WHY RETAIL IS READY FOR BLOCKCHAIN

AUBURN UNIVERSITY

RFID LAB

EXECUTIVE SUMMARY

In the past two decades, there have been several inflection points in retail supply chain that should have changed our data handling procedures from the ground up. There was the case-level RFID initiative from Walmart in 2004, the surge of item-level EPC tagging in 2010, and more recently, efforts with QR codes to trace item identity back to the factory. With each event, we hoped that we finally had the tools for complete item accuracy, and we expected an overhaul of EDI and ASN systems. So far, each effort has contributed great value at specific nodes in the supply chain but has failed to fundamentally challenge our aging data exchange models.

Perhaps we've been looking at the problem the wrong way. Each time we've worked to advance supply chain visibility, we've focused on better methods for creating and maintaining item identity. Moving from the broad SKU-level GTIN identifiers to serialized SGTIN identities gives each item agency, but what's in a name if we can't share it? Looking inside cases with RFID systems helps us validate accuracy of the case, but how do we communicate that with our trading partners? QR codes allow consumers to authenticate an item back to source and are helpful for tracking down counterfeits, but how do we learn where the items were diverted in the first place? We are very good at finding standard models to make things unique, but not so much on the sharing side. It's as if we've all agreed to a language that fully describes all the things we own, but we are stuck trying to shout the particulars to the next partner that may be hundreds of miles away or gossiping the information from one receiver to the next like an enormous international game of "telephone". To stretch the metaphor further, we currently have a robust spoken vocabulary, but what we really need next is a written language.

I believe that with blockchain in the supply chain, we have found that written language. We've finally come to address the gaps in the "in-between", and to fill in technology in the transfer and not just the naming. There has been much hype over various blockchain initiatives these last few years promising to revolutionize everything from banking to voting, but speaking as the physical retail industry, I think we approach the tech differently, with very specific and longstanding pain points. In retail, we're not looking to find a fit for blockchain; instead, we're starting with very real problems and searching out blockchain as a specific solution. I believe with the Chain Integration Project we finally have our best chance for resolving these issues and saving billions of dollars of wasted money in the mysteries of supply chain inaccuracy. I'm very proud to have been a founding member of this initiative at the Auburn RFID Lab, and along with my peers from the other retailers, brands, and solution providers participating in this initiative, I look forward to being able to tell the story to the next generation of supply chain professionals about how we took the first small steps to create the medium for business language to be communicated confidently and efficiently at an item level, and I hope to share how you built that foundation with me.

TERRY BROWN

Director of NA Distribution Technology Transformation

OVERVIEW

In the evolving world of international supply chain, the demand for improved product visibility and source-to-store traceability has never been higher. Many brands and retailers operate trade networks that integrate hundreds of suppliers, logistics providers, and distribution channels with physical footprints spanning the globe. In addition to the distributed nature of supply chain stakeholders, disparate information systems suffer constant communication issues between trade partners, which is largely due to outdated digital strategies and complex, home-grown systems. These assorted systems produce different dialects of data, creating more confusion than clarity when it comes to exchanging product information between trade partners. As legacy systems evolve and serialized systems like RFID are adopted, the retail industry as a whole generates exponential amounts of data. In fact, most supply chains today are flooded with 50 times more data than they were just five years earlier, yet only a quarter of that data is utilized in a relevant timeframe (1). Collectively, burdensome exchange practices and dissimilar data have inhibited the industry's ability to leverage their growing Internet-of-Things (IoT) infrastructure and extract supply chain-wide insights.

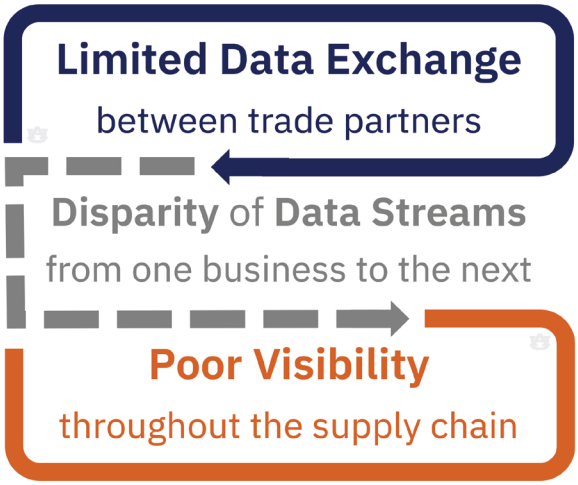
These isolated systems coupled with outdated exchange methods not only restrict visibility throughout the supply chain but also underpin fundamental business operations. Consequently, widespread inefficiencies and substantial costs propagate from one stakeholder to the next. As a result, billions of dollars are lost each year throughout the industry as retailers, brand owners, and logistics providers are plagued by problems like shrink, claims, and counterfeiting. These issues represent only a handful of the problems facing the global supply chain ecosystem, and the retail apparel industry as a whole is plagued with cost-consuming pain points that are consequences of deficient data exploitation.

Enter blockchain, a transformative technology introduced by cryptocurrencies that holds the promise of alleviating today's supply chain pain points. Blockchain technology enables a new type of business model driven by the collaboration between parties who work together to establish a trusted record of information that is maintained through mutual agreement, or "consensus." The responsibility of governing this network and maintaining a collective record of truth is shared amongst network participants, eliminating the need for third parties to facilitate exchange or to act as trusted middlemen. By removing the need for outside entities to establish trust or vouch for integrity, those participating in a blockchain network are able to transact directly and more efficiently, as well as maintain ownership of their data. In the case of a trade network, all relevant stakeholders could share the responsibility of contributing and independently validating product information as goods flow through the supply chain, resulting in a mutually agreed-upon record of information available to relevant trade partners.

Given the current business landscape, there is tremendous application potential for blockchain technology to streamline exchange and cultivate collaboration between trade partners. The retail apparel industry is well-positioned to utilize blockchain, especially where IoT infrastructure and serialized data systems are already in place. Successful implementation of a blockchain-based solution for supply chain is dependent on each stakeholder's ability to identify products and capture information related to those products. Therefore, serialized systems, like RFID or other solutions that are capable of capturing item-level information, are the foundational data sources for a blockchain solution—the more granular the product information is, the more valuable the blockchain application can be. However, use of blockchain technology in retail apparel today is limited, given that insufficient exploration has yet to prove out the potential of this technology.

