POZNAŃ UNIVERSITY OF ECONOMICS AND BUSINESS
Research Papers in Economics and Finance *Vol. 9, No. 2, 2025: 143–167*
https://ref.ue.poznan.pl *https://doi.org/10.18559/ref.2025.2.2022*

Blockchain technology and smart contracts: A potential tool for improving operational profit margin

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Abstract

This study presents a practical framework for implementing blockchain technology, specifically smart contracts, to optimise operations and enhance financial performance in the Consumer Packaged Goods (CPG) sector. It identifies best practices for operational efficiency and outlines the structural flow and challenges of implementing smart contracts in a small-scale CPG company. While blockchain is often associated with cryptocurrency, its value lies in enhancing core business processes such as vendor selection, procurement and legal compliance monitoring. The framework integrates blockchain-enabled smart contracts with project management lifecycle updates to streamline operations, enhance cash flow and reduce the Cost of Goods Sold (COGS). It highlights how procurement processes, legal requirements and vendor management can be streamlined through smart contracts, providing transparency, reducing delays and ensuring regulatory

Keywords

- blockchain
- smart contracts
- COGS
- EBIT
- procurement
- inventory
- profit margin
- corporate operations

Suggested citation: Jaiswal-Dale, A., Lorentz, R. M., Owens, E. L., & Singh, B. (2025). Blockchain technology and smart contracts: A potential tool for improving operational profit margin. *Research Papers in Economics and Finance*, *9*(2), 143–167. https://doi.org/10.18559/ref.2025.2.2022

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compliance. Blockchain is a decentralised database, and its applications span procurement, production processes and inventory management. However, leveraging blockchain effectively requires smart contracts. Integrating these contracts with project management tools ensures efficient operations and measurable financial metrics. This interdisciplinary approach combines technology, business law and project management to deliver actionable insights. The study highlights how modest operational efficiencies can drive profitability in low-margin industries, such as CPG, and establishes a foundation for future implementation studies across other sectors.

Article received 21 January 2025, accepted 29 November 2025.

Introduction

This project examines the impact of blockchain technology, as found in smart contracts, on improving the financial performance of companies with smaller profit margins, such as those in the Consumer Packaged Goods (CPG) sector. Given the number of startups registered post-COVID-19 within the CPG sector, we are ahead of the curve in examining the impact of blockchain on small CPG companies. Blockchain technology, on which cryptocurrency relies for its efficient delivery, has proven to be more relevant and pervasive in business practices than the notion and utility of the cryptocurrency itself (Hashemi et al., 2020; Polyviou et al., 2019). In recent times, cryptocurrency has experienced its ups and downs on the financial markets (Allen & Bryant, 2019; Chen et al., 2021; Sahoo et al., 2020). In contrast, blockchain technology is slowly and surely integrating into business practices (Pankratov, 2021). It will undoubtedly play an increasingly significant role in small startups, which, by nature, are more agile than established businesses. We explore the connectivity between the use of smart contracts, based on blockchain practices, and their impact on improving operational cash flows, specifically affecting the Cost of Goods Sold (COGS) and Earnings Before Interest and Tax (EBIT).

Blockchain is a shared database in which information is recorded in sequential blocks. It can store many types of data, including procurement records, assembly-line production details and inventory information. The use of smart contracts – self-executing agreements built into the blockchain – is becoming increasingly widespread and popular.

However, the effective use of blockchain spans several areas of business and requires coordinated updates. It affects vendor selection and procurement process-

es, as well as the monitoring of legal and regulatory issues. It also influences the project management lifecycle, which must be adapted to support greater agility. This study presents a framework for integrating blockchain into vendor and procurement activities, legal monitoring and compliance, as well as the adjustments needed across project lifecycle management. It also clearly shows the financial metrics that can be impacted by incorporating blockchain. This interdisciplinary approach combines technology, business law and project management to deliver actionable insights and measurable financial metrics.

Business law and traditional contracts provide the legal foundation by defining the rights, responsibilities, obligations and expectations between parties. Smart contracts are automated digital agreements recorded on the blockchain that execute automatically when predefined conditions are fulfilled (Gilcrest & Carvalho, 2018). These contracts represent a fusion of technology and legal frameworks, translating business agreements into enforceable code. These legal frameworks govern critical business functions, including vendor selection, procurement and inventory management, ensuring compliance, accountability and transparency across the supply chain. Smart contracts build on these legal principles by embedding them into automated workflows, adding efficiency by removing the need for intermediaries and enabling transactions to occur seamlessly when agreed-upon conditions are met. By aligning legal agreements with blockchain-enabled smart contracts, businesses can streamline these operational areas, minimise risks and improve cash flow. This integration ensures processes are executed accurately and efficiently, with minimal administrative overhead. The result is a reduced COGS and improved profitability, which is particularly vital for companies in sectors like CPG, where tight margins demand operational precision.

Project management tools align the interdisciplinary components of blockchain, business law and smart contracts to ensure smooth implementation and efficient operations. This integration is crucial in sectors such as CPG, where even slight improvements in cash flow and reductions in the COGS can have a substantial impact on profitability. Two primary methodologies are relevant: Kanban (Gemino et al., 2020) and the process-based approach, commonly known as the waterfall method (Zerjav, 2021). Kanban offers a visual overview of work status, showing which tasks have begun, which are in progress, and which are currently on hold; however, it lacks the depth required to manage financial ledgers. Agile approaches, such as Scrum (Dong et al., 2024), are unsuitable for smart contracts, as daily adjustments are unnecessary; project deliverables are predefined in the contracts. The process-based approach is more effective, given the structured nature of smart contracts. It provides detailed control over tasks by accounting for factors like resource availability, task dependencies, cost variances, risks and scope impacts. This approach ensures that each task aligns with the contractual obligations enclosed in the smart contract.

