düzenleyici çerçeveler ve beceri setlerinin geliştirilmesi gerektiği vurgulanmış ve profesyonellere ve düzenleyicilere pratik öneriler sunulmuştur. Bu çalışma ile, denetimde YZ'nin dönüştürücü rolünün anlaşılmasına katkı sağlanması amaçlanmıştır.

Anahtar Kelimeler: Yapay Zekâ, Denetim, Risk Değerlendirmesi, Etik Sorunlar

JEL Sınıflandırması: M42, M15, O33

GENİŞLETİLMİŞ ÖZET

AMAÇ VE MOTİVASYON

Bu çalışmanın amacı, yapay zekânın (YZ) denetim mesleğindeki dönüştürücü rolünü inceleyerek sunduğu fırsatları, karşılaşılan zorlukları ve gelecekteki yönelimleri ele almaktır. YZ teknolojilerinin denetim uygulamalarına giderek daha fazla entegre olmasıyla birlikte, bu teknolojilerin etkilerini anlamak hem uygulayıcılar hem de akademisyenler için büyük önem taşımaktadır. Bu araştırma, YZ'nin denetim süreçlerinde verimliliği ve etkinliği nasıl artırdığını ortaya koyarken, aynı zamanda veri gizliliği, yetkinlik gereksinimleri ve etik hususlar gibi önemli zorlukları da ele almayı hedeflemektedir. Denetim alanında değişen dinamiklere dair kapsamlı bilgiler sunarak denetçilerin ve düzenleyici kurumların YZ'nin getirdiği karmaşıklıkları etkin bir şekilde yönetebilmesine katkıda bulunmayı amaçlamaktadır.

ARAŞTIRMANIN STRATEJİSİ VE YÖNTEMİ

Bu çalışmada, YZ denetim uygulamalarına entegrasyonunu incelemek amacıyla nitel bir araştırma tasarımı benimsenmiştir. Araştırma stratejisi, akademik literatür, sektör raporları ve vaka analizleri gibi ikincil veri kaynaklarının kapsamlı bir şekilde incelenmesini içermektedir. Bu yöntem, YZ teknolojilerinin sunduğu fırsatlar ve getirdiği zorluklarla ilgili mevcut bilgi ve eğilimlerin derinlemesine analiz edilmesine olanak tanımaktadır.

Veri toplama süreci, risk değerlendirmesi, anomali tespiti ve sürekli denetim gibi temel temalara odaklanarak çeşitli kaynaklardan elde edilen bulguların sentezlenmesini içermektedir. Bu metodoloji, YZ'nin denetim süreçlerine sağladığı avantajların yanı sıra güvenlik açıkları ve etik kaygılar gibi olası risklerin de ele alınmasını mümkün kılmaktadır. Elde edilen verilerin analizi sonucunda, denetçiler ve düzenleyici kurumlar için YZ'nin etkin bir şekilde uygulanmasına yönelik pratik yönlendirmeler geliştirilmesi amaçlanmaktadır. Bu çalışma, akademik camiaya ve sektör profesyonellerine değerli

içgörüler sunarak YZ'nin denetim alanındaki geleceği hakkında bilinçli tartışmaların teşvik edilmesine katkı sağlamayı hedeflemektedir.

BULGULAR VE TARTIŞMA

Yapay zekânın denetim süreçlerine entegrasyonu, geleneksel uygulamaları yeniden şekillendiren önemli fırsatları ve zorlukları ortaya çıkarmaktadır.

Fırsatlar:

YZ teknolojileri, özellikle makine öğrenimi ve veri analitiği, denetim süreçlerinde verimliliği ve doğruluğu artırmaktadır. Büyük veri kümelerini hızla işleyerek denetçilerin risk değerlendirmelerinde daha yüksek hassasiyet elde etmesine yardımcı olur. Bu sayede manuel denetimlerde gözden kaçabilecek kalıplar ve anomaliler tespit edilebilir. YZ'nin sunduğu bir diğer önemli avantaj ise sürekli denetim (continuous auditing) imkânı sağlamasıdır. Gerçek zamanlı finansal işlemleri ve süreçleri izleme yeteneği, denetimlerin zamanında ve daha etkili bir şekilde gerçekleştirilmesini mümkün kılar. Ayrıca, YZ destekli öngörüsel analitik yöntemleri, potansiyel risklerin önceden belirlenmesine olanak tanıyarak organizasyonların sorunları büyümeden ele almasını sağlar.

