



Technology Adoption Factors for Supreme Audit Institutions

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Abstract

Objective –Arguably, there is a shortage of research on how supreme audit institutions can use cutting-edge technologies to make them more effective and stay up with the evolving audit landscape as we are in the 4IR age. Professional auditing and accounting groups encourage using cutting-edge technologies in accounting and auditing duties. However, public sector auditing is trailing behind in the digital transition. Guidelines regarding the elements that superior audit institutions must consider when implementing cutting-edge technologies are still required. This paper fills the gap in the literature by providing technology adoption factors that have been verified for usefulness and practicability and then evaluated in order of significance by experts from eight different countries. Therefore, the findings and recommendations of the paper are applicable and relevant on a global scale.

Design/Methodology –Experts were consulted to validate and rate the importance and practicability of the variables and processes for technology adoption using two Delphi questionnaires.

Results –The technology adoption factors identified were assistance from top management, a plan for embracing technology, and fostering an environment focused on digital culture. Assessing the current systems for compliance with legislation, organization-wide preparation, and the ability to incorporate new technology, ongoing staff training, regulatory compliance, environmental policies, and audit standards are necessary. Evaluating the technology's compatibility and complexity, doing a cost-benefit analysis, and determining whether the auditee platforms are ready for advanced technology auditing were rated as important technology adoption factors by experts.

Keywords: Technology adoption, public sector auditing, digital transformation, supreme audit institutions

1. Introduction

Recent studies investigating the advantages of automated audit systems and their auditors highlight how the audit industry embraces new technologies for executing audits (Ceki, 2019). Auditing firms like Deloitte employ cutting-edge audit technologies such as natural language processing, enabling a computer to understand and scrutinise numerous contracts quickly, to lessen audit expenses (Fotoh & Lorentzon, 2020). In addition, drones, cloud computing, blockchain, and data analytics constitute more innovative auditing technologies (Eulerich et al., 2023). These technologies have the potential to boost performance, facilitate remote auditing, and automate audit procedures. They provide financial benefits like reductions in labour costs and audit duration (Ceki, 2019). As a result, audit technology is regarded as a productive and economical tool in academic literature. This aligns with the techno-economic theory, which portrays technology as a driver of economic expansion for businesses (Bazhal, 2009; Perez, 2009).

Auditing firms in the private sector, namely Deloitte, Klynveld, Peat, Marwick, Goerdeler (KPMG), Ernst & Young (EY), and PwC, extensively utilise data analytics to carry out comprehensive audit risk evaluations and scrutinise the entire populace

(IAASB, 2017). A significant benefit of data analytics is its ability to automate audit processes, encompassing analytical, empirical, and control supervisory procedures. This results in a reduced audit workforce, diminished costs, and improved audit effectiveness (Eulerich et al., 2023). By automating audit procedures, auditors can concentrate on cultivating robust client alliances and delivering superior quality audit services. It liberates auditors to devote their time to other value-enhancing services, such as employing predictive analysis to pinpoint potential opportunities and hurdles for clients (Nathalie et al., 2018). Additionally, it prevents fraudulent activities and promotes a valuable exchange of thoughts concerning the auditor's risk evaluation and audit with the audit committee (Boillet, 2017). Data analytics also enables the early detection of fraud and fosters excellent dialogue between the audit committee and the auditor about audit discoveries.

The argument can be made that there is a significant lack of scholarly work on how technologies can be deployed in public-sector auditing because the supreme audit institutions still need to match the private sector in its digital evolution (Otia & Bracci, 2022). Entities that promote the application of sophisticated technology in accounting and auditing encompass the South African Institute of Chartered Accountants (SAICA), the Institute of Chartered Accountants of England and Wales (ICAEW), the American Chartered Professional Accountants (CPA), and the Chartered Institute of Management Accountants (CIMA). Nonetheless, premier auditing institutions' standards regarding employing state-of-the-art technologies must be in place (Boillet, 2017). As a result, this research seeks to fill this literature gap by detailing the critical factors that SAIs need to consider when integrating advanced technologies. The paper brings an international view of adoption factors because the experts who participated in the Delphi questionnaires were from different countries worldwide. Therefore, the paper's findings and recommendations are applicable and relevant to SAIs on a global scale, ultimately leading to more effective decision-making and improved performance in the audit process.

2. Literature Review

Given that the International Organisation of Supreme Audit Institutions (INTOSAI) is advocating for a digital transformation, SAIs need to prepare to assimilate technology to maintain their competitiveness in the auditing sector. Nevertheless, SAIs in less developed countries must strive to match the adoption of advanced technologies in auditing and need a blueprint for digital transformation that includes a model for integrating new technologies (Otia & Bracci, 2022). Understanding digital transformation and technology adoption is crucial as SAIs in less developed countries often misconstrue digital transformation as merely the automation of auditing processes. Adopting technology is a part of an organisation's digital transformation, encompassing aspects such as digitisation and digitalisation of auditing procedures (Liao & Teo, 2019).