1. Motivation

According to a Deloitte report (Deloitte, 2022), the global blockchain market is projected to grow at a Compound Annual Growth Rate (CAGR) of over 60% through 2030, with more than half of consumer-goods companies actively exploring blockchain solutions for supply chain transparency and automation. Recent analysis by the World Economic Forum highlights that rising raw material costs and supply chain disruptions are compressing margins, making operational efficiency and cash flow optimisation a top priority for CPG firms. Despite this momentum, most existing research focuses on blockchain security or cryptocurrency applications rather than developing practical frameworks for linking blockchain-enabled smart contracts to measurable financial outcomes such as EBIT or COGS. This study addresses that gap by offering a replicable, operations-focused methodology that demonstrates the direct financial impact of blockchain adoption in a real-world CPG setting.

This study examines how blockchain technology and smart contracts can be utilised to enhance financial performance for companies operating on narrow profit margins, with a focus on the Consumer Packaged Goods sector. Blockchain's utility extends far beyond cryptocurrency – it can streamline procurement, production and inventory management processes, providing transparency and automation across operations. Smart contracts, by automating accounting and operational workflows, enable the precise calculation of key financial metrics, such as Earnings Before Interest and Taxes, and help reduce the Cost of Goods Sold, a critical factor for improving profitability in low-margin industries.

2. Methodology

The research follows a business clinical study methodology, mirroring the structured approach of clinical trials to ensure rigor and replicability. In Phase One, the problem statement and research hypothesis (or research question) are clearly defined, establishing the foundation for the study. Phase Two involves gathering pre-intervention metrics and developing a practical implementation framework that addresses the identified challenges. In Phase Three, this framework is deployed as a pilot project within a small CPG company, enabling real-world testing of vendor selection, procurement processes and legal compliance workflows. Post-implementation results are then collected and analysed to measure impact on

operational efficiency, cost reduction and financial performance. The final phase focuses on optimisation, where processes are refined based on the outcomes of the pilot, followed by sharing the post-optimisation results and recommendations for industry adoption.

This paper represents Phase Two of the research: it presents the problem statement and hypothesis and proposes a comprehensive implementation structure. It outlines specific updates for vendor selection, procurement practices, business law compliance and enhancements to the project management lifecycle. These contributions have been incorporated into the Introduction section to clarify the study's context and relevance.

The planned application in a small CPG company serves as a practical test case, using blockchain-enabled automation to enhance operational efficiency, optimise cash flow and increase overall profitability. This research employs a methodology similar to that of a clinical study, utilising a single company as the initial implementation site to investigate challenges, refine processes and measure outcomes. By integrating accounting principles with blockchain solutions and updating project management lifecycles to accommodate vendor, procurement and legal compliance requirements, the framework provides a replicable model for sustainable financial improvement. If successful, it could serve as a template for broader adoption across industries facing similar margin pressures.

To strengthen the analytical rigor of Phase Two, this study incorporates empirical insights from prior research on blockchain-enabled supply chain efficiency. Deloitte (2022) highlights that blockchain automation significantly reduces administrative processing time, reconciliation effort and manual verification steps, improvements particularly relevant for CPG procurement and inventory workflows. Complementing these industry findings, Kouhizadeh and Sarkis (2018) demonstrate, through empirical and conceptual analysis, that blockchain adoption reduces transaction costs, minimises information asymmetry and improves traceability across supply chains. Similarly, Saberi et al. (2019) show that blockchain-based supply chains exhibit measurable gains in transparency, coordination and cost efficiency, including reduced delays and lower resource waste.

Drawing from these studies, we use the documented ranges of efficiency gains, such as reductions in transaction complexity, improved synchronisation between supply chain actors, as well as the elimination of redundant verification activities, to construct expected-impact benchmarks for the planned Phase Three pilot implementation. These benchmarks support a preliminary sensitivity analysis of how improvements in procurement cycle time, vendor compliance accuracy, and inventory visibility could translate into reduced COGS and improved operational profitability. Incorporating these empirical insights into Phase Two strengthens the methodological foundation of the framework and establishes clear, evidence-based expectations for validation during Phase Three.

This paper explores smart contracts and blockchain processes to identify best practices for operational efficiency. Section 3 outlines the fundamentals of blockchain. Section 4 examines whether distributed ledger technology (DLT) can replace traditional ledgers for cost-effective operations. Section 5 discusses the impact of blockchain and smart contracts on project management. In the last, Section 6 addresses current challenges in adopting blockchain and smart contracts within a small CPG startup, offering a concrete organisational context for analysing the problem at hand. The conclusion highlights their potential to automate operational accounting, thereby assessing the impact of smart contracts and blockchain on increasing the operating profitability of smaller companies.

