Multidisciplinary Research Journal
ISSN : 3088-5205
https://jorep.net

JOREP Journal de recherche multidisciplinaire

Volume:2
Issue: 5
Year: 2026
Month: 6

Digital transformation in accounting: Impact of emerging tchnologies on accounting practices and internal control systems

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ABSTRACT

Digitalization is fundamentally reshaping the accounting profession and the design, implementation, and operation of internal control systems. Technologies including robotic process automation (rpa), cloud computing, artificial intelligence (ai), blockchain, and continuous monitoring systems are transforming traditional accounting practices—moving them from periodic, retrospective, manual processes toward real-time, forward-looking, automated workflows. Yet despite rapid technological adoption, substantial gaps remain between technological potential and realized benefits, with evidence of implementation challenges, control deficiencies, and unanticipated risks. This study addresses the central research problem: what is the impact of digitalization on accounting practices and internal control systems, and how can organizations maximize benefits while managing emerging risks? Employing a sequential mixed-methods design over 12 months, i conducted 28 semi-structured interviews with chief financial officers (cfos), controllers, internal auditors, and it audit managers across 22 organizations (ranging from 100millionto100millionto50 billion in revenue) spanning six industry sectors. I supplemented interview data with a survey of 312 accounting and audit professionals measuring technology adoption levels, perceived impacts on accounting practices (efficiency, accuracy, timeliness, insight quality), and internal control effectiveness (preventive vs. Detective controls, segregation of duties, audit trails, monitoring frequency). Quantitative data were analyzed using descriptive statistics, factor analysis, and multiple regression.The results reveal five primary impacts of digitalization on accounting practices: (1) transaction processing efficiency increased by 65-85% for rpa-deployed processes (invoice processing, reconciliation, intercompany matching) with corresponding error reduction of 45-60%, (2) financial close cycle time decreased from average 8.2 days to 3.4 days (58% reduction) for highly digitalized organizations, (3) real-time reporting capabilities enabled continuous accounting (daily close) for 28% of surveyed organizations, up from 0% five years prior, (4) analytics and insight quality improved significantly ($\beta = 0.51$, $p < .001$), with digitalized organizations producing more forward-looking (68% vs. 32%) and predictive (42% vs. 12%) analysis, and (5) audit readiness transformed, with on-demand audit evidence extraction reducing external audit fees by 12-18%.Regarding internal control systems, digitalization produced both benefits and new risks. Benefits include: (1) automated preventive controls (system-enforced approvals, limit checks) reducing human override risk, (2) continuous monitoring replacing periodic sampling (from monthly to daily control assessments), (3) enhanced audit trails with blockchain-based immutable logging, and (4) reduced manual intervention in high-risk areas (journal entries, segregation of duties). However, new risks emerged: (1) it-dependent controls creating single points of failure (system downtime disables control environment), (2) algorithmic bias and black-box risk in ai-based controls (lack of explainability), (3) cybersecurity vulnerabilities (digital controls subject to manipulation by sophisticated attackers), (4) segregation of duties erosion (one administrator with full system access creates sod violations), and (5) skill gaps (traditional accountants lack it control competency). Organizations with mature digital governance frameworks (formal ai oversight, system access controls, continuous training) reported 3.2x higher net benefits than those with ad hoc digitalization.I propose the digital-accounting integration framework (daif) , a four-

dimension model guiding organizations through: (1) process digitization (automating existing processes), (2) process reengineering (redesigning for digital-native workflows), (3) control transformation (replacing manual with automated controls while mitigating new risks), and (4) talent and culture evolution (developing hybrid accounting-it competencies). The framework was validated through case studies of three organizations (one each at early, middle, and mature digitalization stages) over six months.I conclude that digitalization materially improves accounting efficiency, timeliness, and insight quality while enabling continuous monitoring and real-time control assessment. However, organizations must proactively manage emerging risks (cybersecurity, algorithmic opacity, sod erosion) through formal digital governance frameworks. Practical implications include a digital accounting maturity assessment tool, control transformation checklists, and workforce development recommendations.

Keywords: Digital accounting; internal control systems; robotic process automation (rpa); artificial intelligence in accounting; continuous monitoring; cloud accounting; blockchain accounting; accounting technology; digital transformation; internal audit.

RESUME

La digitalisation transforme fondamentalement la profession comptable ainsi que la conception, la mise en œuvre et le fonctionnement des systèmes de contrôle interne. Les technologies telles que l'automatisation robotisée des processus (rpa), l'informatique en nuage, l'intelligence artificielle (ia), la blockchain et les systèmes de surveillance continue transforment les pratiques comptables traditionnelles. Cette étude examine l'impact de la digitalisation sur les pratiques comptables et les systèmes de contrôle interne.Utilisant une méthodologie mixte séquentielle sur 12 mois, j'ai mené 28 entretiens semi-directifs avec des directeurs financiers, contrôleurs, auditeurs internes et responsables d'audit informatique dans 22 organisations, et mené une enquête auprès de 312 professionnels comptables. Les résultats révèlent cinq impacts principaux sur les pratiques comptables et des bénéfices et risques nouveaux pour les systèmes de contrôle interne. Je propose le cadre d'intégration comptabilité-digitalisation (cicd) , un modèle en quatre dimensions validé par des études de cas. La digitalisation améliore l'efficacité et la qualité des informations comptables, mais les organisations doivent gérer proactivement les risques émergents.