2.1 Digital culture

The hesitation of most auditors to utilise state-of-the-art technologies can be attributed to a lack of necessary expertise for a more advanced, automated audit process (Scholtes, 2020; Yahya et al., 2024; Zhang et al., 2018). Consequently, Supreme Audit Institutions (SAIs) must invest in employee training initiatives to equip their staff with digital skills and proficiency in the latest technologies (Widuri et al., 2016). The digital culture within a corporation significantly shapes how employees perceive and utilise technology. Without a well-regulated digital environment that harmonises technology integration with workforce values, it's akin to imposing technology on a potentially unresponsive employee base (Craig et al., 2014).

The theory of planned behaviour suggests that employee attitudes and behaviour changes can foster an acceptance of technology. This acceptance arises when

individuals are prepared to engage with new initiatives (N. Ahmad et al., 2013). Supreme Audit Institutions must cultivate an atmosphere encouraging innovation, experimentation, and trials (Otia & Bracci, 2022). In such an environment, auditors are free to experiment with new concepts, where even failure is perceived as a vital step towards enhancing one's proficiency (Schlaepfer et al., 2017). For a robust digital culture to thrive, it requires digital leadership that is not only supportive of innovation but also unafraid of taking calculated risks (Teichert, 2019).

Digital transformation influences people, culture, and organisational backing, even though the focal point of the paper is technological assimilation rather than digital transformation. To capitalise on the benefits of technology, individuals need motivation, and senior management's support is crucial. Management could designate a Chief Digital Officer and Chief Information Officer to drive technology adoption (Kraus et al., 2021). The capability of an institution to promptly recognise and incorporate novel technologies is a critical component for the fruition of digital transformation (Hess et al., 2016). By proactively positioning themselves as pioneers and early adopters, SAIs must set an elevated benchmark. It is incumbent upon SAIs to explore advanced technologies to enhance their proficiency. Technologies such as blockchain and artificial intelligence are still in their nascency within the SAI community. Thus, SAIs must remain cognisant of these impending disruptions.

Studies from the literature in Table 1 highlight the factors contributing to successful technology adoption at the organisational, technological and environmental levels. The factors from these studies have been used to inform the first Delphi questionnaire.

Author(s)	Purpose	Technological and individual factors	Organisational factors	Environmental factors
(Awuah et al., 2021; Otia & Bracci, 2022; Yusif et al., 2020)	Digital transformation in SAIs. Big data analytics adoption in auditing	Develop data collection platforms to collect and analyse data from auditees, Have innovation labs or working groups experimenting with advanced technologies, Experienced chief technology officer run the adoption of technologies, training on cyber security of big data analytics.	Train staff in big data analytics and AI, embed auditors with digital culture, creativity, and culture where auditors are allowed to experiment. Audit partners lead by example in technology adoption	Government policy, regulations and funding support
(R. Ahmad et al., 2012; Dwivedi et al., 2015)		Decide which technologies to acquire	Budget money for staff training and acquiring advanced technologies costs	Consider the readiness of the auditee platforms for advanced technology auditing ability
(Eulerich et al., 2022)	Robotic Process Analysis adoption	Auditors' competencies and skills, Reward for acquiring tech skills	Audit settings, culture, structure	Legal and regulatory requirements for implementing RPA
(Seethamraju & Hecimovic, 2023)	Artificial Intelligence adoption in auditing	Communicate perceived benefits of AI, compatibility, maturity of AI technology (in use for a long period), ease of data integration and data quality, and trust by auditors of	Train auditors for AI auditing and coding skills to understand and create AI algorithms for auditing, audit firm readiness, assess IT infrastructure	Legal implications of AI, Auditing standards and regulation readiness, Auditee's readiness,

Table 1.
Key technology adoption studies and significant factors from literature

		capabilities of AI supported.	suitability to integrate advanced technologies	
(Al-Okaily et al., 2022)	CAATs adoption factors in the public sector	Compatibility, Auditors competency	Top management support, size of the audit firm and availability of funds to adopt	Government rules, professional body support, job complexity
(Al-Hiyari, 2019)	CAATs adoption	Effort expectancy and performance expectancy	Give incentives for acquiring tech skills, Training staff,	
(Pedrosa et al., 2020)	CAATs adoption	Perceived usefulness, effort expectancy, facilitating conditions,	Top management support, Training, Number of auditors	
(Awuah et al., 2021; Widuri et al., 2016, 2021)	Culture for technology adoption	Select less complex technology.	Capital budget, Firm size,	Government support and funding
(Awuah et al., 2021)	Information technology adoption	Complexity,	IT infrastructure, Audit partners influence adoption,	Hire data scientists or engineers, Training workshops on big data analytics
(Siew et al., 2020)	CAATTs adoption factors	Perceived usefulness, effort expectancy, facilitating conditions, compatibility, trialability, relative advantage	IT capacity and resources, training and auditor's IT competency	Government rules, professional body support, job complexity
(Sayginer & Ercan, 2020)	Cloud Computing adoption factors	Complexity	Top management support, Staff training, Commitment to the project, service provider	Government rules, professional body support, job complexity
(Yusif et al., 2020)	Change management and adoption of information technology	Auditors' participation, Experience,	Availability of change agents, Training, Ongoing technical assistance	
(Clohessy et al., 2019)	Blockchain adoption	Compatibility, maturity, perceived benefits	Management support, firm size, organisational readiness	Government laws, government support, industry competition and pressure
(Li et al., 2018)	Audit analytics	Technological competence	Management support	Standards, Professional body help on data analytics implementation and training
(Puklavec et al., 2018)	Business intelligence (BI) systems	Costs	Management support, project champion, organisational readiness	External support, size, industry