3. Blockchain technology, smart contracts – working in unison

Blockchain technology operates on the principle of decentralisation, meaning that no single entity controls the entire network; the users are stakeholders and nodes in the distributed ledger technology (DLT). Instead, the network is maintained by a network administrator or software developer (Teamhub, 2023). This distributed nature of blockchain ensures there is no single point of failure, making it highly resilient and secure. A distributed ledger is a database that can be shared among multiple participants (Cieplak & Leefatt, 2017, p. 420). It is a decentralised digital record shared instantaneously across the network of participants to establish consensus without a centralised repository of information (Raskin 2017, p. 318). Each participant (or node) holds a copy of the master ledger. Whenever changes are made to a participant's copy, the network is notified and must agree on which changes will be permanently reflected in the master ledger (Nash 2019, p. 799). From a legal standpoint, blockchain development led to the emergence of smart contracts. Based on the distributed ledger technology (Nevil, 2025), smart contracts constitute the "next step in the progression of blockchains from a financial transaction protocol to an all-purpose utility" (Jani, 2020). The code is embedded in the distributed ledger, and once it is activated, it will execute automatically, ensuring that neither party can fail to perform (McKinney et al., 2018). Courts should not need to step in to enforce the smart contract for payment, for example, as once the predetermined event or condition occurs, failure to pay is not a possible outcome within the code (ISDA & Linklaters, 2017).

Since blockchain technology serves as the underlying framework for smart contracts, or self-executing digital contracts whose terms have been translated into code, it offers a paradigm shift in how contractual agreements are executed and

enforced. By leveraging blockchain's inherent characteristics, smart contracts provide transparency, immutability and automation to the operational process, thereby addressing critical pain points faced by companies with tight profit margins.

It is important to note that smart contracts have been gaining momentum, and their validity is increasingly recognised, particularly by state law. For example, Tennessee law states, "Smart contracts may exist in commerce. No contract relating to a transaction shall be denied legal effect, validity or enforceability solely because that contract is executed through a smart contract" (Tennessee Code Annotated (T.C.A.) § 47-10-202). A growing number of states have adopted similar provisions, such as Iowa in 2022 (Iowa Code Annotated (I.C.A.) § 554E.3) and Arizona in 2017 (Arizona Revised Statutes (A.R.S.) § 44-7061). However, these are general provisions whose purpose is to recognise smart contracts and their validity, but they do not address the issues raised by their use.

Despite their many advantages, smart contracts present legal challenges. One of the primary concerns is whether smart contracts constitute legal contracts (Harris Sliwoski, 2023). Even though some smart contracts may legally be considered contracts if they meet all the legal requirements, there is currently no consensus about their definition and their legal nature (Kasatkina, 2021, p. 203), as a smart contract may be considered either a mere computer code (Kasatkina, 2021, p. 204) or a real legal agreement, contractual obligations of the parties being discharged through their automated execution by the computer program (Kasatkina, 2021, p. 204). In addition, smart contracts may give rise to new torts in cases of negligent coding or negligent updates (Temte, 2019, p. 97), not to mention potential data privacy violations (Deloitte, 2022), as smart contracts are not entirely confidential (Gilcrest & Carvalho, 2018, p. 3280).

Within the smart contract, the rules governing payment, resource adjustments and schedule impacts are controlled by the "if/when... then..." code (Filatova, 2020), which is written into the blockchain (Norris, 2019). The program developer or contract business administrator stipulates controls and updates. The DLT controls the release of funds, transactions and status, and interfaces with tools used to manage the project. The hope is that the blockchain will reduce the need for interaction between project stakeholders and clients by updating the nodes in the DLT, so that all who have access to updates within the project are consistently dealing with the project's current official version through their "hash" signatures. This will enable triggering actions that are less likely to produce errors and redundancies among the different stakeholders.

Similarly, smart contracts are specifically established to automate those aspects of "traditional" contracts that have clearly defined outcomes (Jani, 2020), i.e. that are more technical and straightforward than natural language elements, whose subtleties and complexities (like a dispute resolution clause) cannot be conveyed by code (Nash, 2019, p. 821). Using middleware, such as "cryptlets" written in

a programming language, will allow the project manager to integrate with smart contracts and the DLT (Frank, 2016).

The discussion above brings us to the central focus of our research question.

4. Research question: from ledger to blockchain format

To examine the research question, "Can blockchain aid in improving operating profit for companies with slim profit margins, we decided to outline a well-established approach to financial management and accounting, including the calculation of Earnings Before Interest and Tax (EBIT). Additionally, we chose this path to give full credence to our single data point: one small company, perhaps a startup, which can increase its operational efficiency and demonstrate this via a universally acceptable metric, EBIT (Ahluwalia et al., 2020).

Let us begin by outlining the flow of operational transactions that comprise the EBIT process and affect the cost of goods sold. These transactions, recorded in a ledger format, track operational performance through standardized accounting line items, regardless of a company's size or industry (Brigham & Houston, 2015).

The typical format runs as follows:

Sales – Operating Costs = Earnings Before Interest, Taxes, Depreciation and Amortisation (EBITDA)
EBITDA – Depreciation and Amortisation (DA) = Earnings Before Interest and Taxes (EBIT)
EBIT – Interest (I) = Earnings Before Taxes (EBT)
EBT – Taxes = Earnings After Tax or Profits from Operations
Profits from Operations + Depreciation and Amortisation = Net Cash Flow from operations

The main issue here lies in controlling and streamlining both fixed and variable operational costs, as these affect the "cost" of all goods sold. Controlling costs is especially difficult for manufacturing firms operating on slim profit margins, particularly small companies or startups. Among the components of costs (COGS), variable costs are often the least controllable for such firms, defined as follows:

- procurement of raw materials, including their sourcing and pricing,
- trade credit or accounts payable used to finance procurement,
- inventory management, encompassing the financing and storage of inventory and its eventual conversion into accounts receivable or cash as goods are sold,
- collection of accounts receivable or provision of firms' credit policies,

– control and management of all peripheral costs associated with the above activities, such as warehousing, advertising and other management services.

