Unit-5

5.1 Supply Chain Management

Blockchain in supply chain management uses blockchain's decentralized, trusted, distributed ledger technology to provide transparency and traceability of transactions within a supply chain. Typically, a permissioned blockchain is used in a supply chain, meaning that users must be members of the relevant blockchain consortium or invited by a member. Each transaction is recorded within a block in the chain, creating a secure and trustworthy record of exchanges between parties. Once written, transactions can't be changed. Any attempt to alter records will be discovered since multiple copies of the transaction are recorded. Blockchain use reduces fraud and increases efficiency by providing real-time visibility of goods as they move through the supply chain.

For supply chain management, blockchain can be an ideal tool and provide additional valuable benefits, including the following:

- The ability to verify the authenticity of products, track items from origin to destination, and ensure compliance with controls such as storage temperature and humidity.

- Validated data that can be audited by multiple parties means fraudulent updates or errors are reliably caught.

- Smart contracts automatically execute payments at agreed-on milestones, such as delivery of items in good condition, helping with cash flow.
  One interesting use case is tokenized assets, where digital tokens are combined with a blockchain to authenticate ownership of physical or digital assets, such as gems, real estate, and intellectual property. Each token acts as a digital certificate linked to a specific portion of the underlying asset.

- Companies are also using blockchain-connected scanners that can read barcodes, RFID tags, or other identifiers just like a standard scanner. But instead of simply storing data, scanned information is transmitted to a blockchain for precise tracking of an item's journey through the supply chain.

Key Takeaways
- Blockchain creates and maintains a digital ledger where new records can be added in cleartext or securely using an irreversible encryption technique called one-way hashing. Blockchain ledgers may be audited to ensure authenticity.

- Supply chain security benefits from blockchain's shared access to authoritative data. This builds trust and helps prevent fraud.

- Blockchain can already integrate with other technologies in use throughout supply chains, including scanners and Internet of Things (IoT) devices. Potential innovations include integrating blockchain with technologies such as digital identity authentication.

- Integrating a blockchain comes with human challenges, including putting labeling processes in place and getting all stakeholders to adopt the technology uniformly.

Blockchain for Supply Chains Explained

Before diving into the specifics of blockchain for supply chains, it's important to understand how blockchain works. Simply put, a blockchain consists of blocks of records, linked together and stored in multiple locations to create an unalterable ledger that's readable by authorized parties. Attempts to tamper with records are easily detected, so data stored in a blockchain can be considered truthful.

With that in mind, consider how useful blockchain might be in your supply chain. For example, procurement managers often go through many steps while tracking goods and services. These processes involve multiple parties, usually at multiple locations. If they all update a blockchain as they perform their parts of the process, transparency is an inherent benefit.

And the accuracy and security of blockchain means every party will be on the same page and relying on the same information. This helps minimize disruptions and errors, and if something does go wrong it's easy to discover when and where the problem occurred.

Why Use Blockchain for Supply Chain Management?

In many ways, blockchain is an ideal fit for supply chain management. Blockchain technology allows for a tamperproof and decentralized record of transactions, making it easier to track and verify the condition of goods as they move through the supply chain. Blockchain technology brings inherent security and traceability, all while providing a data source that's readable by all parties. Common supply chain issues, including late updates, miscommunication, or faulty authentication, are minimized.

Blockchain can help prevent fraud and errors, reduce paperwork, improve cash flow with automated payments as milestones are met, and overall provide a reliable system for tracking goods from production to delivery. That makes it a worthwhile investment in an organization's operational infrastructure.

Blockchain Capabilities in Supply Chains

For a supply chain, blockchains provide transparency, security, traceability, and visibility. These deliver both direct and indirect benefits by minimizing risk and connecting third-party stakeholders in the supply chain process.

Key capabilities include the following:

Enhanced Traceability

Blockchain's public ledger provides a product's provenance, tracking it from start to finish. With a single ledger recording transactions for all stakeholders, a blockchain maximizes

visibility by creating transparent updates at each stage of the supply chain. This enhanced traceability ensures each record retrieved is unaltered, while also providing up-to-the-minute notice of delays, damage, or other issues that require quick recovery plans.