THE PROBLEMS

In today's retail and apparel industry, there are many factors that prevent organizations from achieving end-to-end product visibility. One of the most critical examples of this is poor communication of data between organizations. The majority of individual products progress through the supply chain in one piece, but their digital attributes are not as fortunate. The data associated with products is often substituted or discarded as goods are transferred from one stakeholder to the next, with each organization redefining and replacing the previous product data with information pertinent to their own operations. This process of altering product information at each touchpoint resembles a convoluted game of "telephone" that takes place on an international scale, with each stakeholder passing along their own interpretation of a product's information. These same problems are not exclusive to retail and apparel; they are common in most supply networks, ranging from food and consumer-packaged goods to automotive parts and aerospace components. According to the World Economic Forum, reducing unreliable communication and outdated technological infrastructure in international supply networks could add $2.6 trillion to global GDP annually, equivalent to a 15% increase in international trade (2). Problems of this size demand attention, but an in-depth look into the underlying causes is essential for determining a viable solution.



Communication pitfalls common to the retail and apparel industry are further compounded by the incongruent output of information systems that complicates the process of exchanging product information. The legacy systems within each organization have been developed in silos over time, resulting in vastly different IT infrastructures from one company to the next. Dissimilar data handling practices further complicate the process of uniting supply chain stakeholders because each party to a transaction communicates their data in a different dialect. Consider an example using spoken languages. Spanish and Portuguese share the same romance language roots, but they are still distinct languages with different rules, vocabularies, and pronunciations. If an individual who is fluent in Spanish and an individual who is fluent in Portuguese were to converse, they might be able to stumble their way through a conversation, but the majority of what the other was saying would be lost in translation. Likewise, product data provided by a brand may have some commonality with the product data produced by a retailer, but more often than not, the differences outweigh the similarities.

Key Facts from Project Zipper

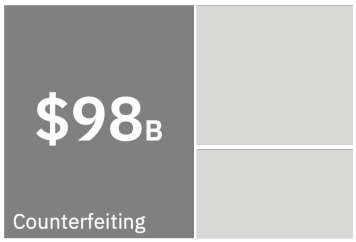
8 Brands

5 Retailers

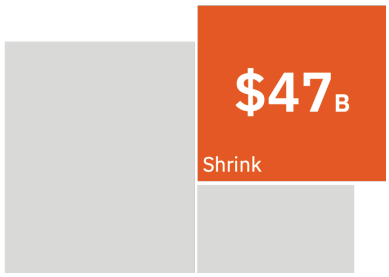
35 **Unique Data Streams**

Project Zipper, a national data exchange study underway at the Auburn University RFID Lab, has provided insight into this problem. Since 2017, Project Zipper has taken an in-depth look at the flow of supply chain data between 13 brand owners and retailers, with each participant contributing data from their legacy and item-level systems (3). Collectively, these 13 organizations submit over 35 unique data streams, and within this assortment of ASN, barcode, and RFID data, no two are alike. Data elements and reporting mechanisms vary by company, requiring a significant amount of time and resources to interpret and analyze. The incongruent output of these seemingly similar systems highlights the dissimilarity of data shared between partners and reinforces the industry-wide need for fluency across organizational borders. Consequently, a significant amount of resources were spent cleaning and consolidating the data streams from Project Zipper before actionable insights were obtained. While important learnings related to ASN accuracy and order integrity were generated upon the conclusion of the first phase of the project, complications related to aggregating and analyzing the data reveal industry-wide ineptitude for outputting homogenous data.

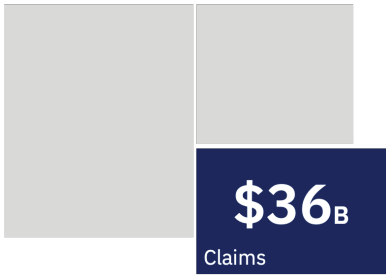
The consequences of limited visibility and deficient communication are substantial, amounting to billion-dollar pain points across the industry that ultimately inflate costs for suppliers, vendors, and consumers. Some of the most prominent sources of cost creation for supply chain stakeholders are claims, shrink, and counterfeiting. Claims and the chargebacks that result from them generally arise between trade partners when shipments are damaged, lost, or inaccurate. In 2017, the total amount of chargebacks in the retail, apparel, and grocery industries exceeded $36 billion (4), with suppliers and logistics providers footing the bill. An entire cottage industry has emerged around the resolution of claims, with some of the largest retailers staffing hundreds of employees or hiring out third parties to negotiate and settle with suppliers. Shrink, or unaccounted for inventory, reached a sum of over $46.8 billion that same year as a result of theft and vendor shortages, due in part to poor visibility and limited auditability throughout the supply chain (5). Counterfeiting and grey market goods are also significant problems that brands and suppliers face in the current business climate, as they contribute to the loss of revenue, dilution of brand image, and other costly concerns. The Global Brand Counterfeiting Report estimates that losses due to counterfeit footwear, apparel, and other high-end consumer goods exceeded $98 billion in 2017 (6).



Counterfeiting is one of the largest pain points across the industry today and it results in loss of revenue and brand dilution



Shrink is unaccounted for inventory and is the result of theft and vendor shortages



Claims and **Chargebacks** occur when shipments are damaged, lost, or inaccurate

= **$181B** TOTAL

Collectively, these costs surpass $180 billion, nearly 5% of total retail sales in 2017 (4). These systemic problems necessitate a solution for better inter-organizational cooperation and supply chain visibility. The advent of blockchain provides a promising solution to the industry problems at hand, and the overall potential of this technology stretches across every industry that operates a physical supply network.

BLOCKCHAIN

Currently, few technologies exist that are as misunderstood and misrepresented as blockchain. An explosion of interest and investment in the space has created a diverse ecosystem of applications, ranging from a platform to trade virtual cats to a solution for scalable interstellar communication. Some have proclaimed blockchain to be a replacement for the internet or a substitute for a database, whereas in reality, blockchain systems are generally built on top of both, acting as improvements or complements to existing digital infrastructure. Cutting through the confusion can be challenging, but at a fundamental level, every blockchain implementation shares a common origin and several core components.

