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SMARTER
EXPERIENTIAL LEARNING TOOLS

Blockchain & Supply Chain

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Blockchain Essentials

The Evolution of Information Management

Section Overview

Objective.

- Understanding of blockchain technology.

Goals.

- Comprehend blockchain functionality.
- Recognize it as a secure, decentralized solution.
- Identify when simpler solutions are sufficient.

Steps.

- Private ledgers.
- Centralized and decentralized solutions.
- Distributed ledgers and consensus protocols.

Information / Data Management

Scope: Collection, storage, processing, optimization, utilization.

Issues: Centralization, security, transparency, efficiency.

Focus:

- **Transactions**: actions that change the state of the system = transfer of data / value between participants of the network.
  - e.g. financial transactions, asset transfers, or contractual agreements
- **Automation**: smart contracts automatically execute operations / logic when conditions are met, ensuring transparent and reliable operations.
- **Security**, **integrity**, **transparency** and **trust.**

Example: *Transactions and payments*

Community of users

Alice, Bob, Charlie, …

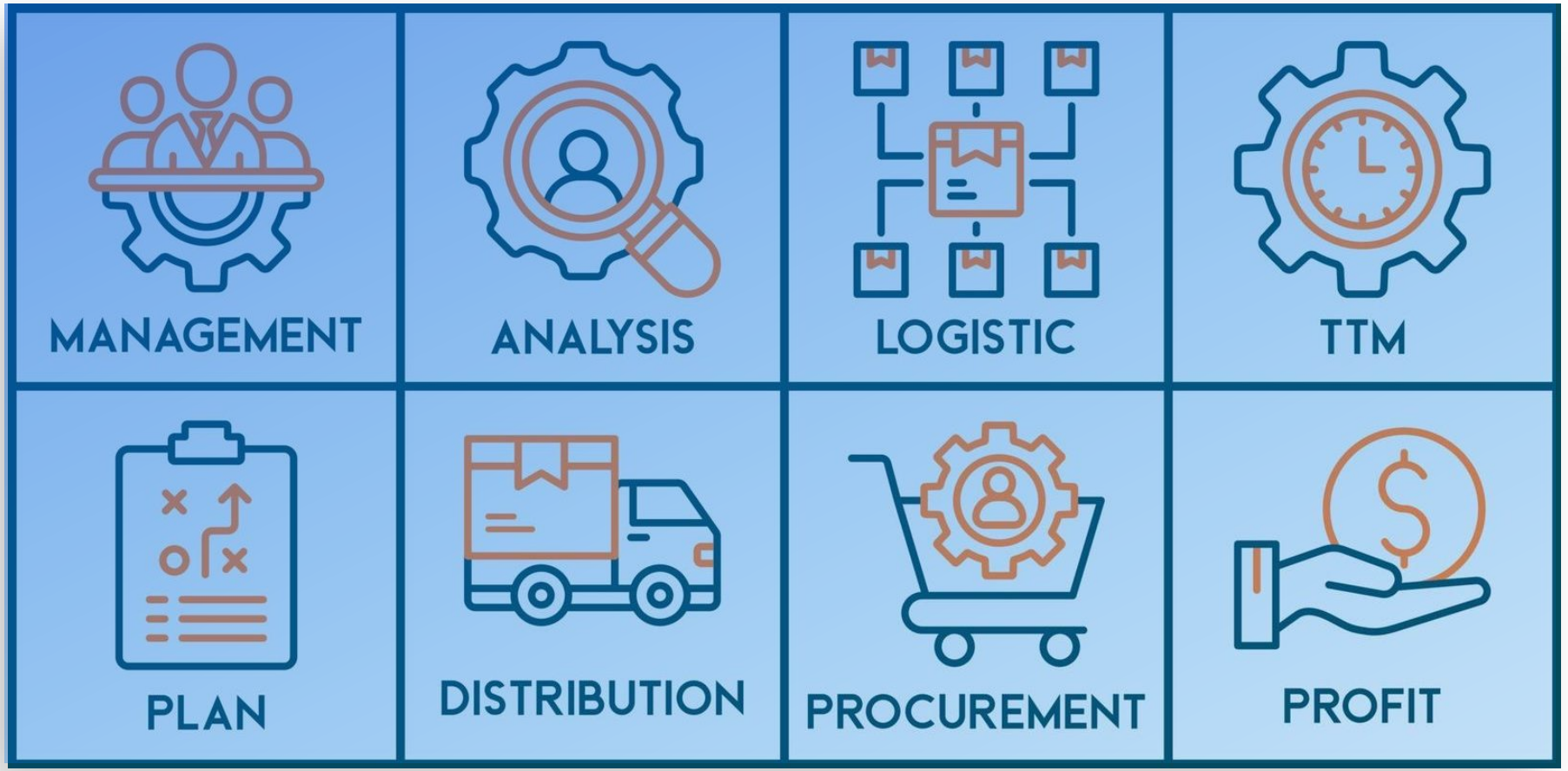
Transaction system

Exchange agreements

Accounting / payment

Credit, debit, balances

Example: *Supply Chain Management*

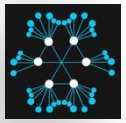


Evolution - Scenarios

01 **No sharing**

02 **Centralization**

03 **Decentralization**



04 **Distribution**

05 **Blockchain**

Scenario 1: *No sharing*

Protocol: Participants manage their own records without sharing any information, not even receipts.

Problem: Lack of verifiable collaboration

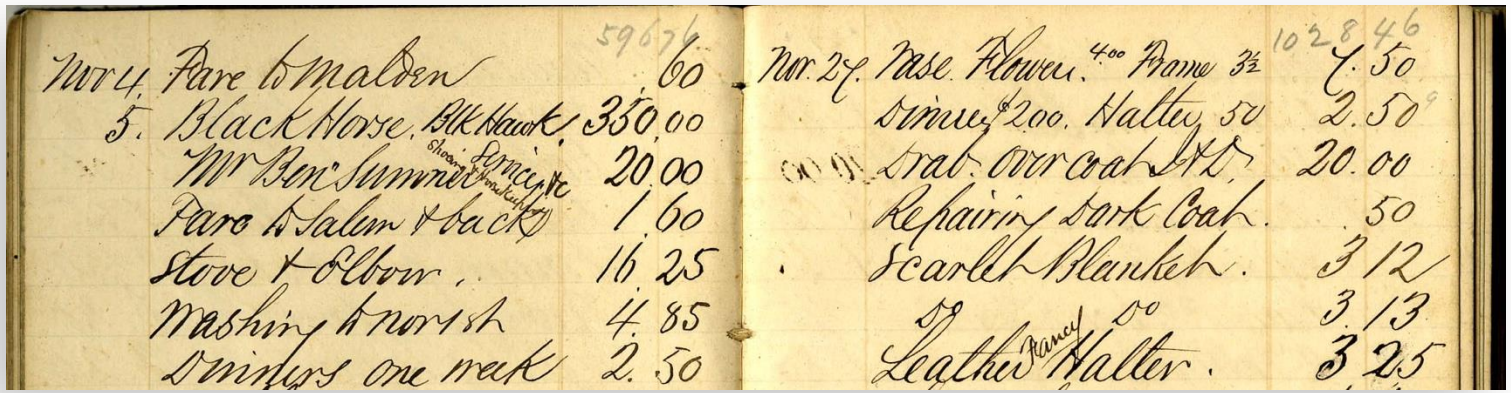
- **Inconsistency**: potential discrepancies.
- **Mistrust**: no independent record verification; potential disputes.

Alternative: Centralization → central copy / authority.

Scenario 2: *Centralization*

Approach: Central authority maintains a consistent single record, eliminating discrepancies and building trust.

