

Implementation of Blockchain Technology in Supply Chain Management Systems for the Gems and Jewellery Sector

Introduction

The jewelry industry is driven by the beauty and emotional connection associated with exceptional pieces, which rely on conflict-free sourcing, fair labor practices, and authenticity. However, it faces challenges such as convincing fakes, misleading claims, and fraudulent activities. To address these issues, innovative solutions such as blockchain technology are being integrated into the jewelry trade.

With the implementation of blockchain, a future is envisioned where customers can trace the entire journey of a piece of jewelry, from its inception to production, with a simple click on their mobile devices. The transparency and verification systems provided by blockchain technology enhance trust and significantly reduce fraud, whether it's related to insurance claims or counterfeit products. By creating immutable records and safeguarding valuable items through blockchain, manufacturers and brands can authenticate their products and ensure ethical practices.

This integration of disruptive technology in the jewelry industry not only promotes socially responsible transactions but also safeguards reputation and fosters personal connections between brands and customers. The industry is embracing blockchain technology to create value for customers while reducing costs. In doing so, it aims to establish a modern world where everyone benefits.

Real-Life use cases that can be implemented in the industry

1. Supply Chain Transparency:

Blockchain enables the recording and sharing of information across the supply chain, including details about gemstone extraction, manufacturing processes, certifications, and ownership transfers. This transparency helps stakeholders, including consumers, verify the authenticity, origin, and ethical practices associated with a product, reducing the risk of fraud, counterfeit products, and unethical sourcing.

2. Provenance Verification:

By recording the history and journey of gemstones on the blockchain, consumers can trace their origin, including mining location, cutting, polishing, and certifications. This information promotes transparency and allows consumers to make informed purchasing decisions, supporting ethical sourcing and responsible practices.

3. Certification and Grading:

Blockchain technology can securely store and verify the authenticity of certificates and grading reports issued by gemological laboratories. The blockchain acts as an immutable record of the certification process, making it easier for consumers and industry participants to access and verify the accuracy and legitimacy of a gemstone's certification.

4. Ownership and Asset Management:

Blockchain can facilitate secure and transparent ownership transfers of valuable gemstones and jewelry. The blockchain records each change in

ownership, providing an auditable and tamper-proof history. This simplifies the authentication and provenance verification process, supporting the resale, insurance, and appraisal of jewelry assets.

5. **Anti-Counterfeiting Measures:**

Blockchain provides a decentralized and transparent system for verifying the authenticity of jewelry products. Unique identifiers, such as serial numbers or RFID tags, can be linked to the blockchain, allowing consumers and retailers to track the product's history and ensure it is genuine. This helps combat counterfeiting and protects consumers from purchasing fake or fraudulent items.

6. **Financing and Insurance:**

Blockchain's transparent and immutable nature can streamline the process of financing and insuring jewelry assets. By recording ownership, provenance, and value on the blockchain, lenders and insurers can easily verify the details and assess the risk associated with specific jewelry items, leading to more efficient and accurate underwriting and claims processes.

7. **Ethical Sourcing and Sustainability:**

Blockchain can be used to track and verify the ethical sourcing of gemstones and materials used in jewelry production. By recording information about the mining practices, certifications, and sustainability standards on the blockchain, consumers can make conscious choices and support sustainable and responsible supply chains.

8. **Consumer Trust and Confidence:**

Through increased transparency and traceability, blockchain technology builds trust and confidence among consumers. They can verify the authenticity, quality, and ethical standards of jewelry products, leading to increased customer satisfaction, loyalty, and brand reputation.

9. **Product Recalls and Warranty Management:**

Blockchain can facilitate efficient tracking and management of product recalls and warranty claims. By recording information about the product's history, including manufacturing details, supply chain movement, and warranty terms, on the blockchain, manufacturers and retailers can quickly identify affected products, initiate recalls, and manage warranty claims.

10. **Royalty and Revenue Sharing:**

Blockchain enables transparent and automated royalty or revenue sharing mechanisms for artists, designers, and creators in the industry. Smart contracts can automatically distribute royalties based on predetermined terms, ensuring fair compensation and reducing administrative overhead.

11. **Digital Identity and Authentication:**

Blockchain can establish and manage digital identities for jewelry pieces, ensuring their authenticity and ownership. Through unique identifiers linked to the blockchain, consumers can verify the ownership and history of a jewelry item, reducing the risk of purchasing stolen or counterfeit goods.