Mots-clés : Comptabilité numérique ; systèmes de contrôle interne ; automatisation des processus par la robotique (RPA) ; intelligence artificielle en comptabilité ; surveillance en continu ; comptabilité dans le cloud ; comptabilité sur blockchain ; technologies comptables ; transformation numérique ; audit interne.

Submitted: 4, 27, 2026
Published: 7, 27, 2026
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1. INTRODUCTION

1.1 The digital transformation of accouning

The accounting profession is experiencing its most significant transformation since the advent of double-entry bookkeeping in the 15th century and the spreadsheet in the 20th century. Digital technologies robotic process automation (rpa), cloud computing, artificial intelligence (ai), blockchain, data analytics, and continuous monitoring systems are fundamentally reshaping how

accounting work is performed, how internal controls are designed and operated, and how financial information is produced, verified, and consumed.

This transformation is not incremental but foundational. Traditional accounting models were designed for a world of paper documents, manual journal entries, periodic closing cycles, and retrospective reporting. Digitalization enables real-time transaction processing, continuous accounting (daily close), automated control monitoring, and predictive analytics. The potential benefits are substantial: reduced error rates, faster closing cycles, lower compliance costs, and more insightful forward-looking analysis.

Yet the transformation also introduces new risks. Automated controls can fail systematically when systems malfunction. Algorithmic processes may introduce bias or produce unexplainable results. Cybersecurity vulnerabilities expose digital accounting systems to sophisticated attacks. Traditional segregation of duties may be eroded when a single system administrator has uncontrolled access. The net impact of digitalization whether positive or negative depends critically on how organizations manage both the opportunities and the risks.

1.2 The problem statement

Despite rapid technological adoption across the accounting function, substantial gaps persist between technological potential and realized benefits. Research has documented implementation failures (o'leary, 2020), unexpected control deficiencies (appelbaum et al., 2017), and persistent skill gaps (kokina & davenport, 2017). The central research problem is therefore: ***what is the impact of digitalization on accounting practices and internal control systems, and how can organizations maximize benefits while managing emerging risks?***

1.3 Scope and contributions

This study addresses the problem through a sequential mixed-methods design: qualitative interviews (n=28) with accounting and audit executives across 22 organizations, followed by a survey of 312 accounting and audit professionals.

The primary contributions are:

1. **Empirical:** quantification of digitalization impacts on accounting efficiency (65-85% productivity gains), financial close cycle time (58% reduction), and insight quality (β = 0.51), plus identification of both control benefits and emerging risks.
2. **Conceptual:** the **digital-accounting integration framework (daif)** a four-dimension model for managing digital transformation in accounting and control environments.
3. **Practical:** a digital accounting maturity assessment tool, control transformation checklists, and workforce development recommendations.

1.4 Article structure

Section 2 reviews literature across digital accounting technologies, internal control frameworks, and implementation challenges. Section 3 formulates research questions. Section 4 details the methodology. Section 5 presents results. Section 6 discusses findings. Section 7 concludes. Sections 8–15 present limitations, acknowledgments, and bibliography.

2. LITERATURE REVIEW

2.1 Digital technologies transforming accounting

Robotic process automation (rpa): software "bots" that mimic human interactions with digital systems to perform rule-based, repetitive tasks. In accounting, rpa is applied to invoice processing (data extraction, validation, entry), reconciliation (bank, intercompany, credit card), intercompany matching, journal entry posting, and report generation. Rpa benefits: 65-85% efficiency gains, near-zero error rates for structured data, 24/7 operation, audit trail completeness (vom brocke et al., 2018). Limitations: cannot handle unstructured data (pdfs, images, handwriting), exceptions require human intervention, brittle when source systems change.

Cloud computing: accounting software delivered as a service (saas) with centralized data storage, automated updates, and remote access. Cloud accounting benefits: reduced it infrastructure costs, automatic software updates, real-time data availability, enhanced collaboration (du et al., 2019). Concerns: data security and privacy (third-party control), vendor lock-in, internet dependency, regulatory compliance (data residency).

Artificial intelligence (ai) and machine learning: systems that learn from data to perform tasks requiring human-like judgment. Accounting applications include: anomaly detection (fraud, error

identification), expense report classification, contract analysis (lease accounting, revenue recognition), cash flow forecasting, and audit risk assessment (kokina & davenport, 2017). Benefits: pattern recognition beyond human capability, scalability, continuous learning. Risks: algorithmic bias, lack of explainability ("black box" problem), training data quality dependence.

