



# The Role of Open Book Accounting and Blockchain Technology in Developing Cost Accounting Systems and Achieving Greater Transparency in Supply Chains – An Applied Study in Iraqi Airways

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## Abstract

This study intends to assess the impact of applying open book accounting endorsed by blockchain technology on improving transparency and efficiency in the supply chains of Iraqi Airways. The importance of the study originates from the critical need to enhance the accuracy of cost reports, facilitate data updates, and reduce financial disputes in view of the challenges confronted by traditional systems in cost accounting and supply chain management. The study problem originates from the insufficiency of transparency, high error rates, and setbacks in updating cost data, which lead to frequent financial disputes and high monitoring costs. These issues prevent operational efficiency and negatively affect both operational and financial performance of the organization. The study employed a descriptive analytical applied approach, obtaining and examining actual secondary data from the company's records and reports for two periods before and after the implementation of the open book accounting system supported by blockchain. The study emphasized on principal measures like error rates in cost reports, data update time, level of transparency, dispute rates, and costs of monitoring and auditing expenses. The study results demonstrated notable improvements after implementation such as error rates declined from 12% to 2%, data update time decreased from several days to minutes, transparency levels increased from 40 to 85 out of 100, and financial disputes declined from 15% to 3%. In addition, there were substantial savings in monitoring and auditing costs, demonstrating the economic feasibility of the application. According to these findings, the study recommends that the adoption of open book accounting endorsed by blockchain technology in aviation institutions and supply chain companies to improve financial and operational efficiency, enhance transparency, and reduce waste and disputes. In addition, suggests providing appropriate staff training, enhancing digital infrastructure, and cooperating collaborating with regulatory authorities to facilitate integration processes and ensure regulatory adherence.

**Keywords:** Blockchain Technology, Cost Management, Open Book Accounting, Supply Chain Efficiency.

## 1. Research Methodology and Previous Studies

### 1.1. Introduction

As a result of expeditious technological development and the Far-reaching changes occurring in the global business sector, organizations are confronting increasing challenges in managing financial and operational resources, especially in the areas of cost accounting and supply chains. Cost accounting Signifies one of the fundamental Foundations that enables firms to measure and analyze the costs associated with production and operations, hence facilitating informed managerial decisions Directed at improving performance and reducing waste.

Notwithstanding, several organizations still depend on traditional accounting systems which suffer from many issues, like data inaccuracy, delays in updating information, lack of transparency, and difficulty in real-time cost tracking. So, these challenges in a negative way affect operational efficiency and reduce stakeholders' trust.

In this regard, Open book Accounting has surfaced as a creative methodology that maintains records in a transparent and auditable approach available to all stakeholders, thus reducing errors and disputes associated with costs. concurrently, Blockchain technology, which provides a distributed, protected against tampering digital ledger, has turned into a powerful supporter that strengthens open book accounting by assuring data integrity and real time updates. This promotes high transparency and fosters trust among customers, suppliers, and organization.

Supply chains are one of the most essential fields where blockchain technology can facilitate transformative change It supports accurate and transparent tracing of all production and financial phases, contribute to reducing errors, hastening processes, and reducing operational costs. In regard of airlines, like Iraqi Airways, where multiple phases, suppliers, and partners are involved, implementing blockchain supported open book accounting turns into immediate a pressing necessity to enhance efficiency and strengthen transparency in supply chain management.

This study seeks to examine how open book accounting and blockchain technology integration into the actual working environment of Iraqi Airways, and to assess the impact of this integration on financial and operational performance indicators. It also seeks to provide practical recommendations that contribute to the development of the accounting system and organizational effectiveness, utilizing the advantages of advanced technologies nowadays business environment.

### 1.2. Study Problem

Iraqi Airways encounters limited transparency and inefficiency in its traditional cost accounting system, causing high error rates, delayed data updates, and increased disputes associated with costs in supply chains. Hence, the study question the effectiveness of applying blockchain supported open book accounting in addressing these issues.

### 1.3. Study Importance

The importance of this study is rooted in demonstrating the application of blockchain supported open book accounting, that consider one of the most recent technological developments in accounting and supply chain management. Under increasing challenges especially for large companies like Iraqi Airways such as lack of transparency, delayed data updates, and high error rates and financial disputes, this study presents innovative and practical solutions through integrating blockchain technology with modern accounting systems.

### 1.4. Study Objectives

1. To evaluate the impact of applying blockchain-supported open ledger accounting on the accuracy of cost reports in the company.
2. To measure the effect of the application on data update speed and process transparency within the supply chain.
3. To determine the extent to which cost-related disputes decrease after implementation.
4. To analyze the economic feasibility of the application by studying the return on investment (ROI).

### 1.5. Study Hypotheses

- Null Hypothesis (H0):  
The application of a blockchain supported open book accounting system has no significant impact on cost report accuracy, data update speed, process transparency, or dispute rates at Iraqi Airways.
- Alternative Hypothesis (H1):  
The application of a blockchain supported open book accounting system has a significant impact on improving cost report accuracy, reducing data update time, enhancing process transparency, and lowering dispute rates at Iraqi Airways.

### 1.6. Study Population and Sample

- Population: All accounting operations and data related to costs and supply chains at Iraqi Airways.
- Sample: Selected financial and operational data from the company's records covering two periods: before and after implementation.

### 1.7. Study Methodology

The study implemented the descriptive analytical approach, based on secondary data collected from the company's records and reports. The data were examined by using statistical methods to analyze the differences in relevant measures before and after the using blockchain which supported by open book accounting.