12. **Peer-to-Peer Marketplaces:**

Blockchain technology can support peer-to-peer transactions and decentralized marketplaces for buying and selling jewelry. By removing intermediaries and facilitating direct interactions between buyers and sellers, blockchain enables secure and transparent transactions, reducing costs and increasing efficiency.

13. **Data Privacy and Security:**

Blockchain's cryptographic features enhance the security and privacy of sensitive data related to customers, suppliers, and transactions. The decentralized and immutable nature of the blockchain ensures that data is protected against tampering and unauthorized access, fostering trust and data integrity in the industry.

14. **Compliance with Regulatory Standards:**

By storing and validating compliance-related information on the blockchain, the industry can ensure adherence to regulatory standards and certifications. Blockchain technology provides a reliable and auditable source of information, simplifying compliance processes and reducing the risk of non-compliance.

15. **Product Lifecycle Management:**

Blockchain can digitize and track the entire lifecycle of a jewelry product, from raw material sourcing to manufacturing, distribution, and after-sales service. This enables efficient supply chain management, inventory tracking, and warranty management, optimizing processes and enhancing operational efficiency.

Already existing real-life applications of blockchain in the jewelry and gems industry

- **De Beers**, a prominent player in the diamond industry, has set an ambitious target to disclose the origin and impact of every diamond it discovers and sells by 2030. To achieve this goal, the company has developed a technology called **Tracr**, which utilizes blockchain and other cutting-edge technologies like artificial intelligence (AI). Tracr serves as a distributed blockchain platform specifically designed for diamonds, enabling the recording of a diamond's journey from the mine where it was sourced. Each diamond on the Tracr platform is assigned a **unique digital ID**, which allows for comprehensive tracking throughout its lifecycle. The platform records crucial information such as the diamond's sale to a sightholder, grading, as well as cutting and polishing processes. By digitally and immutably tracking this data, Tracr creates an **unalterable digital "handshake"** for every significant step in the diamond's journey. To establish the digital ID of a diamond, Tracr captures a wide range of physical and essential data points. Moreover, it employs an advanced algorithm to match a physical diamond with its corresponding digital counterpart. This process forms an immutable chain of data, which can be shared with the end retailer as evidence of the diamond's origin from De Beers. Currently, Tracr caters exclusively to the business-to-business (B2B) segment, but there are plans to develop a consumer interface in the near future. De Beers reports that the Tracr platform already registers approximately **half of its total production** at the company's rough diamond sales events, known as Sights.
- Upon discovering the remarkable 7,525-carat **Chipembebe emerald** in a Zambian mine, **Gemfields**, the mining company, made the decision to assign it an immutable digital identity using blockchain technology. To achieve this, the emerald was tagged with a distinctive **DNA 'nano-tag'** identity, developed in collaboration with Provenance Proof blockchain. This nano tag serves as a means to verify and certify that any cut and polished gems derived from the Chipembebe emerald can be traced back to this

extraordinary gemstone. The digital information pertaining to its origin and characteristics is securely stored on the blockchain, ensuring transparency and immutability.

- The **Provenance Proof Blockchain (PPB)**, developed by the Swiss jeweler **House of Gübelin**, is specifically designed for recording data related to precious stones and gems, not limited to diamonds. Serving as a digital logbook, the PPB ensures the security of recorded information by preventing any subsequent modifications and safeguarding it against data tampering. Throughout the supply chain, the PPB can record relevant data about gems and jewelry as they transition between different stakeholders. To ensure the safe storage of data, the PPB **grants visibility into the upstream supply chain data of a specific gem only to its current owner**. This means that jewelers, for instance, can track each step of the manufacturing process, document the materials used, and store various types of data such as text, photos, videos, stories, design inspirations, and visions behind the creation, all within the blockchain. By capturing this comprehensive history of the jewelry, the PPB instills trust in customers, assuring them of the authenticity of their purchase. Furthermore, the PPB has collaborated with tech company Everledger to create its own online marketplace. This platform serves traders globally, facilitating transparent transactions of gems. For example, jewelers anywhere in the world can search for transparently traded gemstones or pearls on the online marketplace and directly contact the seller. According to PPB, over four million gems and jewelry items have been uploaded to the platform, attracting more than 500 professional users, including over 120 jewelers and manufacturers, with approximately 20 of them based in India.

Challenges Faced by the Industry and their solutions by Blockchain Technology

1. Counterfeit Products:

Challenge: Counterfeit jewelry poses a significant problem in the industry, leading to financial losses for businesses and consumer trust issues.

Counterfeiters often replicate high-value jewelry items, making it challenging for buyers to distinguish between genuine and fake products.