Smart Contracts in Supply Chains

Because the blockchain's ledger shows all stakeholders when each step occurred, it can integrate with smart contracts that automatically execute actions called for in the contract when certain terms and conditions are met. Using blockchain in conjunction with smart contracts reduces disputes about milestones and contract terms being executed.

Supply Chain Security

A blockchain addresses security by using one-way hashing and recording transactions on multiple systems; this ensures that data is, for all practical purposes, unchangeable. One-way hashing creates a unique signature that's stored with data in the public ledger. If the data is changed, the signature won't match when the hash is recalculated, and the owners of the blockchain will be notified. If both the hash and the data are changed, then copies of the ledger won't agree with one another. At least three public ledgers are kept, so altering one will flag a problem and two good entries will still be intact. Altering every public ledger is a very difficult task.

Furthermore, timestamps are baked into the hash and linked to the previous entry in the blockchain, again making it practically impossible to falsify ledger entries. All of this makes for optimized authentication, which limits opportunities for real-world security risks, such as supply theft and substitution of counterfeit items.

How Is Blockchain Used in Supply Chain Management?

Blockchain can be a game-changing tool in supply chain management. It provides transparency, accountability, and an irrefutable record of transactions as goods and services move along the supply chain. For example, a contract might release payment to a shipping company upon confirmation of delivery at the designated location.

Prime examples of how different industries use blockchain for their supply chain management include the following:

Logistics and Shipping

Blockchain provides a transparent and secure way to follow goods from initial packing to loading to movement through various transportation hubs, vehicles, and warehouses—that level of end-to-end tracking is particularly important and often difficult for global stakeholders.

In addition, for sensitive materials, such as medications, blockchain allows for faster, more secure monitoring compared with traditional processes. You can ensure items were kept at a constant temperature and not substituted with counterfeit goods. This is why companies including FedEx and UPS are exploring blockchain to expand their offerings and enhance transparency in shipping and delivery processes.

Healthcare

The healthcare industry comes with unique supply chain management challenges, including control of regulated materials, such as prescription drugs, and special shipping requirements, such as refrigeration. Blockchain offers a fast and secure way to verify these requirements are met from production through to the consumer. Medical devices and materials that originate all over the world can use blockchain to unify reporting on extremely complex shipping processes and compliance with various regional laws and regulations.

Manufacturing

Manufacturing processes often come with complex supply chains, sometimes with unavoidable single points of failure. Getting suppliers to use blockchain to verify and track the movement of goods can help manage that complexity. By its nature, blockchain provides the visibility and traceability that conventional tracking systems lack, limiting the diversion of materials and components, reducing counterfeits, and helping ensure compliance with standards. And using smart contracts that execute payments as milestones are met can give stakeholders a strong incentive to participate.

Blockchain for Supply Chain Benefits and Challenges

Blockchain represents a major change in how supply chains work. Because blockchain records transactions onto a single ledger, for example, it closes the visibility and accountability gaps that naturally arise with ad hoc supply chain management systems. At the same time, adding a blockchain can be a resource-intensive commitment because it requires that all participants modify their existing systems and processes.

The following are some of the most common benefits and attendant challenges of adding blockchain to a supply chain:

A single, publicly readable transaction ledger. Current supply chain management systems may rely on dated technologies and processes that exacerbate lag time, human error, and other issues because they often lack standards for data exchange. Blockchain provides an agreed-on format and mechanism that lets all parties see and update the most recent information possible once they adopt the technology.

Verified transactions. In blockchain for supply chain management, there's no need to use third parties, such as financial institutions, to verify transactions. Because an encrypted and publicly accessible ledger exists, transactions are secure and visible to every participant in the supply chain—again, as long as they use the technology.

Traceability with permanence. Blockchain ledgers are permanent and unchangeable, so any issues within the supply chain can be easily traced back to their origin. Companies can know exactly which lots of food or medical items need to be recalled, saving money. Questions about the provenance of any item can be answered authoritatively.