Nearly ten years ago, a white paper was released that outlined a digital currency powered by a new form of network architecture that allows users to transact directly with one another and without any oversight or involvement from third parties. This was accomplished by dispersing the roles and

Traditional Transaction Model

A customer receives his drink ***directly*** from the coffee shop owner

Step 1:
A customer swipes their credit card to pay for their coffee

Step 2:
The customer's bank receives the transaction information and approves the payment

Step 3:
Inter-bank networks hosted by companies like Visa and Mastercard act as a clearing house between financial institutions by processing the payment

Step 4:
The shop owner's bank receives notice that the payment has been approved

Step 5:
The shop owner receives the funds after the settlement process completes

Blockchain Transaction Model

A customer receives his drink
directly
from the shop owner

The shop owner receives payment
directly
from the customer

The financial exchange - just like the physical exchange – is ***simple***, ***efficient***, and ***economical***

Although Bitcoin was originally created as a Peer-to-Peer network, its underlying blockchain infrastructure is applicable to exchanges between consumers and businesses as well as business-to-business transactions. These transactions do not have to be financial in nature either. Information-only transactions are also optimized through this new transactional model by eliminating intermediaries, increasing efficiency, and reducing costs.

responsibilities performed by traditional trust mechanisms to all network participants, effectively eliminating the need for unbiased entities or trust brokers. The network was self-sustaining, and this feat was accomplished by implementing a new technique for establishing trust among untrusting parties and ensuring accountability throughout the network. Consequently, the protocol for this digital currency fundamentally challenged the traditional way in which we transact with value, with information, and with everything in between.

Within a few years, the implications of this novel application infrastructure began to spread outside of financial services, opening up a world of untapped potential. Much like email was the breakthrough application for the internet in the late '90s, Bitcoin and other cryptocurrencies were the breakthrough application for blockchain in the past decade. The past three years have seen a tremendous amount of investment in the space, with the estimated value of blockchain technology climbing 1,700% from 2016 to 2017 (7). According to a Gartner study, the business value add from blockchain technology is expected to exceed $176B by 2025, implicating continued investment and adoption in the foreseeable future (8). Enterprise investment has significantly contributed to this growth, with billions of dollars poured into research and development efforts across numerous industries. Deloitte's 2019 Blockchain Adoption survey polled over 1,300 executives across a dozen countries and found that over half of respondents consider blockchain technology to be a top-five strategic priority for their organizations this year (9). Another executive survey conducted by Accenture revealed blockchain to be one of the most crucial technologies for driving efficiency in last-mile delivery and for enabling hyper-personalized customer experiences within the next three years (10). Confidence in this technology has grown significantly over the years, and many companies have begun the transition from the exploration phase of blockchain to the implementation phase.

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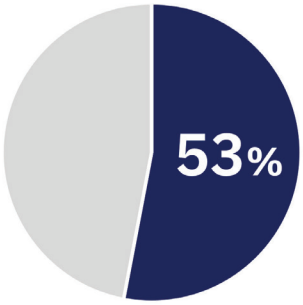
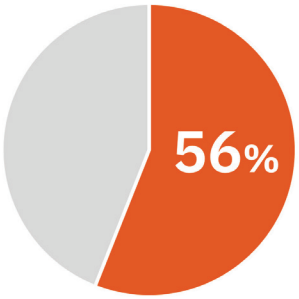
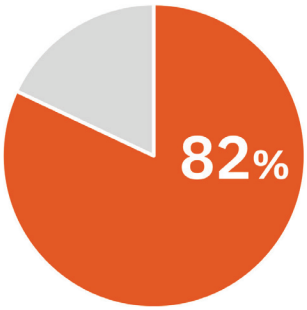


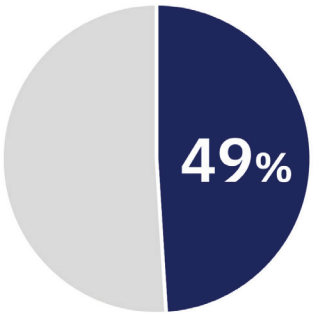
53% of executives consider blockchain to be a **Top 5 Strategic Priority** for their organization in 2019



56% of executives believe that blockchain will be the **Most Important Technology** in the next 3 years for last-mile delivery



82% of executives report that their suppliers, customers, and/or competitors are discussing or working on blockchain solutions to current challenges in the value chain



49% of executives believe that blockchain will play a crucial role in hyper-personalized customer experiences within the next 3 years

While the blockchain space may be crowded with applications and use cases, the technology is essentially a combination of two things: distributed ledger technology and smart contracts. At the heart of every blockchain is a "distributed ledger," or an absolute record of information held by each network participant that is established through collective agreement and maintained through constant cooperation.

Every exchange that occurs between two parties is broadcasted to all relevant stakeholders in the network, and those stakeholders must work together to approve transactions and add them to the consortium's historical record. Transactions are generally grouped together in "blocks," and once a block has enough transactions, it is evaluated by the network and attached to the preceding block upon approval. Each block is linked to its predecessor and eventually to its successor with the use of cryptography, which creates a "chain" of chronological information.

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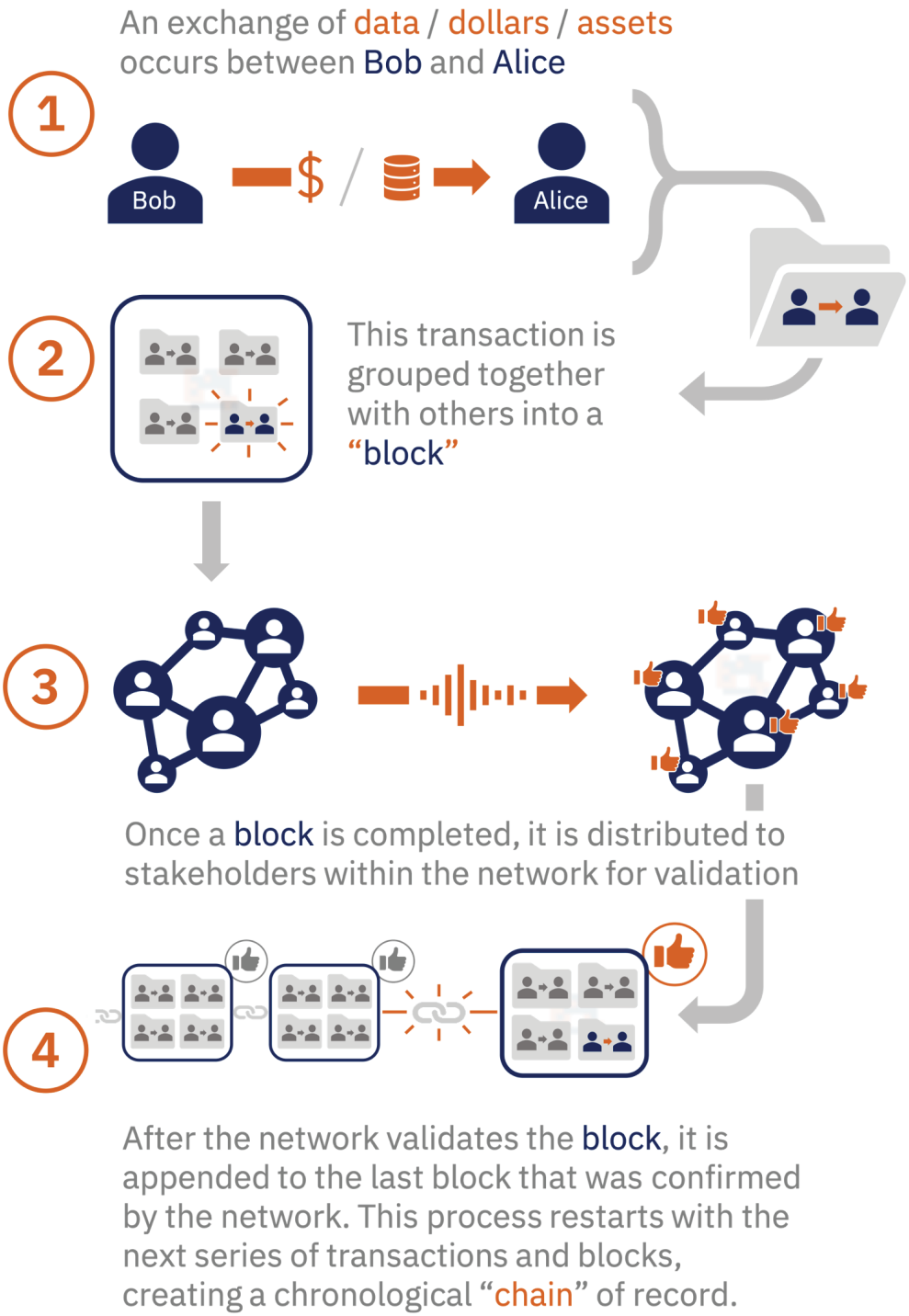
The process of validating and posting information to the ledger is determined on a case-by-case basis, but ultimately, all relevant stakeholders in the network must agree on any additions to the master ledger.