### 1.8. Study Limitations

1. The study is limited to data available from Iraqi Airways during a specific period (six months before and six months after implementation) in 2023.
2. The study does not include other accounting applications or technologies that may have influenced results during the same period.
3. The study relies exclusively on actual company data without using questionnaires or interviews.

### 1.9. Previous Studies

#### 1.9.1. Al-Qaisi (2021)

This study explored the inadequacy of comprehension blockchain's impact on various financial statement items in commercial banks, that limits full employment of the technology to improve financial performance. It attempted to explore blockchain's impact on financial statements (profit-loss, financial position, equity, and cash flows) in Jordanian commercial banks. The findings indicated to a positive impact of blockchain implementation on financial statements, improving performance evaluation and increasing banks' competitiveness. The recommendation were improving blockchain apply in banks to reduce costs, enhance service quality, increase transaction volumes and profitability, facilitate market entry, and ensure continuous banking services.

#### 19.2. Abdulhamid (2023)

The study investigated the barriers of using blockchain in accounting system environment, especially operational risks, insufficiency of suitable accounting systems, and management issues, that affect the framework and performance of accounting and auditing professions. The results indicated operational risks, insufficiency of integrated accounting systems, and management obstacles, alongside blockchain's impact in reshaping and expanding the role of accountants and auditors. The study recommendation was reinforcing the role of professional

and audit companies in regulating blockchain use, performing continuous training for accountants and auditors, and integrating technological advancements into accounting curricula.

### 1.9.3. Al-Sayyid (2025)

This study concentrated on the challenges facing reverse supply chain cost management because of misalignment, insufficiency of accountability, and lack of transparency in information flows among stakeholders. Its objective was to identify vital success factors for using blockchain in improving reverse supply chain cost management, especially in improving product quality, reducing operating costs, and increasing flexibility of information and goods flows. The findings showed that blockchain enhances innovation capacity, improves product quality, reduces costs, and strengthens operational flexibility and risk management when transparency and accountability are ensured. The study recommended establishing clear regulatory standards for IT-based solutions such as blockchain in reverse supply chain cost management.

### 1.10. Study Gap

In spite of number of studies focusing on blockchain technology and its impact on accounting systems and cost management, few have sufficiently analyzed the application of open book accounting enhanced by blockchain and its impact on developing cost accounting systems and enhancing transparency in supply chains, especially in the aviation sector.

The study gap is based on the absence of applied studies which directly evaluate the impact of integrating open book accounting with blockchain on cost report accuracy, data update speed, process transparency, dispute reduction, and the economic feasibility of such an application in terms of return on investment.

According to this study seeks to bridge this gap by executing an applied study at Iraqi Airways, providing an extensive understanding of how blockchain supported open book accounting can improve cost accounting systems and improve transparency in supply chain management.

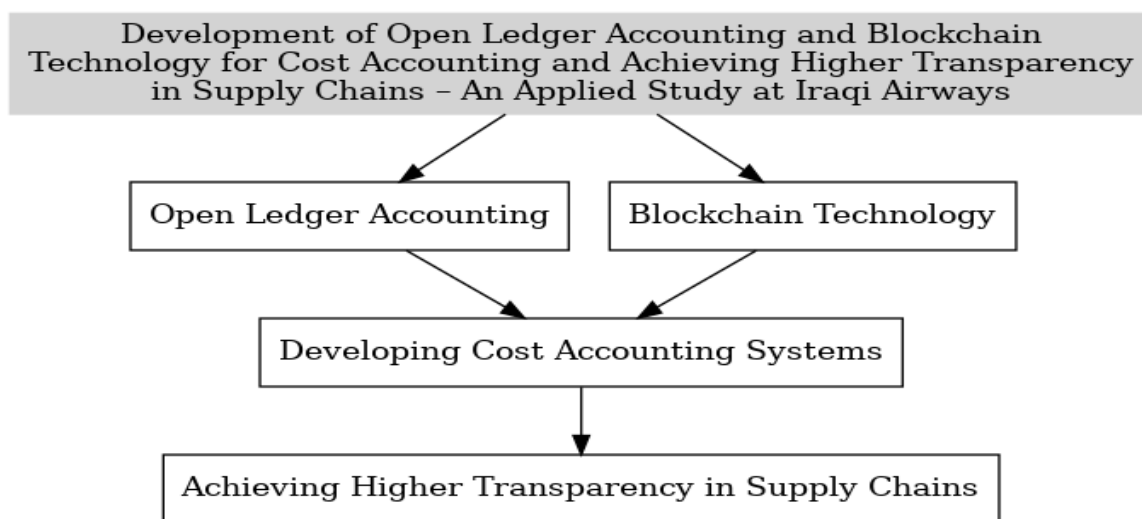


Figure 1. The Conceptual Framework of the Study.

## 2. Cost Accounting and its Role in Enhancing Supply Chain Efficiency

### 2.1. Introduction

Cost accounting is a vital tool for managing advanced industrial firms. It assists improving operational and financial efficiency by analyzing resource utilization and identifying sources of waste. In the context of ongoing evolution of the business environment and the increasing complication of supply chains, the requirement for more accurate and transparent accounting tools, like Material Flow Cost Accounting (MFCA), continues to grow so as to support decision-making and improve overall companies' performance.

### 2.2. Concept of Cost Accounting

Cost accounting especially within the MFCA framework, includes measuring and allocating costs associated with material and energy flows in the production process. Losses and waste are identified and quantified then related to the product or service responsible for them. This method aims to recognize opportunities to reduce negative environmental effect and save money for the company. The concept is reinforced and standardized by ISO 14051, that facilitates its implementation in industrial organizations, especially in Japan (Papasp et al., 2016, 325).