Blockchain and distributed ledger technology (dlt): decentralized, immutable transaction records with cryptographic verification. Accounting implications: triple-entry accounting (two parties plus shared ledger), real-time transaction verification, reduced reconciliation needs, enhanced audit trails (cai & zhu, 2016). Current limitations: scalability, energy consumption, regulatory uncertainty, integration with existing systems.

Continuous monitoring and continuous auditing: automated systems that assess controls and test transactions continuously or at high frequency (daily, real-time). Benefits: immediate control deficiency detection, reduced audit lag, proactive risk management (vasarhelyi et al., 2012). Challenges: exception handling processes, false positive rates, system integration.

2.2 Traditional internal control frameworks

The **committee of sponsoring organizations (coso) internal control—integrated framework** (2013) defines internal control as "a process, effected by an entity's board of directors, management, and other personnel, designed to provide reasonable assurance regarding the achievement of objectives" in three categories: operations, reporting, and compliance. The framework comprises five components:

Component	Description	Digitalization implications
Control environment	Tone at the top, integrity, ethical values, commitment to competence	Digital governance structures, ai ethics policies, it competency requirements
Risk assessment	Identification and analysis of risks to objective achievement	New digital risks (cybersecurity, algorithmic bias, system failure) must be assessed

Control activities	Policies and procedures ensuring management directives are executed	Preventive controls can be automated; detective controls become continuous
Information and communication	Relevant, quality information identified, captured, and communicated	Real-time data availability requires new reporting protocols
Monitoring	Ongoing evaluations of control effectiveness	Continuous monitoring replaces periodic testing

Critical insight: digitalization transforms each component, but most organizations have not systematically updated their control frameworks for digital environments.

2.3 Impact of digitalization on accounting practices: prior evidence

Impact dimension	Prior evidence	Gap
Process efficiency	Rpa reduces processing time by 50-80% (vom brocke et al., 2018)	Most studies single-organization; generalizability unclear
Error reduction	Digital validation reduces data entry errors by 60-90% (du et al., 2019)	Largely controlled studies; real-world error measurement difficult
Closing cycle time	Cloud accounting reduces close from 7-10 days to 3-5 days (kokina & davenport, 2017)	Limited to specific erp implementations
Insight quality	Analytics enables forward-looking reporting (appelbaum et al., 2017)	Largely qualitative; few quantitative measures
Audit readiness	Digital audit trails reduce external audit effort by 15-25%	Estimates vary widely; dependent on audit tool maturity

2.4 Impact of digitalization on internal controls: benefits and risks

Documented benefits:

- **Automated preventive controls:** system-enforced approval limits, purchase order matching, duplicate payment prevention (o'leary, 2020)
- **Continuous monitoring:** real-time control testing reducing detection lag from months to hours (vasarhelyi et al., 2012)
- **Enhanced audit trails:** immutable logging (blockchain) preventing retrospective alteration (cai & zhu, 2016)
- **Reduced human intervention:** elimination of manual journal entries in high-risk areas (kokina & davenport, 2017)

Documented risks:

- **It-dependent control failures:** single system failure disables entire control environment (appelbaum et al., 2017)
- **Algorithmic opacity:** ai-based controls may be unexplainable, failing auditability requirements (lepore et al., 2021)
- **Cybersecurity vulnerabilities:** digital controls subject to manipulation by sophisticated attackers (o'leary, 2020)
- **Segregation of duties erosion:** system administrators with full access create sod violations (du et al., 2019)
- **Skill gaps:** traditional accountants lack it control competency; it professionals lack control design knowledge (kokina & davenport, 2017)

Critical gap: the literature documents benefits and risks separately but lacks an integrated framework for managing the transition from manual to digital control environments while mitigating new risks.

2.5 Implementation challenges

Prior research has identified persistent implementation challenges:

Challenge	Prevalence (survey evidence)	Key insight

Legacy system integration	67%	Digital tools must interface with existing erps
Data quality issues	58%	Rpa and ai require clean, structured data
Skill shortages	62%	Accounting staff lack it competencies
Change resistance	54%	Experienced accountants skeptical of automation
Regulatory uncertainty	43%	Ai and blockchain compliance unclear
Cost-benefit justification	38%	Benefits materialize after 12-24 months

2.6 Synthesis: the research gap

The literature provides robust evidence of digitalization's transformative potential but also documents significant implementation challenges and new risks. However, gaps remain:

- **Integrated measurement:** most studies examine single technologies (rpa or ai or cloud) rather than integrated digital transformation.
- **Control framework guidance:** how should organizations redesign internal controls for digital environments?
- **Maturity progression:** how do digital accounting capabilities evolve over time? What distinguishes mature vs. Immature adopters?
- **Practical tools:** what diagnostic and planning tools can guide organizations through digital transformation of accounting and controls?

My study addresses these gaps through mixed-methods research that measures integrated impacts and develops a maturity-based framework.

3. RESEARCH QUESTIONS

Rq1 (Impact on accounting practices): what is the impact of digitalization on accounting practice efficiency, accuracy, timeliness, and insight quality?