All five of the above activities require tightly coordinated contractual connectivity. When even one link in this chain breaks down, the cost of goods sold is likely to be adversely affected.

The example below illustrates two of the five elements – procurement and inventory management – in a theoretical form, showing how they operate as an executable internal pathway within the firm. This pathway can then be extended to connect with the pathways of external stakeholders, such as raw-material suppliers, creating a broader chain in which all parties work together to improve their collective cost of goods sold.

4.1. Procurement of raw materials through vendor selection and ensuing accounts

Vendor selection is a pivotal process in the intricate landscape of small companies, intimately tied to operational efficiency and profitability. However, traditional approaches to vendor selection often encounter significant challenges, hindering the smooth operation of small enterprises. These challenges include information asymmetry, trust deficits and high transaction costs, which can significantly impact the bottom line of small companies. In response to these challenges, blockchain technology emerges as a promising solution to transform vendor selection dynamics, particularly through the lens of smart contracts (Bai et al., 2021; Guleria & Sharma, 2020).

One of the primary challenges in traditional vendor selection processes is information asymmetry, in which small CPG companies often lack access to reliable information about potential vendors' capabilities, reputations and performance. This information gap can lead to suboptimal vendor choices and operational inefficiencies. Real-world examples, such as Walmart (Hyperledger, 2024) and IBM's collaboration to enhance food traceability and safety through blockchain technology (Sristy, 2021), illustrate how smart contracts can mitigate information asymmetry by providing transparent, tamper-proof records of vendor interactions. Additionally, Procter & Gamble (Ledger Insights, 2021) has implemented blockchain technology in its supply chain to improve transparency and traceability, ensuring the authenticity and quality of raw materials sourced from vendors.

Moreover, trust deficits and opaque contractual agreements pose significant challenges for traditional vendor selection processes, often leading to disputes and misunderstandings between parties. Smart contracts address these challenges by

automating contract execution and establishing transparent and verifiable records of all transactions and commitments. Maersk's TradeLens platform, powered by smart contracts, exemplifies how blockchain technology can enhance trust and transparency in vendor relationships by streamlining global trade processes and reducing paperwork (Maersk, 2021). For small CPG companies, smart contracts offer the promise of automated execution of predefined contract terms, eliminating the need for intermediaries and reducing transaction costs and processing time.

Smart contracts enable automated payments tied to quality metrics, incentivising vendors to meet performance standards and ensuring accountability. Blockchain's immutable audit trail supports fair dispute resolution, enhancing vendor relationships, product integrity and operational efficiency for small CPG companies.

Consider a small apple juice CPG company seeking to optimise its vendor selection process for sourcing organic apples. Integrating smart contracts via blockchain allows the company to establish transparent sourcing protocols, ensuring adherence to organic standards and traceability throughout the supply chain. Automated payment processes based on quality metrics incentivise vendors to consistently deliver high-quality produce. At the same time, the immutable audit trail provided by blockchain technology facilitates transparent record-keeping and dispute resolution. In this way, smart contracts empower small CPG companies to streamline vendor selection processes, mitigate challenges and build trust-based relationships with their vendors, ultimately driving sustainable growth and profitability in the dynamic CPG industry.

Let's take an example of vendor selection. This vendor selection draft outlines the criteria and process for selecting vendors to source organic apples for our small apple juice Consumer Packaged Goods company. This document will provide transparency and guidance to all stakeholders involved in the vendor selection process. The vendor selected can be "coded" for digital operability using selection criteria presented below.

Criteria for vendor selection:

- organic certification: vendors must possess a valid organic certification from accredited certifying bodies to ensure the integrity of the apples sourced,
- quality standards: apples must meet specified quality standards in terms of freshness, flavour and appearance,
- reliability and timeliness: vendors should demonstrate a track record of reliability and timely delivery to meet our production schedules,
- price competitiveness: competitive pricing while maintaining quality standards is essential to ensure cost-effectiveness,
- sustainability practices: preference will be given to vendors employing sustainable farming practices to minimise environmental impact.

Vendor selection process:

- pre-qualification: interested vendors are required to submit their company profile, including certifications, quality control measures and references,
- evaluation: the vendor selection committee will evaluate vendor proposals based on the predetermined criteria,
- negotiation: shortlisted vendors will be invited for negotiation sessions to finalise terms and conditions, including pricing, delivery schedules and quality assurance measures,
- contract signing: upon successful negotiation, contracts will be signed outlining the terms and conditions of the agreement,
- monitoring and performance evaluation: the performance of selected vendors will be monitored regularly against predefined key performance indicators (KPIs).

In the smart contract coding, vendors can be added with their details, including organic certification, quality score, reliability score and price score. This ensures transparency and eliminates biases in the vendor selection process. The authors' proposed flow for automated procurement and inventory management is provided in Appendix, Table A1.

Thus, smart contracts, facilitated by blockchain technology, offer small CPG companies a powerful tool to enhance vendor selection processes, mitigate traditional challenges and foster more transparent and efficient supply chains. By embracing these innovations, companies can gain a competitive edge, improve operational efficiency and build stronger, trust-based relationships with their vendors, ultimately driving sustainable growth and profitability in the dynamic CPG industry.

