GBBC Open-Source Ideas Series

Provenance: a Major Opportunity for Blockchain and a Force for Good

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What is Provenance?

Provenance, simply put, captures the origin and life journey — including ownership history, location, etc. — of a physical or digital asset, be it a diamond, a medical implant, a commodity, user data, or anything of value.

The term provenance is often associated with the art world, where it refers to the chronology of the ownership and location of a piece of art. Collectors require reliable provenance records that confirm the authenticity of artwork, as well as proof of ownership, so the title of ownership can be legally transferred to them upon purchase. Verifiable information on events along the journey of a particular piece of art, such as, its inclusion in a renowned collection, may increase its desirability, and hence its value. On the other hand, holes in the history of a piece of art, particularly times when ownership remains unknown, are undesirable because they may indicate possible forgery or theft.

Why Provenance and Blockchain Matter

Beyond the art world, the ability to digitally capture, store, and retrieve provenance data about physical and digital assets, in a trusted and efficient way, will translate into immense value across industries.

Blockchain technology[1] is a real differentiator that represents a far-reaching opportunity, offering an unprecedented level of transparency and a safe home for provenance data, including the inception, attributes, ownership and production journey, as well as location of any asset. Provenance information recorded on a blockchain becomes more trustworthy, and its management is more efficient.

Provenance is widely recognized as a top use case, and arguably the number one application driving the adoption of blockchain technology, with the potential to yield the most economic value. The potential boost to global GDP by 2030 was estimated by PwC economists to be nearly one trillion US dollars.[2]

With blockchain-backed provenance concerns such as fraud, contaminations, and counterfeit products can be instantly flagged to ensure consumer safety, while saving costs and safeguarding the reputation of producers, manufacturers, and distributors across the entire supply chain. Ultimately, blockchain-backed provenance makes supply chains resilient, while improving customer loyalty and trust. Reliable data can mitigate supply chain disruptions and their negative impacts, increasing capacity for recovery in the case of unintended events.

1   GBBC has compiled an open source and crowdsourced taxonomy including definitions of blockchain and related terms, as part of the Global Standards Mapping Initiative (GSMI).
2   Time for trust: The trillion-dollar reasons to rethink blockchain, October 2020

Businesses can demonstrate that their products are sustainably sourced and manufactured, providing accurate data to validate their claims of ethical practices. Moreover, validated immutable data records can address any greenwashing concerns such as false, exaggerated, or unvalidated claims of sustainable practices. Environmentally friendly products can be backed by provenance data tracking sustainable raw materials and low-carbon production mechanisms. Socially and ethically responsible production practices can be backed by data attesting to fair treatment and wages of workers across all stages of the value chain.

Misconceptions around Provenance

Provenance vs. Blockchain

A common misconception is that using a blockchain automatically means that provenance information is readily available, so as to track any product's origin and life journey. While provenance is not intrinsic to blockchain technology, it can be built and implemented with it in a very effective manner. As previously mentioned, recording provenance data on distributed ledgers makes a strong case.

Blockchain technology provides a safe home that makes provenance information transparent and trustworthy. It stores this information immutably, from raw materials to finished product, and even subsequent transfers of any asset. Commonly siloed and fragmented information about assets can be joined together, producing a holistic view of the exact origins and life journey of an asset, as well as practices around its production and consumption.

However, it is still necessary to deploy technical capabilities to identify, capture, and retrieve the right provenance data. This may involve standardized agreements regarding the definition of assets, their digital representation on a blockchain, or certifications of responsible production practices including fair labor. It may also take the form of a description of individuals and organizations interacting with or bearing some form of responsibility over the existence of certain assets, and activities that generate or use those assets.

In other words, it is essential to define and accurately record the whole picture about the life journey of an asset, and trust that the records are true. These records may include verifications of who created what and why, who updated what and why, when and where changes were made, and what influenced those changes. This data altogether provides a critical foundation for assessing the authenticity, trustworthiness, and traceability — simply put, integrity — of an asset.

Provenance vs. Audit Trail

Although provenance and audit trail are both critical concepts when it comes to data integrity and reliability along the life journey and origins of an asset, they are not the same. While blockchain technology can be used as an audit trail, provenance sits above it.

An audit trail mostly focuses on activities carried out in connection with an asset, and this primarily benefits an IT, privacy, or security office. Hence an audit trail typically functions as a tool to support regulatory compliance. An audit trail can be as simple as a receipt for purchasing office equipment, with details on the amount and date of sale, and description of the equipment that was purchased.

Provenance, on the other hand, is more complex than an audit trail and provides benefits beyond these, thus increasing value for all parties in a network, including the creators and owners of an asset, and anyone involved with using, influencing, and moving that asset. Provenance employs more sophisticated operations that capture a wide range of features around an asset and its life journey. For instance, the airworthiness of a rotor blade can be assured, such that all details around the manufacturing and certification of the rotor blade are captured. Subsequently, every event that the rotor blade goes through, such as maintenance, resale, and transportation, is recorded, as well as all relevant details around the individuals, organizations, and machines that utilize or interact with the rotor blade in any way.