### 2.3. Concept of Supply Chain

Supply chain management consists of activities, processes, and practices via which a business organization collaborates with its suppliers to maximize internal operational efficiency, deliver final products that satisfy customers, and generate profits for shareholders. It incorporates planning, organizing, directing, and controlling all organizational activities to strengthen relationships with suppliers, intermediaries, distributors, and customers. further, it aims to improve internal processes to ensure the flow of products, funds, expertise, and information across the chain (from primary suppliers to end customers).

The objective is to maximize benefits for all links within the interconnected network of supply, manufacturing, and distribution centers (Hussein, 2019, pp. 453–454; Al-Akidi & Mohammed, 2024, 170).

### 2.4. Concept of Transparency

Transparency indicates to the exchange of information and decision making in a clear and accessible approach for anyone interested in attaining information on a particular issue. A transparent system is characterized by

explicit procedures, a clear method of decision-making at the public level, and open communication channels between stakeholders and officials.

Transparency also entails freedom from fraud and deception, making irregularities easily detectable. Broadly, transparency means clarity and the ability to see what is hidden—the opposite of ambiguity. It ensures the free flow of information, allowing employees and external parties dealing with the organization to continuously access and use relevant data (Mosbah, 2021, p. 152).

### 2.5. Concept of Decentralization

It refers to the decision-making method that does not depend on a one central authority but rather on a decentralized network of participants or systems. This approach spreads power and data among multiple parties in a transparent and secure approach, thus enhancing efficiency and objectivity of decision-making throughout real-time and reliable information analysis applying technologies like blockchain and big data, without needing a central authority to control all processes (Theodorakopoulos et al., 2024, 1).

In this study, decentralization refers to a system that distributes power and data among a network of participants rather than being concentrated in one central authority, thereby reducing risks of failure and enhancing security.

### 2.6. Objectives and Importance of Cost Accounting (MFCA)

#### 2.6.1. Objectives (Al-Jabali, 2020, 519)

Cost accounting seeks to assist firms achieving enhanced environmental and financial performance through increasing the efficiency of resource utilization, particularly materials and energy. This can be achieved by several objectives and benefits that strengthen the organization's capacity to make more informed and precise strategic and operational decisions, including:

1. Enhancing transparency: Showing material flows, energy consumption, and associated costs to provide a clearer understanding of environmental and operational aspects.
2. Supplying analytical information: Supplying data to support analysis and decision-making for resource efficiency and cost reduction.
3. Assisting decision-making: Enhancing decisions related to process technology, quality management, production planning, and supply chain activities.
4. Enhancing coordination and communication: Facilitating internal communication regarding material and energy management.
5. Emphasizing waste reduction: Providing accurate data on material and energy consumption to minimize usage in production.
6. Limiting damages and waste: Lowering defective products and non-value-adding costs.
7. Revealing hidden losses: Identifying material losses that traditional finance-focused accounting systems cannot detect.
8. Identifying improvement opportunities: Locating waste and inefficiencies in material flows and developing strategies to reduce them.

#### 2.7. Importance of MFCA

The importance of MFCA lies in its role in enhancing and advancing traditional accounting methods on two main levels: (Al-Jabali, 2020, 518)

1. Economic status: it emphasizes on material costs, which are highly significant in industrial companies. different from traditional accounting systems That are deficient in detailed information on material costs and their flow through the firms, MFCA provides more precise data by linking physical units with financial units.
2. Environmental status: it emphasizes on reducing costs by limiting material and energy consumption, thus causing positive environmental impacts. enhanced resource use reduces waste and emissions, making MFCA a vital management tool for maximizing economic efficiency while improving environmental benefits.

#### 2.8. Types of Cost Accounting (Al-Jabali, 2020, 520)

Considering the economic and environmental obstacles confronting industrial companies, cost accounting becomes a vital implement to enhance performance. It integrates both economic and environmental dimensions to reduce waste and maximize resource efficiency. The method depends on a comprehensive analysis of material, energy, and waste flows, enabling waste identification and process improvement. The main types include:

1. Costs of materials: Covering all materials used in manufacturing (primary, secondary, and auxiliary).
2. Costs of energy: Covering all energy consumed in operations (e.g., fuel, electricity).
3. Costs of the system: Costs associated with handling material flows within the organization, excluding material, energy, and waste management.
4. Costs of waste management: Costs occurring from material losses, like product repair, recycling, waste treatment, and disposal.

#### 2.9. Relationship Between Cost Accounting Accuracy and Supply Chain Efficiency

Accurate cost accounting considerably facilitates to improve supply chain management by providing reliable information to support managerial decisions on logistics strategies and resource allocation. Advanced cost accounting methods, like Activity-Based Costing (ABC), enhance cost accuracy and, in turn, improve logistics management, reduce waste, optimize resource utilization, improve supply chain efficiency, cut operating costs, and raise service quality (Ali et al., 2024,182).

Supply chain management as well utilizes a batch of effective tools created to reduce costs and improve efficiency, like activity-based costing, target costing, product life cycle costing, and transfer pricing. These tools support cost that related to decision making by enabling companies to examine spending at each supply chain level, both in terms of transactions and direct and indirect costs.

In particular, transfer pricing is widely used by multinational corporations to control internal supply chain relationships, often tied to performance measurement systems. Virtual enterprises have emerged as a modern tool enabling non-hierarchical production networks, particularly among SMEs, to collaborate effectively, thereby improving performance and reducing costs.