Examples: Banking systems, government databases, corporate systems, commerce platforms, etc.

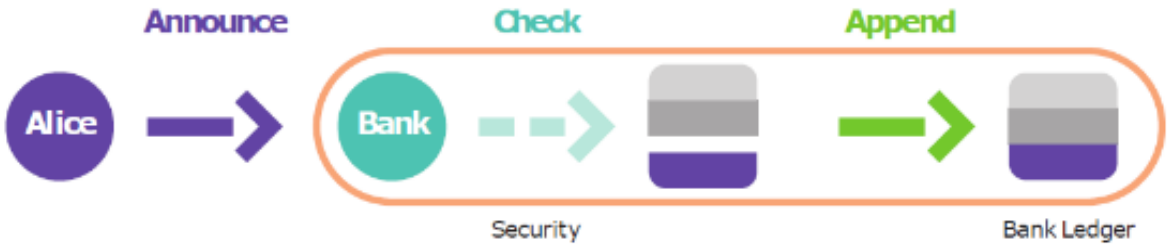


Centralization: Protocol

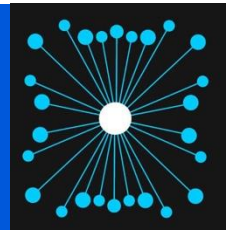
Announce: Users announce their transaction intentions to the central authority.

Check: Central authority verifies the transaction, i.e. authentication and enough funds.

Append: Central authority records the transaction in the (single) ledger.



Centralization: Problems

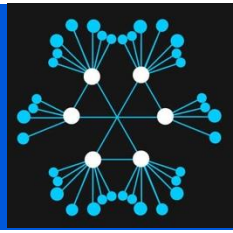


Problems:

- **Dependency**: Reliance on a single point of failure.
- **Trust**: Users must trust the central authority to accurately verify and record transactions.
- **Control**: The central authority can impose restrictions, fees, limit the efficiency, or manipulate records.

Alternative: Decentralization → community copy / multiple validators.

Scenario 3: *Decentralization*



Approach: Community ledger and multiple validators, reducing the risk of a single point of failure and increasing trustworthiness.

Examples: Cloud-based collaboration platforms, e.g. Google Docs and Microsoft Sharepoint, multi-party databases, joint accounting.

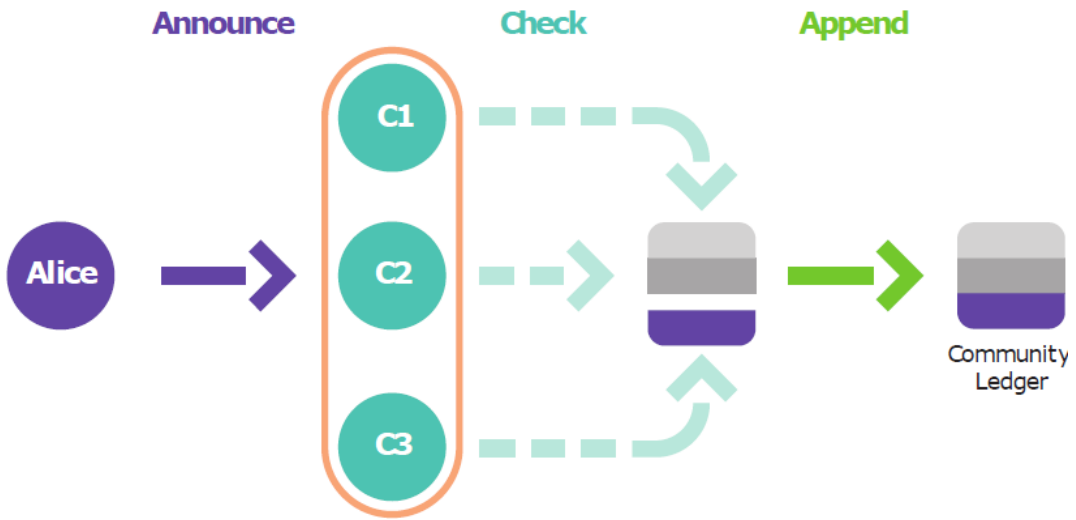
Decentralization: Protocol

Announce: To all validators.

