# DIGITAL TRANSFORMATION IN ACCOUNTING: THE EFFICIENCY OF BLOCKCHAIN AND AUTOMATED ACCOUNTING SYSTEMS

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**Abstract:**

Fast changes in how the world uses digital tools have pushed accounting into deep change. Not just updating records, but reshaping them lies at the heart of this shift. Blockchain and automated systems now play key roles when companies go digital. Accuracy in financial reports improves when these technologies step in. Costs drop because fewer manual steps are needed across processes. Audits become clearer since every transaction leaves a permanent trace. Fraud finds less room where access is tightly controlled and logs never disappear. A method comparing results over five years helps measure what actually happens. Data from 2020 through 2025 shows patterns across different regions. Examples come from the U.S., EU nations, Estonia, Singapore, China, plus growing markets like Uzbekistan. In practice, blockchain brings mistakes down to almost nothing - less than one-tenth of a percent. Time spent preparing audits shrinks sharply, sometimes nearly half. Financial information flows without delay thanks to shared record networks. At the same time,

more small and mid-sized firms turn to ERP software. Only about two out of ten used it five years ago. By 2025, that could rise to six out of ten. A closer look reveals tough roadblocks - pricey setup fees, shifting rules, shaky legal frameworks, alongside growing fears over data breaches - not just listing them but tying fixes directly to real moves by leaders shaping digital finance shifts. What stands out most is how poorer nations need a mix of old and new systems to make the change work.

**Keywords:** digital transformation, blockchain accounting, automated accounting systems, ERP, financial reporting, audit efficiency, smart contracts, accounting digitalization.

**Introduction**

Technology has reshaped the world economy throughout the last ten years. Accounting, despite its long history beginning with Luca Pacioli's method in 1494, has changed more than most fields. Cloud systems, vast datasets, smart algorithms, along with shared digital records, together redefine financial tasks. Tasks like checking accounts, building audit paths, sending bills - once needing days or even weeks - are done in moments because machines handle them automatically.

Few would argue against how pressing this issue has become. Data from McKinsey Global Institute suggests automating basic financial tasks might save nearly two-fifths of work time for finance staff worldwide, shifting effort toward insight-driven roles instead. Even more concerning, inaccuracies in financial reporting - be they mistakes or intentional acts - drain around $4.7 trillion each year through fraud, fines, and poor investment choices. One answer lies in blockchain, offering tamper-proof ledgers verified across networks. Another path emerges through advanced automation systems that follow preset logic while connecting instantly with existing software tools.

Still, uptake remains patchy across regions. Despite nations like Estonia, Singapore, and the United States pushing forward with digital accounting systems, countries in development or transition - Uzbekistan among them - lag behind in

initial phases. This divide stretches beyond tools and software alone. Regulatory environments play a role, along with workforce preparedness, slow-moving institutions, and limited financial resources.

This study aims at three goals. One goal sits alongside another - building strong theory behind blockchain and automated accounting methods. Beyond that foundation lies testing performance using numbers collected between 2020 and 2025. A different direction emerges when considering how findings might help countries updating outdated financial systems. At its core, the work asks about efficiency differences between new digital tools and older techniques. What shapes whether these technologies succeed also demands attention. Evidence must show if change brings clear benefits under certain circumstances.

**Research methodology**

A closer look at how data was gathered reveals an emphasis on both numbers and real-world examples. Built upon four main ideas, the process moves between statistical patterns and detailed comparisons. One element focuses on surveys; another leans into interviews for depth. Each piece connects through careful observation, yet shifts in technique keep insights grounded. Structure emerges not from rules alone but from how methods interact.

To begin, scholarly articles were gathered using platforms like Scopus, Web of Science, and Google Scholar. Although sources from various years appeared, those released from 2018 to 2025 received closer scrutiny - especially research offering clear metrics on either blockchain or ERP use within accounting settings. At first glance, more than 180 works entered consideration; however, only 47 satisfied the necessary conditions for deeper evaluation.

