Transforming the Audit: A Systematic Review of RPA, Zapier, and AI Adoption in External Auditing Practices

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Abstract

External auditing is undergoing a technological transformation as firms adopt automation tools to improve efficiency and audit quality. This literature review critically examines global research on audit automation tools, comparing Robotic Process Automation (RPA), no-code automation platforms (exemplified by Zapier), and AI-based platforms in the context of external audit tasks. It evaluates their effectiveness and limitations particularly for small and mid-sized audit firms—drawing on recent studies, surveys, and audit standards. The review reveals that while large audit firms have invested heavily in automation technologies, small and midsize practices face unique adoption challenges including cost constraints, technical expertise gaps, and integration difficulties. The paper analyzes how these technologies align with established audit frameworks and identifies specific audit tasks suitable for automation. Key findings indicate that properly implemented automation tends to enhance audit quality while improving efficiency, though human judgment remains essential for complex audit areas. The review concludes by identifying significant research gaps, including the need for more studies on small firm implementation, empirical measurement of automation's impact on audit quality, and the evolution of standards to accommodate emerging technologies. This comprehensive analysis provides valuable insights for practitioners, researchers, and standard-setters navigating the rapidly evolving landscape of audit automation.

1. Introduction

Over the past decade external auditing has been quietly but decisively reshaped by a new generation of automation technologies. Robotic Process Automation (RPA) scripts now reconcile millions of transactions in minutes, no-code workflow engines such as Zapier shuttle client evidence between cloud repositories without a single line of code, and artificial-intelligence platforms sift entire ledgers for subtle fraud signatures that traditional sampling techniques routinely overlook. The Big Four alone channelled more than US $9 billion into AI- and RPA-enabled audit tooling by 2020, signalling that automation is no longer an experimental add-on but an essential part of contemporary assurance practice.

Yet this technological momentum is uneven. While global networks can underwrite enterprise-grade bots and data-science teams, small and mid-sized practices (SMPs) still wrestle with high licence fees, sparse IT

support and regulatory uncertainty, leaving a widening capability gap precisely where much of the profession's public-interest work is performed. Recent guidance from the International Auditing and Assurance Standards Board (IAASB) clarifies that automated tools may be used at every audit phase provided the auditor retains responsibility for evidence quality, but it offers little operational detail on how SMPs should validate, document and supervise those tools. Consequently, the profession finds itself at an inflection point: the promise of data-driven, high-coverage audits is clear, yet authoritative, comparative evidence on which tools deliver that promise and under what conditions remains fragmentary.

This literature review addresses that deficit. Its primary objective is to synthesise and critically compare the empirical and conceptual scholarship on three distinct classes of audit automation such as Robotic Process Automation (RPA), No-code workflow platforms and AI suites machine-learning and natural-language-processing

By juxtaposing these technologies along dimensions of technical capability, implementation cost, scalability, compliance risk and documented effect on audit quality, the study aims to illuminate where each tool class demonstrably augments efficiency or assurance quality and where limitations persist, foreground the distinctive adoption barriers facing SMPs, whose resource profiles differ markedly from global firms, map the extent to which current uses align with ISA, GAAS and emerging IAASB non-authoritative guidance and surface empirical and theoretical gaps that must be closed before standards-setters and practitioners can rely on automated procedures with confidence.

The contribution is twofold. First, it offers practitioners a consolidated evidence base for technology selection and phased adoption, emphasising low-cost, high-impact Entry points suitable for resource-constrained firms. Second, it provides researchers and regulators with a structured agenda for future inquiry, highlighting the need for longitudinal, multi-firm studies that isolate automation's effect on detection rates, audit fees and stakeholder trust.

Through this structure the study seeks not merely to catalogue technological options, but to clarify where automation already demonstrably strengthens audit quality, where cautious experimentation

is warranted, and how the profession can navigate the transition from manual to technology-augmented assurance with rigour and confidence.

2. Methodology

This literature review employed a systematic approach to identify, evaluate, and synthesize relevant research on audit automation technologies. The methodology followed these key steps:

2.1 Search Strategy

The review utilized multiple academic databases including SciSpace, Web of Science, ABI/ INFORM, and Google Scholar to identify relevant literature. Search terms included combinations of keywords such as "audit automation," "robotic process automation + audit," "AI + auditing," "no-code automation + accounting," and "Zapier + audit." Additional targeted searches were conducted for specific technologies and their applications in external auditing contexts.

2.2 Inclusion Criteria

Sources were selected based on the following criteria: - Published between 2018-2024, with emphasis on the most recent literature (2020-2024), Peer-reviewed academic articles, Focus on external audit applications (though some internal audit literature was included where relevant), Addressed at least one of the three technology categories: RPA, no-code automation, or AI, Discussed implementation, effectiveness, limitations, or alignment with audit standards.

A systematic and transparent selection process was employed to identify relevant literature on audit automation technologies. Out of 58 studies initially retrieved from major academic databases, 27 studies met the inclusion criteria namely, relevance to external auditing, focus on RPA, no-code tools, and AI. The remaining studies were excluded due to their emphasis on non-audit contexts, coverage of unrelated technologies, insufficient empirical or conceptual content, or redundancy. This rigorous approach ensured that only the most pertinent and robust research informed the final synthesis.

The number of studies included in the systematic review was limited due to the novelty of the research topic. Specifically, the application of

artificial intelligence in auditing remains an emerging area that has not been extensively explored in prior literature, particularly within the specified time frame of this study.

2.3 Analysis Framework

The literature was analyzed using a comparative framework that evaluated each technology across consistent dimensions: Technical capabilities and limitations, Implementation requirements (cost, expertise, infrastructure), Impact on audit quality and efficiency, Alignment with audit standards, Applicability for different firm sizes, and Current adoption patterns

2.4 Synthesis Approach

The review synthesized findings through thematic analysis, identifying recurring themes, contradictions, and gaps across the literature. Special attention was given to empirical studies that measured actual outcomes rather than theoretical benefits. The synthesis also considered the unique challenges faced by small and mid-sized audit firms, as this perspective is often underrepresented in the literature.

This methodological approach enabled a comprehensive and balanced assessment of the current state of knowledge regarding audit automation technologies, while also identifying areas where further research is needed.