(Martins & Thomas, 2016)	SaaS adoption	Relative advantage	Technology competence, management support	Coercive pressures, normative pressures
(Seethamraju, 2015)	ERP systems adoption	Perceived benefits, complexity, compatibility	Organisational readiness, costs, data, quality, integration	Partner support
(Lian et al., 2014)	Cloud system adoption factors	Data security, costs, compatibility	Management support, resources, technical competence, Chief Information Officer, innovativeness	Industry pressure, government policy
(Yang & Wibowo, 2022)	AI adoption	User trust in AI		
(Manrai & Gupta, 2023)	Artificial Intelligence adoption	Reputable AI service provider		

3. Methodology

The paper's goal was to provide technology adoption factors by supreme audit organisations to stay up to date with the rapid shift to 4IR-based tools for increased efficiency in public sector auditing. First, issues influencing the use of new technologies in an auditing environment were examined by analysing literature. The factors influencing technology adoption were identified from the literature and sent to experts in the first Delphi questionnaire to validate and add necessary steps not mentioned. A second Delphi questionnaire was sent to experts to obtain consensus on the valid and required steps and factors to be considered by SAIs in adopting technologies based on results from the first questionnaire. The results from the second questionnaire formed the technology adoption factors for supreme audit institutions.

3.1 Sampling

Purposive sampling, which is more appropriate for this kind of research, was used in the paper (Saunders et al., 2016). The researcher employed purposive sampling and exercised judgment in choosing experts who would best help the researcher achieve the paper's goals (Cohen et al., 2011).

The sample for the Delphi approach was made up of a variety of specialists from different fields. Eight nations—South Africa, Ghana, Kenya, Uganda, the Republic of Kosovo, Vietnam, Turkey, and Norway—were represented among the experts contacted. Nineteen experts answered the first Delphi questionnaire, compared to the original aim of fifteen. The second round involved twelve specialists. Ludwig (1997) states that using a sample size of 15–20 people is the standard procedure for Delphi research. In contrast, a minimum of seven to eight individuals is recommended (Sourani & Sohail, 2015). Since the number of experts involved in this paper is within the range permitted by the literature, it is acceptable. Participants were selected based on their availability, willingness to engage, and experience with information technologies, auditing, and adopting new technologies. The experts included:

- Government officials.
- Qualified internal auditors.
- IT specialists.
- Chief technology officers.
- Chief information officers.
- Innovation leaders.
- Experienced external auditors.
- They also included members of working groups on big data and IT audits.

3.2 Data interpretation

Delphi procedure's decision guidelines for data analysis must be established to gather and arrange expert opinions and impressions (Hsu & Sandford, 2019). A set of criteria has to be followed to define and get a consensus and the votes cast must fall within a predefined range for a consensus. A consensus is declared when 80% of the participants' votes fall between the two groups on a seven-point rating system (Hasson et al., 2000).

Experts were asked to accept, reject, or modify the adoption factors and processes found in the literature in the first round of the Delphi questionnaire. They were also invited to add any further adoption factors and processes they thought fit. Accept indicates that the factor has been identified as critical by the expert. Amend denotes that although the factor is believed to be good, it may be changed or swapped out for another one that the expert adds to the questionnaire. The experts were asked to rate the confidence in accepted, rejected, or altered factors on the same form. Level one denoted no confidence, Level 2 a low degree of confidence, Level 3 a medium degree of confidence, and Level 4 a high degree of confidence.

The second phase of the Delphi questionnaire included all the factors that experts deemed acceptable at a confidence level of 3 and 4, in addition to the newly added factors. The experts were asked to rank the significance of the factors and procedures from round one as either important at level 3 or level 4 being very important.

4. Results and Discussion

Years in the field of expertise

19 responses

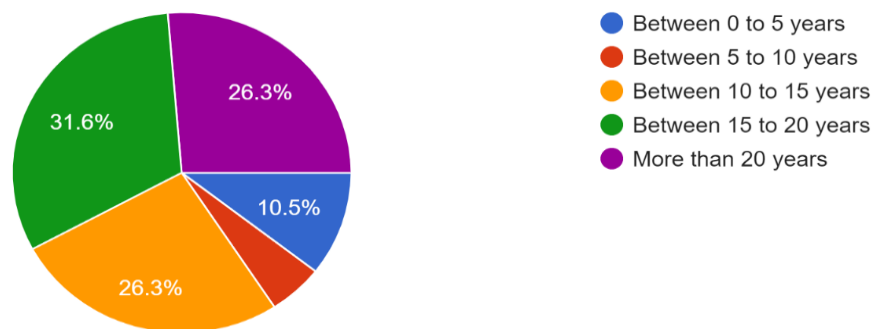


Figure 1.
Job Experience

As depicted in Figure 2, among the professionals, 31.6% have a service spanning 15 to 20 years. When evaluating their professional tenure, it is observed that 26.3% boast of an experience exceeding 20 years. An equal fraction, another 26.3%, have honed their skills throughout 15 to 20 years. A lesser proportion, 5.3%, have gathered their expertise throughout 5 to 10 years. The remaining 10.5% of the pool comprises relatively new entrants with work experience between 0 and 5 years.