Provenance vs. Authentication

Provenance is fundamental to establishing the authenticity of an asset. It can be used as an input to any given process of authentication to verify legitimate origin, production practices, etc. For example, in the case of a piece of art, when all provenance data is captured, and when this data is considered reliable, the authentication of the artwork can be legitimized. As mentioned before, holes in the history of a painting's ownership may conceal possible forgery or theft. Therefore, authentication of this painting cannot occur without the full picture of its life journey, and that is what points to provenance.

Blockchain-Backed Provenance Must Be Open, Collaborative, and Interoperable

Openness is key to make a blockchain project successful because decentralized models rely on networks of participants and users, as opposed to centralized systems. Notions of collaboration, decentralization, and transparency — which are fundamental premises of blockchain technology — would not go well with proprietary approaches or practices.

Much of the openness starts with the code underlying the technology deployed. Both the use and development of blockchain technology and its applications have to be collaborative and interoperable in order to support multiparty activity and network effects. Open-source technologies and open standards are fundamental to enable the necessary level of interoperability across key systems, and thus facilitate collaboration among stakeholders in a network or across a supply chain, including producers, suppliers, distributors, and customers. Without interoperability, these stakeholders in a business network, such as those across different stages of a supply chain, would more likely operate in system silos that could create holes in the integrity of an asset.

When software is open source, it implies that there's a community behind the code, which is developed both collectively and transparently. As opposed to proprietary approaches, open-source software development allows anyone to evaluate, use, and improve or enhance the code. Ultimately, this process helps establish confidence in the technology deployed.

Open standards enable interoperability and ease of communication among devices and systems. They allow for a more efficient use of resources, where developers can quickly and consistently adapt to changing circumstances. As a result, faster development and better quality of applications can lead to greater trust. In the realm of provenance, an example of such an open standard is the W3C's Prov Ontology (PROV-O) specification. This standard provides a foundation to implement provenance applications in various domains that can represent, exchange, and integrate provenance information generated by multiple parties, from different systems, and under diverse contexts.

Blockchain-Backed Provenance Must Be Secure

When implementing a blockchain-backed provenance system, openness must also be paired with an adequate level of security. Security measures are key to prevent bad actors from abusing a given system. Hackers, for instance, can otherwise compromise any stage of a supply chain and create holes in the provenance of an asset. Bad actors can even disrupt access to basic services such as water systems, which would wreak havoc on all aspects of supply chains and threaten their resilience.

A key feature of security also involves privacy to safeguard personal and confidential data. Tools such as the Open Policy Agent framework can be used to verify the identity of parties accessing or modifying provenance data, ensuring that only authorized individuals or entities can perform these actions. Digital identity is fundamental, and innovative features are currently being developed to enable individual data ownership and make data available as necessary, only to authorized parties.[3] Digital identity enhances security and integrity for the creation, exchange, and storage of data.

Blockchain-Backed Provenance in Action

Chronicle
GBBC member BTP has developed Chronicle, an intuitive and versatile provenance product that is backed by blockchain technology and is available as an open-source solution.

Chronicle makes it easy for organizations to immutably record, query, as well as efficiently and securely share provenance information about any asset, in any domain, across multiple parties. Although the Chronicle platform operates on a domain-agnostic basis, BTP has introduced the concept of Chronicle domains that model specific use cases, which are then compiled to create domain-specific APIs that interface with other applications and systems.

Chronicle's primary role is to be the single source of truth about the state of any asset, at any given point in time. This solution is implemented in such a way that sharing this provenance data with multiple interested parties is easy, efficient, and secure.

The Chronicle Stack

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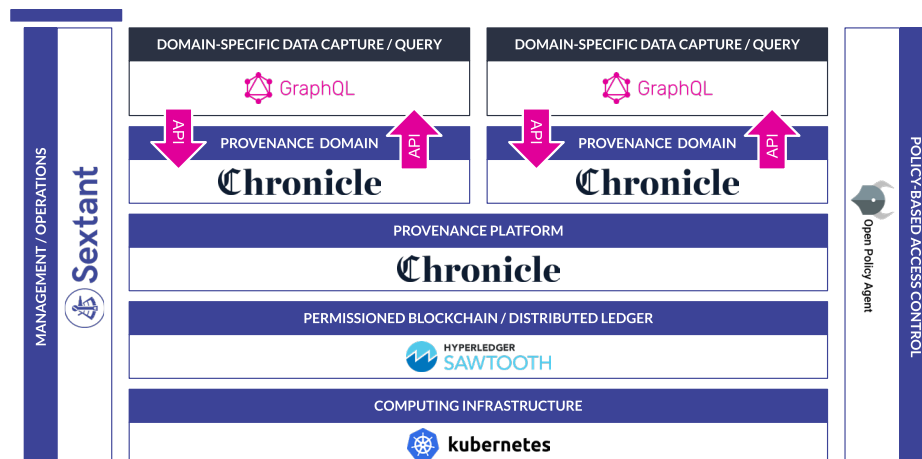
3   GBBC's Global Standards Mapping Initiative has released a report on blockchain applications for digital identity: https://gbbcouncil.org/wp-content/uploads/2021/11/DID_GSMI2_Standalone_.pdf

