

Path To Pour: Wine & Spirits Supply chain Traceability

Summary

- 
- 4 Existing Transparency Challenges
 - 6 Dominant Emerging Technology
 - 8 Market Entrants & Use Cases
 - 10 Technology Considerations
 - 11 Where is the Market Headed?

Editorial

The wine and spirits industry is not just any consumer market; it is in a league of its own. An ever-expanding global market (the wine industry is valued at over \$340 billion, and the spirits sector is valued at around \$500 billion), the industry's blend of tradition, craftsmanship, and stringent regulatory requirements uniquely positions it as a force in the consumer space. With evidence of alcohol production dating back to 6000 BC, these products have played a major role in societal growth, ranging from serving as a form of currency for trade to being a safer alternative to drinking water. This rich cultural history influences market dynamics seen today, attracting a diverse range of consumers, from dedicated collectors to casual buyers. Unlike many industries, the wine and spirits market has proven to be economically resilient, as proven by the 12% growth that followed the 2008 recession and the 20% growth during the COVID-19 pandemic. With formidable product offerings, this industry continues to innovate, utilizing advancements in the digital sphere, changes in customer palate, and evolving regulatory constraints. A key focus is the concept of transparency and traceability in the supply chain.

The production process, which differs from product to product, involves multiple stages from growing to bottling. Each stage has its own set of challenges and requires careful consideration to ensure the quality of the final product. The concept of complete transparency in the supply chain ensures every bottle can be accurately tracked, from growing the necessary crops to distilling and crafting the product, to distribution. Meticulous tracking is essential in maintaining quality and authenticity of products, as is complying with various regulations that govern their production and distribution. By implementing robust traceability systems, the industry can safeguard its heritage, uphold its standards, and foster trust among consumers and collectors who seek genuine and high-quality products.

This white paper will illustrate **why transparency is important** and delve into several key areas: emerging technologies that are reshaping traceability, new market entrants, plus select use cases and considerations for integrating transparency-focused technology. Our goal is to paint a concise and future-oriented picture of a fascinating and trend-setting topic while ensuring current and potential clients are well informed on both the positives of integration as well as possible obstacles.

Existing Transparency Challenges

The wine and spirits industry faces a growing demand for operational transparency throughout the production and distribution process. Consumer demand for sustainability, the desire for authentication, and increasing demands for regulation shape the need for growing insight into the processes behind wine and spirits. Transparency within the supply chain is a fundamental principle that shapes consumer perceptions, drives industry standards, and fosters a culture of integrity and accountability.

Sustainability has become a consistent focal point as consumers look to priori-

tize brands that not only offer a “clean” product but ensure the production cycle is also eco-conscious. Research suggests that “49% of consumers reported that they now consider sustainability credentials when buying food and drink (based on a survey of 14,000 consumers in 18 countries).” This demand is altering organizational processes, such as branding, operations, and marketing. Knowledge of where and how products are made is critical to ensure products meet expectations. Supply chain transparency enables insight into existing sustainability practices; however, it is historically difficult for large and small brands to accom-

plish. The challenge with transparency lies in an unmet need for the following: innovative technologies, close communication with suppliers and distributors, and deep knowledge of individual products. Developing innovative technologies can streamline data collection and improve visibility across the supply chain. Close communication with suppliers and distributors ensures that all parties are aligned with sustainability goals. Deep knowledge of individual products allows for precise tracking and accountability, ensuring each item meets the desired standards. The absence of these elements creates “a complex issue in which multiple criteria





and limitations must be simultaneously considered,” [according to the 44th World Conference of Vine and Wine](#). This issue is challenging for suppliers to successfully evaluate and enhance. Sustainability is a growing requirement for wine and

spirits producers that requires traceability and transparency, which have previously been difficult to achieve.

Authentication is another core driver of, and challenge to, traceability within the industry. Counterfeit wine and spirits have plagued the industry for centuries, with the counterfeit wine industry alone estimated to be **\$65 billion in 2020**. This reality is harmful and even dangerous for a variety of financial, health, and safety reasons, including consumer health concerns, brand reputational risk, and economic impact. In fact, the impact of consumers purchasing counterfeit wine and spirits is estimated to result in “annual fiscal revenue losses of \$8.9 billion.” There is a material detriment caused by an inability to authenticate goods, which enhanced transparency in the supply chain could help solve. The benefits of traceability occur at the consumer, organization, and government levels. Primarily, successful traceability allows the consumer to verify their purchases, ensuring the product comes from a reputable distributor and is what it proclaims to be. Additionally, it enables organizations to safeguard their reputations and product lines by maintaining quality and brand standards. Finally, “traceability enables authorities to track and intercept counterfeit alcohol throughout the supply chain.” These benefits reinforce each other and create a stronger industry and regulatory environment. Authentication of wine and spirits is an enduringly pressing problem for the industry, for which traceability is a viable and necessary solution.

