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Blockchain: The Backbone of Supply Chains in Omni-Channels

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Abstract

From the financial industry to the healthcare industry, many use cases for blockchain have been explored and adopted. However, unlike most industries, the retail industry has yet to fully explore blockchain's capabilities, for the industry's priority is in improving its practices first. One of its practices in the works is omni-channels, which face struggles of its own, that oftentimes result from supply chain inefficiencies. This paper will utilize already explored blockchain potentials as a guide to explore and introduce new potentials in blockchain for supply chain in omni-channels.

Executive Summary

Today's consumers demand seamless shopping experiences, for they are more digitally aware and hold higher standards for businesses. To meet consumers' expectations, businesses want to integrate all channels and processes to develop an end-to-end traceability and transparency to the production, distribution, retailing, buying, and returning of goods. However, the gap between technology and traditional supply chains hinders businesses from fully achieving consumers' expectations. As of today, no single technology has been able to integrate all channels and processes involved in supply chains, which are key to generating seamless shopping experiences. To do so, businesses have built omni-channels, a business model that integrates different shopping channels, but face difficulties in sustaining them due to gaps in supply chain processes. In recent months, blockchain, a decentralized digital ledger, has presented capabilities that may be able to bridge not only the gap between technology and supply chains, but also supply chains and omni-channels. The purpose of this paper is to explore opportunities for blockchain, blockchain enabled supply chain, and blockchain for supply chains in omni-channels. To realize this goal, I will provide an overview of blockchain, draw connections between blockchain and supply chain, explain how blockchain can eliminate supply chain inefficiencies in omni-channels, and then propose a plausible future development for blockchain.

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Chapter 1

Introduction to Blockchain

In a technology-driven society, many people rely on technology for solutions to their problems. Satoshi Nakamoto, the pioneer of blockchain technology, saw an opportunity to resolve the double spending problem that occurred during the 2008 financial crisis with bitcoin. Bitcoin, the first and one of many use cases for blockchain, is a digital currency that people exchange on a peer-to-peer network with no governing authority such as the Central Bank. (“How Does Bitcoin Work,” 2018) People can exchange, buy, or sell bitcoin for currency, products, and services. Encryption keys, which conceal the buyers' and sellers' identities, secure the peer-to-peer exchange. Exchanges are placed in an immutable network of records called blockchain. With no central authority, encryption keys, and an immutable record, blockchain provides end-to-end transparency, security, and traceability in any exchange. Today, there are over 100 start-ups and companies across different industries using blockchain, for it has proven to be one of the most innovative and promising technologies since the creation of the internet.

Blockchain operates in a five-step process. (Figure 1)

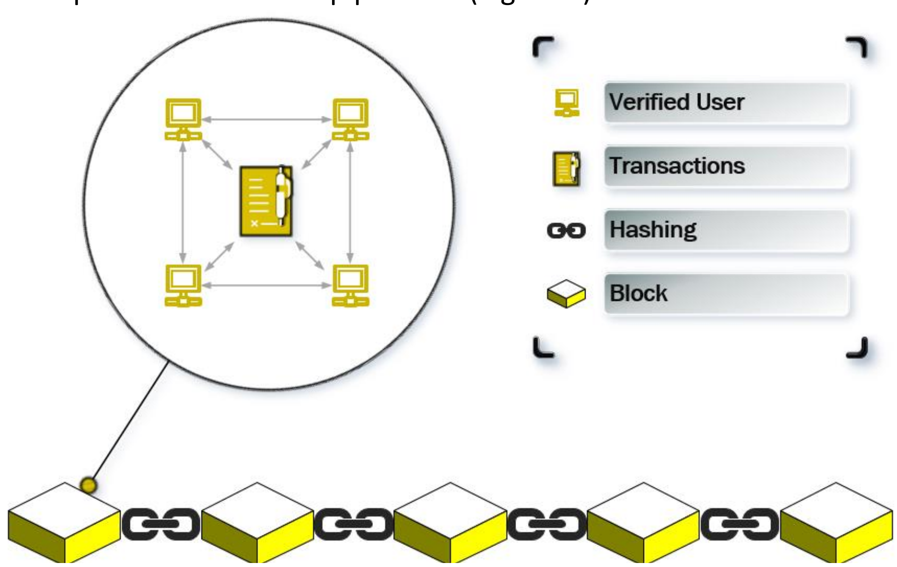

Figure 1

The first process is the exchange or otherwise known as a transaction. A transaction includes smart contracts, an automated, digital version of a traditional contract that runs on an if-then premise, and a cryptographic signature to verify users' identity and their transaction. A smart contract has predefined terms, and when terms are met, expired, rejected, or broken, it executes itself to the next step. For example, two users – a proprietor and a tenant – want to exchange a one-month lease for a total of $1,000 paid in two payments. The first payment is a down-payment of $300, and the second payment is the remaining $700 of the rental cost. The premises of their contract are as followed (Figure 2):