3. Audit Automation Technologies in External Auditing

External auditing is undergoing technological transformation as firms adopt automation tools to improve efficiency and audit quality. Audit automation encompasses a range of technologies from Robotic Process Automation (RPA) that replicates human tasks, to no-code workflow tools like Zapier, to advanced AI-driven audit platforms. Research indicates that automation can free auditors from tedious, repetitive tasks, allowing more focus on judgment-intensive areas. However, adoption has been uneven: while large audit firms (e.g. Big Four) have invested heavily in AI and RPA (with three of the Big Four spending over $9 billion on AI and automation by 2020) ,small and midsize audit practices lag behind due to resource constraints and other barriers. This literature review critically examines global research on audit automation tools, comparing RPA, Zapier (no-code automation), and AI-based platforms

in the context of external audit tasks. It evaluates their effectiveness and limitations – particularly for small and mid-sized audit firms – drawing on recent studies, surveys, and audit standards. Key themes include the relative capabilities of each technology, challenges in scalability and compliance, impact on audit quality, and emerging research gaps in this fast-evolving field

3.1 Robotic Process Automation (RPA)

Bellinga, J., Jansen, T., & Vos, M. (2022), Indicates that RPA refers to software "bots" that automate rule-based, high-volume tasks by interacting with applications just as a human user would. In auditing, RPA enables the automation of structured, repetitive procedures across various software (e.g. pulling data from accounting systems, reconciling accounts, or populating audit workpapers). Prior to RPA, audit software usage was often siloed – for example, using tools like IDEA/ACL for specific data tests or Excel macros for calculations

RPA can integrate these steps end-to-end, executing an entire sequence of audit procedures without manual intervention. Researchers note that auditors could apply RPA in virtually all audit phases that involve routine, rules-based tasks that are time-consuming. Common examples include transaction reconciliations, verifying ledger entries against supporting documents, performing repetitive calculations, and generating standardized audit confirmations or reports

Effectiveness*:* Studies like Wiklund, T. E., & Fallan, E. (2024), consistently show that RPA can improve efficiency and accuracy in audit processes by eliminating human error and accelerating workflows By automating mundane tasks, RPA allows auditors to devote more time to risk analysis and professional judgment. For instance, an RPA bot can handle hundreds of invoice-vouching or data entry tasks in minutes, a speed and consistency unattainable by manual effort. Case evidence also suggests RPA contributes to better compliance with controls – the software follows the prescribed steps exactly, ensuring no checklist steps are skipped When combined with traditional audit procedures, RPA has

been found to augment audit quality by allowing more comprehensive testing (e.g. 100% examination of transactions rather than sampling).

Limitations: Despite its potential, RPA's uptake in external audit has been gradual. A Deloitte survey (2018) found that while 54% of RPA deployments were in accounting/finance departments, only 2% were in internal audit functions indicating that audit applications of RPA were still nascent. External audit firms face several challenges. RPA tools (such as UiPath, Blue Prism) often require significant upfront investment and technical expertise. A single RPA software license can cost $5,000–$15,000 per year which can be prohibitive for small practices. Developing and maintaining bots also demands specialized programming or process-mapping skills. Moreover, RPA excels at structured, unchanging processes; if client systems or data formats change, the bot may break, requiring constant maintenance. Lai, H. K., & Hsieh, S. F. (2025), highlighted a "standardization–regulation lag" in auditing where professional standards and regulations have not fully caught up to automated techniques, making some firms cautious. RPA is best suited for tasks not requiring significant auditor judgment - it cannot make subjective decisions or adapt on the fly, so its role in areas like assessing estimates or exercising skepticism is limited. This means auditors must still supervise and review the outcomes of RPA-driven procedures to ensure they are reasonable and complete.

3.2 No-Code Workflow Automation (Zapier and Similar Tools)

AICPA and CIMA (Dec 2024), emphasize that no-code automation platforms provide a lightweight alternative to full-scale RPA by enabling users to create automated workflows through a visual interface, without programming. Zapier is a prime example, connecting thousands of cloud apps (email, spreadsheets, accounting software, etc.) so that events in one can trigger Actions in another. These "Zaps" can automate many administrative and data transfer tasks relevant to audits. For instance, Zapier could automatically fetch a trial balance exported from a client's accounting system and load it into a spreadsheet or audit software whenever an update occurs, or send notifications to the audit

team's Slack channel when a client uploads new evidence to a shared folder. Such tools essentially leverage the APIs of Modern software – *"thanks to tools like Zapier, Make, and Microsoft Power Automate, you can harness these APIs without needing programming skills"* This ease-of-use is especially valuable for smaller audit firms with limited IT support.

***Effectiveness**:* While academic research on no-code tools in auditing is sparse (as these tools are relatively new to the audit context). Ajish, D. (2024), suggests that they can yield quick efficiency wins for routine workflows. Zapier is highly accessible; it offers a user-friendly interface and even a free plan for basic usage. This lowers the barrier to entry for small firms to experiment with automation. Common applications in practice include client onboarding and file management (e.g. automatically organizing client-provided documents), data synchronization (ensuring figures in working papers, accounting software, and confirmation logs are consistent), and scheduling or reminders (e.g. sending an automated email reminder for pending client information requests). An AICPA guide for small firms notes that even simple tasks like setting up new client records across multiple systems can be automated to save hours per week. Consistency and error reduction are key benefits: a well-designed Zap performs a task the same way every time, reducing the risk of oversight in repetitive processes

For example, if a new client form is submitted, Zapier can reliably populate that data into the audit firm's CRM, planning spreadsheet, and billing system without missing any fields – something that might happen if done manually in haste. Automations can also improve scalability: as the firm takes on more clients or engagements, these background processes don't require proportional increases in staff time, allowing the practice to grow more efficiently

***Limitations**:* (Lombardi, Kim, Sipior, & Vasarhelyi, 2025), indicates that No-code automation tools trade off power for simplicity. They are generally limited to tasks supported by pre-built integrations and structured triggers. In an audit context, this means they work well when

the data and systems involved have standard connectors (e.g. cloud accounting platforms, Google Sheets, email). However, many audit scenarios involve client legacy systems, bespoke databases, or unstructured data (scans of invoices, contracts) that Zapier and other similar automation tools cannot directly handle. Unlike RPA, which can be configured to interact with virtually Any application's user interface, Zapier is constrained to its library of connected apps and APIs

Another concern is data security and compliance: using a third-party cloud service to shuttle confidential financial data raises questions about client consent, data privacy laws, and audit confidentiality. Zapier has obtained SOC 2 Type II compliance for security, but audit firms must still assess whether sending client data through an external platform is permissible and safe. Error handling and control is also an issue – while Zapier will alert on failed "Zaps", auditors need procedures to ensure an Automation failure is caught and remedied (so that, say, a trial balance not updating due to an API error doesn't go unnoticed). In sum, no-code tools offer agility and low cost, but they may not scale to more complex audit testing logic or integration needs. They complement but do not fully replace more robust automation or traditional audit procedures. Zapier. (2024, August 1). *Security and compliance*. Zapier Help Center.