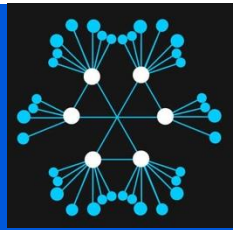
Check: All validators independently verify the transaction.

Append: They reach a **consensus** (e.g. majority) on:

- The validity of the transaction.
- Who is to record the transaction in the (single) ledger.



Decentralization: Problems

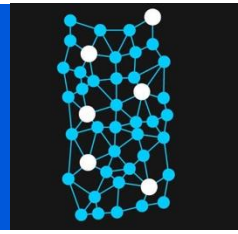


Problems:

- **Security**: Although improved, a group of validators could still collude to manipulate records.
- **Efficiency**: The consensus process can be time-consuming and resource-intensive.
- **Privacy**: Multiple validators can see all transaction details, potentially compromising user privacy.

Alternative: Distribution (multiple copies) and cryptography.

Scenario 4: *Distribution*



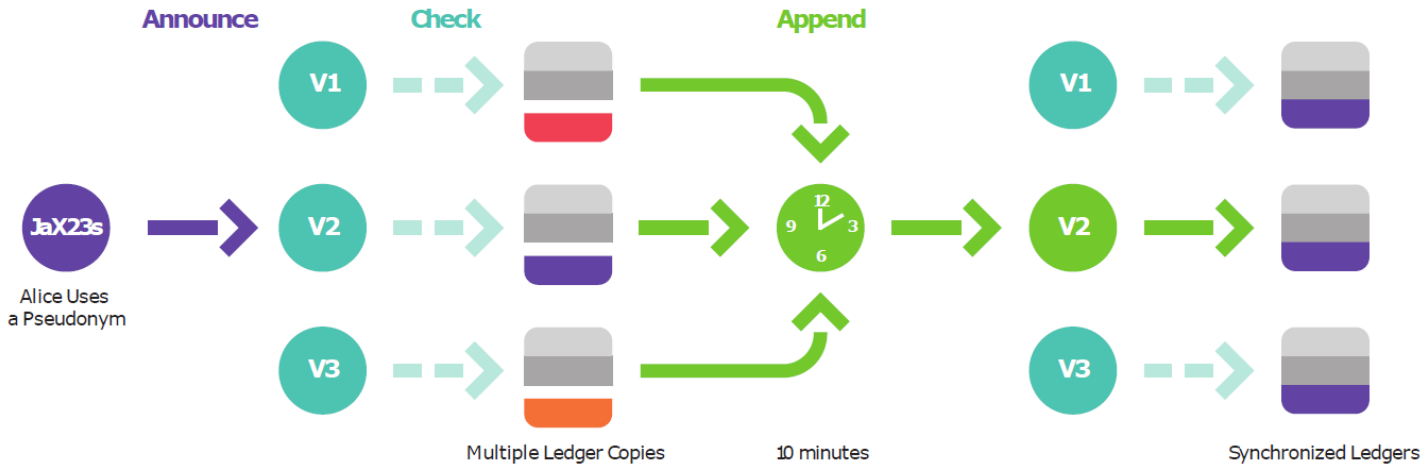
Approach: Each validator maintains a copy of the ledger, enhancing security, distributing the workload, and reducing the risk of collusion; cryptographic techniques protect privacy, prevent manipulation and ensure authentication.

Examples: Peer-to-peer lending platforms, collaborative data networks.

Distribution: Protocol

Announce: Users (pseudonym) send digitally signed transactions to all validators.