4.2. Inventory management and procurement management

Inventory management is crucial to business success, yet traditional practices often suffer from inefficiencies, inaccuracies and transparency issues. Blockchain technology and smart contracts offer innovative solutions by enabling real-time visibility into inventory levels and movements across the supply chain (Gaur & Gaiha, 2020). These tools automate inventory tracking and reconciliation, reducing stockouts, overstocking and inefficiencies. For example, IBM and Walmart's Food Trust platform leverages smart contracts, enabling companies to optimise supply chain efficiency, enhance resource allocation and improve overall operational performance.

Effective inventory management is vital for business success, yet traditional methods often suffer from inefficiencies and transparency challenges. Blockchain

and smart contracts provide real-time visibility into inventory levels and movements, automating tracking and reconciliation to reduce stockouts and overstocking. For instance, IBM and Walmart's Food Trust platform highlights blockchain's ability to create a transparent, immutable ledger for inventory transactions. By leveraging these technologies, companies can optimise supply chain operations, enhance resource allocation, and improve overall efficiency, offering a transformative solution to traditional inventory management challenges.

Blockchain technology transforms procurement by replacing paper-based processes with automated, DLT-based systems, reducing errors, delays and costs through minimised human intervention. Smart contracts streamline multi-party transactions, ensuring compliance and transparency with immutable, auditable operations on the blockchain, enhancing efficiency and trust. Figure 1, which lists the relevant nodes, illustrates this process.

Figure 1. Benefits of traceability using blockchain in supply chain

Source: based on: (Singh, 2022).

Consider a small apple juice CPG company supplying its products to a large retailer. The company faces challenges in managing inventory levels, tracking product movements and ensuring timely replenishment to meet customer demand. By implementing smart contracts, the company can automate various aspects of inventory management.

Similarly, the following tasks in inventory management can be more efficiently managed using smart contracts on a blockchain platform:

1. **Automatic Replenishment**: Smart contracts automate inventory replenishment for small CPG companies, such as those producing apple juice, by triggering orders based on predefined criteria. Integrated with inventory systems, they monitor stock levels in real-time and automatically place replenishment orders when levels drop below a set threshold. This ensures optimal inventory levels, minimises stockouts and guarantees an uninterrupted supply to retailers. By eliminating manual intervention, smart contracts streamline operations, reduce administrative overhead and improve supply chain efficiency, enabling the company to focus on core activities while maintaining seamless inventory management.
2. **Automatic Payment**: Traditional inventory management in the Consumer Packaged Goods sector often involves manual, error-prone financial transactions. Smart contracts automate these processes by executing payments based on predefined terms encoded within the contract. For instance, upon delivery, a smart contract can automatically process payments according to agreed conditions, ensuring transparency and trust as transactions are immutable and verifiable on the blockchain. This automation reduces administrative burdens, streamlines workflows and enhances operational efficiency. By minimising manual intervention, smart contracts enable CPG companies to focus resources on core activities, driving cost savings and improved business performance.
3. **Delivery Slips**: Smart contracts digitise and standardise delivery slips, critical for tracking product movement within the supply chain. For instance, when apple juice products are shipped, the smart contract automatically generates a digital slip detailing product information, quantities, shipment date and destination. Stored immutably on the blockchain, this slip ensures transparency and provides a verifiable transaction record. By reducing paperwork and minimising errors, smart contracts streamline the delivery process, enhance communication among stakeholders and facilitate more accurate reconciliation. Their transparency fosters trust and accountability, strengthening relationships between the CPG company and its partners.
4. **Tracking and Traceability**: Smart contracts enable small CPG companies in the apple juice industry to achieve precise product tracking across the supply chain. Integrated with IoT devices and RFID tags, they capture real-time data on product movement and location. For example, RFID tags in packaging can record

when shipments leave the facility, reach distribution centres, or are delivered to retailers. This visibility allows proactive decisions, such as rerouting to avoid delays or optimising distribution to cut costs. Blockchain's immutable ledger enhances transparency, trust and accountability, fostering efficiency and stronger supply chain relationships.

Table 1. Procurement and inventory workflow – traditional vs blockchain

Workflow component	Traditional procurement / inventory model	Blockchain-enabled smart contract model	Expected financial impact
Purchase Order (PO) creation and approval	Manual data entry; multi-level approvals; frequent delays.	Automated PO creation triggered by predefined conditions; instant validation.	Reduction in cycle time. Faster production scheduling. Improved working capital.
Vendor verification and contract compliance	Verification through email/document uploads; prone to errors; inconsistent audit trail.	Vendor credentials and contract terms stored on-chain; immutable, auto-verified.	Reduction in compliance-related disputes & rework. Reduction in administrative cost.
Goods receipt and inventory updates	Batch updates by warehouse staff; lag between physical receipt and system updates.	Real-time inventory updates recorded via smart contract events.	Lower inventory holding cost due to better demand-supply alignment.
Invoice processing and reconciliation	Manual matching of PO, goods receipt and invoice; high rate of mismatches.	Automatic three-way matching executed by smart contracts.	Reduction in reconciliation cost. Fewer payment delays and penalties.
Payment settlement	Payment triggered manually; delays due to verification steps.	Automatic payment initiation after contract conditions met.	Stronger cash flow measurable EBIT improvement.
Recordkeeping and audit	Paper-based or siloed digital records; difficult audits.	Immutable ledger with complete audit trail; easy compliance checks.	Reduced audit hours. Lower overhead expenses.
Dispute resolution	Lengthy back-and-forth communication; unclear data sources.	Transparent, real-time shared ledger reduces ambiguity.	Fewer disputes. Reduction in hidden costs affecting COGS.
Overall governance and visibility	Fragmented visibility; coordination required across teams.	End-to-end transparency across procurement, inventory and finance.	Improved management decision-making. Higher operational efficiency.