3.3 AI-Based Audit Platforms

AI in auditing encompasses a broad set of technologies, including machine learning algorithms, expert systems, and more recently, natural language processing and generative AI. These AI-driven tools aim to go beyond simple rule execution by identifying patterns, anomalies, or insights in data that a human or simple program might miss. Examples include: anomaly detection systems that flag unusual transactions in a ledger (e.g., based on clustering or predictive models), AI assistants that perform *journal entry analysis* to identify high-risk entries, and cognitive tools that can read and extract information from contracts or invoices using computer vision and NLP. Leading audit firms and software providers have developed AI platforms – for instance, MindBridge AI Auditor analyzes 100% of transactions to risk-score

them, and Deloitte's Argus or KPMG's Ignite use AI to analyze documents and financial data. Ikwuo, A. K., Nworie, G. O., & Moedu, V. O. (2024), indicates that AI can significantly enhance the effectiveness of audits when used appropriately. AI systems excel at handling large volumes of data and finding needles in the haystack, which aligns well with the audit objective of assuring no material misstatements in voluminous accounting records.

Effectiveness: Recent empirical studies like (Kokina, Julia, et al., 2025) are beginning to evidence AI's positive impact on audit quality. Using AI is associated with higher audit quality, as measured by outcomes like fewer going-concern evaluation errors and more accurate identification of internal control issues. One large-scale study found that audit offices which adopted AI (proxied by hiring data scientists/AI personnel) delivered audits with significantly improved accuracy in critical areas, without reducing auditor headcount

AI tools allow auditors to analyze entire data populations rather than samples, *"conduct full-population analyses of transactions, pinpoint high-risk areas, and automate repetitive tasks"*, which leads to detecting issues that might go unnoticed in a traditional audit approach. For example, an AI might flag an odd pattern of revenue entries just below authorization thresholds across an entire year – a subtle indicator of potential fraud or earnings management that a sample-based test might miss. AI-based analysis also provides continuous auditing potential; instead of a one-time annual test, an AI monitor could run on client data regularly to identify Anomalies in real-time, aligning with the trend toward continuous assurance. Beyond transaction analysis, AI is used in document review – auditors have deployed NLP models to read contracts, loan agreements, or lease documents to extract key terms and assess compliance with accounting standards. This not only saves time but can reduce oversight, as AI can ensure that every clause is examined against a checklist (where a human might inadvertently skip a section after dozens of pages). Another benefit noted is in risk assessment and planning: AI can crunch through client and industry data to help auditors

identify which areas likely present the greatest risks of misstatement, thereby focusing audit effort more effectively. In surveys, audit professionals report that AI-based analytics help in identifying better audit focus areas and reducing human errors in routine checks

Limitations: (Abiyyu & Mustafida, 2024), highlighted that despite promising results, AI adoption in external auditing faces significant hurdles, especially for smaller firms. Many of these tools require large datasets and specialized expertise to develop, train, and interpret. Small and midsize firms often lack the data science resources to build custom AI models; they must rely on vendor solutions which can be expensive and may not perfectly fit their methodology. Even for large firms, PwC's Global Internal Audit Study (2023), noted that only about 27% of internal audit functions had invested in AI or RPA recently, with many still *"grappling with more basic technology"* like audit data analytics software. Key challenges identified include: data quality and integration - AI is only as good as the data fed into it, and auditors often encounter messy, incomplete data from clients (especially smaller clients without robust IT systems). Explainability and trust are also paramount: audit standards require auditors to understand and evaluate the evidence; if an AI model flags a transaction as high-risk without a clear explanation (the "black box" problem), the auditor might struggle to justify relying on it. Regulators and standards (PCAOB, ISA) currently emphasize that the auditor remains responsible for conclusions, even if AI was used as a tool, so any AI output must be corroborated and cannot just be taken at face value. Bias and false positives present further issues – AI models might inadvertently learn patterns that are not risks (or miss novel fraud schemes not present in historical data), which can lead to over/under-auditing certain areas. Another practical limitation is cost and scalability: advanced AI platforms often come bundled with enterprise audit Software suites or require cloud computing resources, which may be out of reach for smaller firms. In addition, maintaining AI models (updating them for new data or accounting standards) is an ongoing commitment. Finally, Munoko, I., Brown-Liburd, H. L., & Vasarhelyi, M. (2020) ensure that there are compliance and ethical concerns: using

AI on client data raises questions about data privacy (especially if using cloud-based AI services), and auditors must ensure using AI does not violate any confidentiality or data export regulations. All these factors have led to cautious adoption - many firms are experimenting in pilot programs but not fully deploying AI in core audit processes yet. Nonetheless, the trajectory suggests AI will play an expanding role, and auditors will need to develop competencies to supervise and complement these intelligent tools.

4. Comparative Analysis: RPA vs. Zapier vs. AI in Auditing

The three categories of automation tools offer distinct strengths and serve different needs in external auditing. This section provides a structured comparison of their key characteristics and use-cases.

Table1: Audit Automation Technology

Dimension	Robotic Process Automation (RPA)	No-Code Automation (Zapier)	AI-Based Platforms
Primary Function	Mimics human actions across systems	Connects cloud applications through pre-defined integrations	Analyzes data to identify patterns, anomalies, and insights
Technical Capabilities	Works with any UI-based system including legacy applications	Limited to supported apps with APIs	Capable of analyzing structured and unstructured data
Implementation Complexity	Medium (requires process mapping, some coding)	Low (visual interface, minimal training)	High (requires data science expertise, model training)
Cost Range	$5,000-$15,000 per license annually	Free to $600+ annually depending on usage	Often enterprise pricing ($10,000+) or per-usage models
Typical Audit Applications	Data extraction, reconciliations, confirmation management	Client onboarding, file management, notifications	Risk assessment, journal entry analysis, anomaly detection
Strengths for Auditors	Handles repetitive tasks across multiple	Quick implementation, low barrier to entry	Identifies patterns humans might miss,

	systems		analyzes entire populations
Limitations for Auditors	Breaks if interfaces change, requires maintenance	Limited to supported apps, basic logic only	"Black box" problem, requires validation, data quality dependent
Firm Size Suitability	Medium to large firms with repetitive processes	Small to medium firms seeking quick wins	Primarily large firms, though packaged solutions emerging for SMPs

4.1 Scope of Tasks & Capabilities

RPA excels at mimicking human actions across disparate systems, enabling it to automate a wide variety of audit tasks that involve multiple software applications. It can handle legacy systems and custom interfaces by working through the UI like a human would (Solanki et al., 2024).