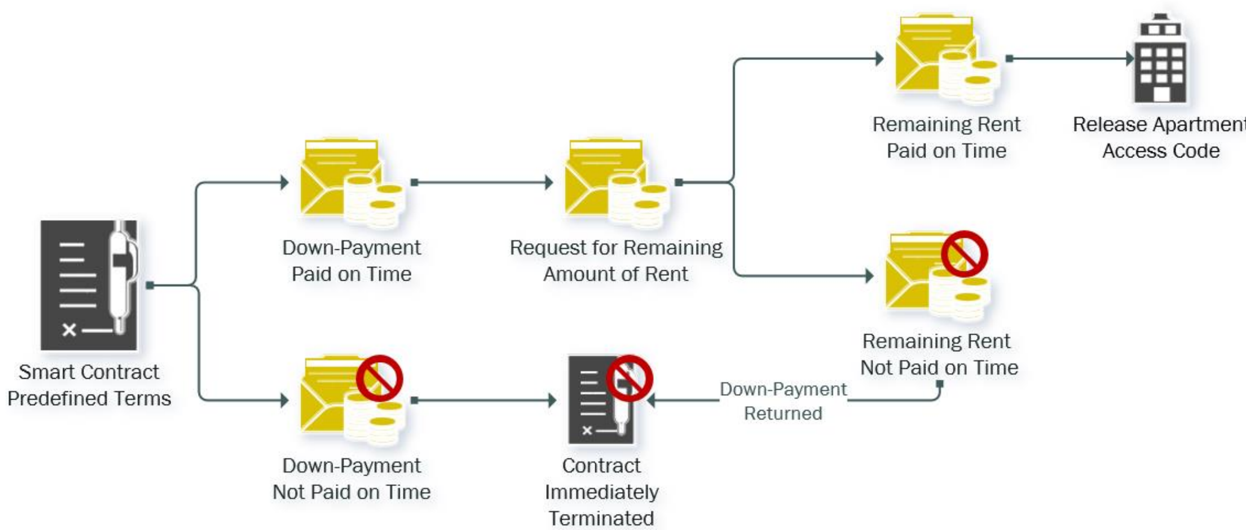

Figure 2

1) If the tenant pays the down-payment before or on its due date, then the tenant receives payment options for the next transaction, which is the total amount of rent due by a specific time and day.

OR

2) If the tenant does not pay the down-payment by its due date, then the contract ends, and the tenant is no longer able to rent the apartment.

AND

1) If the tenant pays the total amount of rent due on time, then he receives an email with an access code to the apartment.

OR

2) If the tenant does not pay the total amount of rent due on time, then the contract ends, the tenant is no longer able to rent the apartment, and the tenant must deposit the down-payment directly into the tenant's bank account.

The second step of the process is the block, where the transaction, whose terms have been set through a smart contract, are pending for approval by the proprietor and the tenant. The block is sent to the proprietor's and tenant's own digital ledgers. The next step (third step) of the process is verification, where the proprietor and tenant will evaluate and meet, reject, ignore, or break the terms of the smart contract. Once the transaction is completed, it will enter the fourth stage, which is the hashing. A cryptographic hash, which condenses information into a fixed value that cannot be regenerated, makes the block immutable. The proprietor cannot falsely claim that he did not receive the tenant's down-payment when a block shows that the tenant did pay. The next transaction carries along the hash of the previous transaction to create an immutable sequence of events. If the tenant met all terms of the smart contract to rent the apartment for one month, the transaction will enter the fifth and last stage, the execution. The tenant now has the access code to the apartment building and can move in and out according to the rental period agreement.

There are two types of blockchain: public and private. The key differences between a public and private blockchain are the user's access to the network and the consensus protocol. In a public blockchain, anyone can join and obtain a copy of the digital ledger. Bitcoin is an example of a public blockchain; anyone can download a Bitcoin wallet or platform on any device. To add in a new transaction to the blockchain, the majority (50% or more) of bitcoin users must reach consensus under a process called mining. (Baliga, 2017) Mining evaluates then adds on the transactions or blocks to the blockchain and maintains neutrality in the network, so a user cannot add new blocks to solely benefit his share. What users decide the value of bitcoin to be is the value – the greater the demand, the greater the value

A private blockchain, otherwise known as a permissioned blockchain, hosts a choice of users. The user that creates the network is usually in charge of inviting other users to the blockchain unless the user grants approval for permissioned users to invite others. In most cases, consortiums such as stakeholders of a company or project run the blockchain. Many companies in different industries are building private blockchain to improve current business processes. The financial services industry was first to adopt private blockchain practices. Two major banks, Société Générale and The Royal Bank of Canada, simulated blockchain platforms in hopes to improve trading processes and to provide more transparent information on credit-scores, respectively.

Société Générale, a French bank serving over 31 million clients worldwide, developed a blockchain-based trading platform called Easy Trading Connect (ETC) to test if blockchain could eliminate the use of paper documents in commodity trading. (Société Générale, 2018) Paper documents are not only difficult to keep track, but also require a significant amount of time to process. To mitigate these difficulties, ETC provides digital versions of letters of credit, certifications and sales contracts, data verification and duplication checker, and real-time updates of the trade. Société Générale, ING, Shandong Bohi Industry, Louis Dreyfus, and their respective company banks partnered up to pilot the first commodity trade (6,000 tons of soybeans) in 2017. Société Générale chose the agricultural sector as its test subject, for the sector has the most complex documentation requirement and process in trading. The trade was executed in these following steps:

1) A China-based buyer, Shandong Bohi Industry, generated a smart contract to be distributed to the U.S.-based seller, Louis Dreyfus, and their respective banks

2) All parties agreed to the terms of the smart contract

3) All parties met all terms listed in the smart contract, so the shipping agent submitted a digital, legally-binding receipt to document shipment (of soybeans) departure

4) ETC automatically checked for all necessary documents – certificates given by Russell Marine Group, Blue Water Shipping, and the U.S. Department of Agriculture – to generate an invoice, which closed the transaction