Zorluklar:

Bununla birlikte, YZ'nin denetimde kullanımı çeşitli zorlukları da beraberinde getirmektedir. Veri gizliliği ve güvenliği konuları büyük önem taşımakta olup, denetçilerin hassas bilgileri koruma ve kötüye kullanım risklerini önleme sorumluluğu bulunmaktadır. Ayrıca, YZ'nin benimsenmesi, denetim profesyonelleri için yeni beceri setlerinin gerekliliğini ortaya çıkarmaktadır. Veri analitiği, programlama ve YZ sistemlerine dair kapsamlı bilgi, günümüz denetçilerinin sahip olması gereken yetkinlikler arasında yer almaktadır. Bu beceri boşluğunun kapatılması için sürekli eğitim ve mesleki gelişim büyük önem taşımaktadır. Etik boyutta ise, YZ'nin karar alma süreçlerindeki kullanımı konusunda şeffaflığı ve hesap verebilirliği sağlamak kritik bir meseledir. Algoritmalarda yer alabilecek önyargılar, kamuoyunun denetim süreçlerine olan güvenini zedeleyebilir ve bu nedenle dikkatle ele alınmalıdır.

Gelecek Yönelimleri:

Elde edilen bulgular, denetim mesleğinin giderek daha fazla YZ teknolojilerine dayanacağını göstermektedir. Bu dönüşüm doğrultusunda, düzenleyici çerçevelerin de değişen dinamiklere uyum sağlaması gerekmektedir. YZ'nin denetim süreçlerine başarılı bir şekilde entegre edilebilmesi için denetçiler, teknoloji sağlayıcıları ve düzenleyici kurumlar arasında iş birliğinin güçlendirilmesi büyük önem taşımaktadır. Böylece, mesleğin güvenilirliği ve etkinliği korunarak, YZ'nin sunduğu avantajlardan en iyi şekilde yararlanılması mümkün olacaktır.

SONUÇ VE ÖNERİLER

Sonuç olarak, yapay zekânın (YZ) denetim süreçlerine entegrasyonu, mesleği dönüştüren önemli bir fırsat sunmaktadır. YZ teknolojileri, karar alma süreçlerini iyileştirerek denetimlerin daha etkin ve verimli yürütülmesini sağlamaktadır. Makine öğrenimi ve veri analitiği gibi ileri düzey yetenekler, denetçilerin daha önce erişemedikleri içgörülere ulaşmalarını mümkün kılarak, geleneksel metodolojilerin ötesine geçmelerine olanak tanımaktadır.

Ancak, bu dönüşüm beraberinde çeşitli zorluklar da getirmektedir. YZ'nin kullanımı, hesap verebilirlik ve denetçilerin gerekli becerilere sahip olması gibi konuları gündeme getirmektedir. Veri gizliliği ve algoritmik önyargılar gibi etik sorunlar da dikkatlice ele alınmalı, böylece denetim süreçlerine duyulan güvenin korunması sağlanmalıdır.

Geleceğe yönelik olarak, denetim alanında YZ'nin inovasyonu daha da artıracağı öngörülmektedir. Özellikle otomasyon ve öngörüsel analitik alanlarında önemli gelişmeler yaşanması beklenmektedir. Bu süreçte, denetçiler ve organizasyonlar için en iyi uygulamaları takip etmek ve yeni teknolojilere uyum sağlamak kritik bir gereklilik olacaktır.

Bu araştırmanın bulguları, hem uygulayıcılara hem de düzenleyici kurumlara önemli çıkarımlar sunmaktadır. YZ'nin denetimde etkin kullanımını sağlamak için sağlam düzenleyici çerçevelerin oluşturulması gerekmektedir. Fırsatları değerlendirirken riskleri minimize eden bir yaklaşım benimsenmesi, denetim mesleğinin gelecekteki başarısını ve güvenilirliğini sağlamada önemli bir rol oynayacaktır. Yapay zekânın denetim alanına entegrasyonu, finansal gözetimin ve risk yönetiminin iyileştirilmesine katkıda bulunarak denetim mesleğini daha güçlü bir hale getirecektir.

1.INTRODUCTION

It is widely acknowledged that artificial intelligence is currently utilized in numerous fields as both an accelerator and an enhancer. One such field is the auditing profession, where AI applications have started to be discussed. This study explores the dimensions of AI use in auditing, focusing on its opportunities, challenges, and future perspectives.

In recent years, the integration of AI technologies into auditing processes has revolutionized traditional practices, offering unprecedented opportunities for enhancing efficiency, accuracy, and decision-making. The advent of AI has introduced innovative tools and methodologies that significantly alter how audits are conducted, pushing the boundaries of conventional approaches. As auditing continues to evolve, AI stands at the forefront, promising to reshape how risks are assessed, decisions are made, and processes are automated. AI's ability to analyze vast amounts of data with precision and speed provides auditors with powerful insights that were previously unattainable. By leveraging

machine learning algorithms, natural language processing, and other advanced AI techniques, auditors can now identify patterns, detect anomalies, and gain a deeper understanding of complex financial landscapes.

