Journal of Business Innovation and Accounting Research
Vol 3, No 3
http://educo-insight.com/journal/index.php/jbiar

Digital Transformation and Perceived Audit Quality: The Roles of Professional Judgment and Skepticism among External Auditors in Turkmenistan

Myrat Durdyyev[1], Rahman Yusuvop[2]
Turkmen State Institute of Economics and Management
durdyy@gmail.com

Abstract
Digital technologies are reshaping external audit procedures, but their relationship with audit quality depends on how auditors interpret technology-generated evidence and sustain professional skepticism. This study examines the associations among digital transformation, perceived audit quality, professional judgment, and professional skepticism in Turkmenistan, an under-researched Central Asian setting. A quantitative-dominant mixed-methods design combined survey responses from 187 accounting and audit professionals with semi-structured interviews involving 24 purposively selected participants. The survey model was estimated using partial least squares structural equation modeling with 5,000 bootstrap resamples, while interview transcripts were analyzed thematically. Digital transformation was positively associated with perceived audit quality ($\beta = 0.412$, $p < 0.001$), professional judgment ($\beta = 0.367$, $p < 0.001$), and professional skepticism ($\beta = 0.298$, $p < 0.001$). Professional skepticism and professional judgment were also positively associated with perceived audit quality. Indirect-effect tests indicated partial mediation through professional skepticism ($\beta = 0.102$, $p < 0.001$), professional judgment ($\beta = 0.105$, $p < 0.001$), and a serial pathway from professional skepticism to professional judgment ($\beta = 0.036$, $p = 0.008$). Interview evidence converged with the quantitative results by showing that analytics and automation improved coverage and efficiency while shifting, rather than replacing, human judgment. The findings suggest that technology investment is most likely to improve perceived audit quality when it is accompanied by training, data-governance controls, and institutional support for skeptical inquiry. Because the study is cross-sectional and relies primarily on self-reported perceptions, the results should not be interpreted as causal evidence of objectively measured audit quality.
Keywords: digital transformation; audit technology; perceived audit quality; professional judgment; professional skepticism; Turkmenistan

1. Introduction
The digitalization of business processes has changed the volume, velocity, format, and provenance of information available to external auditors. Audit firms increasingly use data analytics, cloud-based platforms, automated routines, and artificial intelligence to support risk assessment, substantive testing, anomaly detection, and documentation. These technologies can expand audit coverage and reduce repetitive work, but they also introduce new concerns involving data reliability, model opacity, cybersecurity, algorithmic bias, and overreliance on automated outputs (Alles & Gray, 2016; Appelbaum et al., 2017; Barr-Pulliam et al., 2022). Consequently, the relevant question is not simply whether auditors adopt technology, but whether the technology is embedded in audit processes in ways that improve the quality of evidence and decision-making.

Audit quality is inherently difficult to observe. Classical research conceptualizes it as the joint probability that an auditor detects a material misstatement and reports it appropriately (DeAngelo, 1981), whereas later frameworks emphasize inputs, audit processes, contextual conditions, and outcomes (Francis, 2011; Knechel et al., 2013). Survey-based studies therefore typically measure auditors' perceptions of process quality, competence, due care, compliance, and evidence evaluation rather than objective audit

failures. This distinction is important for the present study: the dependent construct is perceived audit quality, not externally verified audit quality.

Technology may enhance audit quality by allowing auditors to examine larger populations, integrate financial and non-financial evidence, identify unusual patterns, and focus scarce attention on high-risk transactions (Cao et al., 2015; Earley, 2015; Gepp et al., 2018). However, the same tools can weaken audit performance when users accept outputs uncritically, misunderstand model limitations, or lack the expertise required to investigate exceptions. Research on audit judgment therefore treats technological capability and human reasoning as complements rather than substitutes (Brown-Liburd et al., 2015; Barr-Pulliam et al., 2024).

Professional judgment and professional skepticism are central to this complementarity. Professional judgment involves the application of relevant training, knowledge, and experience to decisions required by auditing standards. Professional skepticism refers to a questioning mindset and a critical assessment of evidence. Judgment performance depends on the interaction of knowledge, ability, motivation, task characteristics, and environmental conditions (Libby & Luft, 1993), while skeptical judgments and actions are shaped by auditor traits, incentives, evidence, and organizational context (Nelson, 2009; Hurtt, 2010). Digital tools can support these processes by increasing informational breadth, but they cannot determine the meaning, sufficiency, or implications of evidence without human interpretation.

Most empirical evidence on audit digitalization is drawn from highly developed audit markets or from a limited set of emerging economies. Barr-Pulliam et al. (2022) identify substantial gaps regarding individual, task, and institutional factors that shape technology-enabled auditing. Studies in emerging settings suggest that technology adoption may improve perceived audit quality, yet infrastructure, cost, skill shortages, and organizational resistance remain important constraints (Tran & Anh, 2021; Abdallah et al., 2024). Evidence from Central Asia is especially limited.

Turkmenistan offers an institutionally distinctive setting. A historical World Bank diagnostic described a small and developing audit profession and identified the need for stronger professional education, standards, and quality-assurance mechanisms (World Bank, 2009). Although the institutional environment has evolved since that assessment, publicly available empirical research on contemporary audit practice remains scarce. Studying auditors in this setting can therefore extend the literature beyond mature audit markets while highlighting the conditions under which technology adoption may or may not translate into improved audit processes.