Highest academic qualification

19 responses

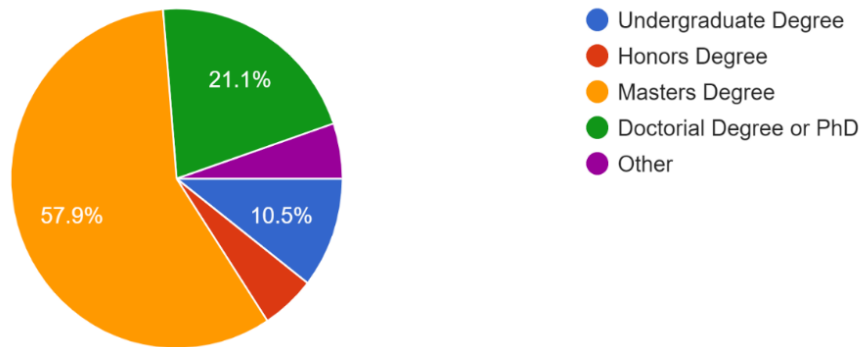


Figure 2.
Educational
qualifications of
experts

As per the data illustrated in Figure 3, it can be inferred that a majority, precisely 57.9% of the professionals, hold a Master's qualification. Interestingly, the following highest percentage is those with a Doctorate or PhD, accounting for 21.1%. Those with an undergraduate degree make up 10.5% of the total, the same percentage as those with both an undergraduate degree and an honors degree. This data effectively highlights the educational qualifications of the experts under consideration.

Organisational factors and processes	Decline at level 1	Amend at level 2	Accept at levels 3 and 4
Top management support			100%
Perform current systems analysis to identify technological, compliance and organisational readiness			100%
Assess client or auditee systems for compatibility with new technology		10.5%	89.5%
Consider the readiness of the auditee platforms for advanced technology auditing ability		15.8%	84.2%
Assess IT resources and facilities readiness for adopted technologies		15.8%	84.2%
Staff training for adopted technologies			100%
Improve technical skills of staff by ongoing training on use of advanced technologies such data algorithm auditing, cloud-based auditing and Big Data analysis, etc.			100%
Develop data collection platforms to collect and analyse data from auditees			100%
Assess IT infrastructure, working and digital culture, and readiness to adopt new technologies		5.3%	94.7%
Change management to prepare employees for new technology		21.1%	78.9%
Determine budget required and whether funds are available to purchase or outsource the technology		5.3%	94.7%
Consider if data extraction from auditee systems is accessible and possible		10.5%	89.5%
Consider auditee data reliability and ethics. SAIs should be able to test data reliability and ethics from the datasets received from auditees.		5.3%	94.7%

Table 2.
Technology
adoption factors
from first Delphi
questionnaire

Organisational factors and processes	Decline at level 1	Amend at level 2	Accept at levels 3 and 4
Determine SAI IT maturity to assess ICT readiness for advanced technology use			100%
Hire data scientists to create procedures for the audit of algorithms or use SAIs experts to create audit algorithms instead of hiring external people.		15.8%	84.2%
Communicate perceived benefits of adopting new technology		5.3%	94.7%
Trust by auditors of the capabilities of AI	5.3%	15.8%	78.9%
Give staff incentives for acquiring tech skills		10.5%	89.5%
Ongoing technical assistance		10.5%	89.5%
Availability of change agents or departmental heads to drive technology adoption	5.3%	15.8%	78.9%
Project champion or dedicated team to drive technology adoption	5.3%		94.7%
Technological factors	Decline at level 1	Amend at level 2	Accept at levels 3 and 4
Analyse current systems for compatibility with new technology		5.3%	94.7%
Assess the complexity of the new technology for ease of use		10.5%	89.5%
Assess the cost-benefit of using and purchasing new technology		5.3%	94.7%
Data security			100%
Consider the sustainability of new technology		10.5%	89.5%
Consider cyber-security risks of adopted technology		5.3%	94.7%
Consider if auditee data integration and automation of risk-based auditing is possible		26.3%	73.7%
Environmental factors	Decline at level 1	Amend at level 2	Accept at levels 3 and 4
Consider professional body guidelines and policies		10.5%	89.5%
Consider regulation on the adoption of audit technologies	5.3%	5.3%	89.4%
Ensure compliance with environmental policies, performance, and other government regulations		15.8%	84.2%
Ensure compliance with quality, reporting and auditing standards			100%
Consider funding support from government and professional bodies	5.3%	31.6%	63.7%
Use an audit model for data algorithm auditing		5.3%	94.7%
Additional factors suggested by experts			
Have a work process for the key staff responsible for technology adoption.			

Organisational factors and processes	Decline at level 1	Amend at level 2	Accept at levels 3 and 4
Perform continuous monitoring and scanning of the new technology developments to ensure the tech stays abreast of new tech and stays relevant.			
Independence for auditors remains key and should be considered in technology adoption.			
Re-engineering of processes to integrate technologies in auditors' work, not only focusing on automating the current processes.			
Partnership with academics and external partners for technology adoption strategy			
Monitor and scan for new technology solutions and usage SAIs systems should be compatible with different auditee systems			

The results reveal a consensus among experts as they assessed nearly all factors as relevant, applicable, and of either moderate or substantial importance for technology adoption. Many experts recognised these factors as crucial, carrying a high priority level of 4. As illustrated in Table 2 below, 75% to 94% of experts considered the factors as either essential or favourable. All experts universally accepted thirty out of the thirty-five adoption criteria. However, 5.3% of experts disagreed with the following five factors:

- Considering regulations when integrating audit technologies.
- Factoring in government and professional body funding support.
- The trust of auditors in AI's potential.
- The availability of change agents, project leaders, or a committed team to encourage technology adoption.