However, the integration of AI into auditing is not without its challenges. Issues related to security vulnerabilities, the need for continuous learning, and ethical considerations present significant hurdles that must be addressed. Ensuring the security and explainability of AI systems, staying abreast of rapid technological advancements, and navigating the ethical implications of AI decision-making are critical concerns that auditors and organizations must grapple with.

This paper explores the multifaceted impact of AI on auditing practices, focusing on the opportunities it presents, the challenges it imposes, and the future directions it may take. By examining the ways AI enhances risk assessment, decision-making, and process automation, while also addressing the associated challenges, this study aims to provide a comprehensive understanding of AI's role in shaping the future of auditing.

2. OPPORTUNITIES PRESENTED BY AI IN AUDITING

AI is revolutionizing the auditing profession by improving effectiveness and efficiency of auditing processes. The benefits, conveniences, and possibilities provided artificial intelligence tools in the auditing domain are compiled as opportunities. A review of the literature reveals that these opportunities presented by artificial intelligence in the auditing field can be categorized under three main headings. The opportunities that enhance auditing efficiency are *risk assessment*, *decision making* and process *automation*. This classification is discussed here under these subheadings based on references from the relevant literature.

2.1. Risk Assessment

Risk assessment is a crucial element of audit planning and directly impacts the efficiency and effectiveness of the audit process. The integration of AI in auditing, particularly in risk assessment, offers new insights into decision-making and problem-solving by leveraging the existing potential of big data and AI technologies, including data mining and machine learning. AI can greatly enhance risk assessment in auditing by identifying the highest-risk audit areas through detection or prediction, thereby reducing overall audit risks (Nur Muslihatun et al., 2021). AI integration in auditing greatly enhances risk assessment by pinpointing the most critical audit areas through classification algorithms like logistic regression, decision trees, neural networks, and support vector machines (Alastal et al., 2024). AI has been widely investigated for its potential in risk mitigation in financial industry, with applications ranging from fraud prevention and money laundering detection to enhancing sound lending

practices (Mishra et al., 2024). AI has profoundly influenced the audit process, especially in risk assessment, by enhancing value and addressing the limitations of traditional auditing methods. Its implementation in auditing has provided deeper insights into risk assessment through the use of models and algorithms, such as classification algorithms and expert systems, to identify or predict high-risk audit areas (Nur Muslihatun et al., 2021). AI technologies, such as data mining and machine learning, have empowered auditors to automate routine audit tasks, freeing up more time to concentrate on areas that require significant judgment and continuous risk assessment during the audit process. However, challenges in using AI for risk assessment include the need for additional training and expertise in AI, as pointed out by respondents in a study conducted in Gulf countries (Alastal et. al., 2024). The adoption of AI-based predictive analysis in professional audits is influenced by factors such as control risk, readiness for IT challenges, and other technological considerations (Rawashdeh, et.al., 2023). Auditors recognize that AI systems have the potential to automate routine audit tasks, facilitate continuous risk assessment, and reduce audit risks. However, they stress the importance of further training and education in AI. The integration of AI in auditing has also highlighted gaps between auditors' awareness of AI technologies and their actual implementation, leading to widespread underutilization (Nogueira, et al., 2024).

Integrating AI into risk assessment in auditing offers benefits like time savings, increased efficiency and accuracy, reduced risks and biases, and enhanced audit quality (Üçoğlu, 2022).

2.2. Decision Making

AI supports auditing decision-making by utilizing big data and AI technologies, including data mining and machine learning, to offer fresh insights into auditing problem-solving (Alastal et al., 2024). AI enhances auditors' decision-making by adding value and ensuring comprehensive transaction coverage rather than depending solely on sampling for assessments. Unlike traditional methods that rely heavily on sampling, AI-driven systems provide comprehensive transaction coverage, reducing the risk of undetected anomalies and enhancing overall audit quality. This shift from sample-based assessments to full data analysis strengthens auditors' ability to detect patterns, anomalies, and potential fraud cases, ultimately increasing the reliability of financial and managerial reports. AI-driven systems aid the auditing process by recognizing patterns within data and formalizing them into predictions, rules, and decisions, thereby increasing efficiency and improving the accuracy of calculations (Dalwai et al., 2022).

The adoption of AI in internal audits is largely motivated by the need to address traditional audit limitations and adapt to evolving work environments, such as those introduced by the Covid-19 pandemic (Dalwai et al., 2022). Research indicates that AI technology enhances audit quality while reducing the time required for auditing processes (Noordin et al., 2022). AI-powered auditing tools

enable precise and thorough audits, which increase financial reporting accountability and ensure audit quality (Hu et al., 2021). This improvement is particularly valuable in large-scale audits, where human auditors may face time constraints and cognitive biases that AI can mitigate.