Additionally, information that is written to the ledger is immutable, meaning that it cannot be altered or destroyed once it is written. Because the update and delete functions found in traditional database systems are disallowed within blockchain-based systems, the integrity of information in the digital ledger can be guaranteed because a transaction record is set in stone once approved. By sharing this single source of transactional truth embedded in the distributed ledger and by contributing to its conservation, every stakeholder is able to operate in congruence with the rest of the consortium, alleviating tension and enabling collaboration through a state of constancy and accountability.



A blockchain network revolves around this core distributed ledger feature, and it provides a fundamental layer of information that the network supports. Smart contracts, the second key component of blockchain technology, are applications or programs built on top of the information layer provided by the distributed ledger. In other words, smart contracts are simply units of code that are written to perform specified tasks. The difficulty of these tasks can vary, with some smart contracts executing simple logic while others execute programs with several levels of complexity. Many smart contract platforms are Turing complete, meaning that a program written for a traditional computing system can also be written as a smart contract on the blockchain. This capability opens up a world of possibilities when coupled with other components of the blockchain because these applications can operate in distributed environments with greater efficiency and scalability by utilizing the collective resources made available by network stakeholders.

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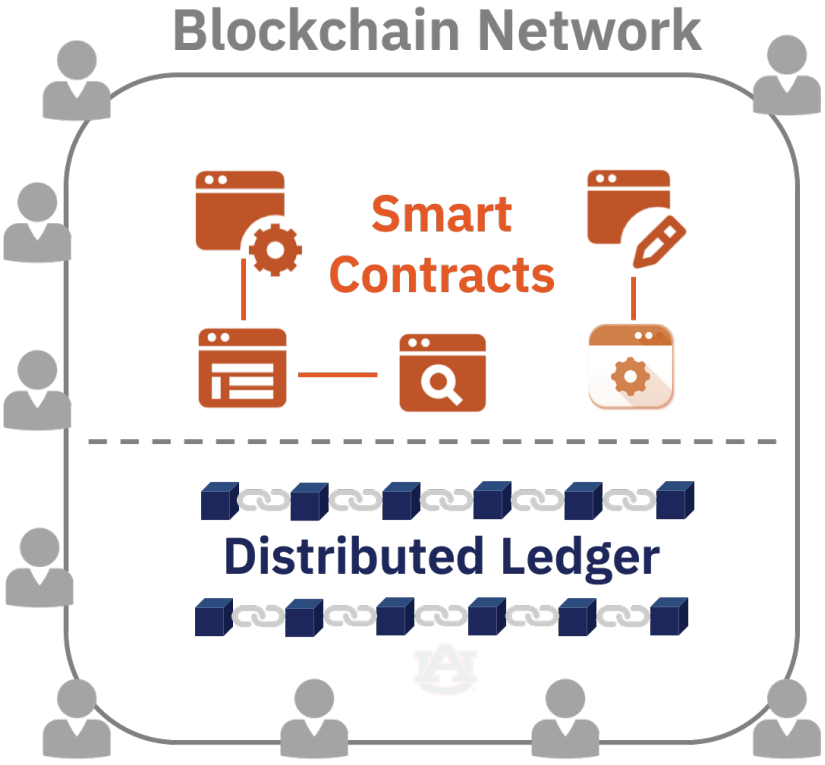
Once a smart contract is written and deployed within the blockchain ecosystem, it can operate autonomously, meaning that it can function independently or without the need for direct input from a user. Therefore, an active smart contract can automate specified tasks and processes within the network, such as reconciling POs and ASNs or auditing shipments with item-level information. The existence of each smart contract is also recorded in the blockchain, including information from the date of its creation to the functions that it performs. While there is significant value in distributed ledger technology on its own, smart contracts are an integral element for leveraging the information within the ledger and extracting maximum value from a blockchain solution. The combination of distributed ledger technology and smart contracts have driven much of the enterprise interest and investment until now, and because driving efficiency is critical for supply chain success, it is an ideal application space for blockchain technology.



Smart Contracts are programs or applications that are built on top of the Distributed Ledger layer. They can execute logic and perform functions much like modern computing systems.

The **Distributed Ledger** is the foundational layer of every blockchain. It is where transaction data and other network-related information is stored, and members of the network work together to maintain it.