Modern practices further demonstrate that integrating tools such as target costing, value chain analysis, and open-book accounting effectively reduces shared costs between suppliers and buyers while achieving target final prices. Techniques like concurrent engineering integrate cost management tools with methodologies such as quality function deployment or flexible manufacturing to design products that meet customer needs at minimal cost, thereby reducing waste and increasing customer value.

These practices emphasize that cost management tools are not isolated but integrated within a strategic framework focused on improving supply chain efficiency and controlling financial performance (Abduldaïm, 2018, 456).

### *2.9. Limitations of Traditional Cost Accounting in the Context of Globalization and Supply Chains*

Traditional cost accounting faces several limitations when dealing with globalization and complex supply chains, primarily because it relies on conventional cost allocation methods that lack flexibility and accuracy. These limitations reduce its effectiveness in supporting strategic decision-making in today's business environment.

#### *2.9.1. Limitations (Al-Saghir, 2020, 164)*

1. Lack of collaboration among supply chain partners due to reliance on internal data without transparent information exchange.
2. Limited transparency in sharing cost information between suppliers and buyers, which is essential for reducing inter-operational costs and achieving competitiveness.
3. Powerlessness deal with advanced supply chain difficulty Because of traditional analytical tools and absence of flexible, integrated information systems.
4. Deficiency of integration within network members because lack of communication channels and shared information systems.
5. Hold-up in engaging third parties (suppliers/partners) in the initial stages of design and production, causing fewer innovative solutions and weaker internal cost management.

#### *2.9.2. Alternatives (Al-Saghir, 2020, 165)*

1. Target costing: Determining product costs according to market accepted prices to lead design and production toward efficiency and cost reduction.
2. Open-book accounting: Encouraging transparent exchange of cost structures between suppliers and buyers to build trust and cooperation while enhancing joint cost management.
3. Parallel cost management: Involving all stakeholders from early design and production stages to limit inter-operational costs and promote innovation.
4. Blockchain technology: facilitating data tracking, enhancing transparency enhancing stakeholder trust in supply chains, then enabling more efficient application of cost techniques like target costing and open-book accounting.
5. Integrated information systems: Provide all parties with precise real time information throughout clear channels of communication to support supply chain decision-making.

Hence, this study adopts blockchain-supported open book accounting to develop the cost accounting system and achieve greater transparency and efficiency in supply chain management at Iraqi Airways

## **3. Open Book Accounting**

### *3.1. Concept of Open Book Accounting*

Open Book Accounting is an accounting approach which enhance cost data or financial to all related groups in a direct and transparent manner, intending to reduce disputes, build trust, , and improve collaboration. This method allows customers, suppliers, to access relevant information, including profit margins, production costs, and actual expenditures, enabling informed decision-making based on real data (Kajüter & Kulmala, 2005, 293).

### *3.2. Objectives of Open Book Accounting*

basic aim of this method is to improve accountability and transparency, while also supporting collaborative decision-making among parties. Key objectives include: (Windolph & Moeller, 2012, 193).

1. Enabling parties to access accurate cost data.
2. Building trust and reducing disputes.
3. Improving joint planning and reducing waste.
4. Facilitating negotiations based on actual data

### *Open Book Accounting and Cost Accounting*

When applied in supply chain environments, open book accounting becomes an effective cost accounting tool, as it allows detailed sharing of cost items between the company and its partners. This helps identify cost reduction opportunities and improve operational efficiency. It can also be integrated with Activity-Based Costing (ABC) or standard costing systems to provide a clearer picture of the actual cost of products and services (Kulmala et al., 2002, 342)

### *3.3. The Role of Blockchain in Supporting Open Book Accounting*

Blockchain technology enhances open book accounting by providing a decentralized, secure, and tamper-proof ledger for accounting transactions. This allows real-time data updates accessible to all authorized parties, reducing

the need for manual audits and increasing trust. Integration of blockchain with cost accounting through the open book model improves data accuracy and ensures its integrity (Kshetri, 2018, 81).

### 3.4. Challenges of Open Book Accounting

Despite its benefits, open book accounting faces several challenges, including: (Seal et al., 1999, 202).

1. Resistance from some parties to share sensitive data.
2. The need for advanced technical infrastructure.
3. Information security risks if access controls are not properly implemented.
4. Legal complexities related to data protection and privacy

## 4. Blockchain- Concepts and Operational Structure

Blockchain has emerged as a digital innovation based on decentralization, cryptography, and collective participation to change the way data is securely and transparently recorded and exchanged. Its applications extend beyond cryptocurrencies to accounting, supply chain, and asset management. This section covers the technical fundamentals for understanding its mechanism and structure.

### 4.1. Blockchain Technology

Blockchain is an electronic database that uses cryptographic mechanisms to create a ledger distributed across all devices in the network. Each node (device) has an identical copy of the database. The technology records transactions and data in a way that ensures all parties agree on the accuracy of information while preventing tampering or alteration. The term "blockchain" consists of two parts:

- Block: A unit containing a set of data.
- Chain: Links blocks together sequentially and securely (Kamel, 2025, 191).

In this study, blockchain refers to a digital technology that relies on a fixed decentralized ledger used to record transactions securely and transparently, enhancing trust among different parties in the supply chain.

#### 4.1.1. Blockchain Mechanisms

Blockchain acts as a decentralized and secure repository for recording transactions in a tamper-resistant manner (Kamel, 2025, 191). It relies on three main mechanisms through which all transactions are executed sequentially and systematically (Badawi et al., 2022, 621-622):

1. Distributed Ledger: A financial record containing data on various assets, shared peer-to-peer across a network. Changes are reflected across all copies within minutes, ensuring security and accuracy.
2. Decentralized Database: Eliminates a single controlling entity, with a global network of computers maintaining the shared database to prevent tampering and enhance transparency.
3. Mining: Computers solve complex mathematical problems to record transactions and validate blocks, with rewards in the form of cryptocurrency.