Subsequently, 94.7% of experts evaluated the importance of these factors as medium or high. As these traits were dismissed by a minimal proportion of experts—only 5.3%, they are incorporated in the criteria required to construct a preliminary framework.

The subsequent paragraph demonstrates how experts suggested including additional factors to those either altered or dismissed. These factors can be found in Table 2 which illustrates a tentative model of the factors that SAIs must consider for technology adoption. During the second iteration of the Delphi questionnaire, these factors were presented to the experts within the preliminary framework. The objective of this second Delphi stage was to reach a consensus on the components of the draft model and their relevance for embracing technology.

Organisational factors and processes	Level 3 No. of experts	Percentage For Level 3 ranking	Level 4 No. of experts	Percentage For Level 4 ranking
Top management support	0	0	12	100%
Perform current systems analysis to identify technological, compliance and organisational readiness	2	16.67%	10	83.33%
Assess client or auditee systems for compatibility with new technology	6	50%	6	50%
Consider the readiness of the auditee platforms for advanced technology auditing ability	3	25%	9	75%

Table 3.
Organisational
factors ranking
from the second
Delphi
questionnaire

Organisational factors and processes	Level 3 No. of experts	Percentage For Level 3 ranking	Level 4 No. of experts	Percentage For Level 4 ranking
Assess IT resources and facilities readiness for adopted technologies	3	25%	9	75%
Staff training for adopted technologies	2	16.67%	10	83.33%
Improve staff technical skills by ongoing training on the use of advanced technologies such as data algorithm auditing, cloud-based auditing, Big Data analysis etc.	4	33.33%	8	66.67%
Develop data collection platforms to collect and analyse data from auditees	4	33.33%	8	66.67%
Assess digital culture, and readiness to adopt new technologies	3	25%	9	75%
Change management to prepare employees for new technology	4	33.33%	8	66.67%
Determine the budget required and availability of funds to purchase or outsource the technology	4	33.33%	8	66.67%
Consider if data extraction from auditee systems is accessible and possible	7	58.33%	5	41.67%
Consider SAIs ability to test data reliability and ethics from the datasets received from auditees.	2	16.67%	10	83.33%
Determine SAI IT maturity to assess ICT readiness for advanced technology use	5	41.67%	7	58.33%
Hire data scientists or use SAI experts to create audit algorithms	10	83.33%	2	16.67%
Communicate perceived benefits of adopting new technology	7	58.33%	5	41.67%
Consider trust by auditors of the capabilities of AI	4	33.33%	8	66.67%
Give staff incentives for acquiring tech skills	7	58.33%	5	41.67%
Ongoing technical assistance from technology service providers	5	41.67%	7	58.33%
Availability of change agents or departmental heads to drive technology adoption	7	58.33%	5	41.67%
Project champion or dedicated team to drive technology adoption	4	33.33%	8	66.67%

At level 4, >70% of experts reaching a consensus on a factor was the cutoff point for higher order (Green, 1982). Similarly, level 4's medium order factor barrier was set between >50% and <70%. On the other hand, the lower-order factors were those that at least >50% of the experts classified at level 3 (Green, 1982). Based on the established thresholds, the majority of experts (71% - 100%) evaluated the following organisational characteristics in Table 3 as high-order factors at level 4 for technology adoption: Top management support, examining present systems to determine technological, compliance and organisational preparedness levels, staff training and evaluating the ethics and dependability of the data from auditee datasets. Considering the auditee platforms' preparedness for the advanced technology auditing capacity, evaluating the IT infrastructure, digital culture, and willingness to adopt new technology were highly ranked by 75% of the experts. Have a work process for key staff members in charge of

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technology adoption. Independence for auditors is necessary and should be considered while adopting new technologies.

The medium-ranked at level 3 organisational factors, by 51% -74% of the experts are: Continuous training on Big Data analysis, cloud-based audits, and data algorithm auditing for auditors. Using change management to educate staff members about new technologies. Establishing the necessary budget and financial resources to acquire or contract the technology. Consider the auditor's trust in AI's capabilities, a committed team or project champion leading the adoption and continuous technical support from technology service providers. Continuously monitor and scan new technological advances to ensure the tech stays current and relevant. The experts' low-ranked level 3 extra variables that were recommended in the first round were: Collaborating with academia and outside partners for technology adoption. Re-engineering procedures to incorporate technology into auditors' work rather than just automating the present procedures.