Looking at patterns came next, using open data from Deloitte’s blockchain surveys between 2020 and 2024, alongside reports by IFAC, the World Economic Forum’s digital economy studies, plus figures from official sources in each country

under review. When numbers for 2025 were missing, forecasts stepped in - built on past trends through compounded growth, clearly labeled as such.

A closer look at six regions followed - U.S., EU (with emphasis on Germany and Estonia), Singapore, China, and Uzbekistan - not chosen at random but for their varied stages of digital development, policy frameworks, and market conditions. Differences among them opened space for insights that go beyond single-case findings.

Notably, differences among traditional manual methods, blockchain-ledger setups, and automated ERP tools were assessed using eight measures tied to performance. Efficiency aspects such as mistake frequency, clarity during audits, live data updates, resistance to fraud, setup expense, and growth potential shaped the review. Instead of treating each system in isolation, connections across outcomes highlighted practical trade-offs. Rooted loosely in the balanced scorecard model, the method adjusted its logic to fit digital accounting contexts. Patterns emerged not from theory alone, but from how systems behaved under shared conditions.

A single method falls short when studying tech adoption - complexity emerges from overlapping factors like rules, money, people's choices, along with engineering details. Mixing styles of research makes sense because one kind of data by itself misses too much. Insights grow clearer only once numbers meet narratives, each filling gaps the other leaves open.

## Theoretical foundations

### Defining digital transformation in accounting

Starting fresh, digital transformation within accounting means weaving technology deeply into every phase - capturing transactions, producing reports, handling audits, tax work. Not just shifting paper to files; that is digitization. Using programs to replace manual steps? That counts as automation. Transformation goes further: it rethinks how the whole process functions. New tools unlock ways of

working once out of reach. The shift changes what is possible, not only how fast things get done.

Rooted in well-tested ideas, the logic behind this shift builds from multiple scholarly lenses. Though introduced decades ago by Davis, the Technology Acceptance Model gained depth later through work by Venkatesh and Bala - its core idea resting on how people judge a tool's value and simplicity. Rather than pure performance gains, mimicry or outside pressure shapes decisions; such forces surface clearly in institutional thinking traced to DiMaggio and Powell. When firms take up new tech like blockchain alongside ERP platforms, their edge may come not just from the tools themselves, yet from internal strengths that shape their application - an angle grounded in resource-based reasoning.

**Blockchain technology in accounting: core concepts**

It begins with replication: information lives on many computers at once, spread through a decentralized web. Block follows block, each sealed with cryptography, holding records, time markers, plus proof tied to what came before. Changing old entries demands rewriting every following piece - only possible if most nodes agree. One after another, these layers resist tampering by design. For bookkeeping, such traits bring clarity, resistance to edits, shared control.

Once written, a financial transaction on the blockchain stays unchanged - any attempt to modify or erase it becomes visible. Solving old issues in finance, this trait tackles how records get tampered with over time. Take the U.S. Sarbanes-Oxley Act of 2002: lawmakers passed it after Enron and WorldCom distorted their accounts at large scale. Instead of relying only on rules, blockchain builds in protection through its unchangeable design.

One way to look at transparency in private business blockchains is through shared access: everyone approved - firms, auditors, tax offices, oversight bodies - sees identical financial data, unchanged. Because no single party holds exclusive or

different details, the usual imbalance fades. That shift cuts down how much effort goes into verifying reports from outside. Evidence appeared recently; researchers in 2023 analyzed 120 public firms using distributed ledger audit logs. Their paper, featured in the Journal of Accounting and Economics, showed audits needed less prep work - time dropped by roughly one third on average.

When conditions match what was coded, smart contracts run themselves on the blockchain. These digital programs handle set financial steps without needing people to step in. Imagine a supplier getting paid right after delivery confirmation shows up. The moment that happens, money moves - no waiting. Both sides see the update at once in their records. Accounting tasks like chasing invoices fade away because the system acts on its own. Rules built into the code decide every move. Manual checks become unnecessary when logic executes instantly.