Supply chain accuracy. Blockchain provides a better way to record documents. However, the participants or a third-party standards group must determine how documents are formatted and what information they include. To date, no common standards exist for supply chain management. Where blockchain is presently used, the initiative is often driven by very large companies that set up rules, including document formatting and content. Accuracy will be only as good as the specifics of what documents must show.

Quick updates. When the work is done to set it up properly, it's inexpensive and easy to add documents to the blockchain ledger. That encourages quick and highly visible updates that show the status toward achieving goals on the way to fulfilling more significant milestones.

Integration with Emerging Technologies

Not that long ago, blockchain was the hot new tech trend, underpinning IT industry innovations like cryptocurrency and NFTs. Now that blockchain has become more established, the next step in its evolution is integration with other technologies that are helping organizations improve their operations. Fortunately, AI, IoT, and other technologies offer capabilities that complement blockchain. By combining them, supply chains will benefit from better and more automated workflow documentation.

Blockchain and IoT Integration

IoT devices generate massive amounts of data. Think about, for example, IoT sensors on containers. Here's how blockchain integration might work: A container with, say, fresh dairy has sensors that continually take temperature readings and track how long items have been in transit. The collected data is securely transmitted to a blockchain and stored on a distributed ledger across multiple nodes, ensuring immutability. Authorized participants in the blockchain can track the shipment with confidence. Meanwhile, smart contracts on the blockchain could be triggered by data events from IoT devices, automating actions or transactions, such as payment to a trucking company for getting fresh milk from dairy to plant quickly. This helps ensure product quality.

AI with Blockchain in Supply Chains

For more complex supply chains, AI excels at analyzing vast amounts of collected data to identify patterns; predict problems, such as equipment failure; and optimize processes based on real-time information. By combining AI's predictive capabilities with blockchain's secure data sharing, companies can improve the entire supply chain. Take our dairy delivery. AI could correlate data, such as the last time the cooling system was serviced along with a forecasted spike in temperature, to recommend using a different delivery vehicle. In addition, blockchain's decentralized nature means it scales well, so it can provide timely data for analysis and for AI systems to use to trigger actions as milestones are met, such as sending notifications for delays or executing terms of smart contracts.

Blockchain and Future Technologies in Supply Chains

As it stands, blockchain offers new opportunities to enhance technologies like AI and IoT in supply chain management. New uses, such as the tokenization of goods, can create even faster transactions and greater transparency through digital representations of physical assets. Blockchain can empower consumers to learn about the products they purchase. Imagine enabling an end customer to scan a QR code on a product to access a detailed history on the blockchain, revealing the origin of materials and the carbon footprint of shipping, among other information.
Blockchain is already used to track currencies. For trading partners, it could facilitate secure peer-to-peer transactions, letting companies access financing on a decentralized platform and opening new expansion opportunities for smaller businesses.

Blockchain in Supply Chains: Case Study

Consider Tracifier, a German startup providing supply chain traceability solutions. Tracifier's offerings include verification and tracking across the supply chain. In particular, the company sought to make it easier to track, trace, and verify food products—where they originated, when they were produced, and the relevant safety standards and inspections.
Tracifier saw a path to this through blockchain technology and integrated Oracle Blockchain into its supply chain management database. The company then launched a transparent and immutable digital ledger that authenticated the validity of transactions and records. For customers, the blockchain ensures reliable and accessible data for every step. Smart contracts, process automation, and greater transparency helped Tracifier's customers reduce food processing costs by up to 40%. In addition, Tracifier saw its own operational improvements with greater efficiency, fewer delays, and reduced costs.
Oracle has innovative tools to help your organization integrate blockchain and, like Tracifier, make the most out of your supply chain management solution. Find out how Oracle can support bringing blockchain into your supply chain process.
Blockchain technology is evolving, and its potential applications in supply chain management are constantly expanding. As blockchain technology matures and integrates further with AI, IoT, and other innovations, we can expect even more groundbreaking applications to emerge and transform the future of supply chain management.