Source: own elaboration.

Table 1 compares the traditional procurement and inventory workflow with the proposed blockchain-enabled smart contract model, demonstrating how automation, transparency and real-time validation directly contribute to reductions in COGS, improvements in cash flow and measurable EBIT enhancement.

Implementing smart contracts demonstrates how automation, transparency and traceability can enhance inventory management processes, ultimately driving operational efficiency and customer satisfaction.

5. Project management techniques for effective implementation

Project management plays a pivotal role in translating blockchain and smart contract concepts into practical, measurable business outcomes. It provides the necessary structure for planning, resource allocation, scheduling and risk management, ensuring that technological innovation aligns with business objectives. In blockchain-enabled projects, effective project management bridges the gap between technical execution and financial performance, coordinating tasks, dependencies and stakeholder communication across multiple nodes and teams.

Smart contracts automate the execution of predefined business rules, but project management ensures their seamless integration into existing workflows. Each task within the implementation framework functions as a modular "block", incorporating essential project elements such as scope definition, schedule tracking, cost variance, risk mitigation and progress reporting. These data blocks can be shared across the blockchain network to maintain transparency and real-time alignment with the validated project baseline. This transparency not only enhances accountability but also supports Earned Value Management (EVM) principles, enabling continuous performance assessment through metrics such as cost and schedule variances, critical ratios and efficiency indices. By embedding these project management methodologies into the blockchain framework, organisations can create a synchronised ecosystem in which automated smart contracts trigger updates, and project managers monitor deviations and optimise delivery. The outcome is a more agile, data-driven project environment that minimises administrative overhead, strengthens stakeholder confidence and directly supports the financial and operational objectives outlined in earlier sections.

The above scenarios in project management can kick off a cost variance and schedule variance analysis (Kerzner, 2022). Cost variance (CV) represents the difference between the earned value and the actual cost payment. The earned value

payment (Christensen & Heise, 1993, pp. 7–15) is earned based on the plan cost. A table for each status report period can be set up, and the cost variance can be assessed as positive, neutral or negative, based on the actual earnings.

The cost can also define the schedule impacts based on the cost through the schedule variance analysis. Schedule variance (SV) is the difference between the earned value and the planned value. Since cost is rate times duration, we can factor out the cost rate through a distributed process of math, leaving you with just the schedule impacts. This leaves the project manager with a status statement indicating whether the project is ahead, on schedule or behind schedule. This can be reported to the team using a project management Application Programming Interface (API), as blockchain does not allow data to be overwritten or changed (Hewavitharana et al., 2019). Once CV and SV are generated, they can be used to define the critical ratio (CR) (Larson et al., 2024), which tells the project manager that the plan is underperforming and must be updated, or the blockchain is overperforming, meaning too much money and resources are being allocated to the blockchain.

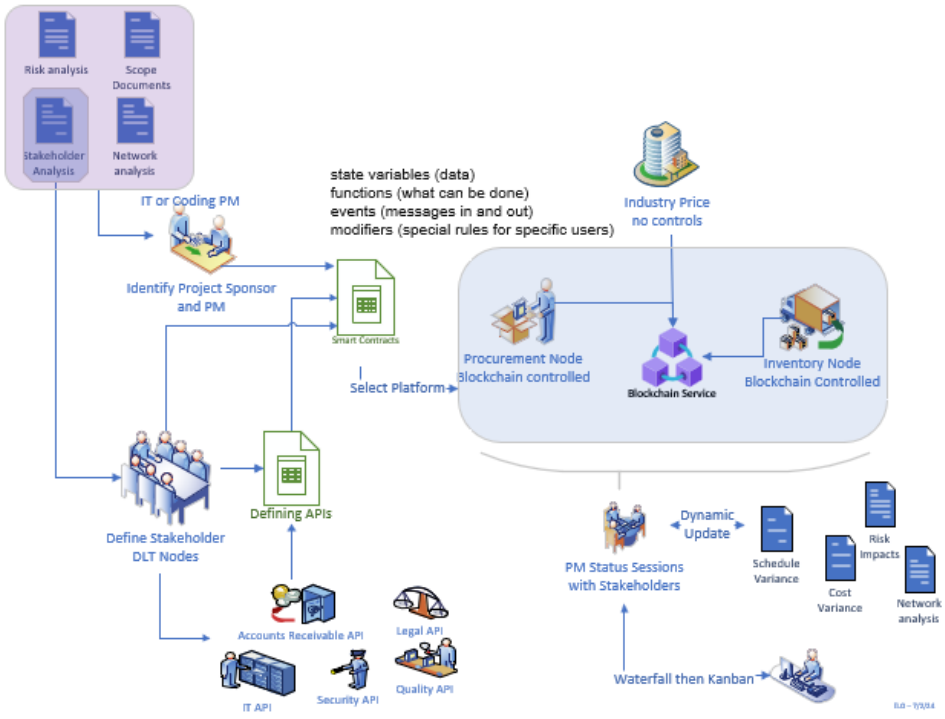

Figure 2. Project management (PM) mindset for blockchain

Source: constructed by the authors as updated PM flow.

With that information, the blockchain smart contracts (Norris, 2019) can be renegotiated, ensuring that funding and resources are updated with each status report period. This prevents the project from starving for resources or over allocating resources that could be used elsewhere. Figure 2 below shows the project management mindset for managing blockchain status.