By automating routine tasks, facilitating continuous risk assessment, and freeing auditors to focus on areas requiring significant judgment and a deeper understanding of the entity and its processes, AI contributes to improved audit quality and efficiency (Fedyk et al., 2022). Leocádio et al. (2024) propose a conceptual framework that positions AI as a tool to transition auditing from retrospective reviews to real-time monitoring, emphasizing its impact on fraud detection and regulatory compliance. They highlight AI's ability to enhance efficiency, accuracy, and risk assessment in audit practices, supporting this study. This dynamic interaction between AI and human auditors enables a hybrid audit model in which technology augments human expertise rather than replaces it.

While some studies suggest that AI may reduce reliance on human auditors and lower audit fees (Alastal et al., 2024), it is crucial to consider the broader implications of AI adoption, including regulatory challenges, ethical concerns, and the need for auditors to develop new skills to effectively work alongside AI. AI platforms designed for auditing deliver time savings, greater efficiency and accuracy, minimized risks and biases, and overall enhanced audit quality (Üçoğlu, 2022). Moreover, the adoption of AI and Information and Communication Technologies (ICT) can significantly improve knowledge management among practicing auditors and elevate the standards of auditing practices (Thottoli, 2024). This advancement in audit practices underscores the importance of balancing automation with professional judgment to ensure that AI-driven insights align with ethical and regulatory expectations.

AI has the potential to significantly impact decision-making in auditing by enhancing effectiveness and efficiency, improving audit quality, and automating routine processes. However, challenges such as regulatory conservatism, ethical implications, and the need for shared accountability between humans and AI must be addressed. Despite these challenges, AI adoption in auditing can lead to improved accuracy, efficiency, and knowledge management for auditors. Future research should focus on refining AI models to better align with auditing standards while addressing challenges related to trust, transparency, and auditor-AI collaboration.

2.3. Processes Automation

AI can significantly improve internal audit processes by automating routine tasks, boosting efficiency, and allowing auditors to concentrate on more complex areas like risk assessment and fraud detection (Saatchi et al., 2024). Traditional audit processes often involve labor-intensive and repetitive tasks, which can be streamlined through AI-powered automation. This not only reduces human error but also ensures a more efficient allocation of audit resources, allowing auditors to dedicate their expertise

to high-risk and judgment-intensive areas. One of the key advancements in AI-driven auditing is Intelligent Process Automation (IPA), which merges robotic process automation (RPA) with artificial intelligence (AI) and provides adaptable and intelligent automation for audit engagements (Zhang, 2019). By integrating AI with RPA, organizations can achieve greater efficiency, accuracy, and faster delivery of information to management (Gao & Kuang, 2023). The implementation of AI in internal audit tasks can streamline processes, making them quicker and more efficient, while also improving auditors' capabilities and allowing for real-time anomaly detection, enabling auditors to proactively identify risks rather than relying solely on retrospective evaluations (Handoko et al., 2023). Almufadda & Almezeini (2022) provide a broad literature review of AI applications in auditing, analyzing prior research published between 2016 and 2020. Their study systematically categorizes AI's impact on auditing, covering key technologies such as natural language processing (NLP), machine learning (ML), deep learning, and robotic process automation (RPA). The study acknowledges the benefits of AI such as automation, fraud detection, and enhanced decision-making. A significant contribution of their work is the discussion on AI adoption by the Big 4 accounting firms. Their research converges on the idea that AI will not fully replace auditors but will significantly reshape their roles and highlights AI's ability to streamline repetitive tasks.

AI-driven technology minimizes the risk of human error and accelerates the auditing process, resulting in more accurate and timely information being provided to management (Murikah et al., 2024; Adamyk et al., 2023). These improvements contribute to greater transparency and reliability in financial statements, which are essential for maintaining stakeholder confidence. AI platforms tailored for auditing offer significant time savings, enhanced efficiency, increased accuracy, reduced risks and biases, and improved quality of audits (Üçoğlu, 2022). Auditors are optimistic about substantial efficiency gains, envision AI-assisted tasks, and predict that AI will become essential, especially for auditing small and medium-sized enterprises (SMEs) (Couceiro et.al., 2020).However, auditors' varying perspectives on the future of auditing firms, the influence of RPA and AI technologies, and the potential for a growing divide between large and smaller firms present challenges for the widespread adoption of AI in auditing (Rikhardsson et al., 2022). This disparity raises concerns about equitable access to advanced auditing technologies and the future landscape of the auditing profession. AI-enhanced tasks in auditing involve evaluating risks associated with specific transactions, carrying out audit interviews, executing diverse analyses, and making physical inspections, signaling a trend towards a greater reliance on AI-driven tasks in the auditing process (Vitali & Giuliani, 2024). Nonetheless, the integration of AI in auditing raises important ethical concerns, such as algorithmic biases, transparency, accountability, and fairness (Vitali & Giuliani, 2024).