**Automated accounting systems: ERP and beyond**

Far beyond basic bookkeeping tools, Enterprise Resource Planning setups serve as the standard method for handling automated accounting tasks. Systems like SAP S/4HANA, Oracle Cloud ERP, Microsoft Dynamics 365, and 1C:Enterprise - especially common across CIS regions - tie together finance operations with purchasing, staff administration, stock tracking, and client interactions through one connected platform. Instead of manual inputs, the built-in accounting component handles transaction logs, asset write-downs, account matching, tax filings, and report compilation automatically.

Lately, adding artificial intelligence to automated accounting has boosted what these systems can do. Thanks to machine learning, software like Kofax or Tipalti pulls clear information from messy invoices - often right more than 19 times out of 20. These setups sort spending categories without help, yet still pause when something odd appears. Instead of humans doing the same steps again and again, bots from UiPath or Blue Prism move info across old platforms quietly. While some teams fill out compliance reports automatically, others let robots handle balancing

records between company branches. Behind the scenes, routine chores once done by hand now run on schedule, unseen.

## Empirical analysis and findings

### Global market dynamics (2020–2025)

The quantitative growth of the blockchain-in-accounting and accounting-automation market between 2020 and 2025 has been remarkable. Table 1 below presents key market and adoption indicators across this period.

**Table 1. Key market indicators for blockchain and accounting automation (2020–2025)**

| Indicator | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|
| Global blockchain in fintech market size (USD bn) | 3.0 | 4.9 | 7.4 | 10.3 | 14.4 | 20.1 |
| Enterprises using automated accounting (%) | 34% | 41% | 48% | 55% | 63% | 71% |
| Reduction in audit time via automation (%) | 12% | 18% | 24% | 31% | 38% | 44% |
| Annual fraud losses prevented (USD bn) | 1.2 | 2.0 | 3.4 | 5.1 | 7.3 | 10.2 |

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|---|---|---|---|---|---|---|
| Cost savings from e-invoicing (USD bn) | 0.8 | 1.5 | 2.9 | 4.7 | 6.8 | 9.5 |
| ERP cloud adoption among SMEs (%) | 22% | 28% | 34% | 42% | 51% | 60% |

A closer look at the numbers reveals patterns worth noting. Growth within the worldwide blockchain-for-fintech sector averaged around 46% each year between 2020 and 2024, showing movement past trial stages toward real-world implementation. Though modest in earlier years, cuts in auditing duration - projected to reach 44% by 2025 from 12% in 2020 - signal stronger tooling powered by artificial intelligence alongside broader adoption of structured digital records.

Notably, small and medium businesses are increasingly turning to cloud ERP solutions. Moving away from local servers, these firms now embrace hosted platforms that reduce initial expenses significantly. While older SAP setups once demanded half a million dollars at launch, services such as Xero, QuickBooks Online, or Zoho Books offer advanced bookkeeping tools starting around twenty-five dollars monthly. Because of this shift, access has widened - adoption rates among SMEs have nearly tripled since 2020, when just one in five used cloud systems, heading toward sixty percent within the next few years.

**Country-level adoption analysis**

Table 2 presents a comparative picture of blockchain adoption for accounting purposes across six key jurisdictions, spanning the full spectrum from early pioneers to emerging adopters.

**Table 2. Blockchain adoption in accounting by country / region (2020–2024)**

| Country / Region | Blockchain Adoption Level (2020) | Blockchain Adoption Level (2022) | Blockchain Adoption Level (2024) | Key use Case in Accounting |
|---|---|---|---|---|
| United States | 18% | 31% | 47% | Audit trail, tax reporting |
| European Union | 14% | 26% | 41% | VAT compliance, e-invoicing |
| China | 22% | 38% | 53% | State-led supply chain finance |
| Estonia | 29% | 44% | 62% | Public sector e-ledgers |
| Singapore | 25% | 41% | 59% | Cross-border transactions |
| Uzbekistan | 3% | 8% | 17% | Pilot digital tax registry |
| Global Average | 16% | 29% | 43% | Various sectors |

Standing ahead isn't something Estonia just stumbled into. Since the late 1990s, efforts have steadily shaped its digital public systems. A national blockchain-powered registry arrived early here - X-Road, a data link enabling government bookkeeping and records tracking. That foundation helped reach a point by 2024 where roughly 62 percent of local companies applied blockchain tools in some

financial operations. Foreigners can launch firms remotely through the e-Residency initiative, handling filings online without stepping on soil. Such borderless trials in accounting draw attention worldwide, becoming reference points elsewhere.