This study addresses three gaps. First, it provides evidence from an under-researched Central Asian jurisdiction. Second, it distinguishes the direct association between digital transformation and perceived audit quality from indirect pathways operating through professional skepticism and judgment. Third, it integrates survey estimates with interview evidence, allowing the statistical relationships to be interpreted alongside practitioners' accounts of implementation barriers and changes in audit work.

The study asks: (1) Is digital transformation associated with higher perceived audit quality? (2) Is digital transformation associated with stronger professional judgment and professional skepticism? (3) Do professional skepticism and professional judgment mediate the relationship between digital transformation and perceived audit quality? The remainder of the article develops the hypotheses, explains the mixed-methods design, reports the findings, and discusses their theoretical, practical, and policy implications.

2. Literature Review and Hypothesis Development

2.1 Digital transformation in external auditing

Digital transformation in auditing is broader than the acquisition of software. It involves the integration of digital tools, data infrastructures, skills, governance arrangements, and redesigned procedures into the audit methodology. Relevant technologies include generalized audit software, advanced data analytics, cloud collaboration platforms, robotic process automation, artificial intelligence, and continuous-auditing applications (Barr-Pulliam et al., 2022). The extent of transformation therefore depends on both technological adoption and organizational capability.

Data analytics can increase the scope of testing and improve risk identification, particularly when auditors can evaluate entire transaction populations rather than conventional samples (Cao et al., 2015; Earley, 2015). Cloud platforms can support standardized workflows and distributed collaboration, while automated

routines can improve consistency in repetitive procedures. Nevertheless, adoption is constrained by client-data access, interoperability, validation requirements, privacy, cost, and the need to reconcile technology-enabled procedures with professional standards (Alles & Gray, 2016; Krieger et al., 2021).

2.2 Digital transformation and perceived audit quality

Technology can improve perceived audit quality through at least three mechanisms. First, broader and more timely data access can strengthen risk assessment and evidence collection. Second, automation can reduce clerical error and free auditors to focus on higher-risk or judgment-intensive areas. Third, standardized digital workflows can improve documentation and compliance. These benefits are consistent with research linking audit analytics to enhanced coverage, efficiency, and anomaly detection (Appelbaum et al., 2017; Gepp et al., 2018).

The relationship is not automatic. Poor data quality, inappropriate model assumptions, or uncritical acceptance of algorithmic results can create new audit risks. Accordingly, digital transformation should be understood as an enabling condition whose quality consequences depend on implementation, competence, and governance. On balance, when auditors perceive that digital tools are appropriately integrated into audit work, they are likely to report stronger process quality, evidence evaluation, and compliance.

H1. Digital transformation is positively associated with perceived audit quality.

2.3 Digital transformation and professional judgment

Professional judgment is required whenever standards cannot prescribe a single mechanical response. Auditors must evaluate risk, materiality, contradictory evidence, accounting estimates, control deficiencies, and the sufficiency of evidence. Digital tools may improve judgment by making patterns, exceptions, and relationships more visible, thereby increasing the informational basis for decisions (Brown-Liburd et al., 2015; Barr-Pulliam et al., 2024).

At the same time, information abundance can create cognitive overload, automation bias, and false confidence. The expected positive relationship therefore presumes that technology is used as decision support rather than as a substitute for professional reasoning.

H2. Digital transformation is positively associated with professional judgment.

2.4 Digital transformation and professional skepticism

Professional skepticism requires auditors to remain alert to conditions indicating possible misstatement and to critically assess the reliability and consistency of evidence. Analytics can stimulate skeptical inquiry by revealing unexpected relationships, outliers, and contradictory signals that might be missed through manual review. Technology can also facilitate comparison across periods, accounts, and external data sources.

However, automated outputs can suppress skepticism if auditors treat them as inherently objective. The positive relationship is therefore most plausible when users understand the limitations of the tools and retain responsibility for follow-up investigation.

H3. Digital transformation is positively associated with professional skepticism.

2.5 Professional skepticism, professional judgment, and perceived audit quality

Skepticism and judgment are conceptually distinct but interrelated. Skepticism raises the auditor's assessment of the possibility that an assertion is incorrect and motivates further evidence collection, whereas judgment converts the available evidence into decisions and actions (Nelson, 2009). A questioning mindset should therefore support more careful evidence evaluation and more defensible professional judgments.

Perceived audit quality is expected to be higher when auditors critically challenge evidence and make well-reasoned decisions. Prior research links skepticism, due care, and judgment quality to stronger audit outcomes and lower acceptance of unsupported client explanations (Hurtt, 2010; Adhikara & Widodo, 2023).

H4. Professional skepticism is positively associated with perceived audit quality.

H5. Professional judgment is positively associated with perceived audit quality.

H6. Professional skepticism is positively associated with professional judgment.

2.6 Mediating mechanisms

A direct technology-quality relationship does not explain how digital tools are converted into audit outcomes. Technology may improve quality by prompting more skeptical inquiry, by strengthening the informational basis for judgment, or through a serial process in which technology first heightens skeptical

attention and skepticism subsequently improves judgment. Because the direct path may remain significant, partial rather than full mediation is expected.

H7a. Professional skepticism mediates the association between digital transformation and perceived audit quality.

H7b. Professional judgment mediates the association between digital transformation and perceived audit quality.

H7c. Professional skepticism and professional judgment serially mediate the association between digital transformation and perceived audit quality.