In connection with sustainability and authenticity focuses, **regulatory pressure** for enhanced traceability within the industry is growing. This stems from “ensuring that each step from the warehouse to the customer is legally sound.” There are regulatory frameworks that must be adhered to, for the purpose of monopoly prevention and encouraging moderation. In the United States, this is rooted in the U.S. Constitution’s 21st Amendment, which grants individual states the authority to regulate the transportation, importation, and distribution of alcohol. This empowers states to establish their own regulatory frameworks. For example, the three-tier system separates the alcohol industry into three tiers to improve the industry: producers, wholesalers, and retailers. These frameworks aim to create a transparent supply chain, ensuring that products are sourced responsibly and ethically. Traceability is crucial to government regulators because it facilitates monitoring and the enforcement of regulations to ensure public safety and environmental protection. Traceability also helps prevent fraudulent activities, ensuring that products meet established standards, and facilitating recalls when necessary. By maintaining a high level of traceability, governments can protect consumers, promote fair trade practices, and ensure that companies are accountable for their products and processes. This is particularly important in the consumables sectors, such as wine and spirits, where the origins and handling of products directly impact public health and safety. Rigorous adherence to traceability and regulatory requirements is essential for the regulatory credibility of the wine and spirits industry.

Dominant Emerging Technology

As the complexity of supply chains has increased over the years due to globalization, changing environments, and compliance regulations, new technologies have emerged to address issues in transparency. Given the latency in technological adoption within this traditional industry, many of these issues can now be addressed with fewer touchpoints than ever before. One of the major technological advancements that has grown exponentially in recent years is the adoption of Blockchain technology. Blockchain use is now expanding into supply chain and traceability for both producers and consumers. By looking at the traditional methods as well as specifics behind these Blockchain and micro processing capabilities, one can see how the path ahead will likely include the adoption of these new technologies.

Blockchain Technology

RFID technology: Radio frequency identification technology or RFID, is an emerging tool that can assist in alleviating traceability issues. RFID technology consists of a small, portable tag, that uses radio waves to identify, track, and communicate information. The tag can store relevant information such as serial numbers, product descriptions, and pertinent data housed within an encrypted library. The technology also utilizes cryptographic security features for authentication & verification purposes. In the current market, verifying a specific vintage, for example, can prove to be an arduous task, especially with increasing volume to meet demand. Before a product goes to market, specific conditions can be as-

signed to the tag to delineate requirements if the producer so chooses. For instance, if the wine bottle is intended for regional market trading (sold within a designated area), this information can be baked into the tag and will trigger conditional processes if those conditions are violated, aiding in the reduction of fraudulent activities.

NFC Technology : Near Field Communication (NFC) technology is another solution that can identify pain points and bottlenecks throughout the supply chain process. This technology is commonly referred to as an “NFC Tag” which is a semi-conductor with a unique ID embedded inside, allowing each individual bottle of wine to be encrypted, thus making replications far more difficult. In an industry where an estimated 20% of all wines sold globally are fakes, these tags present a solution that is both traceable and user-friendly. To facilitate the integration process, brands need to determine what type of information they'd like presented in the tag. For example, if a wine manufacturer knows their consumers have been requesting background information about the product, they may include origin stories of the wine, food pairing ideas, temperature specifics related to storage, and branding images. Like the RFID tag, this solution allows detailed information to be stored within a simple chip and attached to a brand's products. The nuance is that NFC technology allows for even greater specifications by pairing to individual products versus en masse.

NFTs for Collector's Spirits (NFT1): Non-Fungible Tokens (NFTs) evoke an

image of ephemeral industry where digital artwork sells for egregious prices and possess a hard to identify intrinsic value. However, the underlying technology behind NFTs offers a greater solution beyond acting as a digital form of art and can alleviate pain points experienced in the wine and spirits supply chain, while also providing verification on an encrypted chain. In a specific use case, this technology would be assigned to each individual bottle of wine by embedding a tag like a QR code. From there, data would be updated based on where the product is within the supply chain. This allows stakeholders to get visibility into the product, and it illustrates the real-time contributions of each party along the chain. The data is stored in a smart contract which executes only when specific conditions are met, preventing the data being entered from being altered or destroyed. In the current market, once the product is shipped, there is little ability to gain visibility into the product given the available technology and its minimal usage. However, implementing NFT technology presents opportunities across the supply chain. Manufacturers would reap the benefits of being able to record materials, processes, ingredients, and energy usage in a verifiable ledger which ensures a granular understanding of a unique product.