Technological factors	Level 3 No. of experts	Percentage For level 3 ranking	Level 4 No. of experts	Percentage For level 4 ranking
Analyse current systems for compatibility with new technology	4	33.33%	8	66.67%
Assess the complexity of the new technology for ease of use	4	33.33%	8	66.67%
Assess the cost-benefit of using and purchasing new technology	4	33.33%	8	66.67%
Data security	0	0	12	100%
Consider the sustainability of new technology	3	25%	9	75%
Consider cyber-security risks of adopted technology	2	16.67%	10	83.33%
Consider if auditee data integration and automation of risk-based auditing are possible	7	58.33%	5	41.67%

Table 4.
Technological
factors ranking

According to Table 4, most experts, or more than 70%, selected the following technological variables as high-order determinants for technology adoption: Data security. Examine the dangers to cyber-security associated with deployed technology. Examine the new technology's sustainability. Medium-ranked in the technological factors category was assessing the new technology's ease of use as having a high level of complexity. Low-ranked factors were examining whether it is feasible to integrate auditee data and automate risk-based auditing.

Environmental factors	Level 3 No. of experts	Percentage For level 3 ranking	Level 4 No. of experts	Percentage For level 4 ranking
Consider professional body guidelines and policies	5	41.67%	7	58.33%
Consider regulation on the adoption of audit technologies	0	0	12	100%
Ensure compliance with environmental policies, performance, and other government regulations	1	8.33%	11	91.67%

Table 5.
Environmental
factors ranking

Ensure compliance with quality, reporting and auditing standards	1	8.33%	11	91.67%
Consider funding support from government and professional bodies	7	58.33%	5	41.67%
Use an audit model for data algorithm auditing	3	25%	9	75%

According to Table 5, most experts, or more than 70%, gave the following environmental elements a high ranking:

- Consider the audit technology adoption regulations and ensure that environmental policies, performance, and other government requirements are followed.
- Ensure quality, reporting, and auditing requirements are followed.
- For data algorithm auditing, use an algorithm audit framework.
- Experts ranked examining the policies and guidelines of professional bodies as medium rank while considering funding support from professional groups and the government as the sole low-ranked environmental factor.

In summary, Table 6 lists factors SAIs should consider in ranked order, starting from high-ranked to medium-ranked factors. The factors include management support, financial resources, IT maturity assessment, staff training, compliance with policies and regulations, data security, data ethics, and auditee data access. A comprehensive list of factors is detailed in the table below.

Table 6.
Summary of factors and processes in adopting technologies by supreme audit institutions.

High Rank Factors	Medium Rank Factors
<i>Organisational</i>	<i>Organisational</i>
▪ Top management support. ▪ Perform current systems analysis to identify the technological, compliance and organisational readiness. ▪ Staff training for adopted technologies ▪ Consider SAIs ability to test data reliability and ethics from the datasets received from auditees. ▪ Consider the readiness of the auditee platforms for the advanced technology auditing ability. ▪ Assess IT infrastructure, IT maturity, working and digital culture and readiness to adopt new technologies. ▪ Have a work process for the key staff responsible for technology adoption. ▪ Independence for auditors remains key and should be considered in technology adoption.	▪ Improve staff technical skills by ongoing training on using advanced technologies such as data algorithm auditing, cloud-based auditing and Big Data analysis, etcetera. ▪ Develop data collection platforms to collect and analyse data from auditees. ▪ Change management to prepare employees for new technology ▪ Determine the budget required and availability of funds to purchase or outsource the technology. ▪ Consider trust by auditors of the capabilities of AI. ▪ Project champion or dedicated team to drive technology adoption. ▪ Perform continuous monitoring and scanning of the new technology developments to ensure the tech stays abreast of new tech and stays relevant. ▪ Require ongoing technical assistance from technology service providers. ▪ SAI systems should be compatible with different auditee systems.

Technological

- Data security.
- Consider the cyber-security risks of adopted technology.
- Consider the sustainability of new technology.

Environmental

- Consider regulation on adopting audit technologies.
- Ensure compliance with environmental policies, performance, and other government regulations.
- Ensure compliance with quality, reporting and auditing standards.
- Use an audit model for data algorithm auditing.

Technological

- Assess the complexity of the new technology for ease of use.
- Assess the cost-benefit of using and purchasing new technology.

Environmental

- Consider professional body guidelines and policies.

5. Conclusion, Limitations, Implications

The paper highlights a thorough approach to technology adoption in audit organisations in the form of factors to be considered validated for practicability and ranked for importance by experts from eight international countries. It emphasises how important it is for executive leadership to be committed to fostering a digitally oriented atmosphere and implementing a purposeful technology integration strategy. Crucial adoption factors, include current systems analysis, staff training, data reliability and ethics testing, the readiness of auditee platforms, IT infrastructure, working and digital culture, independence of auditors, data security, regulation, compliance with environmental policies, auditing standards, and government regulations. However, other factors, such as communication of perceived benefits, incentives for staff to acquire tech skills, availability of change agents, compatibility of client or auditee systems, partnership with academics and external partners, re-engineering of processes to integrate technologies, monitoring and scanning for new technology solutions, hiring data scientists or using SAI experts to create audit algorithms, considering auditee data integration and automation of risk-based auditing, and considering funding support from government and professional bodies, are not considered very important for technology adoption but are also valid. The effective utilisation of cutting-edge technologies in audit firms depends on a holistic strategy that integrates leadership, culture, and strategic planning with the goals and needs of the organisation. The paper provides important insights and recommendations for factors to be considered to implement cutting-edge technologies for supreme audit organisations successfully.