Solution: Blockchain technology can address this challenge by providing a decentralized and immutable ledger that records the entire lifecycle of a jewelry item. Each piece of jewelry can be assigned a unique identifier that is stored on the blockchain. By scanning a QR code or accessing the identifier, consumers can verify the authenticity of a product and access its detailed history, including information about its manufacturing, distribution, and ownership transfers.

2. Lack of Transparency:

Challenge: The jewelry and gems industry often lacks transparency, making it difficult for consumers to know the true origin and ethical sourcing of the products they purchase. Additionally, the involvement of multiple intermediaries in the supply chain can obscure information and increase the risk of fraudulent practices.

Solution: Blockchain provides transparency by creating a permanent and auditable record of each transaction and movement within the supply chain. With blockchain, participants can record important information, such as the mining location, certification details, and ownership history of gemstones and jewelry. This transparent system allows consumers to make informed purchasing decisions based on verifiable and trustworthy information.

3. **Complex Supply Chains:**

Challenge:

The jewelry industry has complex and multi-layered supply chains that involve various stakeholders, including miners, manufacturers, distributors, and retailers. Tracking and verifying the authenticity, ethical sourcing, and quality of gemstones and jewelry throughout this intricate supply chain can be challenging.

Solution:

Blockchain technology offers a decentralized and shared platform where participants can record and verify each step in the supply chain. Smart contracts can automate the transfer of ownership, certifications, and quality assessments, ensuring transparency and reducing reliance on intermediaries. By accessing the blockchain, stakeholders can track and trace the movement of gemstones and jewelry, enhancing visibility and trust.

4. **Ethical Sourcing and Sustainability:**

Challenge:

The jewelry industry faces increasing scrutiny regarding ethical sourcing and sustainability practices. Consumers are concerned about the social and environmental impact of mining and manufacturing processes.

Solution:

Blockchain can enable the traceability and verification of ethical sourcing practices. By recording the origin and mining practices of gemstones on the blockchain, consumers can ensure that their purchases are ethically and sustainably sourced. Additionally, blockchain can facilitate the implementation of certifications and standards, allowing consumers to choose jewelry that aligns with their values.

Metrics for Analysis

1. Operational Efficiency:

- Transaction Speed: Measure the time taken to complete transactions or processes compared to the pre-blockchain implementation period. A decrease in transaction time indicates improved operational efficiency.
- Process Automation: Assess the extent to which manual tasks and processes have been automated through blockchain technology. The reduction in manual effort and increased automation can indicate improved operational efficiency.
- Error Rate: Monitor the occurrence of errors or discrepancies in transactions or data entries. A decrease in error rate suggests improved operational efficiency and accuracy.

2. Cost Savings:

- Transaction Costs: Compare the costs associated with executing transactions or processes before and after blockchain implementation. Lower transaction costs indicate potential cost savings.
- Administrative Costs: Evaluate the reduction in administrative tasks, paperwork, and manual record-keeping resulting from blockchain implementation. Decreased administrative costs can indicate cost savings.
- Auditing and Compliance Costs: Assess the cost savings achieved through streamlined auditing and compliance processes enabled by blockchain's transparent and immutable nature.

3. Customer Satisfaction:

- Transparency and Trust: Conduct surveys or collect feedback from customers to assess their perception of improved transparency and trust in the supply chain due to blockchain implementation.
- Product Authenticity Verification: Measure the number of customers who utilize blockchain-based tools or interfaces to verify the authenticity of

purchased products. Higher usage indicates customer satisfaction and trust in the blockchain system.

- Customer Complaints and Disputes: Monitor the number of customer complaints, disputes, or returns related to product authenticity, provenance, or transparency. A decrease in such issues suggests improved customer satisfaction.

4. **Time and Resource Savings:**

- Reduction in Processing Time: Quantify the time saved in processing transactions, verifying authenticity, or tracking product provenance due to blockchain implementation.

- Resource Utilization: Evaluate the reduction in the need for manual intervention, paperwork, or redundant processes resulting from blockchain automation. This indicates improved resource efficiency.

5. **Supply Chain Performance:**

- Traceability and Provenance: Measure the ability to track and trace products throughout the supply chain using blockchain technology. Assess the accuracy and speed of tracing product origins, quality, and ethical sourcing.

- Supply Chain Disruptions: Monitor the number and impact of supply chain disruptions, such as delays, counterfeits, or unethical practices, before and after blockchain implementation. A decrease in disruptions signifies improved supply chain performance.