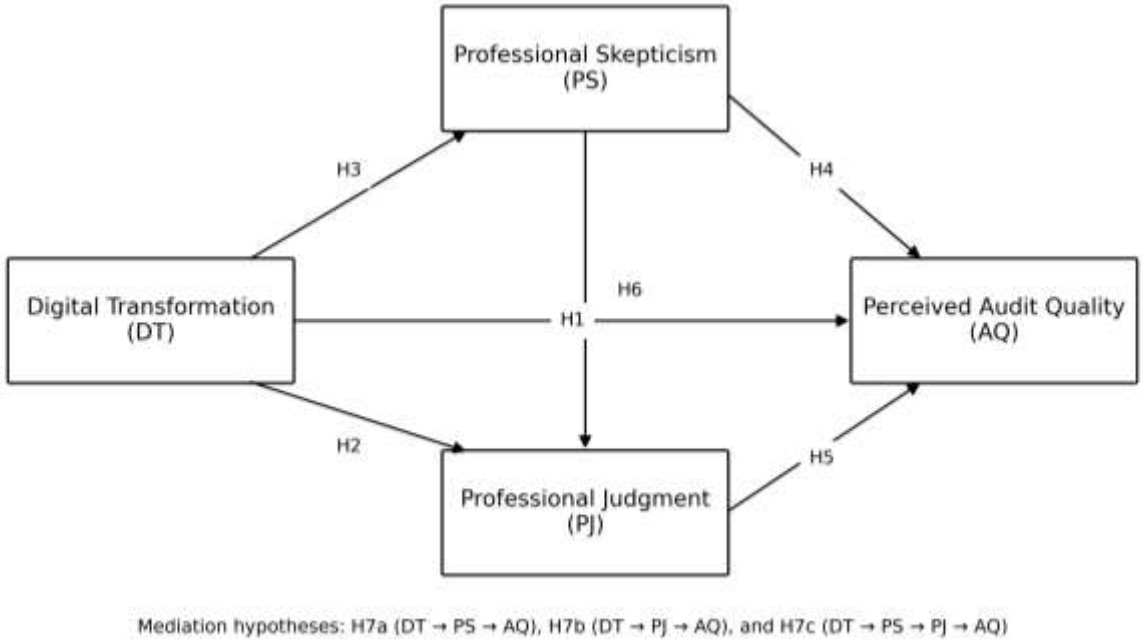

Figure 1. Conceptual model and hypotheses.

3. Method

3.1 Research design and mixed-methods integration

The study used a quantitative-dominant mixed-methods design. The quantitative strand tested the hypothesized relationships using a structured survey, while the qualitative strand used semi-structured interviews to explain how practitioners experienced technology-enabled audit work. The two strands were analyzed separately and integrated during interpretation through comparison of convergence, complementarity, and divergence. This design was appropriate because the structural model estimates the strength of associations, whereas interviews provide contextual explanations that cannot be inferred from path coefficients alone (Creswell & Plano Clark, 2018).

3.2 Population, sampling, and respondents

The authors' sampling frame comprised approximately 450 certified accounting and audit professionals working in public accounting firms in Turkmenistan. Stratification was used to seek representation across firm size, geographic location, position, and professional experience. A finite-population calculation at a 95% confidence level and a 5% margin of error produced an initial survey target of 208 respondents. A total of 250 questionnaires were distributed, and 187 usable responses were returned, corresponding to a response rate of 74.8%.

The achieved sample was below the finite-population precision target. It should therefore not be described as providing a 5% population margin of error. However, it exceeded power-oriented recommendations for estimating a PLS-SEM model with a maximum of three predictors for an endogenous construct (Hair et al., 2019). The sample was consequently considered adequate for model estimation, while generalization to the entire professional population remains cautious.

Table 1. Respondent characteristics (n = 187)

Characteristic	Category	n	%
Gender	Male	112	59.9
	Female	75	40.1
Age	25–34 years	48	25.7
	35–44 years	67	35.8
	45–54 years	52	27.8
	55 years or older	20	10.7
Professional experience	1–5 years	35	18.7
	6–10 years	58	31.0
	11–15 years	51	27.3
	16 years or more	43	23.0
Firm size	Small (1–10 employees)	62	33.2
	Medium (11–50 employees)	78	41.7
	Large (51+ employees)	47	25.1
Position	Junior auditor	29	15.5
	Senior auditor	64	34.2
	Manager	58	31.0
	Partner	36	19.3

3.3 Instrument development and translation

The questionnaire was developed in English from construct domains identified in the audit-technology, audit-quality, judgment, and skepticism literature. Because several measures were adapted and shortened for the Turkmenistan context, the instrument should be regarded as a context-specific operationalization rather than an unchanged reproduction of a single established scale. All substantive items used a seven-point Likert response format ranging from 1 (strongly disagree) to 7 (strongly agree).

The English questionnaire was translated into Turkmen and Russian and then back-translated to assess conceptual equivalence, following established cross-cultural survey procedures (Brislin, 1970). A pilot test involving 30 auditors who were excluded from the main sample was used to evaluate clarity and preliminary reliability. Reported Cronbach's alpha coefficients ranged from 0.78 to 0.91, and minor wording revisions were made before the full survey.