#### 4.1.2. Core Components of Blockchain (Gatteschi et al., 2018, 10-11; Kamel, 2025, 191)

Key components supporting blockchain applications include:

- Immutability: Data cannot be deleted or altered once recorded.
- Transparency & Public Access: Information is available on the chain, threatening privacy risks for sensitive data.
- Smart Contracts: Self-executing codes with potential vulnerabilities.
- Dependency on External Sources: Some applications require external data inputs, creating weaknesses.
- No Support for Lost Credentials: Data cannot be recovered if credentials are lost.
- Cryptocurrency Volatility: Affects blockchain payment applications.
- Limited Development Tools & Standards: Tools are nascent, with no clear standards.
- Technical Complexity: Requires skills for using wallets and understanding blocks.
- Adoption Opportunities: User-friendly tools can reduce complexity.
- Legal & Regulatory Challenges: Laws for smart contracts and widespread adoption are unclear.
- Long-term Investment & Integration Challenges: Requires medium to long-term investment and may not suit all current operations.
- Changes in Business-Customer Relationships: Some clients may prefer human interaction, affecting company strategy.

Blockchain also depends on necessary components ensuring reliability and security:

- Nodes: Devices that store a full copy of the ledger and validate new blocks via consensus.
- Data: transactions or Information to record.
- Hashing: Distinctive digital signature generated cryptographically, sensitive to data changes.
- Previous Block Hash: Connections blocks Step by step to ensure integrity.

#### 4.1.3. Types of Blockchain (Badawi et al., 2022, 624; Zubaydi et al., 2023, 6)

- Public Blockchain: It Open to anyone for writing, reading, and validating transactions.
- Private Blockchain: Controlled by a single entity controlling validation and access Offers privacy and speed but less transparency.
- Consortium/Federated Blockchain: Controlled by a group of entities sharing control. Balances transparency, privacy, and efficiency; suitable for industries and central bank digital currencies.

#### 4.1.4. Characteristics of Blockchain (Lin & Liao 2017, 653; Badawi et al., 2022, 623)

Key elements include:

1. Anonymity: Users identified by cryptographic keys rather than personal identity.
2. Decentralization: No central node; data distributed across the network.
3. Privacy: Allows secure transactions without revealing identity.
4. Transparency: Transactions accessible to all nodes
5. Open Source: Most systems are public and accessible.
6. Independence: Node consensus builds trust.
7. Immutability: Records are immutable and tamper-proof.

## 5. Role of Blockchain in Supporting Supply Chains

Blockchain improves supply chain management through real-time tracking, transparency, cost reduction, and fraud prevention. Integration with accounting and resource management systems facilitates coordination among all parties, enhancing performance and service quality.

### 5.1. Impact on Accounting Efficiency and Anti-Corruption

Blockchain reshapes interactions by automating processes, removing intermediaries, increasing transparency, and enhancing security. It provides a distributed, immutable ledger ensuring data reliability and operational efficiency (Kamel, 2025, 191-192; Issa, 2024, 623). Key advantages include:

- Ease of use
- Reliability and security
- Collective verification
- Immutability
- Eliminating intermediaries
- Enhancing collaboration
- Risk management and duplication reduction
- Cost efficiency

### 5.2. Key Components of Supply Chain Management Systems (Hussein, 2019, 455-456)

- Logistics (transportation)
- Planning and demand forecasting
- Supplier relationship management
- Procurement
- Inventory management
- Manufacturing methods
- Order management
- Internet integration
- Supply chain information systems
- Customer relationship management
- Performance management indicators

### 5.3. Blockchain's Role in Real-Time Tracking and Supply Chain Integration

Blockchain enables transparent, real-time data sharing among supply chain members, accelerating communication, reducing errors, and fostering collaboration. This ensures the right products/services at the right quantity, cost, and quality, enhancing competitiveness and overall performance (Al-Saghir, 2020, 141-142).

### 5.4. Risks and Challenges of Adopting Open Book Accounting and Blockchain in Supply Chains

The adoption of open book accounting supported by blockchain at Iraqi Airways faces several risks:

- Technical infrastructure complexity and integration issues with legacy systems
- High development and training costs
- Security and privacy risks for sensitive financial/logistical data
- Regulatory and legal uncertainties
- Resistance to change within the organizational culture
- Ensuring reliability of data entered into open ledgers, as errors or tampering could compromise transparency and cost report accuracy (Kshetri, 2018, 85)

## 6. Practical Framework of the Applied Study at Iraqi Airways

### 6.1. Introduction to Iraqi Airways and Its Activities

Iraqi Airways is considered the largest airline in Iraq and is a member of the Arab Air Transport Union. Iraqi Airways was established in 1945 by the Iraqi Aviation Association and initially operated British aircraft. In the 1970s, the United States allowed Iraqi Airways' planes to use John F. Kennedy International Airport in New York.

Iraqi Airways was founded by the Iraqi Aviation Association (currently the Al-Farnas Aviation Club) when its administrative board decided on 18/5/1938 to invest the surplus from a nationwide donation campaign. This investment enabled the Iraqi Air Force at the time to purchase 15 Italian bombers and fighters (Breda and Savoia). The surplus, amounting to 23,000 Iraqi dinars, allowed the association to purchase three British aircraft (De Havilland Dragon Rapide), which arrived in Baghdad on 10/1/1938. The airline then began flights to both Iran and Syria, and the Iraqi Airways Department remained under the association until 1/1/1946, when it was incorporated into the Railway Authority (Al-Assaf & Al-Quraan, 2018, 125).