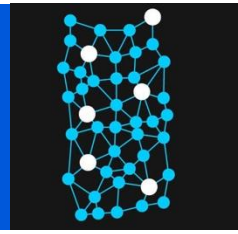
Check: Validators select pending transactions and verify them.



Append: Every certain time (10 min eg.) a validator is chosen to add the transaction:

- Communicate the updated copy (length +1) to the others.
- Upon reception, **longer** copies replace shorter ones.
- The chosen validator receives a reward → community **currency**.

Distribution: Problems



Problem:

- **Subversion**: Malicious validators can create and communicate longer ledgers, corrupting the protocol.

Alternative: **Proof of work** (in general, proof of participation) and block chains.

Scenario 5: *Blockchain*

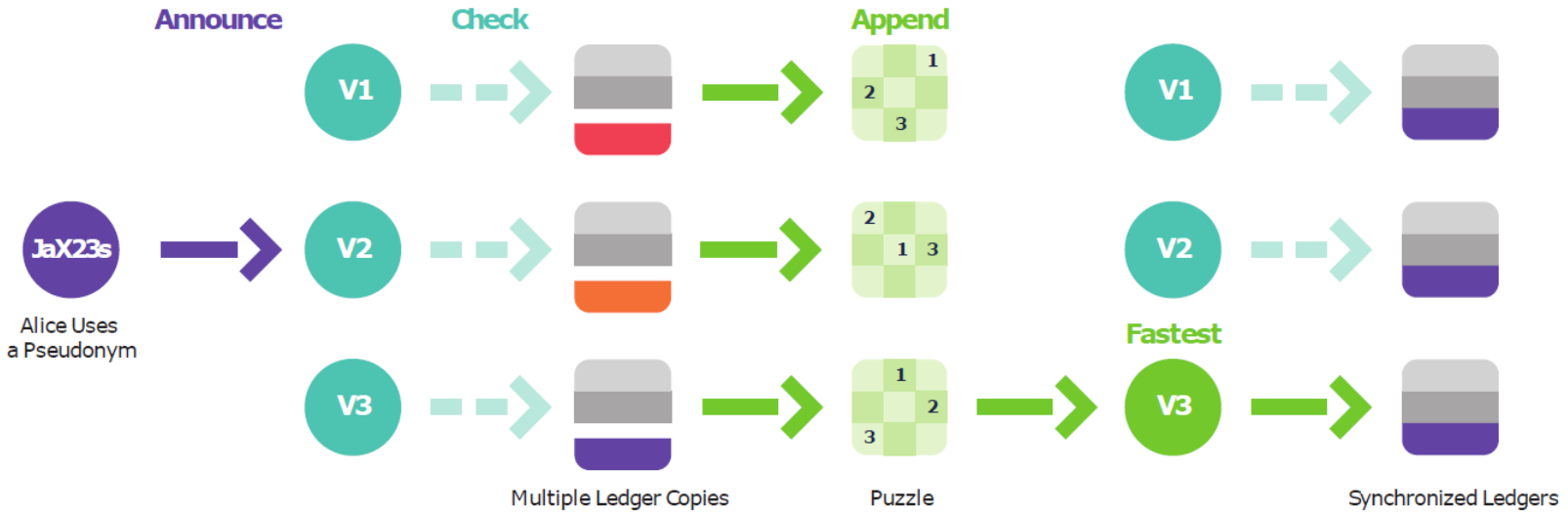
Approach: Proof of Work (PoW) requires validators to solve complex cryptographic puzzles to add blocks (of transactions), making valid and verifiable modifications difficult to achieve but easy to verify. Block chains link each new block to the previous one, ensuring the integrity and immutability of the entire ledger.

Examples: Bitcoin, Ethereum, Hyperledger Fabric, GoChain.

Blockchain: Protocol

Announce: No change.

Check: Validators verify pending transactions and group them into a block.