Table 2. Construct operationalization

Construct	Operational definition	Items	Representative domains	Key sources
Digital transformation (DT)	Integration of digital tools and digitally enabled procedures into audit work.	12	Data analytics; cloud platforms; automated audit software; AI-assisted analysis; workflow integration.	Barr-Pulliam et al. (2022); Earley (2015); Krieger et al. (2021)
Perceived audit quality (AQ)	Respondents' assessment of the quality of audit inputs and processes, not an objective measure of audit failure.	15	Technical competence; independence; due professional care; evidence quality; standards compliance.	Francis (2011); Knechel et al. (2013); Sulaiman et al. (2018)
Professional judgment (PJ)	Perceived effectiveness of reasoning and decision-making in audit tasks.	10	Risk assessment; evidence evaluation; consideration of alternatives; decision justification.	Libby and Luft (1993); Brown-Liburd et al. (2015); Barr-Pulliam et al. (2024)

Professional skepticism (PS)	Questioning mindset and critical assessment of audit evidence.	8	Search for knowledge; suspension of judgment; interpersonal understanding; self-determination; critical evaluation.	Nelson (2009); Hurtt (2010)

3.4 Data collection

Survey data were collected from September to December 2024 through professional meetings, direct distribution, email, and an online survey platform. Follow-up reminders were sent at two-week intervals. The qualitative strand involved 24 purposively selected participants representing different positions, experience levels, and firm sizes. Interviews lasted approximately 45–90 minutes and were conducted in Turkmen, Russian, or English according to participant preference. With consent, interviews were audio-recorded and transcribed verbatim.

3.5 Quantitative analysis

The hypothesized model was estimated in SmartPLS 4 using partial least squares structural equation modeling. The measurement model was assessed using indicator loadings, Cronbach's alpha, composite reliability, average variance extracted (AVE), and the heterotrait-monotrait ratio (HTMT). Values of approximately 0.70 or higher were used as a general loading benchmark; reliability values above 0.70 and AVE values above 0.50 were treated as acceptable. HTMT values below 0.85 were interpreted as evidence of discriminant validity (Henseler et al., 2015; Hair et al., 2019).

The structural model was evaluated using standardized path coefficients, bootstrap t statistics and confidence intervals based on 5,000 resamples, coefficients of determination (R^2), effect sizes (f^2), and Stone-Geisser predictive relevance values (Q^2). Mediation was assessed from bootstrapped indirect effects. Reported SRMR and NFI values were used as descriptive model-fit information rather than as definitive goodness-of-fit tests. Exploratory firm-size differences were examined through one-way analysis of variance.

3.6 Qualitative analysis

Interview transcripts were analyzed thematically using an inductive coding process informed by Braun and Clarke (2006). The analysis involved familiarization with the transcripts, initial coding, aggregation of codes into candidate themes, review of themes against the coded extracts and the full data set, and refinement of theme definitions. NVivo 14 supported data organization. Member checking with a subset of participants was used to assess whether the interpretations reflected their experience.

3.7 Ethical considerations

The source manuscript reports approval by the Research Ethics Committee of the Turkmenistan Institute of Economics and Management. Participants provided informed consent, confidentiality was assured, and participants were informed that they could withdraw without penalty. The official approval number and date should be added before journal submission.

4. Results

4.1 Descriptive statistics and technology adoption

The mean scores for the four latent constructs were above the scale midpoint. Professional judgment had the highest mean (M = 5.34), followed by perceived audit quality (M = 5.21), professional skepticism (M = 5.12), and digital transformation (M = 4.87). Skewness and kurtosis values were modest, although PLS-SEM does not require multivariate normality.

Table 3. Descriptive statistics for the principal constructs

Variable	Mean	SD	Min	Max	Skewness	Kurtosis
Digital transformation	4.87	1.23	1.42	7.00	−0.34	−0.21
Perceived audit quality	5.21	1.08	2.13	7.00	−0.42	0.18

Variable	Mean	SD	Min	Max	Skewness	Kurtosis
Professional judgment	5.34	0.98	2.40	7.00	−0.38	0.24
Professional skepticism	5.12	1.15	1.88	7.00	−0.29	−0.15

Data analytics software was the most widely adopted technology (67.4%), followed by cloud-based audit platforms (52.9%) and automated audit tools (48.1%). AI-assisted analysis, continuous auditing, and blockchain-based verification were less common, indicating that digital transformation was uneven across technologies.

Table 4. Reported technology adoption among respondents

Technology	Adoption rate (%)	Mean usage frequency
Data analytics software	67.4	4.23
Cloud-based audit platforms	52.9	3.87
Automated audit tools	48.1	3.56
AI-assisted analysis	23.5	2.34
Blockchain verification	8.6	1.67
Continuous-auditing systems	31.6	2.89

4.2 Measurement model

The reported measurement statistics support internal consistency and convergent validity. Indicator loadings ranged from 0.698 to 0.891, Cronbach's alpha ranged from 0.896 to 0.941, composite reliability ranged from 0.917 to 0.949, and AVE ranged from 0.612 to 0.651. The lowest loading (0.698) was effectively at the conventional 0.70 threshold and was retained because the construct-level reliability and AVE values remained satisfactory.

Table 5. Measurement-model assessment

Construct	Items	Loading range	Cronbach's α	CR	AVE
Digital transformation (DT)	12	0.712–0.891	0.923	0.935	0.647
Perceived audit quality (AQ)	15	0.698–0.876	0.941	0.949	0.612
Professional judgment (PJ)	10	0.724–0.858	0.908	0.924	0.638
Professional skepticism (PS)	8	0.741–0.869	0.896	0.917	0.651

All HTMT ratios were below 0.85, supporting discriminant validity among the four constructs.