Zapier operates at a higher level of abstraction, connecting applications through pre- defined integrations. It excels at workflow orchestration between modern cloud apps – for example, automatically moving data from one cloud service to another or triggering notifications. However, it cannot perform complex logic beyond the triggers and actions it's configured for, and it only works with supported apps/APIs.

AI platforms have a fundamentally different niche: they are capable of analyzing complex data and making inferences. Rather than executing predefined steps, AI tools can discover trends, anomalies, or predictions (e.g., flagging suspicious entries, predicting which controls might fail) (Hamzah et al., 2024). They are less about connecting systems and more about augmenting the auditor's analysis capabilities.

4.2 Ease of Implementation

No-code tools like Zapier are the easiest to implement, requiring virtually no coding knowledge – an auditor or firm admin can set up

basic automations in hours, with minimal training. RPA lies in the middle; modern RPA software often provides a visual workflow designer, but effectively using RPA in auditing demands a clear mapping of the audit process and some coding/scripting for exceptions. Firms might need to involve IT specialists or train auditors in RPA development according to Wiklund & Fallan (2024) .

AI is typically the hardest to implement, often necessitating data science expertise, careful model training, and longer development cycles. In practice, many audit firms adopt AI via vendor-provided solutions or partnerships, rather than building from Scratch. For small firms, turnkey AI solutions are emerging (some AI audit analytics tools are being offered on a subscription basis), but leveraging them still requires training to interpret results (Murikah et al., 2024).

4.3 Cost and Scalability

GURBAN (2023) explains that there is a trade-off between power and cost. RPA can be cost-effective for automating high-volume tasks, but the license and setup costs remain significant, so it scales well only if the firm has enough repetitive work to justify it.

Zapier's pricing is generally low (even free at small scales), making it very attractive to small and midsize firms – they can start automating without large capital outlays. Its scalability is limited by the fact that as processes grow in complexity or volume, the firm might outgrow what a no-code tool can handle (and higher Zapier tiers or enterprise plans might be needed).

AI implementations tend to be the most expensive initially – investing in AI might involve software fees, cloud computing costs, and hiring/training talent. However, if successfully implemented, AI can scale to handle huge datasets with relatively low marginal cost per additional transaction analyzed. For small firms, though, the ROI on AI is uncertain given the smaller client base; in contrast, a simple Zap might yield immediate visible time savings with almost no expense.

4.4 Compliance and Risk Considerations

All three approaches must be used within the confines of auditing standards, but they pose different compliance considerations. RPA and no-code automations perform predefined procedures, so the primary risk is an automation error (e.g., the bot or Zap fails to execute a step correctly).

The International Auditing and Assurance Standards Board (IAASB) has issued guidance clarifying that using Automated Tools and Techniques (ATT) does not change the auditor's responsibility to comply with documentation and evidence requirements. In practice, this means auditors should retain logs of what the RPA or Zapier automation did and evidence of its results.

AI tools introduce more complex compliance issues: if an AI provides an audit conclusion (say, an AI risk score), the auditor needs to understand the basis for that conclusion to meet the audit evidence standard (ISA 500) which requires auditors to Evaluate the reliability of information used as audit evidence. Lack of transparency in AI decisions can thus be a compliance hurdle.

4.5 Complementary Nature

RPA, Zapier, and AI can be seen as complementary rather than mutually exclusive. RPA provides robust, enterprise-grade automation of audit procedures (ideal for firms with resources and lots of repeatable transactions to audit), Zapier offers agility and accessibility (great for smaller firms to automate incremental tasks quickly), and AI platforms deliver intelligence and depth of analysis (addressing the quality of audit insights more than just efficiency).

The choice often depends on the firm's size, the nature of its client base, and specific audit tasks at hand. Many progressive audit teams are in fact combining them – e.g., using RPA to gather and preprocess data, then AI to analyze it, and no-code tools to handle ancillary workflow routing and communications.

5. Impact on Audit Quality and Effectiveness

A central question in the literature is how automation ultimately affects audit quality traditionally defined as the likelihood of detecting and reporting material misstatements. The evidence to date is cautiously optimistic: properly implemented automation tends to enhance audit quality or at least maintain it while improving efficiency. Several studies have quantified these benefits. For instance, AI-based auditing has been linked to measurable improvements in audit outcomes. A 2024 study by Lin et al. (published in *Management Science*) showed that audits conducted by offices using AI had higher accuracy in going-concern assessments and internal control evaluations compared to those that did not use AI. The AI-enabled offices were better at identifying companies in financial distress (reducing instances where auditors failed to warn of going-concern issues) and more effective at flagging material weaknesses in controls – both indicators of improved audit quality

Importantly, this study and others found no evidence that automation is replacing auditors or weakening professional judgment; instead, AI and other tools are assisting auditors in doing a more thorough job. In fact, the adoption of AI was associated with a slight increase in audit employment needs for certain skill sets, as firms seek people who can work alongside AI (e.g. data analysts), and audit partners Reported that AI did not reduce audit hours to the point of lowering fees due to the need for careful review and compliance work. Vidya, V. (2024)

According to (Tiron-Tudor et al., 2023), RPA and data analytics tools similarly contribute to quality by allowing broader audit testing. By automating tedious tasks, auditors can expand their procedures – for example, using RPA to check 100% of journal entries for basic criteria (proper authorization, round-dollar amounts, weekends postings, etc.) as a supplement to the traditional sample-based substantive testing. Such comprehensive testing has been shown to identify anomalies or red flags that sampling might miss, thereby potentially catching misstatements earlier. An experimental study by Deloitte noted that auditors equipped with RPA and analytics found more exceptions in a dataset than those

using manual methods, with no increase in audit risk. Additionally, automation can enforce consistency in audit execution: a bot will perform the same steps exactly for every client, reducing variance in audit quality that might arise from different staff skill levels or fatigue. This standardization can be seen as aligning practice with the consistency desired by standards like GAAS.