Louis Dreyfus, the trader, reported that the platform reduced trade processing time by 80%. (Suberg, 2018)

The Royal Bank of Canada (RBC), on the other hand, filed a patent for a private blockchain to assess credit scores. On the platform, as described in the patent, the "credit records are recorded using blocks linked by identification data. The credit record stores historical and predictive information about borrowers used to compute credit ratings." (CoinDesk, 2018) RBC wants to provide its customers full transparency to their credit score and its changes – what exactly increased or decreased their credit score and when. Customers will receive alerts whenever there is a change. The greater transparency for customers, in return, is helping RBC collect more unique, end-to-end information on customer spending and borrowing habits. The platform also runs a blockchain of data on customers credit history retrieved from multiple channels, so credit scores cannot be evaluated solely with data from traditional credit agencies. Although the platform has not been yet implemented, RBC is optimistic that it can "fix the broken credit system."

The healthcare industry is another industry exploring private blockchain as a solution to lowering costs raised by stringent regulations and high-quality demands. There has not been any complete implementation for tangible results, however, SimplyVital, a start-up focused on providing providers and patients greater health data management, believes that blockchain can help generate more secure audit logs. (Damiani, 2017) ConnectingCare, SimplyVital's blockchain platform, uses financial forecasting and care coordination, a program that allows the patient's family, healthcare professionals, and administrators to collectively communicate health care decisions, to audit the patient's healthcare bills and to help the patient plan and prepare future payments. This decentralized network can decrease time spent on data retrieval, processing, and sharing. As a result, total transaction costs are lowered, and providers can collect payments from patients more efficiently.

Chapter 2

Blockchain Enabled Supply Chain

A supply chain is a network of suppliers, manufacturers, distributors, wholesalers, retailers, and consumers. A manufacturing supply chain network has four phases for transforming raw materials to finished goods: 1) suppliers provide manufacturers with raw materials, 2) manufacturers produce and supply finished goods to distributors, 3) distributors deliver batches of finished goods to wholesalers and retailers for a point-of-sale, and then 4) the finished goods are available in consumer markets for purchase. Each of the four phases face its own unique challenge. Suppliers provide raw materials, yet their identities are not stringently verified. Companies that source manufacturing to under-developed countries are making headlines for violating labor rights. Distributors are incurring excess costs from unforeseen circumstances such as late shipments. Lastly, wholesalers and retailers do not have real-time visibility into inventory levels which make companies vulnerable to extreme revenue loss. Though supply chain professionals continually update software and design contingency plans to alleviate challenges, those solutions go to waste as consumers continuously and rapidly demand new high-quality products and even more efficient services. This chapter will explore how supply, enabled through blockchain, can bridge gaps between supply chain networks and consumers' ever-changing needs.

Suppliers play one of the most important roles in a supply chain, so verifying their identity, certificates, and qualifications is crucial. Suppliers can falsify documentation and provide inferior or counterfeit products to lower their costs and increase their margins. Raw materials account for 50-80% of the total product cost. Once these raw materials are stolen, it is very difficult to get them back. In 2017, Moog Inc., a U.S. based aerospace and defense company, received 273 defective parts that were unknowingly installed in Boeing 777 wing spoilers. (Goh, 2017) Wing spoilers help slow down planes when they land. That supplier faked certificates for those defective parts. Although Moog Inc. and Boeing stress-tested uninstalled, defective parts for over 720 hours and determined that the parts will not affect flight safety, it is important to note that neither companies were able to identify on which planes each defective part was installed. If the supplier's identity and raw materials were examined and traced, respectively, with blockchain, then Moog and Boeing would have not experienced such an event. Moog could have verified the supplier's identity under a blockchain smart contract. The premises of the smart contract could have been the following:

1) If supplier provides proof of identification, certificates, and employment within 7 days, then contact respective issuer for a cryptographic signature to verify authenticity and provenance of all documents

OR

2) If supplier does not provide necessary documents within 7 days, then end contract

AND

1) If all cryptographic signatures are received within 7 days, then request a document showing unique identification codes for each part

OR

2) If one or more issuer does not provide cryptographic signature within 7 days, then end contract

AND

1) If supplier sends document within 7 days proving that all parts are unique and ready for shipment, then approve a 3-day shipment of parts to the facility

OR

2) If supplier does not send document within 7 days, then end contract.

All parts would have had unique identification codes to trace their journey from raw materials to components of finished goods. This would have helped easily identify where all 273 defective parts were installed. This example is representative of one of the many verification and traceability opportunities that blockchain offers to supply chain processes.