Zooming in on the wine industry, the antiquated methodologies around inventory management have failed to progress, even with the rise of technology, leaving gaps in the current ways of working. To alleviate burdens, and the risk of fraud, integrating technology

like an NFT would link important information to a centralized database, where it is stored, aggregated, and selectively accessible to pertinent parties.

Non-Blockchain Technology

Internet of Things: Internet of Things (IoT) is a concept used to formulate an intelligent network in which all entities are in constant communication and transmit information interchangeably. This information is evaluated and interpreted to provide specific results geared toward targeted products or markets. In the wine and spirits industry, this operates as an integrated approach to counterfeit protection, market transparency, and process optimization. As a hard product, this can be seen through Optical Light sensors or OLS systems. These sensors convert rays of light into electronic signals which communicate that information into data that can be read by a tool, in this case, the IoT. The data is then recorded and determines whether the wine has been opened or is still in transit to its destination. This information capture is revolutionary in an industry that still utilizes traditional methods throughout its supply chain.

Hot-Stamping: Another non-blockchain alternative can be traced to Spanish wineries and vintage Riojas. Spain deployed a Rioja Control Board that employs a security system designed to authenticate their products. Historically, the Board began certifying the aging process in 1974, and over the years, integrated a physical strip using diffractive optical technology called hot stamping. The technology contains both a visible and invisible security feature denoting a bottle's authenticity. Some vineyards have even begun marking bottles with ultraviolet light and integrating them into each winery's computer systems, like how blockchain operates.

Although these developing technologies address many of the issues experienced by viticulturists and supply chains alike, there are few first movers providing an opportunity to venture into a space few have entered. Most vineyards and distilleries utilizing these technological advancements are small, given the upfront cost associated with implementing this new technology. However, as blockchain and micro processing units become increasingly ubiquitous within this space, adoption within the larger players of the industry will be quick, driving this space in an operationally superior direction.



Market Entrants & Use Cases

Blockchain technology paves the way for innovative solutions to bolster targeted areas of the supply chain, as well as tackling the entire supply chain. New platforms and solutions emerging in the wine and spirits industry are causing brands to not only consider integrating a solution but also ensure the proper tool is being utilized. From a blockchain lens, companies like Everledger and Authena utilize the technology to allow users to access detailed information about a product's origin, quality, and authenticity. Alternatively, companies like ePro Vance and Gernep Labelling utilize non-blockchain solutions to ensure trust and authenticity for consumers while purchasing wine and spirits products. By providing notable use cases comparing blockchain versus non-blockchain usage, our goal is to inform readers about the applications of these solutions.

Blockchain Utilization

Everledger

Everledger is a digital transparency company that provides solutions to global supply chains, with the goal of enhancing transparency and visibility. Pertaining to wine and spirits, Everledger supports winegrowers, distillers, and distributors, expanding reach and ensuring brand protection. One of their key offerings is a range of anti-tamper bottle closures, which guarantee that the digital identity and physical entity of each bottle are synchronized. Each Everledger-supported bottle features an NFC-powered tamper detection label, ensuring authenticity with chain-of-custody data, consumer

analytics, certificate of ownership, and blockchain authentication that can be captured all along the supply chain via blockchain technology. In addition, Everledger employs RFID technology on bottles to verify ownership of products. This technology allows consumers to scan an authentic code to prove the legitimacy of a bottle, helping to combat fraud. The RFID tags also offer features such as consumer analytics and blockchain authentication, enhancing the customer experience. In improving their customer experience, Everledger is also tackling one of the primary challenges in the wine and spirits industry: traceability. This benefits not only consumers, but also distributors. Improved traceability ensures that consumers can verify the authenticity of their purchases, protecting them from counterfeit products. Everledger's suite of anti-tamper solutions for the wine and spirits industry include NFC anti-tamper capsules, plastic heat-shrink capsules, NFC stickers, QR codes, tamper tags, and cork tags. These tools provide comprehensive protection and tracking capabilities throughout the supply chain, supported by blockchain technology. This lineup helps brands safeguard the authenticity of their products, enrich customer experience, and gain valuable insights into the journey of each bottle.