Smart contracts automate procurement, payments and inventory management processes by executing predefined terms. However, these automated systems still require oversight, especially when discrepancies arise. Critical Ratio (CR) analysis (Kerzner, 2003) enables project managers to monitor performance, indicating whether resource estimates are overstated (sandbagging) or if the project is at risk of contract violations due to resource depletion. If the CR exceeds or falls below the set thresholds, an Estimated to Completion (ETC) analysis (Fleming & Koppelman, 2010) can be used to forecast potential risks, allowing for timely interventions.

Blockchain's transparency minimises manual intervention, but APIs integrated with the system can enhance visibility by dynamically reporting project status, cost variances (CV) and schedule variances (SV). Earned Value (EV) analysis (Naeni et al., 2011) helps track project progress, resource conflicts and discrepancies between planned and actual outcomes. These metrics provide stakeholders with actionable insights, ensuring the blockchain remains aligned with the project's goals.

The automation within blockchain systems allows smart contracts to address operational changes in real-time. For instance, a smart contract in a small beverage company can trigger a replenishment order when the retailer's inventory reaches a critical level, thereby avoiding shortages. Integrating blockchain with project management tools ensures seamless operations without the need for constant human intervention. Project managers must also define clear contractual terms within the smart contracts, including start and end dates, resource allocation and contingency plans for delays or resource unavailability. Escalation paths embedded in the contracts can initiate corrective actions if deliverables or scope are at risk, maintaining the integrity of both the blockchain and the project.

While blockchain automates many aspects, project management ensures alignment between the blockchain ledger and real-world operations. APIs can report discrepancies between the planned baseline and actual outcomes, enabling project managers to adjust resource allocation, scheduling or scope accordingly. These tools mitigate risks and optimise procurement outcomes, particularly in industries with tight margins.

By integrating EV analysis with smart contracts, project managers gain greater control over project timelines, cost structures and resource management because blockchain can track assets at any point in time (Hewavitharana et al., 2019). This approach allows for continuous monitoring and adjustment, minimising disrup-

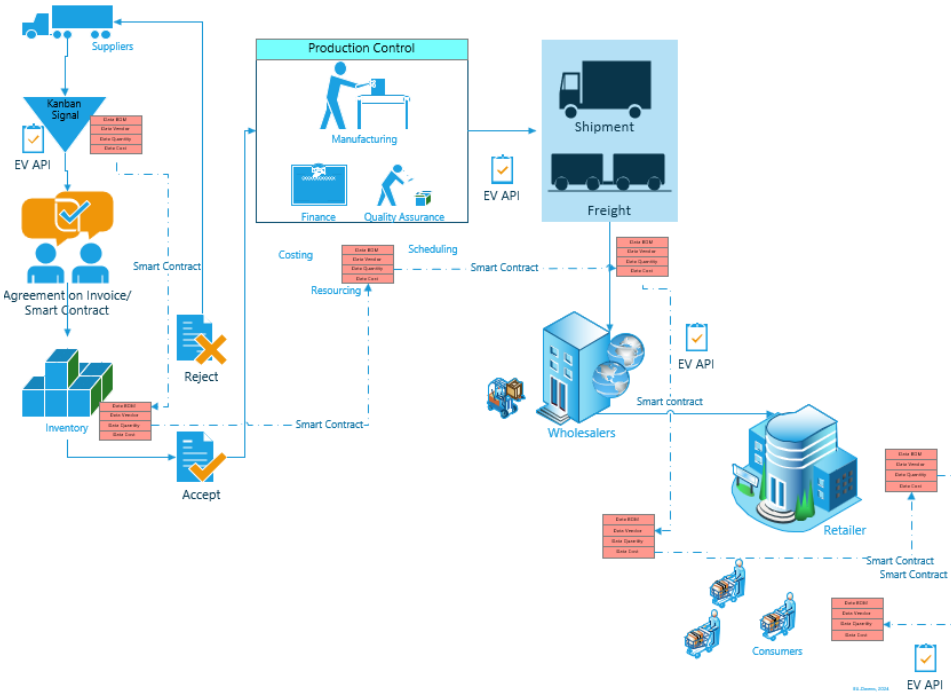

Figure 3. Smart Contract EV/API

Source: authors' own elaboration.

tions while capturing valuable data for future projects. In this way, project management complements blockchain automation by consistently achieving operational efficiencies and financial objectives. Figure 3 illustrates the flow and monitoring of the EV.

6. Practical challenges for implementation of blockchain

The blockchain assumes that many operational items will already be in place for it to work. One potentially problematic issue is the assumption that resources will be available when the contract states they should be. The project team may reassign these tasks to other projects if the smart contract indicates that an action has not been completed and holds payment or resources. When the contract states that all conditions are satisfied, it will authorise the next steps, even if the resources required may not be readily available.

Our first step is to identify and define the process. This is necessary to address the challenges that a clinical study will face while aiming to improve operational performance and reduce COGS. Below are some of the challenges we have identified, along with opportunities to improve operational processes.