Once the suppliers and the raw materials are verified and approved, the next step is manufacturing the goods. The cost of manufacturing can sometimes be financially burdensome, therefore, it is common for companies to source their manufacturing to foreign, under-developed countries, where costs of labor is about 80% cheaper, tax rates are lower, and regulations are few. ("Pros and Cons of Overseas Manufacturing," 2015) However, low costs come at a different cost – poor labor conditions. Manufacturing facilities in Vietnam, for example, deny sick leave, restrict toilet use, pay $6.70 per day, and use hazardous chemicals. ("Hansae Vietnam," 2018) These manufacturing facilities have been receiving notable attention for abusing labor rights and not being held accountable because there is no enough proof. The Coca-Cola Company, an all-American beverage company that sources over one million tons of sugarcane every year from around the world, became aware of poor labor conditions on sugarcane plantations. The Coca-Cola Company, the U.S. Department of State, and a few other companies pledged to end poor labor conditions occurring in sugar manufacturing across 28 different countries before 2020 by using blockchain. ("Coca-Cola to Use Blockchain," 2018) A digital ledger will serve as a registry of workers' rights and proof against any violation; it will provide greater transparency into labor conditions in manufacturing firms. However, even though manufacturing firms decide to adopt this private blockchain platform, the public will not see any changes unless they are informed. A potential solution is negotiating a trade-off. Currently, the manufacturing industry is experiencing labor shortages. In the next decade, an estimate of 2.7 million manufacturing workers are retiring, and the industry will need approximately 3.4 million workers. (“A Shortage of Skilled Workers,” 2017) These shortages are occurring due to limited science, technology, engineering, and mathematics (STEM) graduates, manufacturing facilities’ poor reputation, and workers’ desire for better pay. Taking today’s very vocal and opinionated society into consideration, if manufacturing firms agree to provide the public audience yearly snapshots of the permissioned blockchain, where the company will be inclined to offer greater pay and benefits than the industry standard for the sake of brand reputation, then more people may express interest in joining the manufacturing industry. Blockchain can rebuild trust between manufacturers and laborers and encourage transparency.

The next step in a supply chain is distribution. Wholesalers and retailers rely on distributors to transport goods on-time, at a low-cost, and safely. Sensors attached to modes of transport such as trucks can help determine ideal truckloads to maximize fuel efficiency and minimize excess costs. Data on truckloads, fuel output per delivery, total distance and hours driven by truck drivers, and costs associated with dimensional weight pricing will all be available on one digital ledger, where distributors can easily look for correlations and identify the most profitable delivery methods. (“Blockchain for Trucking,” 2018) However, trucks, especially for food distribution, require very specific packaging and storage (temperature) and struggle to do so. According to the World Health Organization, over 400,000 people die every year after consuming contaminated food. (World Health Organization, 2017) The top two causes of foodborne illnesses are bacteria or viruses exposed during cross-contamination and an improper refrigeration of food during transport. Chipotle Mexican Grill, Inc., one of the most popular fast casual restaurants in the U.S., is famous for their record-breaking outbreaks that occurred between November 2015 and January 2016. There were 55 people infected with a rare strand of E. coli and, of those, 21 were hospitalized. (Food and Drug Administration, 2016) The company, its distributors, and the Food and Drug Administration (FDA) could not name all effected stores until the outbreak ended. As a result, Chipotle lost about $26.4 million dollars in sales in one quarter and a loyal customer base. Although distributors failed to identify the origin of the outbreak, many experts have guessed that the E. coli outbreak began from improperly stored ingredients. A blockchain-based distribution system would have quickly and easily traced the origin of the outbreak along with the rest of its contaminated deliveries.

The most troubling thought behind the Chipotle outbreak was the uncertainty of its scale. Inventory management is the most challenging process in supply chain management, for one mistake can cost company millions of dollars. Nike Inc. lost a whopping $100 million in sales due to lack of inventory control in early 2000s. (“11 Greatest Supply Chain Disasters,” 2006) Common inventory management mistakes involved inaccurate demand forecasting, poor system implementation in warehouses, inadequate inventory checks and updates, and a lack of automation. Although, there are many methods such as First-In, First-Out (FIFO), ABC prioritization, forecasting demands, and regular auditing to avoid these common inventory mistakes, they do not ensure accurate inventory levels. This is primarily because data on inventory levels have to be manually inputted, and human error is inevitable. Opportunities with blockchain for inventory management include, but are not limited to, tracing products before and after they reach wholesalers and retailers, providing a single platform where any permissioned user can view real-time updates, and automatically collecting and analyzing data to build greater insight to demand. For example, S&P Global Platts, a provider of information on energy and commodities market pricing and analytics, announced its plan to develop a permissioned blockchain for oil inventory data in the United Arab Emirates. (Partz, 2018) The permissioned blockchain will host stakeholders involved in the port of Fujarirah's oil trade. The port of Fujarirah has the largest oil inventory storage capacity in the Middle East. The exact amount of oil, its transaction cost, the mode of transport, information on seller and buyer, and all other necessary data will be recorded and available in real-time for all verified users. A blockchain-powered inventory system will improve communication and collaboration amongst all stakeholders in a supply chain and help provide accurate inventory levels for wholesalers and retailers.

Provenance, a startup dedicated to blockchain for supply chain, piloted a 6-month project to trace tuna fish caught in Maluku, Indonesia to a point-of-sale (retailer). (Provenance, 2016) The purpose of this pilot project was to expose illegal activities such as slavery that occur in Indonesia's fishing industry. Indonesia, the largest tuna-producing and exporting country and home to over 60 million people along the coast alone, is representative of blockchain's scalability. First, Provenance partnered with local fishermen, NGOs, two supply chain companies and their stakeholders to compare traditional methods of catching and recording tuna production to blockchain-enabled methods. All eight companies involved in the research use pen and paper to manually create, record, and update documents which masks any unethical behavior that may occur. Provenance's blockchain platform, which is available as either a smart-phone application or a downloadable-program, “links identity, location, material attributes, certifications and audit information with a specific item or batch ID” to trace every step of the supply chain (Figure 3). First, an NGO registers a verified fisherman onto Provenance’s program. The fisherman is expected to have a device that can download Provenance’s program. Whenever the fisherman catches a tuna fish – it takes an average of 30 to 45 minutes to reel in tuna fish – he tags it with a radio-frequency identification (RFID) or unique identifier. From then, the journey of that tuna fish is recorded in each stage of the supply chain.