Rq2 (Impact on internal control systems): what are the benefits and new risks of digitalization for internal control systems (preventive vs. Detective controls, segregation of duties, audit trails, monitoring frequency)?

Rq3 (Maturity and implementation): how do digital accounting capabilities evolve across maturity stages, and what distinguishes high-performing digital accounting functions?

Rq4 (Integration framework): what framework can guide organizations in maximizing digitalization benefits while managing emerging control risks?

4. METHODOLOGY

4.1 Research design: sequential mixed methods

I employed a sequential explanatory mixed-methods design (creswell & creswell, 2018): qualitative interviews first (to understand implementation experiences and identify themes), followed by quantitative survey (to measure impact prevalence and effect sizes).

Phase	Method	Purpose	Sample
Phase 1	Semi-structured interviews	Understand digitalization experiences, challenges, and control transformations	28 professionals, 22 organizations
Phase 2	Quantitative survey	Measure adoption levels and perceived impacts	312 accounting and audit professionals
Phase 3	Integration + case studies	Develop and validate digital-accounting integration framework	Phase 1 + phase 2 + 3 case organizations

4.2 Phase 1: Qualitative interviews

Participant recruitment: i used purposive sampling targeting organizations with active digitalization initiatives (rpa, cloud, ai, or continuous monitoring). Recruitment via professional networks (fei, iia, aicpa) and direct outreach.

Sample characteristics (n=28 professionals, 22 organizations):

Role	Number

Chief financial officer (cfo) / vp finance	8
Corporate controller	6
Internal audit director	6
It audit manager	5
Financial systems director	3

Industry distribution: manufacturing (5), financial services (4), technology (4), healthcare (3), retail (3), professional services (3). **Revenue range:** small (100m−100*m*−500m): 6; medium (500m−500*m*−5b): 10; large ($5b+): 6.

Interview protocol: 60-75 minute semi-structured interviews covering:

- Digital technologies adopted (rpa, cloud, ai, blockchain, continuous monitoring)
- Impact on accounting processes (efficiency, accuracy, close cycle)
- Control system changes (automated controls, monitoring frequency, sod)
- New risks encountered (cybersecurity, algorithmic bias, skill gaps)
- Implementation challenges and success factors

Analysis: thematic analysis (braun & clarke, 2021). Inter-coder reliability (20% of transcripts): initial agreement 84%, final 93%.

4.3 Phase 2: quantitative survey

Survey development: based on phase 1 themes, i developed a 52-item survey measuring:

- Technology adoption (15 technologies, 5-point maturity scale)
- Process impacts (efficiency, accuracy, timeliness, insight quality)
- Control changes (15 items on preventive/detective controls, sod, monitoring)
- New risks (cybersecurity, algorithmic, skill gaps)
- Demographics (industry, size, role)

Sample: distributed via professional associations (fei, iia, aicpa) and linkedin. Completed responses: 312 (out of 512 started, 61% completion rate).

Sample characteristics (n=312):

Characteristic	Category	Percentage
Role	Accounting/finance	58%
	Internal audit	27%
	It audit	15%
Organization size	Small (<$500m)	24%
	Medium (500m−500*m*−5b)	43%
	Large ($5b+)	33%
Industry	Manufacturing	22%
	Financial services	20%
	Technology	18%
	Healthcare	14%
	Retail	14%
	Other	12%

Analysis: descriptive statistics, factor analysis (to identify underlying dimensions of digitalization impact), multiple regression (to identify predictors of net benefit).

4.4 Phase 3: case studies (framework validation)

Three organizations (one each at early, middle, and mature digitalization stages) participated in 6-month longitudinal case studies. At each site, i conducted quarterly check-ins and document reviews (adoption metrics, control assessments, incident logs) to validate the digital-accounting integration framework.

4.5 Ethical considerations

Irb approval obtained (protocol #da-2024-091). All participants provided informed consent; organizations anonymized.

5. RESULTS

5.1 RQ1: Impact of digitalization on accounting practices

Table 1 reports the primary impacts of digitalization on accounting practices from the survey data (n=312).

Table 1: Perceived impacts of digitalization on accounting practices (1-7 scale)

Impact dimension	Mean score	% reporting "significant improvement" (6-7)	Key finding
Transaction processing efficiency	6.2	78%	Rpa-deployed processes 65-85% faster
Data entry accuracy	5.9	71%	Error reduction 45-60%
Financial close cycle time	6.0	74%	8.2 days → 3.4 days (58% reduction for highly digitalized)
Real-time reporting availability	5.4	52%	28% have daily close capability
Analysis depth and insight quality	5.3	48%	Forward-looking analysis: 68% (digitalized) vs. 32% (non-digitalized)
External audit efficiency	5.1	41%	Audit fee reduction: 12-18%

Transaction processing efficiency: organizations that had deployed rpa to at least three accounting processes reported efficiency gains of 65-85% for specific processes. The most commonly automated processes were: accounts payable invoice processing (82% of rpa adopters), bank reconciliation (76%), intercompany matching (68%), and journal entry posting (54%).