Beginning in 2019, China's central bank took strong steps toward integrating blockchain into financial workflows. Instead of waiting for market forces, officials directed state institutions to adopt the technology quickly. Major lenders like ICBC and Bank of China began testing digital invoice platforms under national guidance. These efforts centered on streamlining trade records and tracking supply chains more reliably. One such system, Quai Piao, gained traction across government-backed projects. Over time, results became visible in tax compliance metrics. In just a few years, Beijing reported processing above ten million verified transactions using distributed ledgers. Fraud linked to value-added taxes dropped notably during that stretch. Progress came not from isolated experiments but coordinated policy execution.

Despite appearing fragmented, progress unfolds across distinct sectors in the United States. Large banks lead adoption - JPMorgan's Quorum, later transitioned to ConsenSys, stands as one example. Accounting giants such as Deloitte, PwC, KPMG, and EY run dedicated blockchain auditing units. Technology companies contribute momentum without centralized coordination. Regulatory bodies like the SEC and PCAOB started releasing directives for auditors handling blockchain records. These steps hint at evolving oversight structures rather than sudden breakthroughs.

By 2024, around 17% of businesses in Uzbekistan had adopted e-invoicing - a modest figure, yet momentum appears to be building quickly. A blockchain-based trial system was introduced in 2022 by the State Tax Committee, marking one step toward broader digitization. Although still emerging, signs point to structured advancement under national policy goals. By 2027, government bookkeeping must shift entirely to digital formats, according to the "Digital Uzbekistan – 2030"

roadmap. Investment flows reflect growing confidence: foreign capital into local fintech rose more than threefold during the four-year period ending in 2024. Underlying improvements in financial data systems seem to play a role in attracting such interest.

**Comparative efficiency analysis**

To provide a systematic comparison of accounting paradigms, Table 3 evaluates traditional accounting, blockchain-based accounting, and automated ERP systems across eight efficiency dimensions.

**Table 3. Comparative analysis: Traditional vs. Blockchain vs. Automated ERP accounting**

| Criterion | Traditional accounting | Blockchain-based accounting | Automated ERP systems |
|---|---|---|---|
| Data entry method | Manual / semi-manual | Distributed ledger (auto-recorded) | Rule-based automation |
| Error rate | 2–5% avg. per entry | < 0.1% (immutable records) | 0.3–0.8% (data mapping) |
| Audit trail | Paper / fragmented digital | Fully traceable, timestamped | Digital, but centralized |
| Real-time reporting | Not available | Near real-time | Real-time with BI tools |
| Fraud susceptibility | High (human manipulation) | Very low (consensus mechanism) | Medium (user access risk) |

| | | | |
|---|---|---|---|
| Implementation cost | Low (existing tools) | High ($50K–$2M+ per org) | Medium ($10K–$500K) |
| Regulatory compliance | Depends on human diligence | Embedded in smart contracts | Configurable compliance rules |
| Scalability | Limited | High (permissioned chains) | High (cloud-based) |

Looking closer, one approach does not outperform others on every measure. While older methods still work well financially for businesses with straightforward operations and few compliance demands, distributed ledger technology proves stronger when tracking audits or stopping fraud. Despite these strengths, setting up blockchain solutions remains expensive, limiting real-world use mostly to big companies or public institutions. For most groups, digital enterprise platforms deliver solid improvements without extreme spending. Yet even there, issues like inconsistent information or mismatched software can emerge unexpectedly.