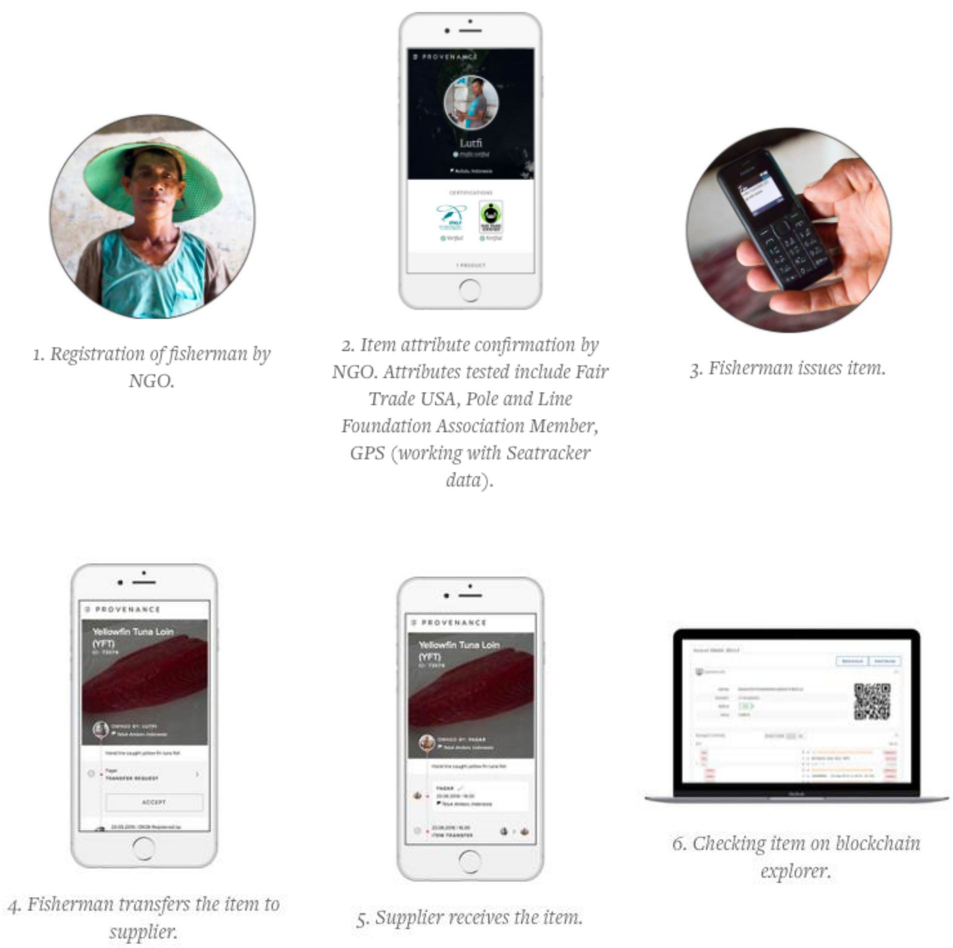

Figure 3

During the manufacturing stage, the unique identifiers are replaced by smart stickers for a variety of packaging which continues the tracing. The company, Provenance, visited markets and restaurants (logged on the platform), and confirmed the success of the end-to-end tracking of tuna-fish. (Figure 4) This pilot program not only protected Indonesian locals from slavery, but also provides 78% of U.S. consumers, who prefer ethical and sustainable products, a trustworthy platform. (Unilever, 2017)

1. NFC-enabled smart stickers carry the Provenance mark along with item or batch IDs.

2. Touching a smartphone over the stickers shows the product's journey from sea to supermarket.

3. The stickers attach to a wide variety of packaging, functioning on both dry and chilled sections

4. Item tracking extends to dining environments, indicating available information on ingredients.

5. Bespoke items such as smart menus can be designed and developed by Provenance for premium brands.

Figure 4

Chapter 3

Blockchain for Omni-Channels in the Retail Industry

Amidst the growth and impact of blockchain across different industries, blockchain use cases for the retail industry is still in its infancy. The retail industry made $23.45 trillion in sales worldwide in 2017 and is expected to grow at a yearly rate of 3.4%. (“Total Retail Sales Worldwide 2015-2020,” 2018) E-commerce accounted for $2.3 trillion of total sales and is projected to double by 2021. (“Global Retail e-Commerce Sales 2014-2021,” 2018) However, brick and mortar retailers have noticed a decline of foot traffic. Consumers’ purchasing decisions have changed drastically since the rise of e-commerce; customers post and read reviews of products beforehand, compare prices of comparable products on smartphones while in-stores, check social media platforms for inspiration, and want a seamless shopping experience. (Mackenzie, 2017) The growing digital engagement pose a challenge for retail companies, for it is difficult to fully trace or understand a customer’s purchasing decision. (Brewer, 2017) Retailers devised omni-channel approaches as a solution, but there are challenges in omni-channels that blockchain may be able to address.

An omni-channel is a customer-oriented sales and marketing strategy that provides customers a cohesive and seamless shopping experience from brick and mortar to e-commerce. (Figure 5) For retailers, omni-channels bridge the gaps between brick-and-mortar and e-commerce to help better understand customers’ purchasing decisions across multiple channels.