However, the literature also cautions that quality gains are not automatic – they depend on proper design and oversight of the automated processes. If a tool is poorly configured, it might overlook certain exceptions or generate false positives that drown the audit team in unnecessary follow-up, diverting attention from real risks. Human judgment remains critical in interpreting the results of automation. For instance, if an AI flags 50 transactions as unusual, the auditor must investigate and determine if they truly indicate issues; if the auditor lacks the expertise to understand the AI's output or rationale, there's a risk of over-reliance or misinterpretation. Recognizing this, researchers emphasize the need for auditors to develop technology competence and for firms to implement robust validation controls over their automation tools.

In terms of efficiency, numerous surveys and case studies document significant time savings from automation. One review of RPA in accounting reported efficiency improvements on the order of 40–80% for automated tasks and noted that error rates on those tasks dropped close to zero. (Ayinla, B. S., et al., 2024) In audit, while exact statistics vary by engagement, firms have cited examples like reducing the time to prepare confirmations or analytical review schedules from days to hours by using bots. These efficiency gains can translate to either reduced audit cycle times or the ability to reallocate effort to more complex audit areas, both of which are beneficial. It's worth Noting that despite these efficiencies, audit fees industry-wide have not plummeted suggesting that firms are using automation to add value rather than simply cut costs. In part, this is because regulators and audit committees expect high-quality audits; any free time is often redirected to deeper analysis or

Addressing persisting audit risks, which aligns with the profession's public interest duty.

The impact on compliance is another aspect of quality. Automation can actually improve compliance with auditing standards by systematically performing and documenting required steps. For example, ISA 230 (Audit Documentation) requires proper documentation of audit work – an RPA can automatically create logs of every step it performed and archive data, creating a clear audit trail. Similarly, data analytics can ensure that analytical review procedures (ISA 520) examine the full range of data and that any variances beyond thresholds are flagged, demonstrating due professional care. On the other hand, new forms of automation (especially AI) raise new compliance questions – like how to document the basis of an AI's risk assessment in the audit file. Standards are evolving: the IAASB has issued non-authoritative guidance on using automated tools and techniques, indicating that such use is permissible but advising auditors to document how these tools were used and how their outputs were evaluated in line with the standards. Thus, while automation generally supports audit quality and compliance, it must be accompanied by updates to methodology and rigorous oversight to fully realize these benefits.

6. Limitations and Challenges for Small and Midsize Audit Firms

Adopting audit automation is not a one-size-fits-all proposition. Small and medium-sized audit firms (SMPs) face unique challenges that can hinder the effective implementation of RPA, no-code tools, and AI. The literature and professional surveys highlight several key limitations:

- **Cost Constraints:** Budget is a major barrier for smaller firms. (Hossain & Paul, 2024), underscored that Advanced RPA and AI platforms often involve substantial acquisition and maintenance costs that SMPs cannot easily absorb. For example, an RPA license costing $10k+ per year or an AI audit analytics subscription may be justified for a Big Four firm auditing dozens of large clients, but for a small

practice with perhaps a few mid-sized clients, the ROI is questionable. IFAC's Small and Medium Practices advisory group notes that cost can be "*very high and prohibitive*," especially in regions where software must be imported at unfavorable exchange rates. Beyond software fees, there are costs in training staff, integrating tools, and dedicating time to set up automations (time that Small firms feel they cannot spare if it's non-billable). Many SMPs operate on thin margins, making them risk-averse about significant tech investments without clear immediate payoff. This often results in a **"wait and see" approach** – smaller firms hold back until solutions become cheaper or proven by others. In the meantime, they may stick to manual methods that feel safer, even if less efficient.

● **Scalability and Volume Issues:** Ironically, while large firms worry about scaling automation up, small firms worry about scaling down – i.e., whether automation makes sense at their smaller scale. Many automation benefits (especially RPA) assume a high volume of repetitive transactions or tasks to automate. A local audit firm that only handles, say, 10 audits a year might not have enough repetitive work to justify developing a bot. In such cases, the fixed effort to automate a task might outweigh the time saved. Furthermore, SMPs often have more diverse client profiles (some very small businesses, some medium), each with different systems, reducing the reusability of a single automated solution across engagements. This can limit the scalability of an automation initiative within the firm. There is also a lack of packaged solutions tailored to small firm needs – large firms often build custom tools in-house or have vendors integrate with their enterprise systems, but small practitioners might use off-the-shelf trial balances, Word/Excel documentation, etc. While no-code tools like Zapier help by offering low-scale automation, not all audit-related tasks fit into those molds. Thus, small auditors may find that beyond a few quick wins (like automating administrative tasks), it's hard to scale automation to core audit procedures in acost-effectiveway.

● **Technical Skills and Expertise:** Implementing and managing automation requires skills that many small audit firms do not possess in-house. Large firms have entire IT audit support teams or innovation departments; a 10-person audit firm likely has none. According to an IFAC survey, SMPs report a wide gap in digital competencies – staff may be proficient with Excel, but not with scripting or data analysis tools. There can be a steep learning curve to understanding how to map audit processes for RPA or to interpret AI outputs. Training is available (and some professional bodies are pushing technology upskilling for auditors), but finding time for training is difficult in small firms where every staff member is heavily utilized on client work. The mindset can also be a barrier: some small firm leaders are hesitant to embrace new technology, either due to lack of awareness or fear of disruption. They might question the reliability of an automated process versus the "tried-and-true" manual approach they've used for years. This resistance or lack of know-how leads to under-investment in technology. As (Wiklund & Fallan, 2024) pointed out, there exists a "supply side lag" wherein auditors themselves (especially in smaller practices) are slow to offer or implement automation, often because they aren't comfortable with it. To overcome this, small firms may need access To shared resources or advisory services that guide them in tech adoption – a role that professional associationsare beginning to play.