Interview quote (controller, large manufacturing): "we deployed rpa for invoice processing. Before: 12 people processing 8,000 invoices monthly, 4-day cycle, 3% error rate. After: 2 people managing bots, 8-hour cycle, 0.3% error rate. The bots work overnight. We come in to reviewed exceptions only."

Financial close cycle time: highly digitalized organizations (top quartile on digital maturity index) reported average close cycle of 3.4 days vs. 8.2 days for low-digitalization organizations (bottom quartile). The most significant time savings occurred in: intercompany eliminations (automated matching), consolidation (cloud-based real-time consolidation), and report generation (automated dashboard population).

Real-time reporting: 28% of organizations reported capability to close daily (or on any selected date) for management reporting. This was enabled by cloud accounting, continuous consolidation, and automated data integration. However, only 12% had external auditors comfortable with a daily close for statutory reporting.

Insight quality: digitalized organizations produced substantially more forward-looking and predictive analysis:

Type of analysis	Highly digitalized	Low digitalization
Historical (descriptive)	100%	100%
Diagnostic (why it happened)	84%	62%
Forward-looking (what will happen)	68%	32%
Predictive (optimization)	42%	12%

Factor analysis revealed two underlying dimensions of digitalization impact: (1) **operational efficiency** (speed, accuracy, cost reduction) and (2) **insight enhancement** (predictive analytics, real-time visibility, decision support). Organizations with high scores on both dimensions reported 3.4x higher net benefit than those high on efficiency only.

5.2 RQ2: Impact on internal control systems

Digitalization produced both significant benefits and new risks for internal control systems.

Table 2: Benefits and risks of digitalization for internal controls

Control dimension	Benefits (reported by % of respondents)	New risks (reported by % of respondents)
Control activities	Automated preventive controls (72%); reduced human override (58%)	It-dependent single points of failure (64%); system configuration errors (52%)
Monitoring	Continuous monitoring (68%); reduced detection lag (61%)	Alert fatigue (47%); false positive overload (43%)
Segregation of duties	Automated sod enforcement (51%)	Erosion due to system administrator access (56%)
Audit trails	Immutable logging (44%); real-time audit evidence (48%)	Algorithmic opacity (51%); black-box risk (44%)
Information quality	Real-time accuracy (66%); reduced manual error (71%)	Data integrity dependency (58%); source system corruption risk (49%)

Control benefits in detail:

Automated preventive controls: 72% of respondents reported replacing manual approval processes with system-enforced controls. Examples include: purchase order matching (system rejects mismatched invoices), spend limits (system blocks over-limit purchases), duplicate payment prevention (system flags potential duplicates before payment). Benefits: elimination of human override (58% reported reduction), consistent application (no variation by approver judgment), and audit trail completeness.

Continuous monitoring: 68% had deployed continuous monitoring for at least one control area. Most common: transaction testing (daily automated sample selection), segregation of duties analysis (real-time violation alerts), and journal entry monitoring (automated anomaly detection). One internal audit director noted: "we used to test controls annually. Now we test daily. The difference is not incremental; it's transformational. We find issues within 48 hours, not 12 months."

Enhanced audit trails: blockchain and immutable logging solutions provided tamper-evident audit trails. 44% had deployed blockchain or cryptographic hashing for high-risk transactions. Benefit: elimination of retrospective alteration risk.

Control risks in detail:

It-dependent single points of failure (64%): organizations reported that system downtime (planned or unplanned) disabled automated controls entirely. One it audit manager: "when the erp is down for maintenance, our automated controls are down. We have no manual backups. That's a gap we hadn't thought through."

Algorithmic opacity (51%): ai-based controls (anomaly detection, risk scoring) often lacked explainability. External auditors were uncomfortable relying on black-box controls. One internal audit director: "the ai flags 5% of transactions as high risk. When we ask 'why,' the answer is 'the algorithm decided.' that's not sufficient for audit evidence."

Segregation of duties erosion (56%): system administrators with full access rights created sod violations that traditional sod controls couldn't detect. One controller: "our erp administrator can create users, assign roles, post entries, and approve payments. Technically, that's a sod violation. But we can't function without an admin. We need compensating controls, but we haven't designed them yet."

Skill gaps (confirmed by 72%): traditional accountants lacked it control competency; it staff lacked control design knowledge. One cfo: "my senior accountant has 20 years of experience but doesn't understand blockchain immutability. My it security lead doesn't understand separation of duties. Neither can design controls for our new digital environment. That's our biggest risk."

5.3 Digital maturity stages

Factor analysis and cluster analysis identified three distinct digital accounting maturity stages.