Iraqi Airways faces multiple challenges related to the complexity of supply chain management, particularly in an operational environment that requires high accuracy in cost monitoring and transparency in financial and administrative processes. The company’s supply chains involve purchasing spare parts, fuel management, ground services, and contracting with local and international suppliers. This highlights the importance of adopting advanced cost accounting systems and modern technologies such as blockchain to enhance performance efficiency and ensure precise and transparent tracking of operational costs.

In this context, this study aims to explore the potential integration of cost accounting and blockchain technology at Iraqi Airways, with the goal of improving transparency and efficiency in supply chains, reducing waste and unjustified costs, and supporting the sustainability of the company’s operations in a constantly evolving competitive environment

Table 1. Iraqi Airways Fleet (Passenger Aircraft).

Aircraft	In Service	On Order	Total	Options	Business Class	Economy Class	Total Passengers	Notes
Airbus A320-214	3	—	3	—	0	180	180	
Airbus A321-231	2	—	2	—	0	220	220	
Airbus A330-200	1	—	1	—	24	264	288	
Boeing 737-700	2	—	2	—	12	125	137	
Boeing 737-800	11	20	32	10	12	150	162	
Boeing 737-800	1	75	0	75	—	—	—	Used by the Iraqi government
Boeing 747-400	2	—	2	—	74	338	412	
Boeing 767-300	2	—	2	—	18	221	239	
Boeing 777-200	1	10+	11+	—	14	350	364	
Boeing 787-900	—	10+	10+	5	Not announced	Not announced	—	Delivered in 2017
Bombardier CRJ-900	6	—	6	—	0	90	90	
Bombardier Series 300	—	5	5	11	12	140	152	Delivered in 2016

Source: Iraqi Airways Fleet | Air fleets Aviation, 2017.

Table 2. Iraqi Airways Cargo Fleet.

Aircraft Type	In Service	On Order	Total	Options
Boeing 747-200F	1	—	1	—

Source: Iraqi Airways Fleet | Air fleets Aviation, 2017.

Table 3. Airlines in Iraq.

Airline	IATA	ICAO	Call Sign	Founded	Commenced Operations	Main Airports	Type	Notes
Iraqi Airways	IA	IAW	IRAQI	1945	1945	Baghdad International Airport	Government	
Ur Air	UD	UBD	URAIR	2019	2019	Baghdad International Airport	Private	
Burhan Air	-	-	-	1972	2014	Baghdad International Airport	Private	Helicopter operator
Fly Erbil	HW	BAY	HAWLER	2015	2018	Erbil International Airport	Private	
Fly Baghdad	IF	FBA	FLY BAGHDAD	2014	2015	Baghdad International Airport	Private	

Source: Khumas (2020), Insights and Reflections on Aviation Activities in Iraq with a Special Look at the Establishment of Iraqi Airways.

5.2. Supply Chains and Their Importance in Iraqi Airways

The supply chains in Iraqi Airways represent a complex set of operations and services, including the provision of spare parts, maintenance, fuel management, logistics, and ground services, in addition to coordination with suppliers, other airlines, airports, and regulatory authorities.

1. Assessing the effect of using Blockchain that supported Open book Accounting on Cost Report Accuracy in Supply Chains: The traditional supply chain system in the firm facing significant difficulties in accurately recording costs related to logistics and supplies, such as data is distributed across multiple entities, leading to discrepancies in reports and difficulties in verification. Using blockchain that supported by open book accounting intends to provide a unified, secure digital record that logs all transactions related to procurement, maintenance, fuel, and logistics in real time. This enhances the reliability and accuracy of cost reports while minimizing potential fraud and human errors.
2. Examining the Effect of Implementation on Data Update Speed and Process Transparency within the Supply Chain: Supply chains in Iraqi Airways require continual updates of information to eliminate maintenance delays or shortages of spare parts. implementing blockchain technology allows data to be updated instantly and transparently, making accurate and up-to-date information available to all relevant parties (e.g., suppliers, maintenance management, procurement management). This improves coordination and enables quicker and better decision-making within the supply chain.



- 3. Determining the level of Cost-Related Dispute Reduction Post-Implementation: Disputes regularly happen within parties in the supply chain because of discrepancies in cost information or service quality. Implementing an open book accounting system enables each party to track all financial and logistical transactions clearly, considerably reducing conflicts related to costs, delays, or service quality. Parties can refer to unified and reliable digital records for verification.
- 4. Analyzing the Economic Feasibility of Implementation through Return on Investment in the Supply Chain: Blockchain technology reduces costs associated with traditional operations, such as manual auditing, transaction verification, and dispute resolution. By minimizing the time and effort required to update data and resolve disputes, the company can achieve significant financial savings. ROI analysis will focus on costs saved compared to implementation and training expenses, in addition to indirect benefits such as improved service quality and increased partner trust within the supply chain.
- 5. Assessing the Impact of Implementing Blockchain-Supported Open Ledger Accounting on Cost Report Accuracy: Error rates in cost reports were analyzed before and after system implementation, reflecting the degree of accuracy of reports generated by adopting open ledger accounting with blockchain compared to the traditional system.
- 6. Assessing the Impact of Implementing Blockchain-Supported Open Ledger Accounting on Cost Report Accuracy: Error rates in cost reports were analyzed before and after the system implementation. This reflects the degree of accuracy of reports generated by adopting open ledger accounting with blockchain compared to the traditional system.