References

- Ahmad, N., Amer, N. T., Qutaifan, F., & Alhilali, A. (2013). Technology adoption model and a road map to successful implementation of ITIL. *Journal of Enterprise Information Management*, 26(5), 553–576. <https://doi.org/10.1108/JEIM-07-2013-0041>
- Ahmad, R., Kyratsis, Y., & Holmes, A. (2012). When the user is not the chooser: Learning from stakeholder involvement in technology adoption decisions in infection control. *Journal of Hospital Infection*, 81(3). <https://doi.org/10.1016/j.jhin.2012.04.014>
- Al-Hiyari, A. (2019). The value relevance of purchased goodwill in Malaysian firms: The pre-and post-IFRS evidence. <https://www.researchgate.net/publication/326711731>
- Al-Okaily, M., Alqudah, H. M., Al-Qudah, A. A., & Alkhwalidi, A. F. (2022). Examining the critical factors of computer-assisted audit tools and techniques adoption in the post-COVID-19 period: internal auditors perspective. *VINE Journal of*

- Information and Knowledge Management Systems.
<https://doi.org/10.1108/VJIKMS-12-2021-0311>
- Awuah, B., Onumah, J. M., & Duho, K. C. T. (2021). Information Technology Adoption within Internal Auditing in Ghana: Empirical Analysis. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.3824403>
- Bazhal, I. (2009). Inclusive Growth, Innovation and Technological Change: education, social capital and sustainable development. 7th International Conference.
- Boillet, J. (2017). How will AI Enable us to Work Faster, Smarter. Available at: https://www.ey.com/en_gl/insights/assurance/how-ai-will-enable-us-to-work-smarter-faster Accessed 28 November 2024
- Ceki, B. (2019). Re-purposing audit assurance: The techno-economic implications of blockchain for auditor-client engagements. In T. Moloi & Madelowotan (Eds.), *International Conference of Accounting and Business In the 4IR Era*. (pp. 222–238).
- Ceki, B. (2024). Ceki, B. (2024). A model for the adoption of technologies by the supreme audit institutions. PhD thesis. [Thesis]. University of Johannesburg.
- Clohessy, T., Acton, T., & Rogers, N. (2019). Blockchain Adoption: Technological, Organisational and Environmental Considerations. In *Business Transformation through Blockchain* (pp. 47–76). Springer International Publishing. https://doi.org/10.1007/978-3-319-98911-2_2
- Cohen, L., Manion, L., & Morrison, K. (2011). *Research Methods in Education*. Routledge Editors.
- Craig, R., Amernic, J., & Tourish, D. (2014). Perverse audit culture and accountability of the modern public university. *Financial Accountability and Management*, 30(1), 1–24.
- Dwivedi, Y. K., Wastell, D., Laumer, S., Henriksen, H. Z., Myers, M. D., Bunker, D., Elbanna, A., Ravishankar, M. N., & Srivastava, S. C. (2015). Research on information systems failures and successes: Status update and future directions. *Information Systems Frontiers*, 17(1), 143–157. <https://doi.org/10.1007/s10796-014-9500-y>
- Eulerich, M., Masli, A., Pickerd, J., & Wood, D. A. (2023). The impact of audit technology on audit task outcomes: Evidence for technology-based audit techniques. *Contemporary Accounting Research*, 40(2), 981–1012.
- Eulerich, M., Pawlowski, J., Waddoups, N. J., & Wood, D. A. (2022). A framework for using robotic process automation for audit tasks. *Contemporary Accounting Research*, 39(1), 691–720.
- Fotoh, L. E., & Lorentzon, J. I. (2020). Critical issues of the audit expectation gap in the era of audit digitalisation.
- Green, P. (1982). The Content of a College-Level Outdoor Leadership Course.
- Hasson, F., Keeney, S., & McKenna, H. (2000). Research guidelines for the Delphi survey technique. *Journal of Advanced Nursing*, 32(4), 1008–1015.
- Hess, T., Matt, C., Benlian, A., & Wiesböck, F. (2016). Options for formulating a digital transformation strategy. *MIS Quarterly Executive*, 15(2), 123–139.
- Hsu, C. C., & Sandford, B. A. (2019). The Delphi technique: making sense of consensus. *Practical Assessment, Research, and Evaluation*, 12(10), 10.
- IAASB, (2017). Exploring the Growing Use of Technology in the Audit, with a Focus on Data Analytics. Available at: <https://www.iaasb.org/publications/exploring-growing-use-technology-audit-focus-data-analytics>. Accessed 25 July 2020.
- Kraus, S., Jones, P., Kailer, N., Weinmann, A., Chaparro-Banegas, N., & Roig-Tierno, N. (2021). Digital Transformation: An Overview of the Current State of the Art of Research. *SAGE Open*, 11(3). <https://doi.org/10.1177/21582440211047576>
- Li, H., Dai, J., Gershberg, T., & Vasarhelyi, M. A. (2018). Understanding usage and value of audit analytics for internal auditors: An organizational approach. *International Journal of Accounting Information Systems*, 28, 59–76.