In summary, while AI enhances audit efficiency, accuracy, and risk management, its integration into auditing also presents challenges related to ethical considerations and the potential digital divide among

firms. Addressing these concerns requires a balanced approach that combines AI's capabilities with human expertise, ensuring that audit quality is improved while maintaining professional and ethical integrity. Future research should explore how AI can be regulated and standardized across different auditing environments to mitigate risks while maximizing its benefits.

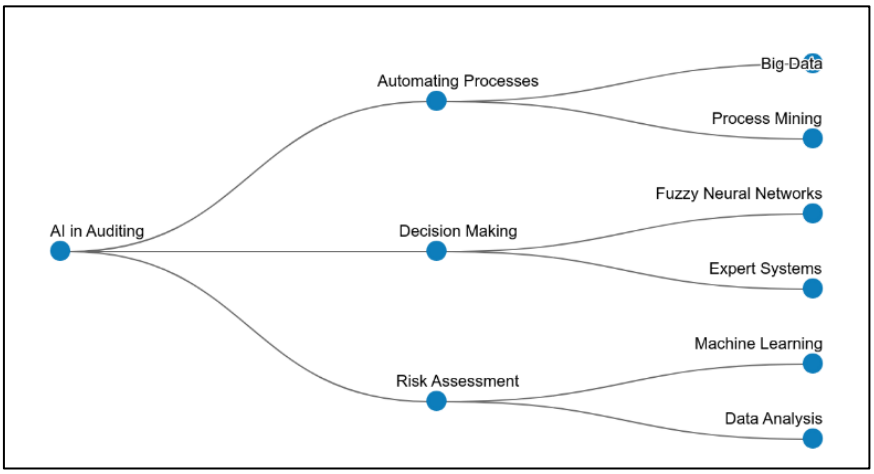

Figure.1. Concept Map of AI opportunities in Auditing
Source: Scopus AI, https://www.scopus.com/search/form.uri?display=basic#scopus-ai (13.08.2024)

The figure above was created with AI from the SCOPUS database based on the literature including the references in the text and provides a conceptual framework summarizing the opportunities of AI in auditing. It visualizes how AI enhances efficiency and accuracy in areas such as risk assessment, decision-making, and process automation.

3. CHALLANGES PRESENTED BY AI IN AUDITING

The integration of AI in auditing brings with it several challenges that must be addressed to ensure effective and responsible use. Reviewing the recent literature on these challenges that come with implementing AI in auditing include issues related to **security vulnerabilities**, the **need for new skills** among auditing professionals, and **ethical concerns.** This inference is supported with references from the relevant literature under the following subheadings for each challenge.

3.1. Security Vulnerability

The adoption of AI and machine learning (ML) in auditing encounters obstacles due to limited explainability of outcomes, which can affect both transparency and interpretability (Zhang et.al., 2022).

Moreover, incorporating AI into auditing raises important ethical issues, such as algorithmic biases, transparency, accountability, and fairness risks, which must be carefully considered to ensure the responsible use of AI in auditing (Vitali & Giuliani, 2024; Dambe et al., 2023). These concerns also underscore the potential security risks linked to the use of AI in auditing.

AI-powered systems in auditing present novel security risks stemming from their self-learning capabilities, which can bring potential insecurities. The use of AI in audits introduces risks linked to the limitations of cognitive-based technologies and uncertainties surrounding AI system utilization (Murikah, et.al., 2024). Specific vulnerabilities include issues related to the robustness of models, security concerns, and challenges in explainability and interpretability (Munz et.al., 2023). Additionally, problems such as bias, fairness, and privacy concerns are associated with deploying AI technologies in auditing.

Despite advantages of using AI tools in audit functions, key security concerns in AI auditing include risks related to the self-learning nature of AI, as well as issues with model robustness, security, explainability, interpretability, bias, fairness, and privacy (Bhalla, 2024). Addressing these challenges requires continuous learning and adaptation. In line with the relevant literature review, the potential security vulnerabilities when implementing AI in auditing processes can be summarized below.

Cybersecurity Risk: While AI can automate cybersecurity tasks and detect threats in real-time, it also introduces new vulnerabilities. The sophistication of cyber-attacks continues to evolve, posing additional risks that AI systems must be prepared to address (Dambe et.al., 2023).

Data Security and Privacy Concerns*:* The application of AI in auditing processes raises concerns regarding data security, the risk of data leakage, and digital fraud. This is particularly pertinent in the realms of Robotic Process Automation (RPA) and Intelligent Automation (IA), where the handling and processing of sensitive data can exacerbate these risks (Al-Slais & Ali, 2023).