● **Compliance and Regulatory Pressure:** While automation can help with compliance, it also introduces uncertainties that smaller firms find daunting. Audit standards are principle-based and do not explicitly detail how to incorporate technologies, which can leave SMPs unsure about what's permissible. For instance, if a small firm wanted to use an AI tool for analytical procedures, there may be questions like: How to validate the tool's accuracy to satisfy ISA 500's requirement on evidence reliability? Will our peer reviewer or regulator accept conclusions that were based on an AI's analysis? This lack of clear guidance or precedents (the "standardization–regulation lag" noted earlier) can make small practitioners reluctant to venture into automation for core audit areas. They fear a misstep could lead to a

deficiency in an external inspection. Additionally, compliance includes client confidentiality – small firms worry that using cloud tools (Zapier, cloud AI platforms) could violate privacy if data isn't handled properly. Larger firms mitigate these with custom private cloud deployments and legal counsel; smaller ones might simply avoid using a tool altogether to be safe. Another regulatory aspect is that in some jurisdictions, audit regulators have not yet fully endorsed or vetted specific audit tech. Without external pressure or encouragement, the impetus to invest is low. On top of that, smaller firms often have smaller clients that themselves are not technologically advanced – if a client's records are all on paper or in a basic accounting system, the opportunity for automation (which often relies on digital data inputs) is limited. This creates a demand side lag, where clients of small audit firms aren't pushing or facilitating automation because they don't have sophisticated systems to interface withefallan.no. In summary, regulatory uncertainty and the traditional nature of many small clients' record-keeping reduce the practical drive for SMPs to automate.

● **Integration and Tool Overload:** Fossung, M. F., & Manfo, R. N. (2024). Discussed that Small firms also face the challenge of navigating an overwhelming array of technology options with limited resources to evaluate them. Should they invest in an off-the-shelf audit software that offers some automation, or a separate RPA tool, or simply use Excel add-ins? The wrong choice could be costly. There is a risk of adopting tools that don't play nicely together – for example, if an SMP uses one software for working papers and the client uses another system for accounting, integration can be complex. No-code tools can bridge some gaps but not all.

In light of these limitations, research points out that small and midsize firms require tailored strategies to adopt automation successfully. This might include starting with low-hanging fruit (simple automations in admin tasks), leveraging affordable tools (like the free or low-cost tiers of software), and collaborating through networks or alliances to share technology resources. Some professional bodies have suggested "guided

digitalization" programs for SMPs, addressing their cultural and knowledge barriers by sharing success stories and providing training. Overcoming these challenges is crucial for smaller firms not to be left behind, as automation becomes increasingly standard in the audit market.

7. Alignment with Audit Standards and Automatable Audit Tasks

The adoption of automation tools must be aligned with established audit frameworks (such as the International Standards on Auditing (ISA) and, in the U.S., Generally Accepted Auditing Standards (GAAS)). These frameworks emphasize auditor responsibility for planning and performing procedures to obtain sufficient appropriate evidence and for maintaining professional skepticism. Automation can assist in performing audit procedures, but it does not alter the auditor's fundamental obligations under the standards. Current standards were largely written before the proliferation of AI and RPA, yet they are generally principles-based, meaning they do not prohibit the use of technology as long as the audit objectives are met and due care is exercised.

In fact, standard-setters have been supportive of using advanced tools. ISA 315 (Revised 2019) on risk assessment explicitly acknowledges that auditors may use automated tools and techniques as part of understanding the entity and identifying risks. The IAASB's guidance on ISA 315 gives examples of how data analytics and other tools can be used for risk assessment procedures – for instance, using an automated process to analyze an entire general ledger for unusual entries as part of brainstorming fraud risks. Similarly, ISA 520 (Analytical Procedures) can be fulfilled with the help of analytics software that compares expectations to recorded amounts. ISA 230 (Audit Documentation) was supplemented by guidance in 2020 to illustrate how to document work when using automation, ensuring the auditor's documentation demonstrates what the tool did and how results were evaluated. GAAS

in the U.S. (AICPA standards) and PCAOB standards also do not object to using technology; the AICPA has even published audit data analytics guides encouraging their use. The key message from regulators is that the auditor is ultimately responsible: if a bot or AI is used, the auditor must have sufficient basis to trust its Output and must follow up on any issues it identifies as if the auditor found them manually.

Certain audit tasks are particularly suitable for automation under these frameworks, often because they involve high-volume data or straightforward checks that do not require subjective judgment. Based on the literature and audit practice, these tasks include:

- **Data Extraction & Validation:** Retrieving client data from accounting systems (trial balances, transaction listings) and checking its integrity. RPA can log into client systems or use exports to gather this information systematically. Since completeness and accuracy of data are prerequisites for audit testing (ISA 500), using automation to ensure all data is captured and accurately transferred can strengthen the evidence-gathering process.

- **Reconciliations:** Comparing two independent data sources is a common audit step (for example, reconciling the general ledger to subledgers or bank statements). This is a rule-based task that RPA excels at – the bot can match items and report discrepancies, which the auditor then investigates. Automating reconciliations not only speeds them up but often performs a more thorough job (checking every transaction rather than samples). This aligns with audit objectives in areas like cash (ISA 570 going concern procedures often involve bank reconciliations) and can be documented as part of working papers.

- **Analytical Procedures:** At both the planning stage and substantive testing stage, auditors perform analytics (ISA 520). Tools ranging from Excel macros to AI algorithms can automate the calculation of financial ratios, trend analysis, and outlier detection. For example, a no-code tool could regularly pull monthly sales data and compare it to

prior year or budget, flagging any unusual fluctuations for the auditor's attention. Automated analytical procedures can increase the likelihood of identifying risk factors and are easily documented. They also free the auditor to focus on interpreting the results rather than doing the calculations. Statistical evidence shows that many auditors see analytics as the first step in automation – by 2023, about 65% of finance functions (including audit) are using some form of AI/analytics, reflecting that these tools are becoming mainstream for initial risk assessment KPMG. (2023, October). AI in audit: 2023 survey report. KPMG LLP.

- **Routine Test of Controls:** If an auditor is testing controls that have a high volume of operations (e.g., verifying that all invoices over $5,000 were approved by a manager), RPA can be deployed to check each case in the Population against the approval list. This supports compliance with ISA 330 which requires appropriate sampling or testing of controls – here the "sample" can be the entire population via automation. The auditor then only needs to examine exceptions. Studies note that such use of automation can significantly improve compliance testing efficiency without sacrificing coverage .

- **Substantive Testing and Journal Entry Analysis:** Some substantive tests lend themselves to automation, particularly those involving cross-verification (e.g., matching sales orders to invoices to payments for revenue completeness testing). RPA and AI can perform these matches and highlight any items that break the expected link. Journal Entry Testing (required by ISA 240 for fraud) is a standout example: audit software with AI can comb through all journal entries using criteria for risk (entries made at odd times, by unauthorized users, etc.). This is now a fairly common practice in larger audits, and even smaller firms are starting to adopt simplified versions (e.g., using Excel-based scripts or built-in accounting system reports). By automating journal entry analysis, auditors adhere to standards by examining the ledger comprehensively for fraud red flags.