Table 4. The Impact of Implementing Blockchain-Supported Open Ledger Accounting on Cost Report Accuracy

Measure	Before adapting (%)	After adapting (%)	Rate of Improvement
Frequency of Error Rate in Cost Reports	12	2	83.3% decrease

The table shows a significant decrease in the error rate in cost reports, from 12% before the implementation of the blockchain-supported open ledger system to 2% after implementation, representing an improvement rate of 83.3%. This substantial improvement is attributed to the adoption of blockchain technology, which ensures that every transaction is recorded in an encrypted and transparent manner, with decentralized verification by network nodes, thereby reducing the likelihood of manipulation or human errors. Additionally, the system relies on open ledgers that allow all relevant parties to access data instantly, enhancing verification accuracy and minimizing errors in cost reporting

5.3. Measuring the Effect of Implementation on Data Update Speed and Process Transparency within the Supply Chain

The time required to update cost data and the level of process transparency were monitored. The new system provides instant automatic updates and enhances the clarity of information for all parties involved

Table 5. The Effect of Implementation on Data Update Speed and Process Transparency within the Supply Chain

Measure	Before adapting	After adapting	Rate of Improvement
Data update duration	7 days	5 minutes	Over 99% improvement
Transparency Level (out of 100)	40	90	125% increase

The table demonstrates a significant improvement in system performance in terms of data update speed and process transparency within the supply chain. The time required to update cost data was reduced from 7 days to just 5 minutes, representing an improvement of over 99%. This improvement is attributed to the blockchain-supported open ledger feature, which enables instant and secure data updates. Transactions are recorded directly and shared among all relevant parties, accelerating information updates and saving substantial time and effort. Furthermore, the transparency level increased from 40 to 90 out of 100, a 125% increase. This growth reflects the system’s strong capability to provide clear and real-time information, enhancing trust and collaboration among parties within the supply chain.

5.4. Determining the Extent of Cost-Related Dispute Reduction Post-Implementation

The proportion of disputes related to cost reports was measured before and after the implementation. The system helped clarify details and significantly reduce conflicts

Table 6. Determining the Extent of Cost-Related Dispute Reduction Post-Implementation

Indicator	Before adapting (%)	After adapting (%)	Decreasing Rate
Rate of Cost-Related Dispute	15	2	86.7% decrease

The table shows a significant decrease in the rate of disputes related to cost reports, declining from 15% before implementation to 2% after the adoption of the blockchain-supported open ledger system, achieving a reduction of 86.7%. This substantial decrease is attributed to the increased transparency and accuracy in data recording provided by the system, which reduces ambiguity and misunderstandings among different parties. Furthermore, decentralized verification and smart contracts ensure data integrity and facilitate transaction traceability, thereby minimizing conflicts and fostering a more collaborative and trustworthy working environment.

5.5. Analyzing the Economic Feasibility of Implementation through Return on Investment (ROI)

The costs and financial benefits resulting from the implementation of blockchain-supported open ledger accounting were analyzed over the first and second years, taking into account both initial and operational expenses

Table 7. Return on Investment (ROI).

Item	Year 1 (USD)	Year 2 (USD)	Notes
Single time System adapting Cost	200,000	—	Starting investment cost
yearly System Operation and Maintenance Cost	30,000	30,000	covers training and maintenance
Cost Savings from Monitoring and Auditing	105,000	105,000	considerable reduction in costs
Net Benefits (Savings – Cost)	(95,000) Loss	75,000 Profit	Profitable outcome after the first year
Return on Investment (ROI)	-47.50%	125%	Return on Investment improves after payback

The table shows that the implementation cost of the blockchain-supported open ledger system was high in the first year (USD 200,000 initial investment plus USD 30,000 for operation and support). Despite the net loss in the first year (USD –95,000) and a negative ROI of –47.5%, the significant annual savings in monitoring and auditing costs (USD 105,000) began to take effect. In the second year, the results shifted to a net profit of USD 75,000, with the ROI increasing to 125%. This demonstrates that investing in this system yields growing benefits over the medium term, as the initial costs are offset by improved efficiency, reduced errors, and accelerated processes, ultimately leading to increased profits and reduced waste.

Table 8. Assessing the Impact of Integrating Open book Accounting and Blockchain Technology on Efficiency and Transparency in the Supply Chain.

Measure	Conventional Situation	Situation after integration	Improvement Rate (%)	Note
Efficiency of supply chain management (out of 100)	55	80	45%+	Considerable increase in control and supervision capabilities
Time of Invoice Processing (days)	10	2	80% reduction	Significant Speeding up in financial processes
Percentage of Recovered Missed Costs (%)	70	95	25%+	Decrease in financial losses and increase cost recovery
Satisfaction of suppliers and partners (out of 100)	60	85	41.6%+	Enhanced collaboration and Reliability among parties
Transparency in processes (%)	50	90	80%+	More transparent work environment and improved transparency

The table demonstrates a clear improvement in several key indicators after implementing the blockchain-supported open ledger system compared to the traditional situation. efficiency of supply chain management increased from 55 to 80, representing an improvement of over 45%, reflecting enhanced control and precise monitoring through transparent open ledgers. Time to process invoices Decreased from 10 days to 2 days, an 80% reduction, significantly speeding up financial processes and minimizing payment delays. The percentage of recovered lost costs enhanced from 70% to 95%, showing a reduction in financial losses and increased effectiveness in cost control. Supplier and partner satisfaction rose from 60 to 85, an improvement of over 41.6%, reflecting enhanced collaboration and trust among parties through greater transparency and reliable information. At last, process transparency increased from 50% to 90%, an enhancement exceeding 80%, creating a understandable and more transparent work environment that strengthens the integrity and reliability of supply chain operations.