Append. PoW consensus:

- Validators work on solving (difficult) puzzle that includes some information of the previous block. Once solved, it includes the solution within the block and append it to the end of the ledger; communicates the +1copy to the others.
- Upon reception, PoW is checked (easy) and +1copy replaces shorter ones.
- The wining validator receives a reward → community currency.

Blockchain: Problems

Problems:

- **Forking**: Two validators may solve the puzzle *simultaneously*, creating two competing chains of the same length. Due to the longest chain rule, such forks are unlikely to persist.
- **Attacks**: 51%, sybil, double-spending, etc. Achieving majority control is extremely difficult, maintaining the blockchain's integrity and trustworthiness.
- **Resource Intensity**: PoW consumes significant energy. Alternative consensus mechanisms, e.g. PoS or PoA, eliminate the need.

Blockchain: Smart Contracts

Information: Blockchain ensures secure, immutable, and verifiable storage. Distributed ledger provides a tamper-proof record.

> *Example*: Supply chain - supplier, logistics provider, and retailer record updates on a shared ledger.

Logic: Combine operations and logic with information, enhancing functionality and reducing discrepancies. Smart contracts execute automatically based on pre-set rules.

> *Example*: Supply chain - implement a discount system based on agreed conditions among parties.

Key Takeaways

Evolution of Information Management

Progressed from private ledgers to centralized, decentralized, and distributed systems, improving verification, security, and efficiency.

Benefits of Blockchain

Security is enhanced with cryptographic techniques. Transparency is achieved through immutable ledgers. Efficiency is increased by consensus mechanisms like PoW and PoS.