- **Confirmations and External Communications:** The process of sending and receiving confirmations (ISA 505) involves repetitive outreach to banks, customers, suppliers, etc. While third-party confirmation platforms exist, an RPA could also be configured to send emails/faxes and track responses. Likewise, tracking legal letters and other correspondence can be automated. Automating these tasks ensures timely follow-up and that no confirmation request "falls through the cracks," thus improving the reliability of confirmation evidence. (One caveat is that the response evaluation still requires auditor judgment – e.g., interpreting a response from a lawyer – which automation cannot handle fully).

- **Documentation and Report Preparation:** Automation can assist in compiling audit documentation and even drafting sections of the audit report. For example, standardized sections of audit reports or management letters can be generated from templates once the inputs (like materiality, key audit matters, etc.) are determined. Zapier or RPA can assemble these pieces, reducing the clerical work for audit seniors. This must be done carefully to ensure compliance with ISA 700 series (auditor's reports) – typically an auditor will review and edit any automated draft. Nonetheless, it streamlines the process and reduces the chance of omitting required wording by using up-to-date templates.

It should be noted that not all audit tasks are automatable. Areas requiring significant professional judgment – such as assessing the reasonableness of management's estimates (ISA 540) or evaluating the overall presentation of the Financial statements – currently defy straightforward automation. AI is being explored in some of these areas (for instance, AI tools that read annual reports to assess tone or consistency, which might inform the auditor's overall review), but such applications are in early stages and would augment rather than replace auditor judgment. Audit standards implicitly require a human touch in these evaluations, and no research to date suggests that automation can or should replace that aspect.

Overall, research suggests that about "70–80% of rules-based processes" in accounting (and by extension many audit processes) "are suitable for automation". Auditors must identify which tasks fall in that bucket while ensuring they design automated procedures that still meet the intent of the audit standards. When done correctly, automation is not at odds with ISA or GAAS – rather, it can strengthen adherence by performing meticulous checks and providing a fuller evidence set, all documented in a reproducible way.

8. Practical Implications for Audit Practitioners

The findings of this review translate into several actionable implications for audit practitioners – particularly for small and mid-sized audit firms seeking to adopt automation:

- Start Small and Strategically: Firms should begin their automation journey with easily achievable, high-impact targets. Rather than overhauling core audit procedures immediately, an effective strategy is to automate low-risk administrative or data-processing tasks. For example, using a no-code tool like Zapier to streamline client onboarding workflows or send automated document request reminders can yield quick efficiency wins with minimal investment. Early success in these areas builds confidence and demonstrates return on investment, which can then justify further automation initiatives. Kononenko, L., & Gai, O. (2024)

- Leverage Existing Technology Tools: Before investing in new RPA or AI systems, firms are advised to maximize automation features in the software they already use. Modern accounting and audit software often include built-in automation or scripting capabilities (for instance, Excel macros or data analytics add-ins) that can be utilized at little extra cost. By fully exploiting such features, practitioners can improve processes without the learning curve of entirely new systems. This approach aligns with resource constraints common in SMPs and ensures that any advanced tool adoption is truly necessary and value-adding. (Lidiana, 2024)

- Prioritize Data Quality and Standardization: (Adeoye et al., 2023) underscores that the benefits of automation and AI are heavily dependent on data quality. Audit firms should work proactively with clients to improve "data hygiene" – for instance, encouraging clients to maintain well-organized digital records and standardized formats for financial data. High-quality, structured data enables tools to function optimally and reduces the risk of garbage-in, garbage-out issues. Poor data quality will directly limit the effectiveness of audit analytics and AI-based tests, no matter how sophisticated the tool. Therefore, investing effort in data cleaning and client education about data standards is a crucial prerequisite for successful automation.

- Focus on Training and Upskilling Auditors: As automation tools become integrated into the audit process, the skill set for auditors must evolve. Firms should invest in training programs to ensure staff can effectively use new technologies and – importantly – interpret and scrutinize their outputs. This includes not only technical tool training, but also cultivating a mindset of professional skepticism in an automated environment. Auditors need to understand the limitations of each tool (e.g., knowing when an AI's anomaly detection might produce false positives/negatives) and be prepared to perform further investigation or manual intervention when warranted. By upskilling their teams, firms can ensure that automation augments rather than diminishes audit quality, with humans providing oversight over automated routines. (Riantono et al., 2023)

- Update and Document Audit Methodologies: Introducing automation into the audit workflow necessitates revisions to the firm's audit methodology and documentation practices. Practitioners should establish clear protocols for selecting which audit tasks to automate and for validating the tools used. Each automated procedure must be documented in line with auditing standards (e.g., ISA 230 on documentation and ISA 500 on audit evidence) to show what was done by the tool and how its results were evaluated by the auditor. Developing an "automation handbook" or internal guidelines is

advisable – it should cover how to review and test automated work (for example, checking that an RPA script correctly extracted all relevant data). Such rigor ensures that the use of technology remains compliant with audit standards and can stand up to quality control or external inspection. Thorough documentation of automated procedures will also help in knowledge transfer and in scaling automation use across the firm.

- Collaborate and Share Resources: Small audit practices might lack the in-house IT resources that large firms enjoy, but they can compensate by collaborating within professional networks or associations. Firms should consider joining alliances, technology user groups, or pilot programs (sometimes offered by institutes or vendors) to share knowledge and even costs. For instance, several small firms could jointly hire an RPA consultant to develop a bot that they all use for a common task, or share access to an AI-based analytics platform. Such collaboration can significantly lower barriers to entry – allowing SMPs to benefit from advanced technologies that would be impractical to implement independently. It also creates a community of practice where lessons learned and best practices for audit automation are disseminated, accelerating collective learning in the profession. (Vitliemov & Penchev, 2022)

- Stay Informed – but Be Realistic: (Eulerich et al., 2022) ensures that the landscape of audit technology is rapidly evolving, so practitioners should keep abreast of emerging tools and trends (through continuing education, industry publications, and experimentation). However, it is equally important to maintain a realistic perspective and not adopt technology for its own sake. Not every new tool will suit every firm or client base. Audit partners should evaluate new solutions based on concrete needs and demonstrated benefits, rather than hype. A balanced approach involves piloting promising tools on a small scale and scaling up only upon proven success. By staying informed, auditors can avoid falling behind; by staying critical, they ensure that

any adopted innovation truly aligns with their audit objectives and risk management practices.