Asset Integrity Management

Blockchain-backed provenance solutions such as Chronicle can add trust and transparency to a wide range of markets. One promising use case is that of Asset Integrity Management (AIM). AIM is the practice of tracking and managing an asset to ensure its ability to perform its function effectively and efficiently, while minimizing health and safety risks, and maintaining compliance with regulations. Key industries using AIM include Aerospace & Defense, Energy & Utilities, and Oil & Gas.

AIM practices have traditionally been centralized, siloed, and paper-based. This has not only proven costly and inefficient, but also prone to error and fraud. BTP's Chronicle platform has been successfully implemented as part of an AIM project in the energy and utilities space. The project's goal is to demonstrate how capturing and recording provenance information can help guarantee the safety of critical infrastructure. For instance, a burst gas pipe or failure of a welded joint can cause serious damage to communities and energy supplies, ultimately exposing energy firms to liability risks.

Chronicle can immutably record and query provenance data on specific infrastructure assets such as gas pipes. It is through this critical infrastructure that the origin and life journey of these assets needs to be captured and traced, as well as activities carried out by the different stakeholders along the manufacturing, logistics, and installation process, such as staff, suppliers, and subcontractors.

Another example where digital provenance benefits AIM is in projects envisioned to guarantee the integrity of an aircraft's spare parts. Each commercial and defense aircraft is made up of thousands of different parts. Verifying the origin of these parts, in addition to keeping track of their maintenance and overhaul history, is critical for determining airworthiness. Otherwise, the stakes are high and the costs can be devastating. Aircraft operators, part manufacturers, and suppliers can use a digital provenance solution to capture, store, and retrieve trusted data, in real time, about aircraft parts, as well as activities such as certification, repair, and maintenance, carried out in connection with those parts. This solution can instantly identify if there is a flaw, such that adequate corrective actions can be taken.

Real Estate Integrity Management

In the real estate sector, there is major value placed on real estate integrity and its efficient management. Physical properties have an owner and a value, among other defining characteristics, which need to be carefully captured and documented. Challenges today include ownership verification and history, delays in ownership transfer, conflicting or lost records, unauthorized sale of properties, and failure to detect fraud - all due to lack of transparent, openly available, and secure records around provenance.

Property registration operations can greatly benefit from the ability to immutably capture, record, and query trusted provenance information on property value, ownership, and transfers. When this information is made accessible by all parties involved in real estate transactions, as a single source of truth, a wide range of efficiencies can ensue. Transparency around the full history of ownership of a piece of land, with timely and tamperproof data, can ensure no records are lost or mismatched. Real-time registration and transfer of ownership can be greatly facilitated, ensuring authorized sales and minimizing ownership disputes.

Land registries can greatly benefit from updated, accurate, and transparent data on property ownership. Citizens in turn can benefit from increased real estate integrity and management, especially given the size and complexity of transactions involving real estate transactions. Not only can real estate purchase processes be facilitated, but also opportunities for inclusion through real estate ownership, the ability to utilize real estate as collateral to access financial services, and ultimately support economic development.

User Consent Management

BTP's Chronicle platform has also been successfully deployed in a number of projects where user consent is the asset in need of being made trustworthy. Blockchain-backed provenance functionalities applied to user consent ensure that user consent upon onboarding and use of any product or service, and any updates thereafter, are captured immutably, and shared safely and securely with authorized parties.

For instance, a legaltech firm has integrated Chronicle into its contract management platform in order to provide an identity service with transparent user consent management across multiple parties. This enables financial institutions to digitally obtain required know-your-customer (KYC) information in an efficient, trusted, and secure manner.

Provenance, a Force for Good

Provenance is increasingly accepted as critical to our confidence in the assets we rely on as a civilization. These assets span the entire spectrum of human activity, ranging from raw data, transactions with financial instruments, medical records, regulatory reporting, supply chains, and activities such as maintenance, repair, and operations of critical infrastructure.

With adequate provenance, customers can take ownership of their purchase decisions to support sustainably produced products. Investors can better identify opportunities to deploy funds toward supporting ethical practices with a long-term view of financial success. There can be better accountability for practices driven by short-term gains at the expense of people and the planet. For instance, increasing reliance on large-scale public datasets by climate and environmental researchers, as well as AI tools, demands reliable provenance. Otherwise, any results derived are inherently untrustworthy and may be unsuitable for meaningful research or strategic decisions.

A lack of efficient and trustworthy provenance practices, on the other hand, negatively affects both businesses and consumers, and will ultimately cause serious harm to the global economy. Unless this is addressed, even attempts at regulatory oversight may prove less effective.