AI System Vulnerabilities: As AI becomes more integrated into critical decision-making processes, it underscores the necessity to ensure the security and reliability of these systems. This involves identifying and addressing potential vulnerabilities to maintain their integrity and effectiveness (Calvo et al., 2023).

3.2. Continuous Learning Needs

The integration of AI by auditing firms can enhance audit quality and decision-making processes. However, challenges arise from the conservative stance of external regulatory bodies and the difficulties in documenting technology use for verification purposes by regulators (Seethamraju & Hecimovic, 2020). Continuous learning is essential for overcoming the challenges associated with AI auditing. AI systems, with their ability to self-learn, identify patterns in data, and incorporate these patterns into predictions, rules, and decisions, require ongoing updates to maintain their effectiveness. To address emerging regulations and ensure responsible AI use, organizations can benefit from anticipatory thinking and a flexible model risk audit (MRA) framework.

AI systems require constant updating and retraining to remain accurate and effective. The dynamic nature of auditing, including changes in regulations, industry standards, and business practices, necessitates that AI models continuously adapt to these shifts. Failure to maintain AI systems with up-to-date knowledge can result in outdated analyses, incorrect conclusions, and reduced audit quality. Auditors must also stay informed about AI advancements to effectively interpret and oversee AI-driven processes.

Ongoing enhancement of AI capabilities is crucial for audit practitioners in the evolving AI landscape. To uphold the quality of professional judgments and sustain industry standards, auditors must continuously refine their AI skills and technologies (Dalwai et al., 2022). A major challenge in using AI for auditing is the need for continuous learning about AI advancements. Auditors have highlighted that AI integration is complex and demands extensive training and understanding (Alastal et al., 2024). The study found that factors such as age, gender, and educational background significantly affect both how frequently AI technologies are used and the perceived importance of these technologies in audit tasks (Nogueira et al., 2024). The need for continuous learning in artificial intelligence systems for audit processes, which is a significant challenge in itself, brings with it many fundamental difficulties in terms of implementation. Moreover, findings of Leocádio et al. (2024) complement this study by reinforcing the argument that AI not only enhances audit quality but also necessitates careful governance and adaptation to maintain trust and accountability in the profession.

Lack of Information Technology Proficiency and Communication: Auditors frequently struggle with lack of proficiency in Information Technology, which creates challenges in effectively communicating and collaborating with IT personnel and interacting with information systems. This skill gap can impede the successful and comprehensive implementation of Continuous Auditing practices (Sulistyowati et al., 2021).

Explainability of AI Results: The limited explainability of AI and Machine Learning outcomes presents a significant barrier to their adoption in auditing. To address this challenge, techniques like Explainable Artificial Intelligence (XAI) are being developed to improve the interpretability of AI applications in auditing tasks, making them more transparent and understandable for auditors (Zhang, Cho & Vasarhelyi, 2022).

Organizational Implementation of Continuous Auditing: Implementing Continuous Auditing within an organization presents a considerable challenge, necessitating a gradual approach to effectively tackle the broad range of issues typically associated with implementation projects. This methodical progression helps ensure a smoother transition and addresses potential obstacles systematically (Kiesow, Zarvić & Thomas, 2015).

Integration of AI and ML for Audit Inquiry: The potential of AI and Machine Learning for audit inquiry remains largely unexplored, creating a challenge in the transformation of auditing practices. As a result, this area presents significant opportunities for future research, with discussions focusing on how automated auditing can be further developed and applied (Raschke et al., 2018). Ganapathy (2023) provides a **technical breakdown** of AI applications and acknowledges challenges such as data quality, AI interpretability, and regulatory frameworks. That study reinforces the argument that AI adoption must be carefully managed

These challenges in implementing continuous learning in AI systems for auditing encompass issues related to technology proficiency, explainability of AI results, organizational implementation, auditability measures, and the integration of AI and ML for audit inquiry.

3.3. Ethical Considerations

In line with the relevant literature it is observed that the incorporation of AI in auditing brings to the forefront several ethical issues, such as algorithmic biases, transparency, accountability, and fairness (Laine et al., 2024). Seethamraju and Hecimovic (2023) take an empirical approach, using the Technology-Organization-Environment (TOE) framework and data from semi-structured interviews to explore the factors influencing AI adoption in audit practice. A key concern highlighted in their research is the challenge posed by AI's black-box nature, which they argue may reduce transparency and increase regulatory scrutiny over audit quality. The findings of Seethamraju and Hecimovic (2023) complement this study by providing empirical evidence on the technological, organizational, and environmental challenges of AI adoption, reinforcing the argument that AI implementation requires careful governance and adaptation to maintain audit quality and accountability. The study conducted by Murikah et al. (2024) identifies five key sources of technical and human biases in AI systems used in auditing. It also highlights broader issues, such as the trade-offs between efficiency and thoroughness, the potential erosion of human skills and judgment, and privacy concerns stemming from uncontrolled exploitation of personal data. To address these challenges, the study recommends implementing strong governance frameworks, conducting risk assessments prior to deployment, continuously monitoring performance, and establishing policies that promote trust and collaboration to ensure that ethical principles are effectively integrated into auditing practices (Vitali & Giuliani, 2024).