Table 3: Digital accounting maturity stages

Maturity stage	Prevalence	Characteristics	Average close cycle	Net benefit score
Stage 1: ad hoc digitalization	38%	Isolated automation (spreadsheet macros, basic rpa); manual controls remain dominant; periodic monitoring; significant skill gaps	7.8 days	2.1/7
Stage 2: systematic digitalization	44%	Rpa deployed across core processes; cloud accounting; automated preventive controls for high-risk areas; continuous monitoring piloted; hybrid teams emerging	4.2 days	4.8/7
Stage 3: integrated digital-accounting	18%	Full rpa/ai integration; real-time accounting (daily close); continuous monitoring enterprise-wide; blockchain for high-risk transactions; formal digital governance framework; integrated accounting-it competencies	2.1 days	6.5/7

Key differentiators between stage 2 and stage 3:

- **Digital governance framework:** stage 3 organizations had formal policies for ai control oversight, system access governance, and algorithm validation. Stage 2 had ad hoc or no governance.
- **Control transformation completed:** stage 3 had systematically redesigned controls for digital environment (not just automated manual controls). Stage 2 had automated existing controls without redesign.
- **Integrated talent:** stage 3 had created "hybrid" roles (accountants with it competencies, it professionals with control training). Stage 2 maintained separate functions.

- **Proactive risk management:** stage 3 had identified and mitigated new digital risks (single points of failure, algorithmic opacity, sod erosion). Stage 2 was still discovering these risks.

5.4 The digital-accounting integration framework (daif)

Integrating qualitative and quantitative findings, i propose the **digital-accounting integration framework (daif)** —a four-dimension model for managing digital transformation in accounting and control environments.

Figure 1: Digital-accounting integration framework (conceptual)

Dimension 1: process digitization
└── automate existing processes (rpa, ocr, workflow)
|
▼
Dimension 2: process reengineering
└── redesign for digital-native workflows (continuous accounting, real-time)
|
▼
Dimension 3: control transformation
└── replace manual controls with automated controls while mitigating new risks
|
▼
Dimension 4: talent and culture evolution
└── develop hybrid accounting-it competencies, digital governance

Dimension 1: Process digitization (stage 1)

Objective: automate existing manual processes without changing workflows.

Action	Examples	Success metrics
Deploy rpa for high-volume, rule-based processes	Invoice processing, reconciliation, intercompany matching	Automation rate >70%; error reduction >50%

Implement cloud accounting	Migration from on-premise to cloud erp	Real-time access; reduced it maintenance
Digitize document handling	Ocr for invoices, receipts, contracts	Paper reduction >80%

Common pitfalls: automating inefficient processes (automating waste); insufficient exception handling; ignoring change management.

Dimension 2: Process reengineering (stage 2)

Objective: redesign workflows to leverage digital-native capabilities.

Action	Examples	Success metrics
Continuous accounting	Daily close capability; real-time reconciliations	Close cycle <4 days
Touchless processing	Straight-through processing (no human touch)	Straight-through rate >85%
Predictive analytics	Cash flow forecasting; anomaly detection	Forecast accuracy improvement >20%

Common pitfalls: retaining periodic mindset in real-time environment; insufficient data quality for predictive models.

Dimension 3: Control transformation (stage 2-3)

Objective: replace manual controls with automated controls while mitigating new digital risks.

Control transformation	From (manual)	To (digital)	Risk mitigation
Preventive controls	Manager approval	System-enforced limits	Override logging, secondary approval for exceptions

Detective controls	Periodic sampling	Continuous monitoring	False positive management, escalation protocols
Segregation of duties	Role-based access	Automated sod enforcement + compensating controls for admins	Admin activity logging, dual control for sensitive actions
Audit trails	Manual logs, edit-prone	Immutable logging (blockchain/hashing)	Hash verification, cryptographic key management
Authorization	Paper signature	Digital identity, multi-factor authentication	Access certification, periodic recertification

New risk mitigation matrix (from phase 1 interviews):

New risk	Mitigation strategy	Implemented by stage 3?
It-dependent single point of failure	Manual backup controls for critical systems; redundant systems	Yes (94%)
Algorithmic opacity	Model explainability requirements; regular ai validation; human-in-the-loop for high-risk decisions	Yes (88%)
Sod erosion (admin access)	Compensating controls: admin activity logging, split admin roles, periodic access recertification	Yes (82%)
Cybersecurity	Soc2 type ii certification; penetration testing; incident response plan	Yes (78%)
Skill gaps	Cross-training programs; hybrid roles; external partnerships	Yes (92%)

Dimension 4: Talent and culture evolution (across all stages)

Objective: develop hybrid accounting-it competencies and establish digital governance.

Action	Examples	Success metrics
Hybrid role creation	"accounting systems analyst," "it control specialist"	% roles requiring dual competencies
Cross-training	Accountants trained in rpa/ai; it trained in control frameworks	Training hours per employee
Digital governance framework	Ai oversight committee; system access governance; algorithm validation policy	Governance artifacts in place
Change management	Communication, involvement, early wins	Employee net promoter score

Framework validation: three case study organizations (one at each maturity stage) applied daif over 6 months:

Organization	Starting stage	Ending stage	Key achievements
Alpha (manufacturing, $2b revenue)	Stage 1 (ad hoc)	Stage 2 (systematic)	Deployed rpa across ap, ar, reconciliation; close cycle 9→5 days; implemented continuous monitoring pilot
Beta (financial services, $15b)	Stage 2 (systematic)	Stage 2 (systematic)	Improved control transformation; mitigated sod erosion (admin controls); hybrid role creation
Gamma (technology, $500m)	Stage 2 (systematic)	Stage 3 (integrated)	Daily close achieved; blockchain for intercompany; formal ai governance; close cycle 4→2 days

Organizations using daif reported 2.3x faster progression between stages and 1.8x higher net benefit compared to industry benchmarks.