Table 6. Discriminant validity: HTMT ratios

Construct	DT	AQ	PJ	PS
DT	—			
AQ	0.623	—		
PJ	0.587	0.712	—	
PS	0.541	0.689	0.734	—

4.3 Structural model and direct hypotheses

All six direct paths were positive and statistically significant. Digital transformation was associated with perceived audit quality (β = 0.412, p < 0.001), professional judgment (β = 0.367, p < 0.001), and professional skepticism (β = 0.298, p < 0.001), supporting H1–H3. Professional skepticism was associated with perceived audit quality (β = 0.341, p < 0.001) and professional judgment (β = 0.423, p < 0.001), while professional judgment was associated with perceived audit quality (β = 0.287, p < 0.001), supporting H4–H6.

Table 7. Direct structural paths

Hypothesis	Path	β	t	p	Decision
H1	DT → AQ	0.412	6.847	< 0.001	Supported
H2	DT → PJ	0.367	5.923	< 0.001	Supported
H3	DT → PS	0.298	4.512	< 0.001	Supported
H4	PS → AQ	0.341	5.234	< 0.001	Supported
H5	PJ → AQ	0.287	4.156	< 0.001	Supported
H6	PS → PJ	0.423	6.891	< 0.001	Supported

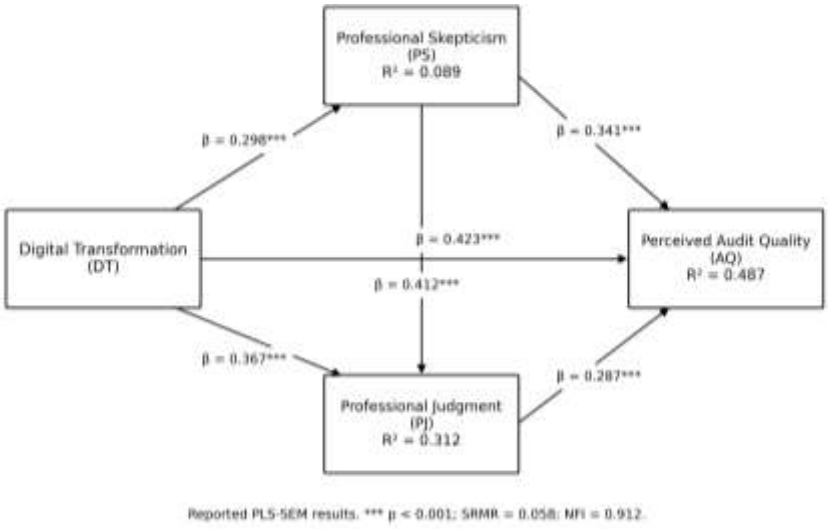

Figure 2. Reported PLS-SEM structural model.

4.4 Mediation analysis

The bootstrapped indirect effects supported all three mediation hypotheses. Professional skepticism partially mediated the digital-transformation–perceived-audit-quality relationship (β = 0.102, 95% CI [0.058, 0.156], p < 0.001). Professional judgment also partially mediated the relationship (β = 0.105, 95% CI [0.062, 0.161], p < 0.001). The serial indirect effect through professional skepticism and professional judgment was smaller but statistically significant (β = 0.036, 95% CI [0.018, 0.062], p = 0.008). Because the direct DT → AQ path remained significant, the results indicate complementary partial mediation rather than full mediation.

Table 8. Bootstrapped indirect effects

Hypothesis	Indirect path	Indirect β	95% CI	t	p	Type
H7a	DT → PS → AQ	0.102	0.058, 0.156	3.847	< 0.001	Partial
H7b	DT → PJ → AQ	0.105	0.062, 0.161	3.912	< 0.001	Partial
H7c	DT → PS → PJ → AQ	0.036	0.018, 0.062	2.634	0.008	Partial

4.5 Explanatory power and predictive relevance

The model explained 48.7% of the variance in perceived audit quality, 31.2% of the variance in professional judgment, and 8.9% of the variance in professional skepticism. Q^2 values were positive for all endogenous

constructs, indicating in-sample predictive relevance. The reported effect sizes of digital transformation ranged from 0.098 to 0.187, suggesting small-to-moderate incremental explanatory contributions.

Table 9. Explanatory power and predictive relevance

Endogenous construct	R^2	Adjusted R^2	Q^2	f^2 for DT
Perceived audit quality	0.487	0.478	0.294	0.187
Professional judgment	0.312	0.304	0.196	0.142
Professional skepticism	0.089	0.084	0.057	0.098

4.6 Exploratory differences by firm size

Respondents from larger firms reported higher digital-transformation, perceived-audit-quality, professional-judgment, and professional-skepticism scores. The original manuscript reported significant one-way ANOVA results for all four constructs. Recalculation from the published group means, standard deviations, and sample sizes confirms significant differences for digital transformation, perceived audit quality, and professional judgment, but not for professional skepticism at the 5% level. The values below are approximate because they are based on rounded summary statistics and should be replaced by results rerun from the raw data before submission.