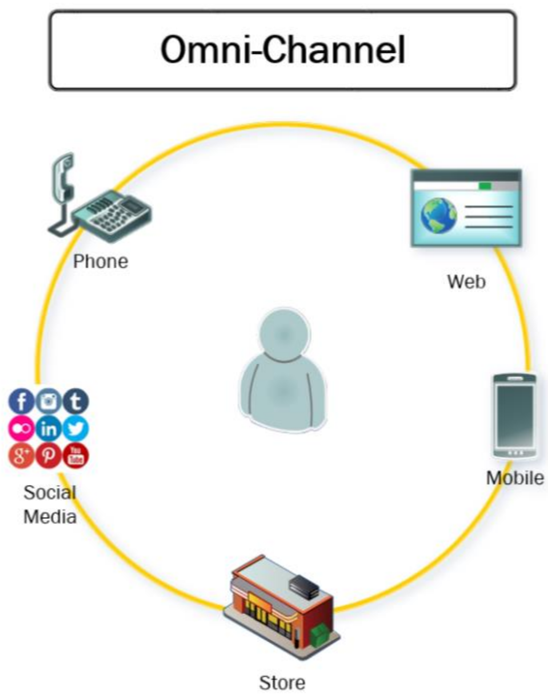

Figure 5

Starbucks, the world's largest coffee house chain with a revenue of $22.39 billion in 2017, is example of an omni-channel retailer. ("Starbucks: Revenue Worldwide," 2017) Starbucks seamlessly integrated its website, mobile application, and physical stores when designing its rewards program. According to the terms and conditions of the rewards program, a few of the perks include earning two stars for every dollar spent on purchases, redeeming free food or drinks after earning 125 stars or on birthdays, and getting free in-store refills. ("Starbucks Card Terms & Conditions," 2018) On the Starbucks website, customers can find information on benefits of the rewards program, sign-up for the program, and manage their profile such as reloading their balance. (Figure 6) On the Starbucks mobile application, customers make their order, receive an alert when the order is complete, and can view their reward status. (Figure 7) The menu and payment options are identical across all channels. Once customers pick up their orders in-stores, their reward status (number of earned stars) automatically updates.