AUBURN RFID LAB

SERIALIZED DATA

But how exactly can blockchain technology alleviate pain points facing the retail and apparel industry today? Because limited visibility and communication constraints hold back current supply chains, blockchain technology has the potential to enable real-time visibility from source to store and enhance collaboration between supply chain stakeholders. A survey of brands, retailers, and logistics providers conducted by the Auburn University RFID Lab in February of 2018 revealed that poor visibility and communication throughout the supply chain are the most critical use cases for blockchain in the retail industry. The utility of a blockchain solution for supply chain hinges upon a stakeholder's ability to identify and capture the items that they are trying to track throughout

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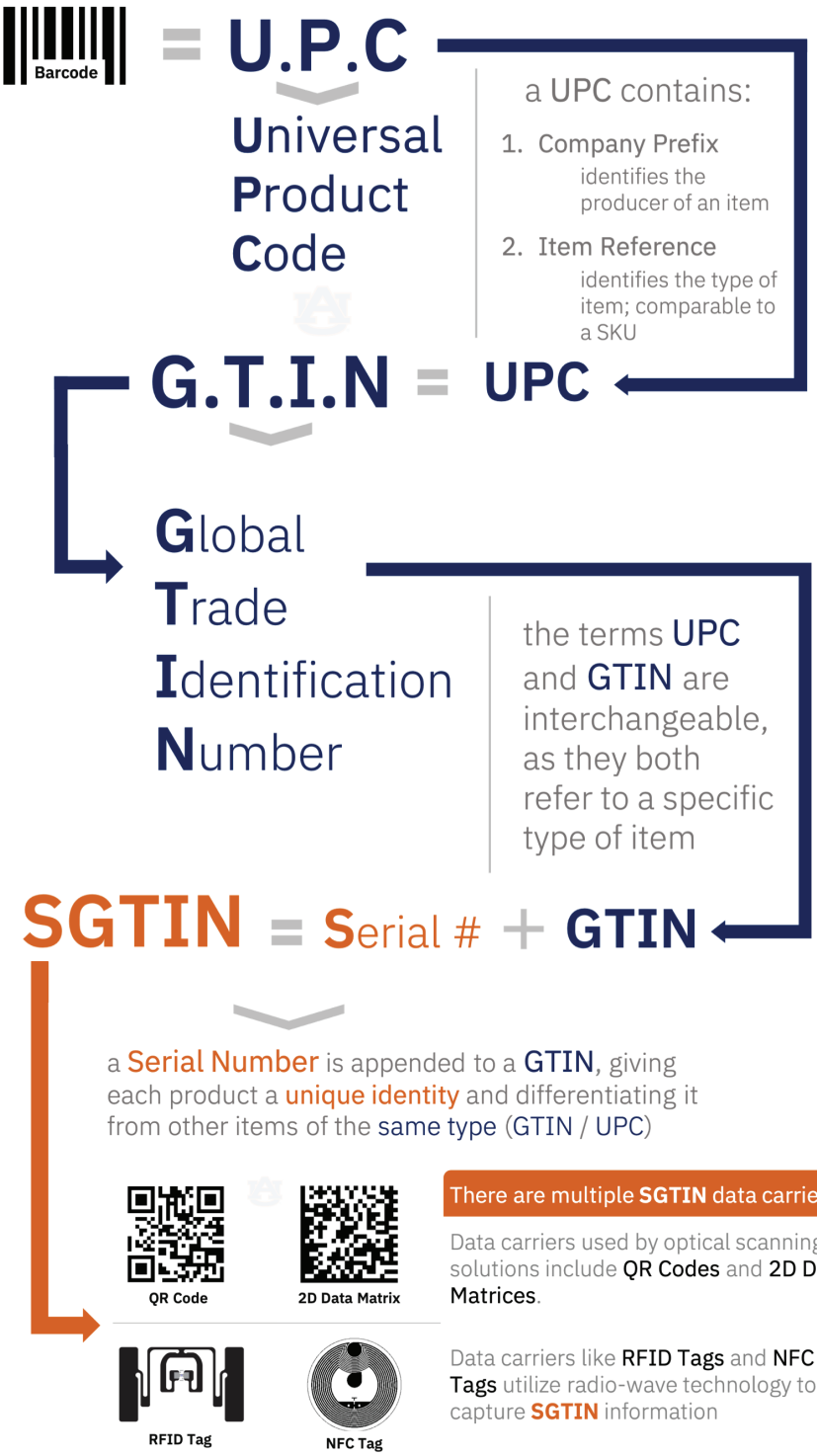
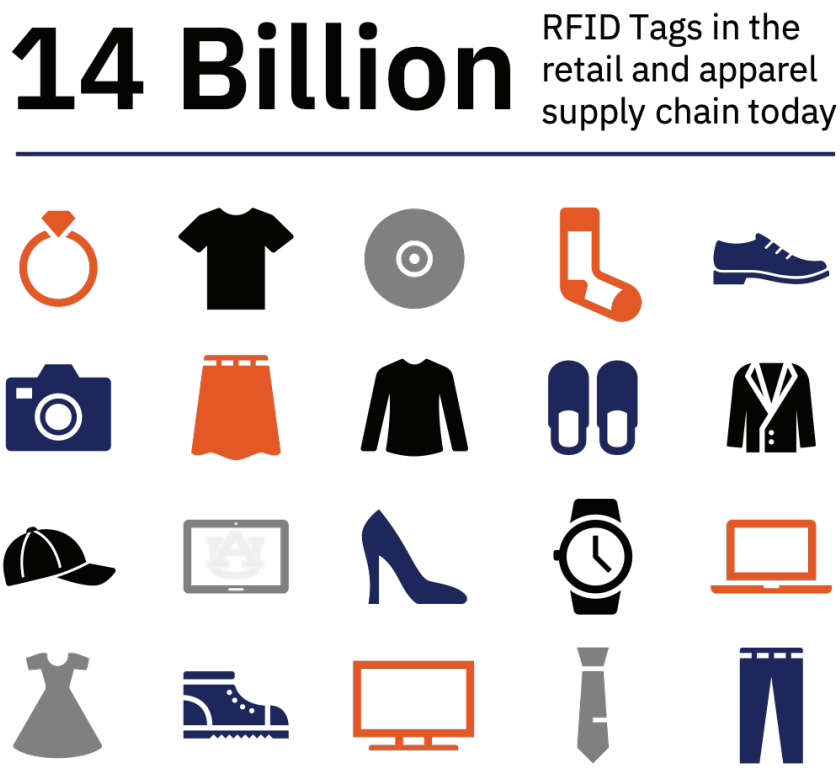
the products' lifecycles. Technologies like RFID enable an organization to accomplish this by assigning serialized identities to goods and deploying capture systems that read that serialized information, effectively creating a unique digital representation for each physical product. Other serialized data carriers, like QR codes and NFC tags, can also perform these key functions, but what exactly is serialized data and what role does it play within the blockchain?