Table 10. Firm-size comparisons based on reported summary statistics

Construct	Small firms (n = 62)	Medium firms (n = 78)	Large firms (n = 47)	Approx. F(2,184)	Approx. p
Digital transformation	4.12 (1.34)	5.01 (1.12)	5.67 (0.89)	25.21	< 0.001
Perceived audit quality	4.78 (1.21)	5.34 (0.98)	5.62 (0.87)	9.59	< 0.001
Professional judgment	5.01 (1.08)	5.42 (0.94)	5.71 (0.82)	7.37	0.001
Professional skepticism	4.89 (1.23)	5.18 (1.12)	5.38 (1.01)	2.61	0.076

Note. Values in the firm-size columns are means with standard deviations in parentheses. Approximate F statistics were recalculated from the reported summary statistics and may differ slightly from raw-data estimates.

4.7 Qualitative findings

Thematic analysis produced four themes that explain how practitioners interpreted digital transformation in audit work.

Theme 1: Greater efficiency, coverage, and accuracy

Participants described analytics as expanding the scope of substantive testing, reducing manual processing, and directing attention toward unusual transactions. A senior auditor stated:

"The use of data analytics has transformed how we approach substantive testing. We can now analyze entire populations rather than samples, which significantly improves our ability to detect anomalies."

This theme supports the positive DT → AQ path, although the perceived benefit concerned process coverage and anomaly detection rather than independently verified audit outcomes.

Theme 2: Implementation barriers

Participants also identified limited infrastructure, implementation cost, data-access constraints, and resistance among some experienced professionals. These accounts indicate that technology adoption is uneven and that organizational resources condition whether tools become embedded in audit methodology.

Theme 3: Technology changes rather than replaces judgment

Interviewees consistently distinguished between automated analysis and the interpretation of results. An audit partner explained:

"Technology provides us with more information and better analysis, but the judgment about what that information means and how to respond remains fundamentally human."

This interpretation converges with the positive DT → PJ path and supports a complementarity view of technology and professional expertise.

Theme 4: Training and competency development

Participants emphasized continuing professional development in analytics, information systems, data governance, and the critical evaluation of automated outputs. Training was viewed as necessary both to realize efficiency gains and to prevent overreliance on technology.

4.8 Mixed-methods integration

The quantitative and qualitative findings were integrated in a joint display. The strands were largely convergent: statistical relationships were consistent with interview accounts of improved coverage, changed judgment processes, and resource-dependent adoption. The qualitative data also qualified the survey results by showing that technology benefits were conditional on infrastructure, skills, and human review.

Table 11. Joint display of quantitative and qualitative findings

Quantitative result	Qualitative evidence	Integration	Interpretation
DT → AQ positive (β = 0.412)	Analytics increased population coverage, anomaly detection, and workflow efficiency.	Convergence	Technology was associated with higher perceived process quality, but objective audit outcomes were not measured.
DT → PJ positive (β = 0.367)	Technology provided more information but did not replace interpretation.	Convergence	Digital tools operated as decision support rather than autonomous judgment.
PS and PJ mediated DT → AQ	Participants emphasized critical follow-up and human review of automated outputs.	Complementarity	The qualitative evidence explains why technology quality benefits depend on skeptical inquiry and judgment.
Higher DT scores in larger firms	Cost, infrastructure, and training were described as major implementation barriers.	Convergence	Resource asymmetry may widen technology-enabled quality differences across firms.

5. Discussion

5.1 Digital transformation and perceived audit quality

The positive association between digital transformation and perceived audit quality is consistent with the proposition that analytics and automation can improve audit coverage, consistency, and evidence processing. The coefficient for DT → AQ was the largest direct path in the model, and the interview data described concrete process improvements such as full-population analysis and faster identification of anomalies. These findings extend evidence from other emerging settings and align with research showing that audit analytics can improve the efficiency and scope of audit procedures (Tran & Anh, 2021; Gepp et al., 2018).

The result should nevertheless be interpreted carefully. The study measured auditors' perceptions of audit quality using self-reported process attributes. It did not examine restatements, inspection findings, litigation, modified opinions, or other objective outcomes. The findings therefore demonstrate that technology adoption is associated with stronger perceived audit processes; they do not prove that technology caused higher realized audit quality.

5.2 Professional judgment and skepticism as mechanisms

The findings support a complementarity model in which technology enhances the information available for judgment rather than replacing professional reasoning. The positive DT → PJ path and the interview evidence both indicate that practitioners viewed technology as improving the basis for decisions. This is consistent with the judgment literature, which emphasizes that performance depends on the interaction of knowledge, task structure, and environmental support (Libby & Luft, 1993).

Professional skepticism was associated with both judgment and perceived audit quality. The mediation results suggest that part of the technology-quality relationship operates through a more questioning approach to evidence. Analytics may identify anomalies, but skeptical judgment determines whether those anomalies are investigated, contextualized, and translated into audit action. This interpretation is consistent with Nelson's (2009) distinction between skeptical judgment and skeptical action and with IAASB guidance that automated tools do not reduce the auditor's responsibility to critically evaluate evidence.

The serial mediation pathway was statistically smaller than the single-mediator paths, but it is theoretically meaningful. It indicates a sequence in which technology heightens the visibility of unusual evidence, skeptical attention increases, and judgment improves. Because the direct DT → AQ path remained significant, other mechanisms—such as standardization, documentation quality, workflow coordination, and error reduction—also appear to contribute.

5.3 Firm size and institutional conditions

Technology adoption was substantially higher in large firms than in small firms. Interview accounts attributed this pattern to differences in infrastructure, implementation budgets, access to specialists, and training. This resource asymmetry is consistent with the broader literature on the diffusion of advanced audit analytics (Krieger et al., 2021). It also has regulatory significance: if technology becomes increasingly necessary for complex audits, smaller firms may face growing capability gaps.