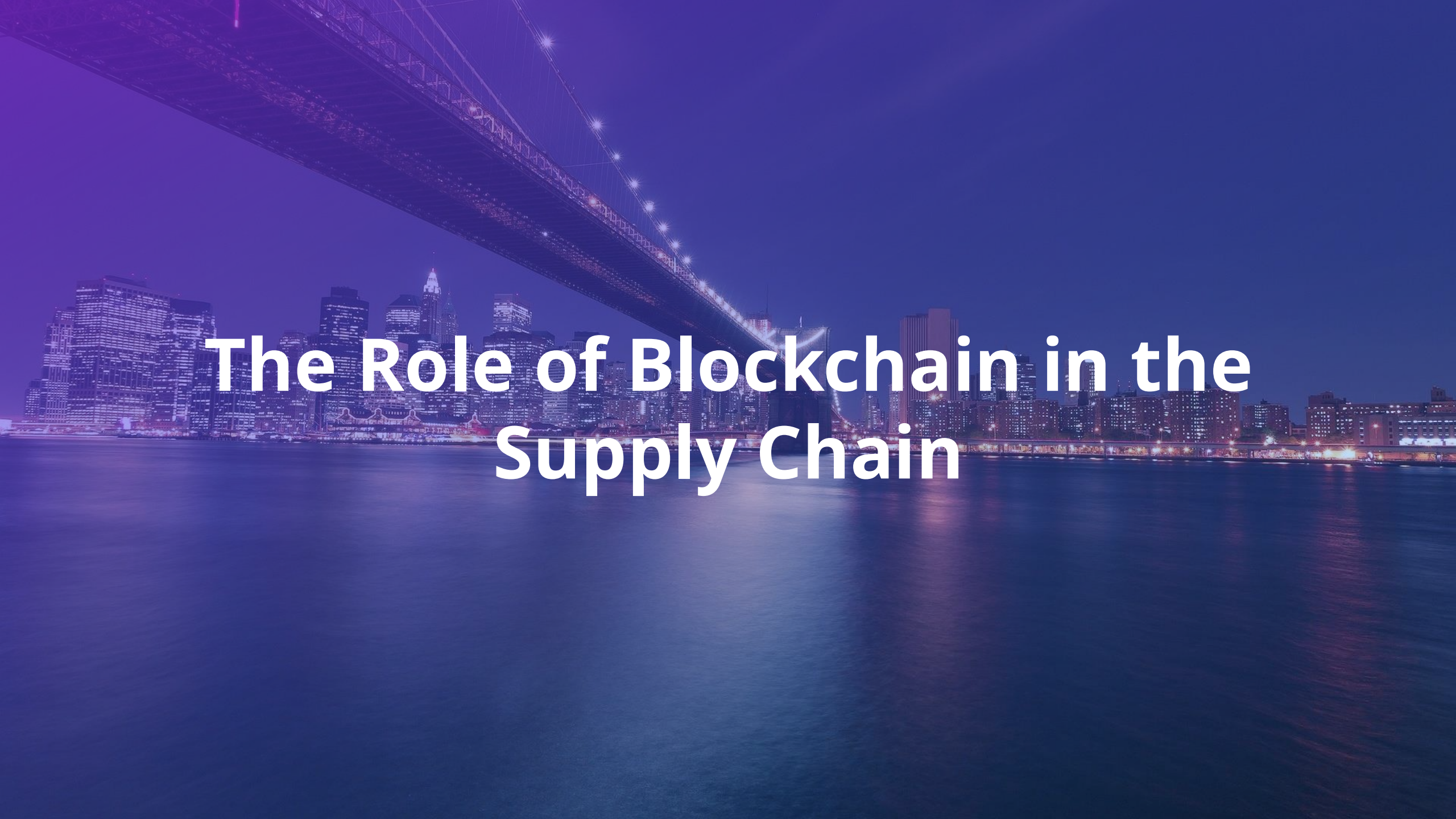
Key Takeaways

Smart Contracts

Combine data and logic for automated operations, enhancing transparency and reliability, particularly in supply chain management.

Simplicity vs. Complexity

Complex systems are not always necessary; simpler solutions can suffice depending on specific needs.



The Role of Blockchain in the Supply Chain

Section Overview

Objective.

- Understand the role of blockchain in transforming supply chain operations.

Goals.

- Gain insights into current challenges in supply chain planning and execution.
- Learn how blockchain technology provides secure, transparent, and efficient solutions.
- Examine real-world examples where blockchain is driving innovation in supply chain processes.

Steps.

- Supply chain insights.
- Blockchain's potential impact on the supply chain
- Real examples of Blockchain for the supply chain.

Supply Chain Insights - *Gartner, 2024*

In an ever-evolving world of constant uncertainty and disruptions, the ability to make intelligent decisions becomes the ultimate winning strategy for generating value. **Supply Chain Planning leaders** must elevate their role to be “decision shapers”, steering and driving the organization’s most critical business decisions.

Supply Chain Insights - *Gartner, 2024*

Supply chain planning leaders spend endless hours establishing and improving planning processes with a strong focus on process discipline and technology enablement. Achieving planning excellence requires a **substantial cultural shift** as most stakeholders view planning as hard or impossible due to increased uncertainty and fail to recognize that planning is about managing uncertainty, not trying to eliminate it.

Supply Chain Insights - *Gartner, 2024*

Supply Chain Planning transformations are the catalysts to drive resiliency and embrace agility. Most of the organizations today have embarked a journey of organizational transformation, digital transformation, or both. Yet, only a few achieve the full expected ROI and even less who sustain benefits over time.

Then, Blockchain in Supply Chain?

1 Transparency and Traceability in Real-Time Product traceability

- Blockchain makes it possible to trace every step of a product from its origin to the final consumer. This is key in sectors such as food, pharmaceuticals or fashion.
- Shared visibility: All parties involved (suppliers, manufacturers, distributors, retailers) have access to the same up-to-date information, reducing disputes and fraud.

Then, Blockchain in Supply Chain?

2 Security and Fraud Reduction

- Unalterable data: Once the information is recorded in the blockchain, it cannot be modified without leaving a trace, which protects against malicious alterations.
- Counterfeit prevention: Very useful in luxury products, electronics and medicines, guaranteeing authenticity.