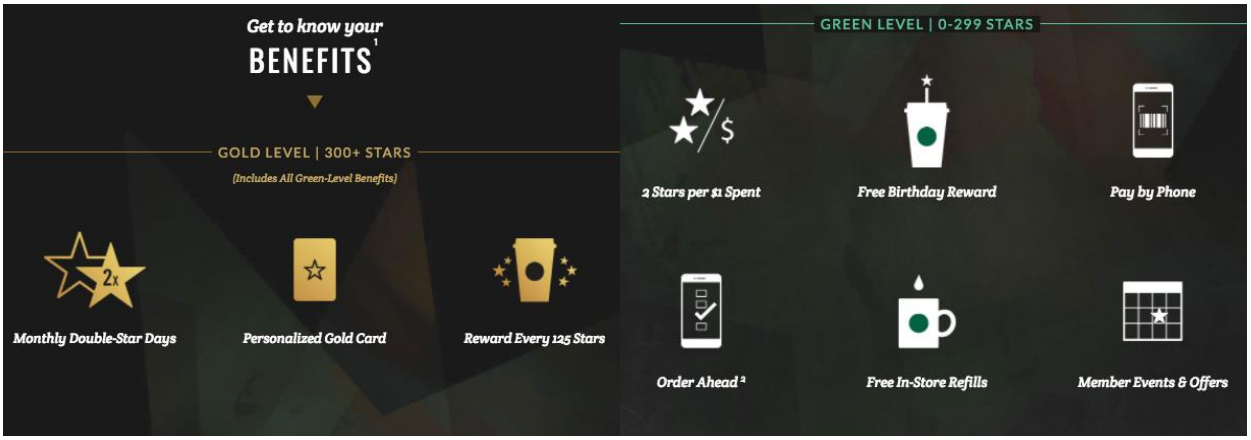

Figure 6

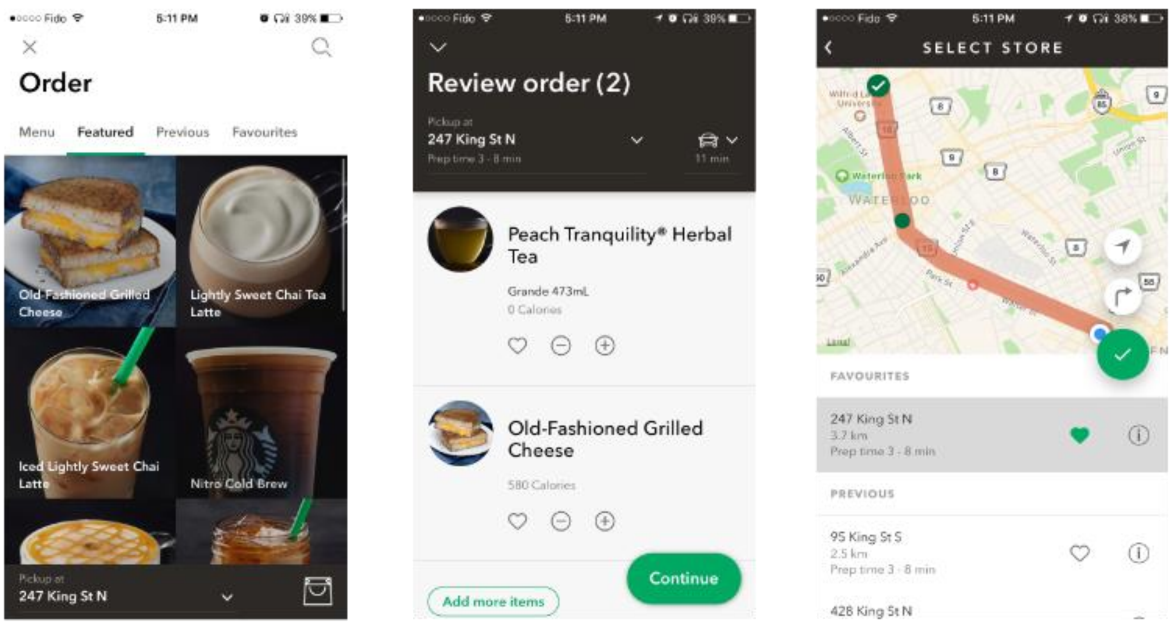

Figure 7

However, Starbucks' omni-channel results in one major issue: speed of service. Starbucks' order fulfillment wait-time is said to be less than five minutes, but only one of every four customers will get their order on time. An order can take up to 15 minutes to fulfill during peak-hours with mobile ordering accounting for 20% of orders. The reason behind delayed order fulfillment time is not the amount of orders, but the inability to automatically and efficiently divide and assign orders amongst staff members. Staff members – cashiers, baristas, managers, shift supervisors – are each responsible for completing tasks relevant solely to their position. Therefore, cashiers cannot help baristas complete orders even if there are no in-store orders to take. Kevin Johnson, Starbucks' Chief Operating Officer, said the "long wait-times are hurting sales." ("Starbucks Still…," 2017) A potential solution is to implement blockchain for evenly distributing staff members' tasks. A blockchain-based task scheduler connected to all point-of-sale would have smart contracts for each staff position that enables tasks to be distributed to others if premises are met. For example, if a cashier's point-of-sale is inactive for 3 minutes and a barista's point-of-sale has more than 3 orders to be fulfilled, then an order is automatically assigned to the cashier. This will require Starbucks to train all staff how to prepare drinks, but staff members will fulfill orders quicker which results in more sales.

Neiman Marcus (Neiman), a luxury department store chain with 42 locations across the U.S, also operates omni-channels. Neiman's website will register the details of any search and automatically find the nearest locations with product availability. Then, the customer can either order the product online for delivery or an in-store pickup. If a customer decides to randomly visit one of Neiman's stores, finds a shirt that he likes but is hesitant from purchasing it, he can "record 360-degree videos of himself trying on [the] clothing in the store, which he can then save and take a look later when he's ready to buy online or in-store" on Memory Mirror, one of Neiman's technology tools. (Figure 8) ("10 Examples…," 2017) Another Neiman's application, the Snap. Find. Shop, allows customers to upload photos of any random product that they find to compare with currently available Neiman products. (Figure 9) If Neiman carries a similar product, customers can purchase it directly on the application. Neiman combines information on in-store and online product availability to provide customers a seamless purchasing experience.

Figure 8

Figure 9

However, in 2017, Neiman lost the interest and confidence of a few of its vendors due to poor inventory management. Neiman's merchandising system did not notify vendors when products were completely sold out which resulted in lost sales. Moreover, Neiman could not verify exact levels of product inventory, but asked vendors to buy back leftovers when excess inventory were found. This did not only burn bridges between the company and vendors, but also placed pressure on suppliers to have raw materials on demand. Steven Dennis, a former Neiman executive, said "they have lost total visibility of their business." (Fickenscher, 2017) A potential solution is to implement blockchain for inventory management. A blockchain-based inventory management system will offer accurate, transparent, real-time updates of inventory levels. Unique identifiers attached to products will help find and update products' exact location or journey, and with a decentralized inventory network, all relevant users can view changes in inventory levels as a result of sales or returns. This eliminates poor communication between suppliers, vendors, and retailers, and reduces the chances of not meeting demands due to unavailable products.

Another challenge for omni-channels is returns. Apple, the largest company in the world with a market value of $752 billion in 2017, offers the most seamless shopping experience yet has one of the worst return processes. (Taylor, 2015) First, Apple has strategically designed their products, website, social media, and physical stores to give off a unified and simplistic feeling. Apple limits product colors to shades of black, silver, and gold. The layout of Apple's website and physical stores are monochromatic, and Apple's social media accounts also keep up a noticeable "Apple vibe" to each post. (Figure 10) Second, Apple offers seamless technical support. Customers can request support representatives, who will guide customers through a chat bar, on the website, be directed to or schedule support representatives at Genius Bars in physical stores, or run diagnostics, which support representatives will receive automatically, on devices. Through each phase of conducting technical support, all channels are receiving updates on information for the case; a customer can walk into an Apple store with a case number to continue the diagnostics that began online. Apple ensures its channels provide consumers with a memorable brand experience. However, returns are not a part of the omni-channel. According to Apple's standard return policy, "only items that have been purchased directly from Apple, either online or at an Apple Retail Store, can be returned to Apple. Apple products purchased through other retailers must be returned in accordance to their respective returns and refunds policy." ("Returns & Refunds," 2018) Customers have mixed feelings by the fact that Apple products purchased from other retailers are treated as if they are not Apple products. Apple enacted that policy because there is no way for Apple to trace the journey of its products sold from other retailers, and in-store returns are cheaper and more profitable. (McKevitt, 2018) Returns (made through reverse logistics) have hidden costs for labor, customer service, financing, shipping, receiving, warehousing, and more. ("The Six Hidden Costs," 2017) Additionally, returns made in-stores can be easily placed on shelves for resale. A potential solution is to implement blockchain for tracing all Apple products' end-to-end journey and enabling a seamless returning experience. Apple can run a decentralized network for returns where customers, delivery services, warehouses, and all relevant parties can trace the journey of the return. Apple can require all other retailers to join the product network, so Apple can view and verify the authenticity and provenance of products, and then allow customers to return products to any channel. This guarantees customers an efficient returns experience.