5.6. Statistical Analysis to Assess the Impact of Integrating Open Ledger Accounting and Blockchain Technology

Table 9. Estimation of the Probability Value (p-value).

Indicator	Mean Before Implementation	Mean After Implementation	Difference (After – Before)	p-value	Interpretation
Error Rate in Cost Reports (%)	12	2	–10	< 0.01	Significant and statistically meaningful decrease, clearly improving accuracy.
Data Update Time (minutes)	10,080 (7 days)	5	–10,075	< 0.01	Substantial improvement in update speed, highly significant statistical difference.
Transparency Level (out of 100)	40	90	50	< 0.01	Notable and statistically significant increase in transparency.
Cost-Related Dispute Rate (%)	15	3	–12	< 0.01	Significant reduction in disputes, indicating better cost clarity.

The results of statistical analysis show a strong and positive impact of implementing blockchain-supported open book accounting on the cost system performance at Iraqi Airways. A notable decrease in the error rate in cost reports was observed, falling from 12% to 2%, supporting the study hypothesis that integrating open book accounting with blockchain technology enhances the accuracy of accounting data. Additionally, data update time was dramatically reduced from 7 days to 5 minutes, enhancing the company's ability to make faster and more effective managerial decisions. This supports the second study objective of improving data update speed and

increasing operational transparency. Moreover, the transparency level increased substantially from 40 to 90 points, confirming that the implementation improves the clarity of operations and cost reports. This, in turn, contributed to a reduction in cost-related disputes, which declined from 15% to 3%, supporting the study hypothesis that this integration reduces financial conflicts resulting from ambiguity or errors in cost reporting. Altogether, these results Confirm the study’s main hypothesis showing that implementing blockchain-supported open book accounting can notably improve the accuracy, transparency, and efficiency of the cost accounting system at Iraqi Airways

Table 10. Hypothesis Testing (Two Sample Mean Comparison Test).

Benchmark	Mean Before Implementation	Mean After Implementation	Significant difference (statistically) (p-value < 0.05)	NOTE
Error Rate (%)	12	2	Yes	Large and statistically significant difference; technology improved accounting accuracy.
Data Update Time	7 days	5 minutes	Yes	Substantial difference in update speed, enhancing rapid decision-making.
Transparency Level (out of 100)	40	85	Yes	Significant and statistically meaningful increase, reflecting higher transparency.
Dispute Rate (%)	15	3	Yes	Major decrease indicates better clarity and reduced financial disputes.

The above table show that all main indicators demonstrate statistically significant enhancements after implementing blockchain supported open book accounting. Error rates declined significantly, data update times were significantly sped up, transparency levels rose significantly, and cost related disputes were greatly reduced. These means strong evidence that the integration of open book accounting with blockchain technology enhances the accuracy, efficiency, and transparency of the cost management system at Iraqi Airways.

Table 9. Rate of relative improvement.

Indicator	Rate of relative improvement (%)	Note
Rate of Error	83.3% decrease	Considerable decline in errors, Improving data credibility.
Time of data update	Over 99% improvement	Tremendous improvement from days to minutes.
Degree of transparency	112.5% increase	Transparency almost doubled, Enhancing trust among parties.
Rate of disputes	80% decrease	Reduction in disputes reflects greater stability in accounting operations.

The table shows the significant relative improvements for all critical indicators following the implementation of blockchain supported open book accounting. Error rates declined substantially data update times were drastically reduced, transparency levels nearly doubled, and cost related disputes were significantly reduced. These results collectively show that the integration of open book accounting with blockchain technology has a profound positive impact on the accuracy, efficiency, and reliability of the accounting and supply chain processes.

Table 10. Correlation Analysis between Transparency and Supply Chain Efficiency.

Relationship	Coefficient of correlation	Degree of Correlation	Note
Transparency ↔ Efficiency	0.85	Strong	Strong positive correlation; increased transparency is accompanied by a significant improvement in efficiency.

The above analysis shows a strong positive correlation between transparency and supply chain efficiency. This means that as transparency within the system increases, the efficiency of supply chain operations also improves significantly. Implementing blockchain supported open book accounting enhances transparency that in turn facilitates to more effective and reliable supply chain management.

6. Conclusions

1. The study presented that implementing a blockchain supported open book accounting system causes a significant enhancement in the accuracy of cost reports with the error rate decreasing rapidly from 12% to 2%.
2. The combination of open book accounting and blockchain technology cause reducing data update time from a number of days to just a few minutes, improving the speed of managerial decision making.
3. The application raised transparency in the supply chain from 40 to 90 points indicating higher clarity in operations and cost reporting.
4. The system has been reduced cost associated disputes from 15% to 3% contributing to more reliable relationships among stakeholders and optimized partnership.
5. The study presented obvious economic viability for investing in this system, achieving a profitable outcome on investment after the first year, with estimated increased profitability over the medium term.

## 7. Recommendations

1. Urge organizations specifically in the aviation field, to apply open book accounting and blockchain technology to enhance the accuracy and efficiency of cost operations.
2. Provide tailored training sessions for employees to enhance understanding and ability to apply the new approach effectively.
3. Strengthen technological infrastructure to facilitate the integration of blockchain with existing accounting systems and ensure continuous operations.
4. Apply change management plans to reduce employee resistance and ensure a seamless transition to the new system.
5. Execute periodic evaluations of the open book accounting system to ensure ongoing performance and the achievement of desired objectives.

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