- Manage Client Expectations: Finally, auditors should communicate proactively with clients about their use of automation and what it means for the audit. Clients may need reassurance that automated procedures still result in a high-quality, diligent audit. Explaining the benefits (for example, "our data analytics tool checks 100% of transactions, which allows us to identify anomalies more effectively") can enhance client trust. At the same time, practitioners should be cautious about over-promising, such as clients assuming that automation will immediately reduce audit fees. In reality, efficiency gains from technology are often reinvested into performing a more thorough audit (broadening the scope of testing, etc.) rather than simply cutting time. Clear communication will help clients appreciate the value added by automation while understanding that the fundamental audit assurance – and the auditor's professional judgment – remain intact.

By following these implications, audit practitioners – especially those in smaller firms – can navigate the automation journey more effectively. The key is a strategic, incremental approach: leverage easy wins, build internal skills, update processes, and learn from peers, all while maintaining compliance and clear communication. Such an approach ensures that automation enhances audit quality and efficiency without undermining the core principles of auditing.

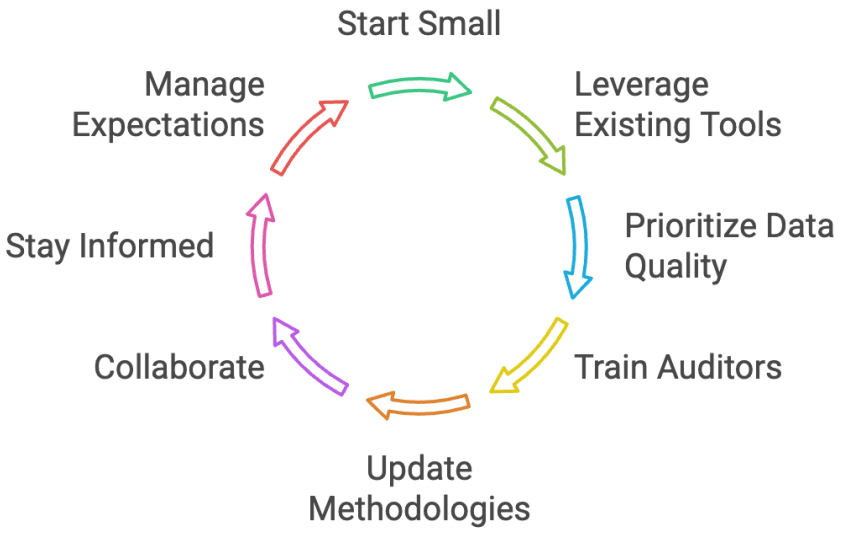

Figure 1: Audit Automation Cycle
Prepared by the researchers

9. Research Gap and Future Directions

Although recent literature has mapped the technological possibilities of robotic process automation, no-code workflow tools, and AI in external auditing, the empirical underpinnings of these discussions remain thin. Much of the literature is conceptual, survey-based, or confined to single-firm case narratives, leaving unanswered the critical question of whether and to what extent; automation demonstrably improves audit quality, efficiency, and risk detection across diverse audit settings. This paucity of outcome-oriented research is particularly acute for small and mid-sized practices, whose resource profiles differ markedly from the large firms that dominate existing studies. Consequently, an evidence gap persists between the theoretical promise of audit automation and verifiable, generalisable results, underscoring the need for robust empirical investigations that can inform regulators, standard-setters, and practitioners alike.

Identification of the Gap: there is An empirical gap that implies a lack of direct empirical study of key questions[1], and an evidence gap refers to missing or insufficient evidence on outcomes of interest In this review, the two are closely related: there is a *shortage of empirical evidence demonstrating the actual impact of automation on audit quality and effectiveness*. The paper notes that many claims about automation benefits have not yet been rigorously validated in real audit settings; for example, it concludes that more empirical measurement of automation's impact on audit quality is needed. This suggests that while conceptual arguments and anecdotal successes exist, the audit field lacks comprehensive data on whether tools like RPA or AI truly improve audit outcomes (e.g. error detection rates, audit report quality, efficiency gains) in practice. In particular, there is little longitudinal or experimental evidence isolating the effect of these technologies.

Justification: This gap arises because much of the current literature consists of conceptual discussions, surveys of perceptions, or pilot case descriptions, rather than robust empirical assessments. The methodology of the review itself gave "special attention to empirical studies that measured actual outcomes rather than theoretical benefits - implying such studies were rare and needed highlighting. For Instance, the claim that automation "tends to enhance audit quality" is promising, but *how much* quality improvement occurs and under what conditions remain open questions due to limited empirical studies. The evidence gap is apparent in areas like audit quality: do AI analytics actually lead to detecting more misstatements or fraud, or do they mainly improve efficiency? The review cites optimistic indications but acknowledges the need for solid evidence. Without sufficient empirical data, auditors and regulators must rely on theory or vendor claims, which is a tenuous basis for wide adoption.

Future Research Directions: Closing the empirical/evidence gap will require scholars to conduct rigorous studies that generate measurable evidence of audit automation's effects. One future research direction is to perform quantitative studies (field experiments, archival analyses, or

controlled simulations) that compare audit engagements with and without automation. For example, researchers could partner with audit firms to introduce an RPA or AI tool in certain engagements and measure differences in audit findings, time spent, or error rates relative to a control group of traditional audits. Such studies would empirically verify whether tools genuinely increase the likelihood of detecting misstatements or reduce audit hours, thereby producing evidence for or against the assumed benefits. Another direction is survey and interview research targeting firms that have adopted these technologies, to collect systematic data on outcomes like audit quality, efficiency, client satisfaction, etc. Although some surveys exist, more fine-grained empirical data (perhaps through mixed-methods studies) would help quantify benefits and identify any unintended consequences (e.g. over-reliance on automation). Cross-country or cross-industry empirical comparisons could also be insightful – for instance, examining if firms in regions with different regulations experience different impacts from AI in audits. In summary, future research should prioritize building an evidence base – using robust empirical methods – to confirm, nuance, or challenge the presumed advantages of RPA, AI, and no-code tools in auditing. This will not only fill the empirical gap but also provide practical insights backed by data, which are crucial for standard-setters and practitioners.

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