The key ethical considerations in the literature regarding the use of AI in auditing to maintain integrity and trust by avoiding bias are as follows:

***Fairness and Non-Maleficence*:** Ethical frameworks in AI auditing emphasize the importance of fairness, avoiding harm, and upholding responsibility in the application of AI technologies.

***Transparency and Accountability*:** The integration of AI in auditing brings forth ethical challenges, particularly the need for transparent processes, accountability, and the mitigation of algorithmic biases (Vitali & Giuliani, 2024).

Privacy and Data Governance: Ethical AI auditing requires a thorough understanding of data privacy, security, and responsible deployment of AI systems, ensuring that data is handled ethically (Sethy et al., 2023).

Trust and Responsibility: Building and maintaining trust, ensuring accountability, and prioritizing societal well-being are essential for the ethical development and use of AI systems in auditing (Vitali & Giuliani, 2024).

Human Oversight and Ethical Maintenance: It is crucial to combine human oversight with automation and establish processes for ethical maintenance of AI systems to ensure that ethical principles are upheld even after deployment (Düdder et al., 2021).

As a recommendation for these considerations, it is essential to conduct comprehensive governance and risk assessments before deploying AI systems in auditing. This ensures that AI is integrated responsibly and in alignment with ethical standards. Continuously monitoring the performance of AI systems and their ethical impact is crucial for maintaining the integrity of the audit process and sustaining trust. Establishing policies that promote trust and collaboration can help effectively translate ethical principles into practical auditing practices, ensuring responsible AI usage (Jedličková, 2024; Vitali & Giuliani, 2024)

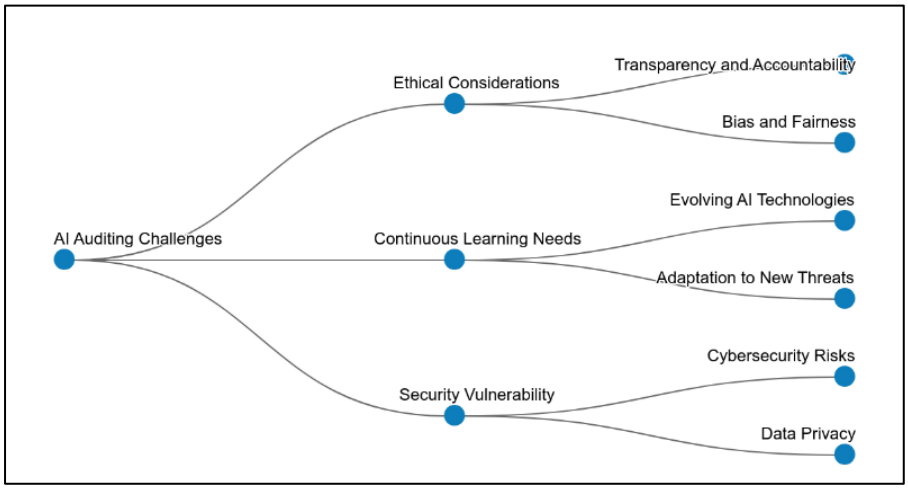

Figure 2. Concept Map of AI Challenges in Auditing

Source: Scopus AI https://www.scopus.com/search/form.uri?display=basic#scopus-ai (13.08.2024)

The figure above was created with AI from the SCOPUS database based on the literature including the references in the text and illustrates the key challenges associated with integrating artificial

intelligence into auditing. It highlights issues such as security vulnerabilities, the need for continuous learning, and ethical concerns, showing their impact on AI adoption in audit processes.

4. FUTURE DIRECTIONS OF AI IN AUDITING

As AI continues to evolve, its integration into auditing practices will likely accelerate, leading to transformative changes in the profession. The future directions of AI in auditing can be explored through several key areas such as enhanced automation, predictive analytics, continuous auditing, and ethical considerations. Research on AI technologies like expert systems and neural networks in auditing has highlighted their significant impact on audit evidence, especially with expert systems (Al-Sayyed, Al-Aroud, & Zayed, 2021). Despite these advancements, auditors continue to use a blend of manual and computer-based methods, reflecting a preference for traditional practices alongside the adoption of AI.