Authena

Authena leverages blockchain and IoT to enhance traceability and fraud protection. Their product offerings encompass efficient supply chain management, real-time tracking, and optimized routes that reduce waste, improve sus-

tainability, and optimize inventory. Authena also offers quality assurance and safety by monitoring product safety and ensuring compliance. For consumers, Authena provides real-time information to empower informed decisions and build trust through transparency. One of their key products, Authena LIVE, offers real-time traceability and condition monitoring at the unit level across the entire value chain, providing real-time data visibility. Another product, Authena SHIELD, ensures transparency and authenticity with tamperproof unique product IDs that activate a digital product passport, guaranteeing integrity, authenticity, and direct access to product information for decision making. Authena's product lineup includes Near Field Communication (NFC) tags, which determine the origin of products, such as where grapes were grown and the production date. Additionally, Authena employs NFTs to assign unique IDs or digital certificates, tracing an item's storage conditions and production sites. Authena's blockchain offerings and technologies ensure compliance with the latest European and United States regulations, generating accurate, real-time data over supply chains with a focus on addressing sustainability and traceability. They have also incorporated an AI-enabled dashboard to improve traceability. This dashboard serves as a tracking portal to record and maintain Key Data Elements (KDEs) associated with specific Critical Tracking Events (CTEs). Features include live alerts, digital audits, and advanced analytics, which facilitate sustainable decision-making, optimize resource allocation, and reduce waste.

Non-Blockchain Utilization

eProvenance

eProvenance is a leader in the monitoring and analysis of wine shipment conditions. The company employs environmental factors on wine quality. Data collected by these sensors feeds into their Online Monitoring System (OMS), a comprehensive database and analytical tool. The OMS provides interactive graphs, statistical summaries, and comparative views, allowing consumers to assess shipment quality and plan future strategies. Through the OMS dashboard, consumers can fully understand shipment conditions, identify flaws in shipping methods, verify the origin of shipments, and monitor temperature and distribution. By working with leading producers and importers, eProvenance ensures proper cold chain management for wine and that each bottle reaches consumers in its original condition to preserve the wine's quality and taste.

Gernep Labeling

Gernep Labeling specializes in hot stamping, offering precise positioning, foil ribbon, and sealing functions with coding, dating, and tamper-evident labels. Their labeling systems encompass self-adhesive, wet glue, and hot melt labeling. By incorporating these labeling features, Gernep works with companies in the wine and spirits industry in verifying the authenticity of their products, preventing counterfeits. These features include special inks and intricate designs that are difficult to replicate and specific to each wine and spirits brand. In addition, Gernep allows for the creation of unique, tamper-evident identifiers on each bottle. Notable projects in the wine and spirits industry include work with Faust Brewery, The Shed Distillery, and Emil Scheibel-Schwarzwald Distillery. For The Shed Distillery, a distillery located in Ireland with gin, vodka, and whiskey products, Gernep Labeling addressed a requirement orientation of bottles, which included sensitive grasp cork locks on their bottles.

The companies mentioned tackle a variety of issues in the wine and spirits industry, including traceability and sustainability by utilizing both blockchain and non-blockchain solutions. As blockchain technology continues to evolve, smaller companies are likely to emerge in this industry. As larger companies consider adopting blockchain solutions, they must carefully determine several factors before implementation.

In the following section, we will explore the technological considerations that companies need to evaluate when deciding if blockchain is the right solution for their company's supply chain challenges.



Technology Considerations

The decision to integrate a traceability solution into a business necessitates detailed insight into the 'whys' and the 'hows.' It is essential to assess the goals and perform a careful evaluation of both the suitability of the technology for the company's supply chain profile as well as the predictability of investment returns. To complete this thorough evaluation, there are implementation considerations that must first be addressed.

Cost Implications

Implementing a technology-based traceability system involves significant cost considerations. For example, adopting a blockchain supply chain management system can cost between \$80,000 and \$150,000. Moreover, while RFID tags are relatively low-cost, they must be purchased in large volumes and implemented across the supply chain, incurring further expenses (Cost of RFID Tags). Other costs include manual labor, consulting fees, hardware and software purchases, infrastructure upgrades, system integration, employee training, and ongoing data management. Hidden costs such as potential downtime during implemen-

tation and the learning curve for staff also need to be factored in. Companies must conduct a thorough return on investment (ROI) analysis to justify these expenses. This analysis should compare the initial and ongoing costs against future benefits such as improved regulatory compliance, enhanced consumer trust, reduced risk of fraud, and increased operational efficiency. Comparing these figures and considering the timeframe over which the ROI will be evaluated can help companies determine the financial viability and strategic value of investing in technology-based traceability. By understanding both the short- and long-term financial impacts, companies can make informed decisions about investing in traceability technologies.