In Turkmenistan, these organizational constraints operate within a professional environment for which publicly available institutional evidence remains limited. The World Bank's 2009 diagnostic is now dated, but its emphasis on professional education, standards, and quality assurance remains relevant to interpreting the present findings. The study suggests that digitalization policy should be linked to broader professional-capacity development rather than treated as a stand-alone technology initiative.

5.4 Theoretical contributions

The study contributes in four ways. First, it extends audit-technology research to a Central Asian setting that is largely absent from the international literature. Second, it reframes the technology-quality relationship as a mediated process involving professional cognition rather than a simple direct effect. Third, the results distinguish professional skepticism from professional judgment while showing their sequential relationship. Fourth, the mixed-methods joint display identifies organizational resources and training as conditions that help explain variation in the quantitative relationships.

5.5 Practical and policy implications

Audit firms should evaluate digital transformation as a socio-technical program. Software acquisition should be accompanied by data-quality controls, model validation, documentation protocols, cybersecurity safeguards, and clear accountability for human review. Training should focus not only on tool operation but also on interpreting outputs, identifying limitations, and designing follow-up procedures.

Regulators and professional bodies can support smaller firms through shared training, implementation guidance, scalable technology standards, and continuing professional development requirements. Quality-assurance reviews should examine whether automated procedures are appropriately designed, validated, and linked to audit assertions. Policies should avoid equating the presence of technology with audit quality; the relevant issue is whether technology supports sufficient appropriate evidence and defensible professional judgment.

Universities and professional-education providers should integrate audit analytics, information systems, data governance, and algorithmic literacy into accounting curricula. These technical competencies should be taught alongside skepticism, ethics, and judgment because the study indicates that technology benefits are partly realized through these human capabilities.

5.6 Limitations and future research

1. First, the cross-sectional design precludes causal inference. Longitudinal or quasi-experimental studies are needed to determine whether technology adoption precedes improvements in audit outcomes.
2. Second, the principal constructs were measured from the same respondents at one point in time, creating potential common-method variance and social-desirability bias (Podsakoff et al., 2003). Future studies should combine survey data with system-use logs, engagement records, inspection results, or client-level outcomes.
3. Third, perceived audit quality is not equivalent to objective audit quality. Future research should examine restatements, inspection findings, audit adjustments, reporting timeliness, and fraud detection.
4. Fourth, the constructs were measured using context-adapted item sets. The complete item wording and source mapping should be reported in an online appendix, and future studies should replicate the factor structure using confirmatory and cross-validation samples.

5. Fifth, the sampling frame and professional-population estimate require documentary verification. The achieved sample was adequate for PLS-SEM estimation but fell below the survey's initial finite-population precision target.
6. Sixth, the qualitative report would be strengthened by fuller disclosure of interviewer characteristics, coding roles, saturation criteria, reflexivity, and participant identifiers for quotations.
7. Seventh, digital transformation was modeled as an aggregate construct. Future studies should distinguish analytics, cloud platforms, automation, artificial intelligence, blockchain, and continuous auditing because their risks and judgment requirements differ.
8. Finally, the exploratory firm-size ANOVA should be rerun from the raw data. The recalculated values based on rounded summary statistics differ from those in the source manuscript, particularly for digital transformation and professional skepticism.

6. Conclusion

This study examined the relationship between digital transformation and perceived audit quality among external accounting and audit professionals in Turkmenistan. Digital transformation was positively associated with perceived audit quality, professional judgment, and professional skepticism. Professional skepticism and professional judgment partially explained the technology-quality relationship, including a significant serial pathway from skepticism to judgment.

The mixed-methods evidence indicates that digital tools can expand coverage, reduce manual error, and improve access to relevant information, but their value depends on human interpretation and critical follow-up. Technology therefore changes the locus of audit work rather than eliminating judgment. The practical implication is clear: investment in analytics and automation should be matched by investment in professional competence, skeptical inquiry, data governance, and scalable support for smaller firms.

The study provides an initial empirical foundation for research on technology-enabled auditing in Central Asia. Its contribution is strongest when the findings are interpreted as evidence about auditors' perceptions and reported practices, not as causal proof of objectively measured audit quality.

Declarations

Acknowledgements: The author thanks academic reviewers and colleagues who may provide comments during the journal submission process.

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Competing interests: The authors declare no competing interests.

Data availability: The dataset may be requested from the corresponding author subject to institutional permission and confidentiality requirements.

References

Abdallah, B., Ghanem, M., & Mahboub, R. (2024). Impact of personal, task, and environmental factors on auditor's judgment and decision-making: Evidence from Lebanese certified public accountants. International Journal of Applied Economics, Finance and Accounting, 19(2), 284–300. https://doi.org/10.33094/ijaefa.v19i2.1717

Adhikara, M. F. A., & Widodo, A. (2023). Public accountant professional skepticism behavior in improving audit quality: A path analysis. JEMA: Jurnal Ilmiah Bidang Akuntansi dan Manajemen, 20(2), 264–282. https://doi.org/10.31106/jema.v20i2.20616

Alles, M. G. (2015). Drivers of the use and facilitators and obstacles of the evolution of Big Data by the audit profession. Accounting Horizons, 29(2), 439–449. https://doi.org/10.2308/acch-51067