Before a product can be accounted for on a blockchain or traced throughout the supply chain, it must first have a digital identity. This digital identifier must also be unique so that the asset is distinguishable from others. Therefore, these identities must be serialized in order for each item to maintain singularity. This task can be performed by Serialized Global Trade Identification Numbers (SGTINs). A SGTIN attaches a unique serial number to the end of standard product



information found in barcodes, allowing for identical items with the same Universal Product Code (UPC) or SKU to be differentiated. The standard for SGTINs supports a number of adaptations, so multiple methods for fusing item-level information to physical products exist. Some of the most popular methods are EPC-enabled RFID tags, QR codes, and serialized barcodes. While each approach has a different method of interpreting and assigning item-level data, they all trace back to an underlying SGTIN. If serialized identities are assigned at the item-level, the granularity provided by SGTINs is more specific than the limited visibility provided by class or SKU-level systems.

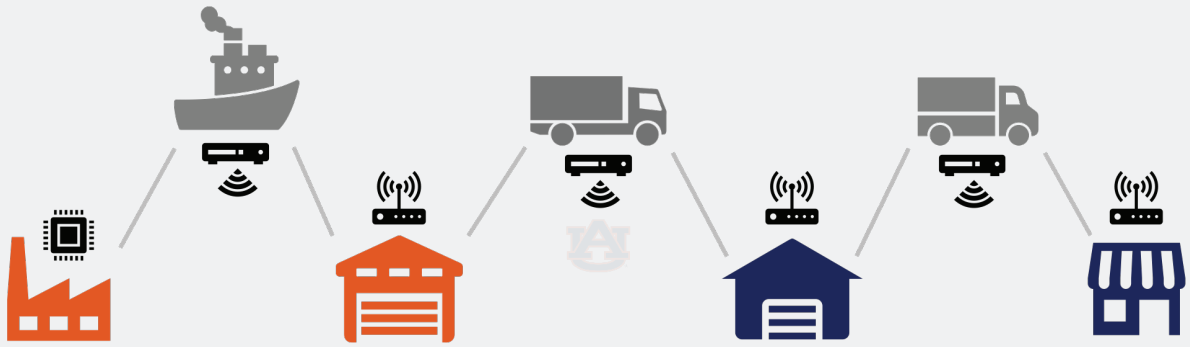
Most legacy systems, like barcode, do not support serialized item-level data and rely solely on class or SKU-level identification. As a result, legacy systems offer limited visibility compared to item-level systems; thus, they are a less-than-ideal information inputs for a blockchain solution that is designed to optimize visibility and traceability. Consequently, the detail and assurance



afforded by item-level systems provide an ideal data source for ultimate visibility enabled by a blockchain solution. There are over 14 billion individual items accounted for with SGTINs in the retail supply chain today, ranging from luxury coats and jewelry to t-shirts and tennis shoes. Global brands such as Nike, Calvin Klein, Lululemon, and Levi's have integrated RFID tags into their product lines, and logistics providers like FedEx and UPS have adopted the serialization solution as well. Additionally, the 2018 RFID Adoption Survey conducted by Dr. Bill Hardgrave of Auburn University revealed that 70% of the top 100 apparel retailers in the U.S. are using RFID technology, with companies like Target and Macy's spearheading adoption. Collectively, these companies and their suppliers have created an international trade network that is rich with item-level data. Furthermore, by leveraging their serialized systems and utilizing blockchain as a medium of exchange, disconnected supply chain stakeholders can be unified within a shared digital ecosystem.

BUSINESS VALUE FOR SUPPLY CHAIN STAKEHOLDERS

There is a tremendous amount of business value that can be unlocked for each supply chain stakeholder if a blockchain-based solution is successfully deployed because each trade partner stands to benefit from the visibility and transparency created throughout the supply chain. Not only would blockchain alleviate communication pain points and streamline data exchange between organizations, but each stakeholder would also have the ability to track allotted goods throughout their lifecycles. Brands and suppliers could track product distribution downstream, and retailers could monitor the status of an order upstream. Custody and ownership of goods could be determined with greater accuracy and less latency, thus transitioning a trade network from dependence on financial ownership to confidence in physical ownership. More frequent order updates could be triggered by checkpoints enabled upstream and be automated with smart contracts, providing wholesale buyers the same level of visibility for their orders that most consumers have for individual orders today.



The use case for traceability has been explored by a number of blockchain projects within the food and grocery industry. Additionally, several projects have demonstrated the ability to trace goods back up the supply chain, resulting in better visibility for sellers and consumers. Success stories, such as Walmart and IBM's Food Trust, have demonstrated the feasibility of this technology for the food supply chain. However, nearly every blockchain pilot or proof-of-concept to date has utilized case or class-level data, meaning that individual goods are collectively identified by a case code or SKU that could potentially be shared with thousands of other identical products. For this reason, users must presume the integrity of cases or rely on class-level identifiers that cannot provide absolute certainty about individual products. However, in the retail supply chain where serialized data systems have been widely adopted, stakeholders can confirm the absolute integrity of each item as it makes its way through the supply chain. This eliminates the assumptions and trust requirements necessitated by less granular information. By leveraging the serialized data infrastructure found through the retail and apparel supply chain today, trade partners can generate an unprecedented level of visibility by exploiting the item-level data already embedded in their processes.

In addition to solving existing supply chain problems, blockchain technology can be a catalyst for organizations looking to usher in the next generation of the supply chain. One key consideration for supply chain stakeholders is enabling demand-driven capabilities. A dynamic supply chain driven by consumer demand will be a crucial element for competitiveness in the near future, as fluctuations in consumer sentiment and international trade have a ripple effect on the value chain. Exposure to macroeconomic trends represents a growing risk area for organizations who operate sophisticated supply networks, thus, mandating better flexibility and adaptability on a global scale. For an organization to respond effectively to unforeseen events, it must be well connected and well informed—ready to react when the unexpected arises. However, this level of adaptability hinges on insightful data and active cooperation. KPMG cites "information latency and a lack of a timely, accurate visibility to actual demand and available supply" as one of the top inhibitors for establishing a demand-driven supply chain (11).

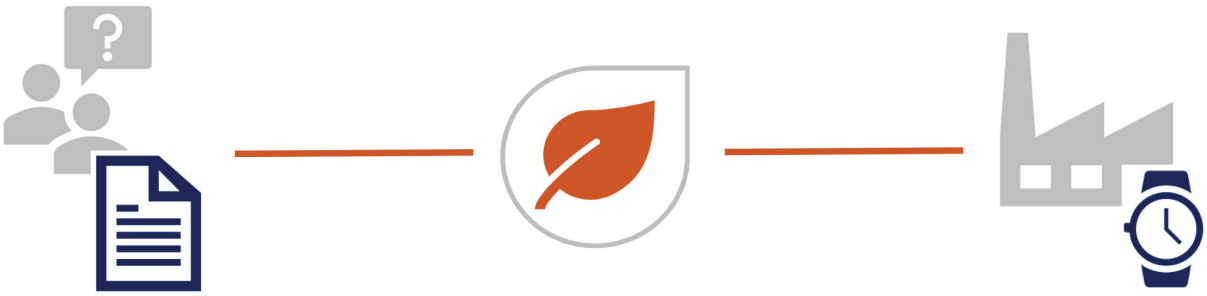
The efficiency, visibility, and traceability enabled by blockchain can offer a number of unique value propositions to each stakeholder in the retail and apparel supply chain. Furthermore, brand owners, 3PLs, retailers, and solution providers stand to gain a significant amount of value from the adoption and implementation of blockchain.