AI-powered systems can continuously monitor transactions, processes, and controls, providing auditors with real-time insights into an organization's financial health and compliance status. The adoption of AI is anticipated to enhance the efficiency and effectiveness of audit procedures, improve cost-benefit outcomes, and bolster the detection of material misstatements in financial statements. Moreover, AI-driven continuous auditing will enable organizations to respond more swiftly to emerging risks and regulatory changes, ultimately leading to more agile and resilient business operations.

Studies indicate that AI remains underutilized in audit practices, with Robotic Process Automation being one of the few AI technologies occasionally employed. While AI approaches for big data are rapidly advancing, there is a notable scarcity of methods designed for small data (Wassie & Lakatos, 2024).This limitation poses challenges for firms that rely on smaller datasets for automation, highlighting the need for more tailored AI solutions in these scenarios (Puthukulam et al., 2021).

The integration of AI in auditing is anticipated to lead to significant transformations in the profession, enhancing the reliability and security of financial statement analysis. This shift will likely improve the accuracy of audits, reduce errors, and strengthen the overall trust in financial reporting (Rodrigues et al., 2023). The study conducted by Dalwai et al. (2022) discusses the impact of AI on auditor judgment and professional skepticism, arguing that AI assists rather than replaces human auditors by providing deeper insights from large datasets. That study states that AI will not replace auditors but will fundamentally reshape their roles by augmenting decision-making and automating routine tasks. Findings of that study also complement this article by providing a technical perspective on AI applications, reinforcing the argument that AI’s successful adoption in auditing requires both technological advancement and regulatory adaptation.

The development and implementation of AI in auditing are expected to profoundly influence the future of the profession, particularly from the perspectives of education, professional practice, and ethical considerations. As AI becomes more integrated into auditing, it will necessitate changes in educational curricula, professional standards, and ethical frameworks, ensuring auditors are equipped to navigate the complexities and responsibilities that come with these advanced technologies (Heye, 2021).

The future perceptions of artificial intelligence (AI) in auditing are shaped by several anticipated developments. Large audit firms are expected to continue investing in expert systems and neural networks tailored to specific industries, aiming to reduce audit risks and enhance efficiency. Multinational corporations may also integrate AI into their audit functions to strengthen internal controls and mitigate business risks, thereby improving overall governance. Additionally, the trend towards AI is likely to influence auditor training, including professional examinations and continuous development, with future research exploring how AI tools can be incorporated into auditing education. However, there are concerns about whether audit committees will be able to understand and effectively challenge auditors' judgments based on AI systems, raising questions about the implications for their effectiveness (Omoteso, 2012). Due to the massive volume of data generated by organizations, the adoption of more advanced technologies becomes necessary. In the future, AI and Robotic Process Automation (RPA) are expected to be increasingly integrated into auditing processes to enhance efficiency, accuracy, and scope. The incorporation of AI in auditing focuses on automating routine tasks, analyzing large datasets, and identifying patterns that may indicate anomalies or risks. This transition is supported by the belief that AI will not only enhance the efficiency of audits but also enable auditors to focus on more complex, judgment-based tasks (Nunes, Leite, & Pedrosa, 2020).

5. CONCLUSION

In summary, the future of AI in auditing is seen as highly promising, with the capability to greatly transform the profession. It is expected to enhance decision-making processes, boost efficiency, and tackle complex audit challenges. Nonetheless, this advancement brings forth critical questions regarding accountability, the necessity for training, and the importance of human judgment within the auditing process.

The integration of AI into auditing presents a profound shift in the landscape of financial oversight and risk management. AI technologies offer significant opportunities to enhance the efficiency, accuracy, and scope of auditing practices. By leveraging advanced algorithms and data analytics, auditors can achieve unprecedented levels of insight and precision, transforming traditional methodologies and setting new standards for performance.

Despite these advantages, the adoption of AI in auditing is accompanied by notable challenges. Security vulnerabilities, the necessity for ongoing learning and adaptation, and ethical considerations pose critical concerns that require careful attention. Addressing these challenges is essential to fully harness the potential of AI while mitigating risks and ensuring the integrity of auditing practices.

Looking ahead, the future of AI in auditing is poised to bring about further innovations and refinements. As technology continues to evolve, AI is likely to drive even greater advancements in automation, predictive analytics, and risk management. For auditors and organizations, staying informed about emerging AI capabilities and best practices will be crucial in navigating this dynamic landscape.

Overall, the impact of AI on auditing is both transformative and complex. By understanding and addressing the opportunities and challenges associated with AI, the auditing profession can leverage these technologies to enhance its effectiveness and adapt to the evolving demands of the modern financial environment.

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