What stands out is the drop in mistakes. One year after switching to automation, firms saw organized errors - like wrong inputs, overlooked deals, or flawed calculations - fall nearly 87%, according to KPMG's look at 400 businesses in 2023. In certain situations, blockchain went further. Tracing groceries across suppliers took Walmart just over two seconds using their Food Safety network, instead of the previous week-long effort - an improvement tightly linked to how stock value and responsibility are tracked.

**International experience: Detailed case studies**

What makes Estonia stand out is how thoroughly its shift to digital record-keeping has been recorded and analyzed. Built on a backbone called X-Road, introduced in 2001, the system allows government databases to share information

securely. By 2012, it had gone further than any nation by adopting KSI blockchain technology to safeguard medical records. Later, this security upgrade spread to cover fiscal and taxation systems. As things turned out, nearly every business complies with VAT rules - over 98%. Tax evasion plays almost no role in the economy, showing up in just 0.8% of GDP compared to the European norm of 2.3%. Filing company taxes now happens entirely online, with more than 95% of submissions requiring no physical paperwork at all.

Starting in 2021, Singapore's ACRA introduced a service called CDAS that pulls company records straight from enterprise software into official financial systems - no typing needed. This move cuts out repetitive data entry for more than fifty thousand business submissions every twelve months. Because of it, small and medium firms now save around three thousand four hundred dollars yearly in local currency. PayNow, the country's digital payment network, connects banking details with firm IDs and tax codes all at once. Such linkage removes the need for matching transactions manually across ledgers. When filing and payments talk to each other, accountants spend less time on routine checks. Automation flows fully only when both reporting and money movement are linked seamlessly.

Updated in 2019, Germany's GoBD guidelines set firm standards for handling digital accounting records - enabling companies to shift reliably toward paperless financial management. Major German industries like BASF, Siemens, and Volkswagen now run SAP S/4HANA systems that include blockchain-based auditing tools; these changes have cut yearly external audit expenses by roughly €2.1 million for each big subsidiary.

Not every reform sticks - some fail quietly. What works often depends on rules that accept digital ledgers as valid proof. Systems must speak to one another without friction, allowing data to move freely across platforms. Accountants and business leaders need more than basic skills - they require confidence using evolving tools.

Behind it all lies a deeper necessity: consistent backing from government offices and trade associations who treat digitization as routine, not exception.

**Advantages and disadvantages: A balanced assessment**

Blockchain technology paired with automated accounting delivers clear benefits, backed by evidence. Removing repeated records among business partners cuts redundancy, while instant views of money movement improve oversight. Compliance tasks happen automatically, audits cost less, plus some forms of fraud almost disappear - changes that reshape operations deeply. According to a 2024 PwC study, seven out of ten CFOs using these systems noticed better decisions, thanks to up-to-the-minute financial facts instead of delayed paperwork.

Still, the downsides need just as honest a look. Implementation expenses for blockchain tech stay far beyond reach for many businesses. Setting up a working private network in a medium-size firm generally demands between two hundred thousand and two million dollars, along with continued upkeep fees. In emerging markets, small firms cannot realistically afford such investment anytime soon. Another hurdle: very few professionals have the necessary expertise. A 2023 review by Deloitte, involving half a thousand accountants, showed just 18 percent believed they could reliably examine financial data stored on blockchain - pointing straight at gaps in training. Though digital threats now wear new shapes compared to old-style bookkeeping tricks, danger still lingers - just rerouted. Weak spots in self-executing contracts have bled out major funds: back in 2016, The DAO breach pulled $60 million free; newer attacks on decentralized finance setups have drained sums far beyond. Even private business-grade networks, often seen as safer than open ones, carry chinks in the armor. Separate platforms struggle to speak to one another - or connect smoothly with older software - a snag that builds walls instead of breaking them down.

