The Connected Forest: Blockchain's Role in Forestry 4.0

Overview

The transformation of traditional resource sectors like forestry into the modern, sustainable, and optimized industries of the future is the overarching promise of digital transformation. The key to this shift is in the way that data is used to streamline and automate the complex processes involved in resource development, support best practices in ESG and facilitate the effective use of Big Data.

In natural resources, emerging data management technologies like blockchain have demonstrated large-scale benefits and in 2021, have now reached the maturation stage of commercial viability. In other sectors like oil and gas, mining and agriculture, blockchain applications are increasingly used to establish the provenance and authenticity of resource assets and products, reduce friction across trade borders and modernize operations.

With superior data awareness and the digitization of resources down to the level of individual trees, the "Smart Forests" enabled by blockchain have the potential to transform Canada's forestry sector into a world leader in modernization.

Key benefits of blockchain in forestry include:

- **Transparent, trusted and organized data**
- **Streamlining of regulatory compliance**
- **Transferable digital sustainability certifications**
- **Enhanced information awareness and security**
- **Lower cost trade and transactions**

Forestry Challenges

According to McKinsey and Company[i], the forestry sector has lagged other industries in embracing digital technologies. While other sectors like agriculture are experiencing productivity gains that range from 5% to an impressive 25% per year due to the adoption of digital tools like real-time geospatial monitoring and advanced analytics, forestry is largely dominated by the same manual processes established 300 years ago by the progenitor of sustainable silviculture, Hans Carl von Carlowitz[ii].

This lack of technological adoption extends beyond resource development to the supply and trade networks in forestry, which still rely heavily on labour-intensive manual administration. This creates major challenges for verifying the origin and sustainability of wood products, which is often conducted at a high expense by third-party organizations. With successful industry modernizations already well underway across comparable sectors like agriculture, mining and energy, forestry is primed to join the next wave of the digital economy.

The 4th Industrial Revolution

The digital transformation newly being adopted by the forestry sector is part of a broader global move towards modernization known as the 4th Industrial Revolution, or Industry 4.0. Enabled by advanced technologies like machine learning, Big Data analytics and remote sensing, both the volume and precision of information available to support more effective operations has increased dramatically.

However, the effectiveness of these digital technologies relies on one factor – that the data involved in the advanced analytics and automated processes of Industry 4.0 can be trusted to be true. At its essence, blockchain is the underlying fabric of information that supports the digitization of industries like forestry through providing "technological trust", where each piece of data can be instantly and automatically verified.

Technological Trust

Major challenges in forestry mirror those across traditional industries – a variety of counterparties and compliance regimes, intricate networks of supply chains and a heavy burden of administrative documentation. At the root of these issues is information asymmetry, where one party has full access to verified data, and counterparties – such as trading partners, regulators or are required to spend time, money and effort validating this information.

The architecture of blockchain[iii] eliminates these barriers by building a foundation for shared business processes. A blockchain is a distributed, immutable electronic database that contains a ledger of every transaction that has ever taken place on the network. With each piece of information stored as "blocks", sequentially linked together, and secured by advanced cryptography, the origin and authenticity of every piece of data can be almost instantly verified.

All parties involved in a process or transaction can be permissioned to view this information on the network, removing the need for intermediaries and administrators to validate it. Combined with tracking technologies like RFID tags or other unique identifiers, this creates an unbroken chain of provenance from origin to destination. For example, in the case of forestry, this means that forestry companies, government agencies and trading partners all work from the same set of trusted facts across a single shared system.

"By enabling blockchain—combined with artificial intelligence and emerging Industry 4.0 capabilities such as smart and connected products, services and plants—the forest products industry stands to benefit across the value chain."

-Accenture, Blockchain in Forest Products

Application Overview

As a technology that provides advanced traceability, automates business processes and increases the efficiency of operations, blockchain provides diverse benefits across industry verticals.

Primary advantages of blockchain for the forestry sector include:

- **Sustainability and Environmental and Social Governance (ESG)**
- **Supply Chain Optimization**
- **Royalty Data Submissions**
- **Transaction Management**
- **Resource Security**

Sustainability and ESG

With 40% of the world's certified forests[iv], Canada is a global leader in sustainable forestry, and the adoption of blockchain technologies will provide a new system for automating the certification process up from the tree level. Streamlining trade by ensuring compliance with diverse regulatory regimes, blockchain enables Canada to digitize the sustainability status of its forests and timber products.

With many certification programs like the Program for the Endorsement of Forest Certification (PEFC) and the Forest Stewardship Council (FSC) requiring increasing levels of traceability, blockchain can play an important role in facilitating ESG credentials, and these organizations are actively seeking participation in blockchain projects and consortia.

Key ways blockchain can facilitate ESG:

- **Support for the certification of REDD+ carbon status**
- **Compliance with traceability standards for PEFC and FSC certification**
- **Establishment of proof-of-origin for streamlining international trade**
- **Creation of verified digital certifications for Canadian forestry products**

Accurate measurement for sustainable silviculture is another way that blockchain can play a critical role in ensuring high ESG standards for forestry. Linking forest-level GIS and digital measurement systems that determine overall health, security and sustainability with the RFID tagging of individual trees creates a holistic forestry information system that extends beyond borders into global trade.

"With its enhanced data security and traceability, blockchain technology has enormous, game-changing potential that reaches far beyond the realm of finance."