BUSINESS VALUE
FOR BRAND OWNERS

Brand owners at the inception of the supply chain are the primary target of claims or chargebacks issued by retailers and are the largest victim of counterfeiting and grey market goods. Both of these billion-dollar pain points can be contested with blockchain technology because of its capacity to alleviate tension between trade partners and enable authentication of assets. The current claims process between brand owners and retailers is ambiguous and inefficient, and limited auditability of orders often contributes to lengthy negotiations and costly conclusions for brand owners. However, in a blockchain ecosystem where brand owners and retailers exchange item-level data related to shipments and orders, disputes can be settled with hard data and resolutions can be expedited because both parties are referencing the same source of information made available by the distributed ledger. By accelerating the claims process and reducing overall chargebacks, brand owners can save time and cut costs.

With blockchain, brands can combat counterfeiting by maintaining immutable records of all commissioned products and by sharing item-level detail with vendors and consumers to ensure the authenticity of goods. The anti-counterfeiting use case is especially compelling for brand owners who operate international networks of suppliers and third-party manufacturers, as most counterfeit goods originate overseas. By documenting and distributing the identities of legitimate goods, a brand owner can crackdown on counterfeit goods being produced upstream and supplement product verification efforts with retail partners and patrons downstream. By using item-level information to empower data-driven decisions, illegitimate distribution channels can be identified and bad actors can be severed from the supply network. Buyers big and small can obtain assurance of each product's authenticity, eradicating the grey area that many wholesale buyers and consumers find themselves in today.

Additionally, by maintaining item-level information on each product's fulfillment path, a brand owner can support sustainability initiatives with hard data and prove provenance to its customers. Vertical brands, in particular, can benefit the most from this capability. By enabling end-to-end visibility, vertical brand owners would have the capacity to share each product's complete history from source to store, putting ethical practice and sustainable sourcing on display for consumers.



Claims

- Faster reconciliation due to improved auditability
- Time and Cost savings

Sustainability

- Product provenance for consumer engagement
- Highlight ethical sourcing

Counterfeiting

- Ability to determine provenance
- Ideal platform for product authenticity

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BUSINESS VALUE

FOR RETAILERS

Retailers also bear a significant burden as a result of the claims remediation process, and some of the largest retailers employ hundreds of full-time employees who are dedicated to negotiating and collecting claims and chargebacks from suppliers. At their origin, claims arise when retailers receive mis-shipments or inaccurate orders from suppliers, and these errors tend to propagate throughout the rest of the retailer's operations. Inaccurate shipments must be accounted for and subsequent adjustments must be made to fulfillment strategies and expected inventory quantities, creating a harmful ripple effect throughout the rest of the retailer's operations. Therefore, it is in the best interest of retailers and their suppliers to reduce the overall number of claims and streamline the remediation process. Stakeholders benefit from cost and time savings, and retail operations experience fewer interruptions. By utilizing the distributed ledger to read item-level information related to inbound shipments, retailers can conduct more conclusive audits and equip their claims teams with more precise data when mis-shipments occur. More granular information related to goods received ultimately creates a richer supply of data for retailers to disseminate throughout distribution channels, improving visibility and inventory accuracy across the value chain.

Shrink, or unaccounted for inventory, is another billion-dollar problem that plagues most retailers. Commonly, the source of this uncertainty can be traced back to misinformation related to goods that were expected but never received. Though there are various factors that contribute to shrink, vendor shortages comprise over a quarter of the total sum. Limited upstream visibility inhibits a retailer's ability to adjust for these shortages, forcing them to react retrospectively rather than plan proactively. If brands were to publish order information with item-level detail to the distributed ledger and share it with their respective retailers, a blockchain solution could minimize shrink, remove ambiguity from business processes, and alleviate tension in the overall trade relationship.

Visibility created by the blockchain can also provide opportunities for enhanced supplier score-carding, where retailers evaluate order integrity over time and assess trade relationships as needed. With the help of supply chain stakeholders upstream, retailers could provide proof of provenance and verification of product authenticity, effectively telling the story of an item and boosting consumer engagement. Lastly, retailers can leverage the data within the distributed ledger to streamline their omnichannel operations, uniting distributors and stores by sharing supply levels and enabling the organization to operate as a cohesive unit.

Claims

- Faster reconciliation due to improved auditability
- Time and Cost savings

Consumer Engagement

- Product provenance for customer assurance
- Promote fair trade practices

Shrink

- Improved on-hand inventory accuracy
- Transparency for inventory management

BUSINESS VALUE

FOR LOGISTICS PROVIDERS

Logistics providers also stand to gain from the adoption of blockchain technology, as they are also targeted by trade partners during claims disputes. In the current logistics environment, most Third-Party-Logistics companies (3PLs) receive little to no information regarding the content of the shipments that they receive and deliver, resulting in a significant amount of risk whenever disputes arise. Therefore, because logistics providers receive blindly, product information afforded by a blockchain solution is immensely valuable. After all, in the words of FedEx's Chairman and CEO Fred Smith, "information about the package is as important as the package itself" (12). An item-level record of product information shared by relevant supply chain stakeholders would enable a 3PL to confirm information related to a shipment and ensure the integrity of its contents by contributing its own item-level entries to the distributed ledger. Foreknowledge of upcoming shipments would allow a logistics provider to plan trailer capacities preemptively, to reroute shipments as needed, and to circumvent costly bottlenecks. Additionally, with item-level data available within the distributed ledger, 3PLs would no longer have to rely on averages for trailer and capacity planning and would use exact details for more precise calculations instead.

Blockchain has also been proven to accelerate transaction turnovers for 3PLs. One logistics provider utilized smart contracts to reduce Bill of Lading transfer time to only 4 minutes – a process that could take up to 10 days traditionally (13). The automation of this particular process saved not only a significant amount of time for the 3PL, but also a substantial amount of resources compared to existing paper-based processes. Across the maritime freight industry, about 400,000 trees worth of paper is used annually for Bills of Lading. Therefore, blockchain-based systems pose an environmentally friendly and digitally efficient alternative. Altogether, the collective business value of blockchain technology for logistics providers is substantial, especially in the case of claims reduction and transaction expedition that ultimately translate into cost-cutting and time savings.