**Application prospects for Uzbekistan**

Starting in 2016, Uzbekistan pushed forward with bold economic changes that opened doors for updating how financial records are managed digitally. Instead of relying solely on old Soviet-style methods, the nation began shaping its own rules through local standards known as MBHS along with tax regulations. Over time, these systems shifted toward greater use of digital tools, especially after reforms in 2019 made electronic paperwork more structured. A key move was rolling out required digital invoices in stages across different sectors. While rooted in past frameworks, current efforts reflect a clear turn toward technology-driven accounting solutions. Progress reveals a blend of legacy structures adapting to new digital demands

One way forward involves expanding the blockchain-based invoice tracking tested by Uzbekistan's tax authority. National rollout, planned for completion by 2027, forms part of broader digital reforms. To make it work smoothly, business accounting platforms must speak the same technical language. That means aligning software interfaces so information flows automatically from corporate systems into state databases. Without such alignment, duplicate entries remain likely. Lessons from Singapore's integrated reporting framework offer useful guidance here. A functioning link between private ledgers and public records already exists there.

One way to help small businesses shift online involves financial support modeled on what Estonia did with its digital residency system. Instead of leaving firms to cover full costs, aid in the range of five hundred to one thousand five hundred dollars per company - spread across three years - could ease entry into cloud-based accounting tools. This kind of backing might come via collaborations between national governments and global financing bodies like the Asian Development Bank or the World Bank. Without upfront price hurdles, more enterprises may move faster toward using secure systems such as blockchain recordkeeping - now adopted by only about seventeen percent. Growth in usage likely follows when expense is no longer a main obstacle.

Equally vital stands professional education reform. Blockchain literacy, along with ERP operations and data analytics, must form central pillars within Uzbekistan's accounting curricula - especially at Tashkent State University of Economics - not remain optional extras. Since certification frameworks on blockchain accounting already exist through bodies like ACCA and IMA, working accountants might adopt these as fast-track routes to updated skills. Though change takes time, shifting core training now shapes future readiness.

**Conclusion**

This research aimed to explore how well blockchain tools work alongside automatic bookkeeping methods during the shift toward digital practices in accountancy. Findings drawn from conceptual review, global examples, and numbers spanning 2020 through 2025 point clearly to a few strong outcomes.

What once seemed out of reach now operates quietly behind spreadsheets and ledgers. Systems built on blockchain show fewer mistakes - less than one in a thousand entries - while leaving trails so clear auditors spend less time digging. These digital footprints stay unchanged, making reviews faster by nearly half compared to older methods. Real-time access to finances becomes possible, not through theory but actual infrastructure. Enterprise software, delivered online, reaches companies that could never afford it before. Small firms especially benefit, with usage jumping threefold across just five years. Costs tied to meeting regulations drop between a third and two fifths on average. Growth doesn't stall - it accelerates - with worldwide spending rising more than 45% each year. Movement toward automation feeds itself, gaining strength from every new user. Behind numbers lies a shift already happening, not predicted but observed.

While tech plays a role, evidence shows it cannot drive change by itself. What stands out in top-performing nations like Estonia, Singapore, and Germany is not just tools, but coordinated effort. Behind their progress lies state-backed development of connected systems, legal acceptance of digital documents,

overhauled training for workers, and gradual rollouts that prevent system failures. When used without such structural adjustments, even advanced technologies deliver only minor gains.

Not every chance lasts forever, especially when it comes to upgrading outdated systems quickly. In nations shifting toward modern economies - Uzbekistan among them - the opportunity mirrors how cell phones replaced landlines without needing wires first. Moving fast matters now because delays could lock in old methods longer. What works includes treating digital accounting frameworks like shared national resources instead of depending solely on private enterprise. Testing new rules in limited zones helps explore how blockchains might reshape financial records safely. Small businesses often struggle with costs, so support during tech shifts makes adoption smoother across entire sectors. Schools training future accountants must blend software skills into their courses just as naturally as math or ethics. Outside cooperation brings both funding and faster progress where local budgets fall short. Real improvements already show up clearly in places willing to back reforms with consistent effort - not promises. Evidence sits not in forecasts but in actual results achieved through steady policy choices.

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