1. Buyer involvement.
   The blockchain/smart contracts will not be implemented until both parties, producers and, eventually, buyers (B2C or B2B), agree to use the blockchain technology on the same blockchain platform.
2. Cost and complexities.
   A readily available blockchain platform can be employed if both parties agree on a specific Cloud environment on a pre-selected blockchain platform, which could cost approximately $5,000 per month. This cost is solely for infrastructure. Additionally, there is the cost of hiring in-house personnel, including a smart contract programmer, who is needed to write smart contracts. This is an additional cost. Other complexities include integrating blockchain with current software packages, as well as regulatory/legal issues (Fulmer, 2018), among others.
3. Software automated internal business operations.
   Blockchain is just a digital ledger. To seamlessly impact business operations, decisions must be automated. For example, an order to replenish stock should be automatically triggered from the buyer to the seller. Payment transactions, order generation and automated status checks are tasks involved. These can be triggered only if the buyer and seller already have software that automates business operations.
4. Identify the best “ledger”/”account” within business operations.
   COGS is a metric achieved by pooling several accounts, or “ledgers”, that have both cash inflows and outflows. The question, then, is which of these accounts offers the greatest cost-effectiveness when placed on a blockchain – is it inventory, procurement or another operational ledger entirely?
5. Identify the appropriate external stakeholder to partner with for blockchain implementation.
   Supply chain links, even for smaller CPG companies, are varied and numerous. From raw-material procurement to value-adding suppliers, the question becomes which link/node offers the strongest partnership for testing a blockchain process. Should the pilot involve an ingredient supplier, a wholesale distributor or another stakeholder in the chain?

These are just a few elements that pose significant roadblocks to blockchain implementation. However, over time and as business practices become increasingly digitised, many of these roadblocks will either fade away or be replaced by relevant digital platforms.

7. Future directions

Building on the implementation framework developed in Phase Two, the next stage of this business clinical study will focus on pilot deployment and empirical validation within a small CPG company. Phase Three will operationalise the proposed blockchain-enabled smart contract model across selected workflows, specifically vendor selection, procurement management, purchase order management and quality-control documentation. This real-world implementation will enable continuous monitoring of workflow speed, cost reductions and contractual compliance using both automated and manual performance indicators.

To strengthen empirical contribution, Phase Three will incorporate quantitative impact measurement, informed by findings from previous studies and industry benchmarks. For example, Deloitte (2022) reports that blockchain-based automation in supply chain processes can reduce administrative processing time by 30–50%, lower reconciliation costs by 20–40% and improve working capital availability by 3–6% due to faster approvals and settlement cycles. In CPG operations, some other research estimates that even a 1–2% reduction in COGS can lead to disproportionately larger gains in EBIT for firms operating on narrow margins. These benchmarks will guide the performance expectations of our pilot study and serve as comparative indicators for assessing improvements in procurement cycle time, inventory holding costs and transaction-related expenses.

Phase Three will also evaluate organisational readiness, including the training requirements for finance, procurement and legal teams, the integration needs with existing ERP systems, and the governance mechanisms necessary to support smart contract execution.

Overall, the future phases of this clinical-style methodology will transform the conceptual framework into an evidence-based operational model, enabling us to validate financial impact, identify best practices and develop a replicable roadmap for broader adoption across the CPG sector and other low-margin industries.

Conclusions

In this paper, our objective is to outline, in chronological order, the challenges and benefits at different stages of implementation that can be employed by a set of CPG producers and their B2B partners, provided they are in mutual agreement to test the process.

Smart contracts can enable cost-effective operations through the inherent efficiencies, automation, transparency and security of blockchain technology.

Additional benefits include faster decision-making time, reduced authorisation requirements and the elimination of unnecessary steps, all of which are interconnected. However, the remaining questions are at what stage of production, at what level of earnings before interest and tax (EBIT), and at what profit-margin threshold blockchain becomes cost-effective?

Based on the findings, we recommend that companies initiate pilot implementations in high-impact areas, such as vendor payments, purchase order tracking and quality assurance approvals – processes that often bottleneck CPG supply chains. Firms should also invest in training project managers and finance teams to understand smart contract design, compliance implications, and the integration of smart contracts with existing ERP systems. Measures such as defining clear performance metrics (COGS reduction, cycle time improvement and working capital gains) and continuously monitoring them will allow firms to evaluate ROI and make data-driven scaling decisions. Project management tools and methods are used to ensure the operations run smoothly. The blockchain's automated actions will allow the project team to focus on risk mitigation and future project designs.

Our next step in this clinical-style study with a beverage manufacturing firm is to validate this framework under real-world conditions, measuring its effect on procurement cycle time, inventory holding costs, and transaction cost reduction. If successful, this model could serve as a replicable pathway for other CPG companies and industries with tight margins to achieve greater operational efficiency, stronger cash flow management and improved profitability through blockchain-enabled automation (Raskin 2017, p. 309).

Appendix

Table A1. The flow of automated procurement and inventory management proposed by the authors

If	Then	Comment
...YOURPACK delivers the packaging line to Panache until the 1st of March 2025	...50 per cent of contract amount is automatically paid to the account of YOURPACK	
...YOURPACK delays the delivery of packaging line to Panache until the 1st of March 2025	...payment to YOURPACK is calculated as 50 per cent of the contract minus 0.3 per cent of the contract amount per one day of this delay	The delivery is finalised after quality inspector of Panache digitally approves the incoming quality control checklist
...packaging line is reaching the planned production output of 2,000 bottles per shift	...50 per cent of contract amount is automatically paid to the account of YOURPACK	
...packaging line delays reaching the planned production output of 2,000 bottles per shift	...payment to YOURPACK is calculated as 50% of the contract minus 0.3% of the contract amount per one day of such delay	Production output is calculated by packaging line automatically and is sent on hourly basis to both companies
...Panache delays the payment based on abovementioned conditions more than for 24 hours	...packaging line gets blocked automatically until the payment is received by YOURPACK	Blocking and unblocking of packaging line is steered by the system which receives the input from blockchain protocol

Source: authors' own elaboration.

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