- <https://doi.org/10.1016/j.accinf.2017.12.005>
- Lian, J. W., Yen, D. C., & Wang, Y. T. (2014). An exploratory study to understand the critical factors affecting the decision to adopt cloud computing in Taiwan hospital. *International Journal of Information Management*, 34(1), 28–36.
- Liao, L. , & Teo, E. A. L. (2019). Managing critical drivers for building information modelling implementation in the Singapore construction industry: an organizational change perspective. *International Journal of Construction Management*, 19(3), 240–256.
- Ludwig, B. (1997). Predicting the future: Have you considered using the Delphi methodology?. *Journal of extension*.
- Manrai, R., & Gupta, K. P. (2023). Investor's perceptions on artificial intelligence (AI) technology adoption in investment services in India. *Journal of Financial Services Marketing*, 28(1), 1–14.
- Martins, R., & Thomas, M. A. (2016). An empirical analysis to assess the determinants of SaaS diffusion in firms. *Computers in Human Behavior*, 62(1), 19–33.
- Nathalie, B., Geneva, H., & Jean-Henry, M. (2018). The Potential Impact of Blockchain Technology on Audit Practice. *Journal of Strategic Innovation and Sustainability*, 14(2), 35–39.
- Otia, J. E., & Bracci, E. (2022). Digital transformation and the public sector auditing: The SAI's perspective. *Financial Accountability and Management*, 38(2), 252–280. <https://doi.org/10.1111/faam.12317>
- Pedrosa, I., Costa, C. J., & Aparicio, M. (2020). Determinants adoption of computer-assisted auditing tools (CAATs). *Cognition, Technology and Work*, 22(3), 565–583. <https://doi.org/10.1007/s10111-019-00581-4>
- Perez, C. (2009). Technological revolutions and techno-economic paradigms. *Cambridge Journal of Economics*, 34(1), 185–202. <https://doi.org/10.1093/cje/bep051>
- Puklavec, B., Oliveira, T., & Popović, A. (2018). Understanding the Determinants of Business Intelligence System Adoption Stages: An Empirical Study of SMEs. *Industrial Management & Data Systems*, 118(1), 236–261. <https://doi.org/10.1108/IMDS-05>
- Saunders, M., Lewis, P., & Thornhill, A. (2016). *Research Methods for Business Students* (7th ed.). Pearson Education Limited.
- Sayginer, C., & Ercan, T. (2020). Understanding determinants of cloud computing adoption using an integrated diffusion of innovation (doi)-technological, organizational and environmental (toe) model. *Humanities & Social Sciences Reviews*, 8(1), 91–102. <https://doi.org/10.18510/hssr.2020.8115>
- Schlaepfer, R., Von Radowitz, K., Koch, M., & Merkofer, P. (2017). Digital future-readiness – How do companies prepare for the opportunities and challenges of digitalization? <https://www2.deloitte.com/content/dam/Deloitte/ch/Documents/consumerbusiness/ch-cip-en-swiss-transformation.pdf>
- Scholtes, J. (2020). Text mining and e-discovery for big data audits. *ECA Journal*, 1, 133–140.
- Seethamraju, R. (2015). Adoption of software as a service (SaaS) enterprise resource planning (ERP) system in small and medium-sized enterprises (SMEs). *Information Systems Frontiers*, 17, 475–492.
- Seethamraju, R., & Hecimovic, A. (2023). Adoption of artificial intelligence in auditing: An exploratory study. *Australian Journal of Management*, 48(4), 780–800.
- Siew, E. G., Rosli, K., & Yeow, P. H. (2020). Organizational and environmental influences in the adoption of computer-assisted audit tools and techniques (CAATs) by audit firms in Malaysia. *International Journal of Accounting Information Systems*, 36, 100445.
- Sourani, A., & Sohail, M. (2015). The Delphi method: Review and use in construction management research. *International Journal of Construction Education and*

- Research, 11(1), 54–76.
- Teichert, R. (2019). Digital transformation maturity: A systematic review of literature. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, 67(6), 1673–1687. <https://doi.org/10.11118/actaun201967061673>
- Widuri, R., Ferdiansyah, I., & Kongchan, P. (2021). The influence of culture, technology, organization, and environment on the adoption of computer-assisted audit techniques. *PalArch's Journal of Archaeology of Egypt/Egyptology*, 18(1), 494–504.
- Widuri, R., O'Connell, B., & Yapa, P. W. (2016). Adopting generalized audit software: an Indonesian perspective. *Management Audit Journal*, 31(8/9), 821–847.
- Yahya, M. R., Jalaluddin, & Batara, G. (2024). Current auditor expertise and future relevance of innovative audit technology: evidence from Indonesia public sector auditor. *Asia Pacific Journal of Public Administration*, 46(4), 471–487. <https://doi.org/doi.org/10.1080/23276665.2024.2312139>
- Yang, R., & Wibowo, S. (2022). User trust in artificial intelligence: A comprehensive conceptual model. *Electronic Markets*, 32(4), 2053–2077.
- Yusif, S., Hafeez-Baig, A., & Soar, J. (2020). Change management and adoption of health information technology (HIT)/eHealth in public hospitals in Ghana: A qualitative paper. *Applied Computing and Informatics*, 18(3/4), 279–289.
- Zhang, C., Dai, J., & Vasarhelyi, M. A. (2018). The impact of disruptive technologies on accounting and auditing education. *CPA Journal*, 88(9), 20–26.