-Forest Stewardship Council

Supply Chain Optimization

International trade is quickly undergoing an unprecedented digital transformation, one in which greater connectivity is removing many of the trade barriers that add high costs to industry and limit SME participation. Across industries, the complex nature of supply chains and need to navigate the shifting landscape of regulatory compliance has led to the growing adoption of blockchain technologies for traceability.

Through digital certifications and provenance records, blockchain ensures that all parties within an international trade transaction can access the same verified information. Connected to GIS[v] data from point-of-origin tracking systems like RFID tags, the modern forestry supply chain provides an unalterable and real-time account of the movement of its products across service providers and borders, with a shareable digital record that eliminates costly friction and reporting requirements.

Royalty Data Submissions

A critical business process in the forestry industry that can be optimized and automated through the use of blockchain technologies is the submission of production data to government authorities for the calculation of crown royalty revenues. The need to maintain highly precise financial data and fully secure these systems in light of cybersecurity risks provides an ideal use care for blockchain applications that capture at-source production measurement data and automatically share it with regulators through a decentralized platform. Advanced encryption secures this data throughout the entire process, reducing

risk and creating an immutable, accurate record for compliance records and royalty settlement. Through reducing systemic friction and frequent error reconciliation, when deployed at scale blockchain can significantly reduce G&A costs, as has been proven out in other industries like Oil & Gas.

Transaction Management

Another area where blockchain applications can reduce expenses in forestry is through the digital optimization of transactions. By linking point-of-origin, certification and measurement data to financial transactions throughout the forestry economy, organizations can significantly reduce the need for transaction certifiers and intermediaries like lawyers and accountants and ensure through verified measurement that forest owners and stakeholders like Indigenous peoples are fairly compensated.

The rising need for compliance with strict Know-Your-Client (KYC) regulations to prevent money laundering and illicit lumber sales has added a new dimension to forestry transactions, and this need to automate compliance is a leading use case for blockchain across all industries.

Smart contracts[vi], which are pre-programmed digital agreements that use the data in the blockchain as the basis for execution, help automate transactions and significantly reduce costs. As forestry's modern payments network evolves, it may conduct business in the future through its own digital currency or market-tradeable digital securities.

Benefits of blockchain for forestry transactions:

- **Reduction in costs for data verification and KYC**
- **Accurate and timely accounting**
- **Equitable payment assurance or and incentives to local stakeholders**
- **Digital securitization of forestry assets**

Resource Security

In an era of growing resource security threats and illegal logging, technologies that support traceability are essential for industries such as forestry. According to the World Wildlife Foundation[vii], unsustainable practices and illegal clearcutting could result in the loss of 420 million acres of forest in ecologically important regions by 2030, and preventing rapid deforestation is a critical global climate and economic priority.

Blockchain proof-of-provenance can significantly reduce the trade of illicitly obtained forestry products and ensure that only sustainably harvested, legal timber is traded in the market[viii]. Across the world, projects that use blockchain as the basis for forest product certification to prevent the illegal timber trade are moving ahead quickly in counties including in China, Finland and Spain.

Current Use Cases

As blockchain technologies transition from the experimental Proof-of-Concept stage to fully commercial solutions, numerous projects around the world are using blockchain technologies to modernize forestry operations and transactions. Led by major corporations and global governments including IBM,

Emerging blockchain projects in forestry:

Wood Tracking Protocol (WTP)[ix]: Sponsored by Swiss NFP Climate Ledger, the WTP deploys blockchain to create a fraud-proof replacement for the manual paper processes currently used in the Peruvian Amazon's forestry management. In a country where 80% of national logging exports are illegal, the project has gained significant support from government and industry partners as a way to prevent deforestation while support the emergence of sustainable industries.

Chainwood (Spain)[x]: The Spanish Ministry of Agriculture, Fisheries and Food has announced the success of Chainwood, its pilot project to certify the sustainability of forestry products on blockchain. With participation from technology and industry partners, the project resulted in the successful trial of a system that tracked wood products from their origin lumber throughout processing as biomass and cellulose pulp.

Woodchain (France)[xi]: Funded by certification body PEFC International, Woodchain unites major lumber firms in France and Italy to create a proof-of-origin system on blockchain to help streamline cross-border trade and support ESG certification. The project measures and certifies forestry products throughout the full value chain,

Regan Network (Peru)[xii]: In an innovative pilot funded by the Rainforest Foundation, blockchain technology is being used to store real-time GIS data about the health of a threatened region of the Amazon Rainforest. Showing blockchain's potential for fostering ESG best practices, incentive payments for maintaining the health of the forest are automatically provided to local residents using smart contracts that execute based on information in the database.

Future Vision

The connected forest of the future is a place where deep insights into ecology and sustainability meet a streamlined digital network of transactions and trade – and from production to consumer, an unbroken and intelligent flow of information enables policies that will protect our planet's forests for decades to come. Blockchain is a significant evolution of current data management practices in forestry, and the technological trust it provides will build the digital foundation of Canada's Forestry 4.0.

As with all major technological shifts, the combined power of the public and private sector will be essential in supporting blockchain's adoption in forestry. Canada's unparalleled high standards in sustainability and certification make it ideal for the formation of an innovative consortium that will unite diverse interests like government, corporations and Indigenous and local stakeholders to explore how blockchain can help transform this key industry in alignment with national strategic goals.

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