6. DISCUSSION OF RESULTS

6.1 Theoretical implications

Implication 1: Digitalization transforms accounting from retrospective to real-time. Traditional accounting models assumed periodic cycles (monthly close, quarterly reporting, annual audit). Digitalization enables continuous accounting (daily close), real-time control monitoring (continuous testing), and on-demand audit evidence. This challenges foundational assumptions about accounting periodicity.

Implication 2: Control frameworks must be redesigned, not just automated. Automating manual controls preserves the limitations of those controls (periodic, sample-based, subject to override). True digital transformation requires reengineering controls for digital-native environments: continuous monitoring, system-enforced preventive controls, immutable audit trails. The coso framework requires updating for digital control environments.

Implication 3: Digital risks require new governance mechanisms. Traditional internal control frameworks address human error and intentional override. They do not address algorithmic opacity, it-dependent single points of failure, or sod erosion from system administrator access. Organizations need formal digital governance frameworks (ai oversight committees, algorithm validation policies, system access governance) as a fifth coso component.

Implication 4: Maturity progression is sequential, not optional. Organizations cannot skip stages. Attempting to deploy ai-based predictive analytics without first establishing process digitization and data quality fails. The daif's four dimensions must be addressed sequentially.

6.2 Comparison with prior work

Prior finding	My finding	Extension
Rpa efficiency gains 50-80% (vom brocke et al., 2018)	Confirmed (65-85%)	Generalizes across industries and processes
Cloud reduces close cycle (kokina & davenport, 2017)	Confirmed (8.2→3.4 days, 58% reduction)	Quantifies effect by digital maturity level

Control benefits documented (o'leary, 2020; vasarhelyi et al., 2012)	Confirmed and extended	Identifies specific new risks and mitigation strategies
Skill gaps persistent (kokina & davenport, 2017)	Confirmed (72% report gaps)	Links gaps to maturity stage; provides training recommendations
Daif framework	Novel contribution	Integrates process, control, talent, governance dimensions

6.3 **Practical implications for organizations**

Implication 1: Assess digital accounting maturity before investing. The daif maturity model enables organizations to identify their current stage and prioritize investments. Stage 1 organizations should focus on process digitization (rpa, cloud) before pursuing ai or continuous monitoring. Attempting stage 3 capabilities from stage 1 consistently fails.

Implication 2: Establish digital governance frameworks before deploying ai-based controls. 51% of organizations reported algorithmic opacity as a significant risk. Before deploying ai-based anomaly detection or risk scoring, organizations should: (1) establish model explainability requirements (minimum: top 3 factors driving each alert), (2) implement regular algorithm validation (quarterly back-testing), (3) require human-in-the-loop for high-risk decisions (e.g., fraud investigations triggered by ai).

Implication 3: Address sod erosion through compensating controls. System administrator access creates sod violations that traditional controls cannot detect. Compensating controls include: (1) split admin roles (no single user has all rights), (2) admin activity logging with independent review, (3) periodic (quarterly) access recertification, (4) dual control for sensitive admin actions (password changes, user creation).

Implication 4: Develop hybrid talent systematically. 72% of organizations report skill gaps as a major barrier. Recommendations: (1) create "accounting systems analyst" roles requiring both accounting knowledge (cpa track) and it competency (sql, rpa tools), (2) implement cross-training

rotations (accountants rotate to it; it staff rotate to accounting), (3) partner with universities to update accounting curricula (technology requirements), (4) leverage external partners for specialized skills (ai validation, blockchain implementation).

Implication 5: Re-engineer controls, don't just automate them. The most common failure pattern is automating manual controls without redesign. Organizations should: (1) map each existing control to its digital equivalent (preventive vs. Detective, continuous vs. Periodic), (2) identify new digital controls not possible in manual environment (real-time matching, predictive anomaly detection), (3) redesign control activities for digital-native workflows (daily close, continuous monitoring), (4) update control documentation for digital environment.

6.4 Digital accounting maturity assessment tool

Based on daif, i have developed a **digital accounting maturity assessment tool** (available in supplementary materials). Organizations score themselves on 20 items across four dimensions:

Dimension 1: Process digitization (5 items): rpa deployment, cloud accounting, ocr/document digitization, workflow automation, exception handling.

Dimension 2: Process reengineering (5 items): continuous accounting, straight-through processing, real-time reporting, predictive analytics, integrated data.

Dimension 3: Control transformation (5 items): automated preventive controls, continuous monitoring, sod automation, immutable audit trails, digital governance.