Advanced Planning

- Data-driven trailer and capacity planning
- Superior shipment visibility

Claims

- Faster reconciliation due to improved auditability
- Time and Cost savings

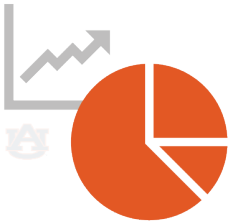
Sustainability

- Replace paper-based processes
- Expedite transaction turnovers

BUSINESS VALUE

FOR SOLUTION PROVIDERS

The potential impact of blockchain in the supply chain creates a wealth of opportunities for solution providers as well, especially those that currently offer serialized data solutions. The success of blockchain applications for supply chain is mainly dependent on the ability of trade partners to identify and capture the product information flowing through their facilities. Solution providers that offer hardware, software, and integrated solutions often fill this critical role for end-users and play an essential part in any successful blockchain ecosystem. Additionally, by utilizing the open-source blockchain frameworks made available by Hyperledger, Corda, and Ethereum, solution providers can offer block-chain-compatible products to their customers, complete with track and trace capabilities built off of blockchain-based software. Hyperledger frameworks, such as Fabric and Sawtooth, have been developed as back-end components for blockchain applications and intentionally leave the front-end or user-facing portion of the software stack open for others to occupy. That being said, technology companies with domain expertise have the opportunity to leverage these open-source frameworks and take advantage of their modularity, scalability, and efficiency. Solution providers can also utilize smart contracts to deploy applications throughout the blockchain ecosystem; thus, enabling process automation and increasing operational efficiencies while ensuring immutability and transparency throughout the trade network.



New Market Opportunities

- Burgeoning enterprise demand for blockchain products and services
- Open-source initiatives accelerate development

Integrated Products

- Add blockchain to customer tool belts
- "Blockchain-ready" serialization solutions

CONCLUSION

While blockchain does have the potential to solve current business problems and lay the foundation for future business models, it must first overcome several hurdles before reaching mass adoption. Education about this novel technology is needed for individuals and enterprises, and extensive research must be done to expedite its adoption. One such initiative is underway at the Auburn University RFID Lab. This project, dubbed "CHIP," will be the first of its kind in the retail industry to support item-level data streams from multiple stakeholders and is backed by a consortium of 20+ end users, solution providers, and supporting organizations (14). By leveraging existing consortia and implementing a live proof-of-concept, the RFID Lab and its partners are working together to prove the potential of blockchain technology in the retail supply chain.

As blockchain progresses along the emerging technology curve, there is an ever-growing supply of experiential learnings and innovative solutions that are enabling organizations to put the technology into practice. Each stakeholder in the supply chain stands to gain from the implementation of blockchain in their core operations. Ultimately, the greatest amount of business value will be achieved through collective adoption of the technology throughout the entire trade ecosystem; this holds true for any industry, whether it be apparel, food, consumer packaged goods, automotive, or aerospace. The total worth of a blockchain solution for supply chain is influenced by the number of trade partners that are participating because, at its most fundamental level, the viability and value of a network grow exponentially as each stakeholder joins. A common adage in the business world today is that blockchain is a team sport, mainly because its success is fundamentally driven by collaboration and collective effort. The most pressing business cases—visibility, traceability, and consumer engagement—can only be realized if essential stakeholders are willing to play their part, and while individual organizations may be able to put the technology into practice, doing so in isolation defeats its purpose. Successful adoption of blockchain in retail will require industry-wide effort, so strong consortiums, engaged stakeholders, and established IoT infrastructure are critical for the success of any initiative. While a significant journey for implementing this technology lies ahead, the retail and apparel industry is ready for blockchain.

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CONTRIBUTORS

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Allan is actively leading the blockchain and broader data initiatives at the RFID Lab, having previously led the first phases of Project Zipper and the CHIP Project. Allan has been with the Lab since May 2017, and he graduated from Auburn University in May 2019 with a bachelor's degree in Accounting. Allan is also a Certified Blockchain Solutions Architect (CBSA) and a Certified Blockchain Security Professional (CBSP).

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Will Sansom - Senior Analyst

Will Sansom is a key analyst on the CHIP Project and has been with the Lab since January 2019. He is an undergraduate student at Auburn University pursuing a bachelor's degree in Supply Chain Management with a minor in Finance, with an expected graduation date of December 2020.

Drew Mixson - Analyst

Drew Mixson is an analyst for the CHIP Project and has been with the Lab since January 2019. He is currently pursuing a bachelor's degree in Supply Chain Management with a minor in Philanthropy and Nonprofit Studies, with an expected graduation date of May 2020.

ABOUT THE CHIP PROJECT

The CHIP Project is a blockchain proof-of-concept for serialized data exchange in the retail apparel supply chain. CHIP, an acronym for CHain Integration Project, will be the first of its kind in the industry, with the goal of integrating item-level data streams from various stakeholders into a blockchain solution, creating a common record of information jointly shared by trade partners that will ultimately enable end-to-end visibility and data-driven decision making throughout the value chain.

Since the inception of the project in June 2018, CHIP has onboarded 21 partners that will participate directly in the proof-of-concept and support the project as a collective working group. Of those contributing to the project, there are five brand owners including Herman Kay, Nike, PVH Corp., Spanx, and Under Armour in addition to three national retailers, namely Dillard's, Kohl's, and Macy's, and one global logistics provider, FedEx. Over half a dozen technology solution providers are engaged as well, including Avery Dennison, Checkpoint, IBM, Mojix, Smartrac, SML and Zebra Technologies. Strategic partnerships with Collaboration LLC, Elverston, LLC, GS1 US, Hyperledger, Mindy Rector Consulting, Tuskegee University, and Vaspar Strategies will also propel the project forward and ensure compliance with global standards.

ABOUT THE RFID LAB

The Auburn University RFID Lab is research center that focuses on the business case and technical implementation of emerging technologies in the retail, aerospace, and automotive industries. Since its inception in 2005, the RFID Lab has conducted a series of seminal business value studies that have led to the adoption of RFID and other IoT technologies throughout multiple industries. Sponsors of the RFID Lab include: Amazon, Avery Dennison, Boeing, Checkpoint, Delta, FedEx, GS1 US, Intel, Mojix, Nike, NXP, Smartrac, SML, Target, Home Depot, Tyco, VF Corp, Walmart, and Zebra Technologies.

If you would like to connect with the Auburn University RFID Lab, please contact Justin Patton at **jbp0033@auburn.edu** or **334-734-4034**