Alles, M. G., & Gray, G. L. (2016). Incorporating big data in audits: Identifying inhibitors and a research agenda. International Journal of Accounting Information Systems, 20, 44–59. https://doi.org/10.1016/j.accinf.2016.07.002

Appelbaum, D., Kogan, A., & Vasarhelyi, M. A. (2017). Big Data and analytics in the modern audit engagement: Research needs. AUDITING: A Journal of Practice & Theory, 36(4), 1–27. https://doi.org/10.2308/ajpt-51684

Barr-Pulliam, D., Brown-Liburd, H. L., & Munoko, I. (2022). The effects of person-specific, task, and environmental factors on digital transformation and innovation in auditing: A review of the literature. Journal of International Financial Management & Accounting, 33(2), 337–374. https://doi.org/10.1111/jifm.12148

Barr-Pulliam, D., Calvin, C. G., Eulerich, M., & Maghakyan, A. (2024). Audit evidence, technology, and judgement: A review of the literature in response to ED-500. Journal of International Financial Management & Accounting, 35(1), 36–67. https://doi.org/10.1111/jifm.12192

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Brislin, R. W. (1970). Back-translation for cross-cultural research. Journal of Cross-Cultural Psychology, 1(3), 185–216. https://doi.org/10.1177/135910457000100301

Brown-Liburd, H., Issa, H., & Lombardi, D. (2015). Behavioral implications of Big Data's impact on audit judgment and decision making and future research directions. Accounting Horizons, 29(2), 451–468. https://doi.org/10.2308/acch-51023

Cao, M., Chychyla, R., & Stewart, T. (2015). Big Data analytics in financial statement audits. Accounting Horizons, 29(2), 423–429. https://doi.org/10.2308/acch-51068

Creswell, J. W., & Plano Clark, V. L. (2018). Designing and conducting mixed methods research (3rd ed.). SAGE.

DeAngelo, L. E. (1981). Auditor size and audit quality. Journal of Accounting and Economics, 3(3), 183–199. https://doi.org/10.1016/0165-4101(81)90002-1

Earley, C. E. (2015). Data analytics in auditing: Opportunities and challenges. Business Horizons, 58(5), 493–500. https://doi.org/10.1016/j.bushor.2015.05.002

Francis, J. R. (2011). A framework for understanding and researching audit quality. AUDITING: A Journal of Practice & Theory, 30(2), 125–152. https://doi.org/10.2308/ajpt-50006

Gepp, A., Linnenluecke, M. K., O'Neill, T. J., & Smith, T. (2018). Big data techniques in auditing research and practice: Current trends and future opportunities. Journal of Accounting Literature, 40, 102–115. https://doi.org/10.1016/j.acclit.2017.05.003

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. European Business Review, 31(1), 2–24. https://doi.org/10.1108/EBR-11-2018-0203

Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. Journal of the Academy of Marketing Science, 43(1), 115–135. https://doi.org/10.1007/s11747-014-0403-8

Hurtt, R. K. (2010). Development of a scale to measure professional skepticism. AUDITING: A Journal of Practice & Theory, 29(1), 149–171. https://doi.org/10.2308/aud.2010.29.1.149

International Auditing and Assurance Standards Board. (2020). Non-authoritative support material: Using automated tools and techniques in performing audit procedures. International Federation of Accountants.

Knechel, W. R., Krishnan, G. V., Pevzner, M., Shefchik, L. B., & Velury, U. K. (2013). Audit quality: Insights from the academic literature. AUDITING: A Journal of Practice & Theory, 32(Supplement 1), 385–421. https://doi.org/10.2308/ajpt-50350

Kokina, J., & Davenport, T. H. (2017). The emergence of artificial intelligence: How automation is changing auditing. Journal of Emerging Technologies in Accounting, 14(1), 115–122. https://doi.org/10.2308/jeta-51730

Krieger, F., Drews, P., & Velte, P. (2021). Explaining the (non-)adoption of advanced data analytics in auditing: A process theory. International Journal of Accounting Information Systems, 41, 100511. https://doi.org/10.1016/j.accinf.2021.100511

Libby, R., & Luft, J. (1993). Determinants of judgment performance in accounting settings: Ability, knowledge, motivation, and environment. Accounting, Organizations and Society, 18(5), 425–450. https://doi.org/10.1016/0361-3682(93)90040-D

Nelson, M. W. (2009). A model and literature review of professional skepticism in auditing. AUDITING: A Journal of Practice & Theory, 28(2), 1–34. https://doi.org/10.2308/aud.2009.28.2.1

Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. Journal of Applied Psychology, 88(5), 879–903. https://doi.org/10.1037/0021-9010.88.5.879

Salijeni, G., Samsonova-Taddei, A., & Turley, S. (2019). Big Data and changes in audit technology: Contemplating a research agenda. Accounting and Business Research, 49(1), 95–119. https://doi.org/10.1080/00014788.2018.1459458

Sulaiman, N. A., Yasin, F. M., & Muhamad, R. (2018). Perspectives of audit quality: An analysis. Asian Journal of Accounting Perspectives, 11(1), 1–27. https://doi.org/10.22452/AJAP.vol11no1.1

Tran, T. Q., & Anh, H. T. (2021). Perception of digital transformation effect on audit quality: The case of Vietnam. Journal of International Economics and Management, 21(3), 91–107. https://doi.org/10.38203/jiem.021.3.0037

World Bank. (2009). Report on the observance of standards and codes (ROSC): Turkmenistan—Accounting and auditing. World Bank.