Data Collection

Data collection is an impactful consideration that, while not unique to wine and spirits, presents a significant hurdle to the successful implementation of supply chain traceability endeavors. Despite the allure of advanced solutions like blockchain, the reliability of data inputs remains a persistent challenge. Inaccurate or incomplete data can undermine

the integrity of the entire traceability system, fostering misinterpretation or distrust among stakeholders. Thus, it is imperative for organizations to prioritize data quality assurance mechanisms, leveraging validation protocols and data governance frameworks to ensure the integrity of information throughout its lifecycle.

Moreover, the complexity of supply chain networks exacerbates the difficulty of obtaining trustworthy data. The production and distribution process includes a long and varying list of moving parts that do not necessarily communicate much information to one another. With numerous nodes and actors involved, information exchange becomes susceptible to errors, delays, and intentional tampering. Achieving consensus on data standards and protocols becomes paramount, necessitating collaboration and alignment among all parties in the supply chain ecosystem. By fostering transparency and accountability in data-sharing practices, organizations can mitigate the risk of data manipulation and foster a culture of trust that underpins the success of traceability initiatives.



Where Is the Market Headed ?

Despite cost and integration concerns, and the challenges associated with data collection, the market is moving towards widespread blockchain adoption to address supply chain traceability. Several major players in the industry, including Pernod Ricard and Diageo, have already begun to adopt blockchain technology, demonstrating the future of the market. As emerging technologies continue to develop and gain a stronger position in the market, producers and consumers are seeing new avenues to ensure and communicate across a transparent supply chain. Full-scale Web3 adoption has the potential to introduce an interactive experience that transcends the traditional consumer-producer relationship, and as Web3 continues to develop, so do its implications for supply chain transparency.

Wine & Spirits Enter the Metaverse

«**Metaverse**» has become a buzzword with a negative connotation in terms of societal reliance on technology. However, consumers are increasingly seeing the positives. For many, the metaverse enables them to socialize and communicate with others from anywhere in the world, while developing a more personal connection than one might expect from a text or phone conversation. Users can share information, or physically display their possessions in a way that historically would only be possible if everyone was under the same roof. This is where the wine and spirits industry is expected to expand and ensure authenticity for consumers.

Building on existing **NFT technology**, wine and spirits producers are expected to utilize the metaverse to go further than simply attesting to their product's authenticity and journey through the supply chain. Collectors of premium wine and spirits want the utmost proof that what they have purchased is exactly what they intended, and for collector products, the pathway the bottle took from creation to purchase is where the value is located. In the metaverse, the consumer can find this value. Through scanning the QR code on a bottle, they can enter an immersive digital world that provides access to detailed information about its entire product lifecycle, including tasting notes, food pairings, and sustainability practices. On top of this, virtual tasting rooms offer an immersive experience for consumers to sample wines from around the world and attend virtual vineyard tours where they can see the origins of the very bottle they purchased. Through gamification and social sharing, wine enthusiasts forge connections with producers and fellow aficionados, fostering a sense of community within the virtual realm. The metaverse holds boundless potential to revolutionize the wine and spirits supply chain, surpassing physical limitations to create a world of transparency and trust.



Conclusion

As emerging technologies continue to reshape the landscape of traceability, from blockchain to IoT sensors, the wine and spirits industry is poised for further evolution and refinement. New market entrants, coupled with select use cases, highlight the diverse array of opportunities that lie ahead, promising greater efficiency, sustainability, and consumer trust.

However, amidst these advancements, it's crucial to remain mindful of the potential challenges and considerations for integrating transparency-focused technology. Achieving transparency in the wine and spirits supply chain is a multi-faceted journey that demands a holistic approach. While emerging technologies offer promise, their efficiency hinges on addressing technical, organizational, and regulatory challenges. Despite the wine and spirits industry historically being traditional in nature, and reluctant to meet constantly changing consumer demands, the global marketplace of today demands more. Embracing innovation while navigating the complexities of implementation, stakeholders can unlock the full potential of traceability to safeguard quality, integrity, and trust throughout the supply chain.

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