Dimension 4: Talent and culture (5 items): hybrid roles, cross-training, change management, digital governance framework, external partnerships.

Scoring: 1 (not started) to 5 (fully implemented). Total score (20-100). Maturity classification: <40 (stage 1 - ad hoc), 40-70 (stage 2 - systematic), >70 (stage 3 - integrated).

6.5 Unanswered questions and future research

Question 1: how does blockchain-based triple-entry accounting affect audit and control requirements? My study had limited blockchain adoption (44% for high-risk transactions). As adoption grows, control frameworks will need substantial revision.

Question 2: how does ai-based control explainability evolve with newer architectures (explainable ai)? Current black-box risk may decrease with technical advances.

Question 3: how do small and medium-sized enterprises (smes) achieve digitalization benefits with limited resources? My sample oversampled larger organizations; sme-specific guidance is needed.

Question 4: how does digitalization affect the future of the accounting profession (employment, skills, roles)? The transformation is ongoing; longer-term workforce impacts are not yet visible.

7. CONCLUSION

This study addressed the impact of digitalization on accounting practices and internal control systems. Through mixed-methods research (28 interviews, 312 surveys), i identified five primary impacts on accounting practices (efficiency +65-85%, close cycle -58%, real-time reporting enabled, insight quality improved, audit readiness enhanced) and documented both significant control benefits and new digital risks.

7.1 Summary of contributions

Empirical contribution: quantification of digitalization impacts on accounting efficiency, close cycle time, and insight quality. Identification of three digital accounting maturity stages and their distinguishing characteristics.

Conceptual contribution: the **digital-accounting integration framework (daif)** —a four-dimension model guiding process digitization, process reengineering, control transformation, and talent evolution.

Practical contribution: digital accounting maturity assessment tool, control transformation checklists, new risk mitigation strategies, and workforce development recommendations.

7.2 key takeaways

- Digitalization materially improves accounting efficiency (65-85% gains), close cycle time (58% reduction), and insight quality ($\beta = 0.51$).

- Benefits require sequential maturity progression (stage 1: digitization, stage 2: reengineering, stage 3: integration). Skipping stages fails.
- Control benefits include automated preventive controls, continuous monitoring, and enhanced audit trails.
- New digital risks require active mitigation: it-dependent single points of failure, algorithmic opacity, sod erosion, skill gaps.
- The digital-accounting integration framework provides a roadmap for maximizing benefits while managing risks.

8. LIMITS OF THE STUDY

I acknowledge eight limitations:

Limitation 1: Self-reported impact data. All survey data are perceptual. Objective performance data (actual close cycle times, error rates) were not consistently available across organizations.

Limitation 2: Sample bias toward larger organizations. My sample oversampled larger organizations ($500m+ revenue) that have greater resources for digitalization. Findings may not fully generalize to smes.

Limitation 3: Cross-sectional design. The survey captures a single timepoint. Digitalization impacts unfold over years; longitudinal tracking would be valuable.

Limitation 4: Technology evolution rapidity. Digital technologies evolve quickly. My findings reflect the 2023-2025 period; future technologies (e.g., generative ai in accounting) may produce different impacts.

Limitation 5: Control effectiveness measurement. I measured control transformation (automation, monitoring, audit trails) but not direct effectiveness (error prevention, fraud detection rates). Effectiveness measurement requires controlled studies.

Limitation 6: Case study duration. Case studies (6 months) captured early-stage framework application but not long-term outcomes.

Limitation 7: Single researcher. As sole author, i conducted all interviews, analyses, and interpretations. Independent replication would strengthen confidence.

Limitation 8: Geographic scope (us-centric). All organizations are us-based. Regulatory environments (e.g., gdpr, data residency) in other jurisdictions may affect digitalization impacts.

9. ACKNOWLEDGMENTS

I express sincere gratitude to the 28 accounting and audit executives who shared their digital transformation experiences, and to the 312 survey respondents. I thank the professional organizations (fei, iia, aicpa) for facilitating recruitment. Any errors are solely my own.

10. AUTHOR CONTRIBUTIONS

As the sole author I'm responsible for all aspects: conceptualization, methodology, data collection, analysis, writing, and project administration.

11. COMPETING INTEREST

The author declares no competing financial, professional, or personal interests. No technology vendor, consulting firm, or professional organization provided funding or support for this research.

12. FUNDING INFORMATION

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors. All costs (survey platform fees, transcription services) were borne by the author.

13. DATA AVAILABILITY

Anonymized interview transcripts are available from the author upon reasonable request subject to ethical approval. **Survey data** (anonymized) are available at https://osf.io/digital_accounting (doi: 10.17605/osf.io/8kqbm). Digital accounting maturity assessment tool is included in supplementary materials.

14. DISCLAIMER

The findings, interpretations, and conclusions are solely those of the author and do not necessarily represent the views of any participating organization or professional body. The digital-accounting integration framework and maturity assessment tool are provided for informational purposes; organizations should adapt to their specific circumstances.

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