Then, Blockchain in Supply Chain?

3 Operational Efficiency and Cost Reduction

- No intermediaries: Smart contracts automate processes, reducing the need for third parties and speeding up payments, quality verification or goods release.
- Digital documentation: Less paperwork, fewer human errors and streamlined processes.

Then, Blockchain in Supply Chain?

4 Sustainability and Social Responsibility

- Evidence of ethical practices: Consumers and regulators demand more sustainable supply chains. Blockchain enables proof that products come from responsible sources.
- Regulatory compliance: Facilitates audits and certifications, helping to meet international standards.

Then, Blockchain in Supply Chain?

5 Resilience and Risk Management

- Rapid response to problems: If a problem arises (e.g., contamination in a batch of food), blockchain helps to quickly identify and isolate the source.
- Supplier diversification: Provides a secure network to integrate new suppliers in case of disruptions.

Then, Blockchain in Supply Chain?

6 Integration with Other Technologies

- IoT + Blockchain: IoT sensors automatically record data such as temperature, humidity or location on the blockchain, ensuring that the information is reliable and in real time.
- AI for Prediction: Artificial intelligence can analyze blockchain data to anticipate problems or improve decision making.

Blockchain for Supply Chain

Let’s see some examples…

Questions from examples

Q

What do you think managers consider the benefits of blockchain in their companies?

Q

Which are the differences with previous technology?

Supply Chain Digitalization

AntChain’s Blockchain-as-a-Service (BaaS): Digitizing Industry Collaboration.

AntChain and Duduhuandian

Blockchain Integration in Battery Swap Operations

- The battery swap company Duduhuandian (“Dudu Battery Swap” in Chinese) has integrated operational data from its batteries onto the blockchain.
- Recyclers gain access to comprehensive health data of batteries without requiring individual disassembly, thereby increasing the batteries’ market value.
- Financing and leasing institutions, leveraging this blockchain-verified data, have extended an operational lease loan of 20 million yuan, significantly reducing overall financing costs for the company.

AntChain and the GSBN

Blockchain in Maritime Trade

- The Global Shipping Business Network (GSBN) has implemented blockchain technology to facilitate the exchange of electronic bills of lading (eBL) among stakeholders in international maritime trade.
- The blockchain platform assures the authenticity of both the eBL content and its circulation, thereby simplifying operational procedures and enhancing collaborative efficiency.
- By the end of 2023, GSBN had successfully facilitated the issuance of over 120,000 electronic bills of lading.

AntChain and Trusple

Advancing Global Trade Finance

- Ant Group has introduced Trusple, an innovative digital platform designed to facilitate international trade and finance using blockchain technology.
- Primary objectives.
  - To enhance the speed, safety, and efficiency of global trade finance processes.
  - To mitigate traditional inefficiencies by digitizing order management, thus reducing paperwork and streamlining shipping and payment procedures.
- The platform digitizes orders and transactions, replacing conventional paper-based systems.
- Its blockchain infrastructure ensures transparency and traceability, which are critical for maintaining authentic and verifiable records, thereby strengthening risk management practices.

AntChain and Trusple

Strategic Partnership and Global Trade Implications

- BNP Paribas has joined as a strategic banking partner, contributing its robust global digital financial infrastructure to the initiative.
  - This partnership facilitates enhanced access for SMEs to international trade, leveraging advanced digital solutions to overcome traditional barriers.
  - The integration of Ant Group's technological innovation with BNP Paribas' extensive financial networks underscores a synergistic approach to modernizing trade finance.
- The collaboration is anticipated to promote more efficient and secure trade flows, particularly between France and China, thereby fostering international economic integration.
- It exemplifies how the convergence of blockchain technology and strategic financial partnerships can redefine the paradigms of global trade.

Questions from examples

Q

What are the main needs that vendors must cover?

Q

How consumers have to address those needs?

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Thank you!
Questions?

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