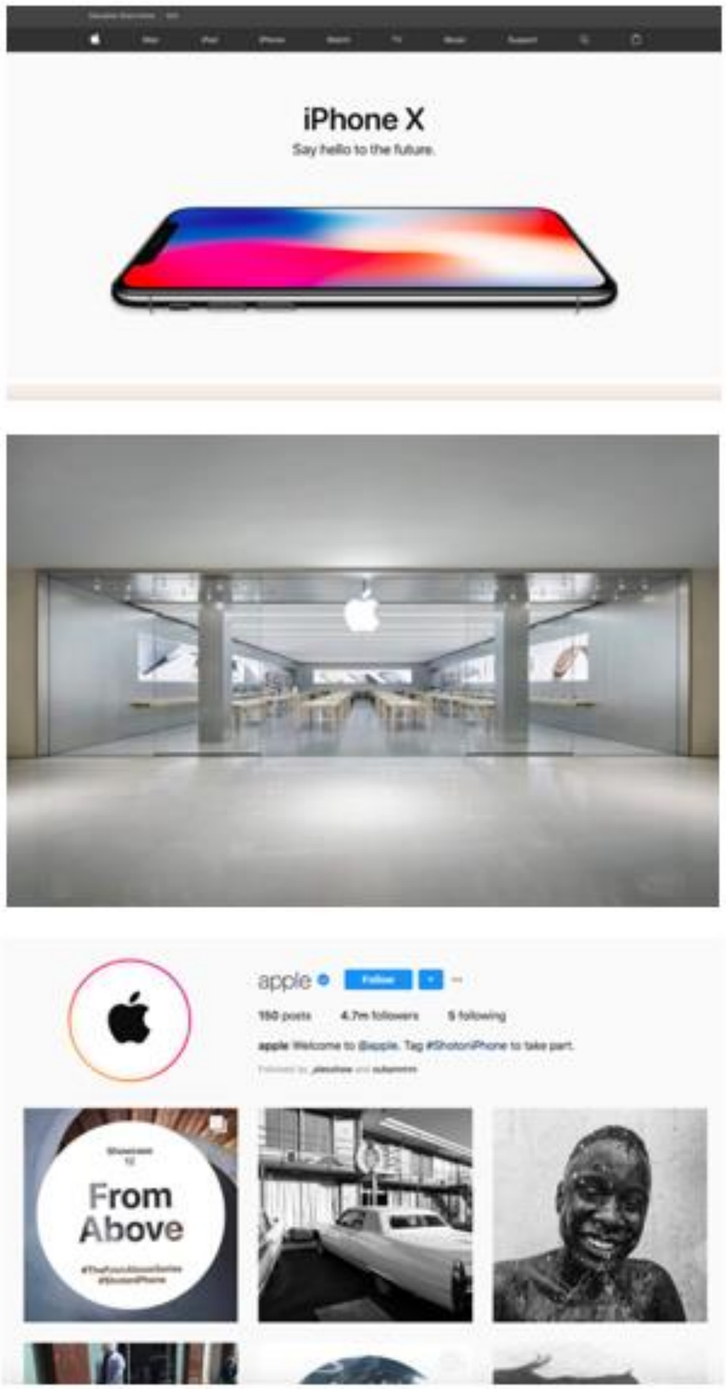
iPhone X
Say hello to the future.
apple
Follow
150 posts
4.7m followers
5 following
apple Welcome to @apple. Tag #ShotoniPhone to take part.
From Above

Figure 10

Chapter 4

Conclusion: Looking Forward

Looking forward, scalability will be the greatest challenge for blockchain. As a decentralized network grows, transaction processes slow, and digital ledgers become congested with transactions. (Szego, 2017) Ethereum, a decentralized network supported by its cryptocurrency for application development, has taken a foot forward to address scaling concerns. The company implemented a scaling solution which entails a two-layered blockchain called sharding; “a blockchain is split into different sections called shards, each of which can independently process transactions.” (Stark, 2018) However, the scale that Ethereum’s platform can support is not representative of the scale involved in consumers’ shopping experiences (from initial research and development for production of goods to returns). In comparison to traffic jams, where the amount of traffic is representative of such a scale and rerouted through multi-layered or sectioned highways, transactions can also be “rerouted” to different layers of blockchain on a multi-layered blockchain. (Figure 11) Therefore, a multi-layered blockchain is a potential solution to scalability concerns. The first layer of a multi-layered blockchain would hold a single blockchain. As shown in the figure below, there is a blockchain for supply. This blockchain for supply builds a decentralized network and pool for all parties and materials involved in the supply of raw materials. Once the blockchain for supply is created, it will be compressed to one of the blocks for a larger decentralized network. This larger network will be a blockchain for all stages involved in a supply chain such as distribution, manufacturing, inventory management, and more. The final layer is an even larger network with compressed blocks of all stages that affect a customer’s shopping experience, such as research and development, production of goods, and business processes. This multi-layered blockchain approach will not only help reduce transaction time and costs, but, most importantly, distribute and better organize transactions across appropriate ledgers.

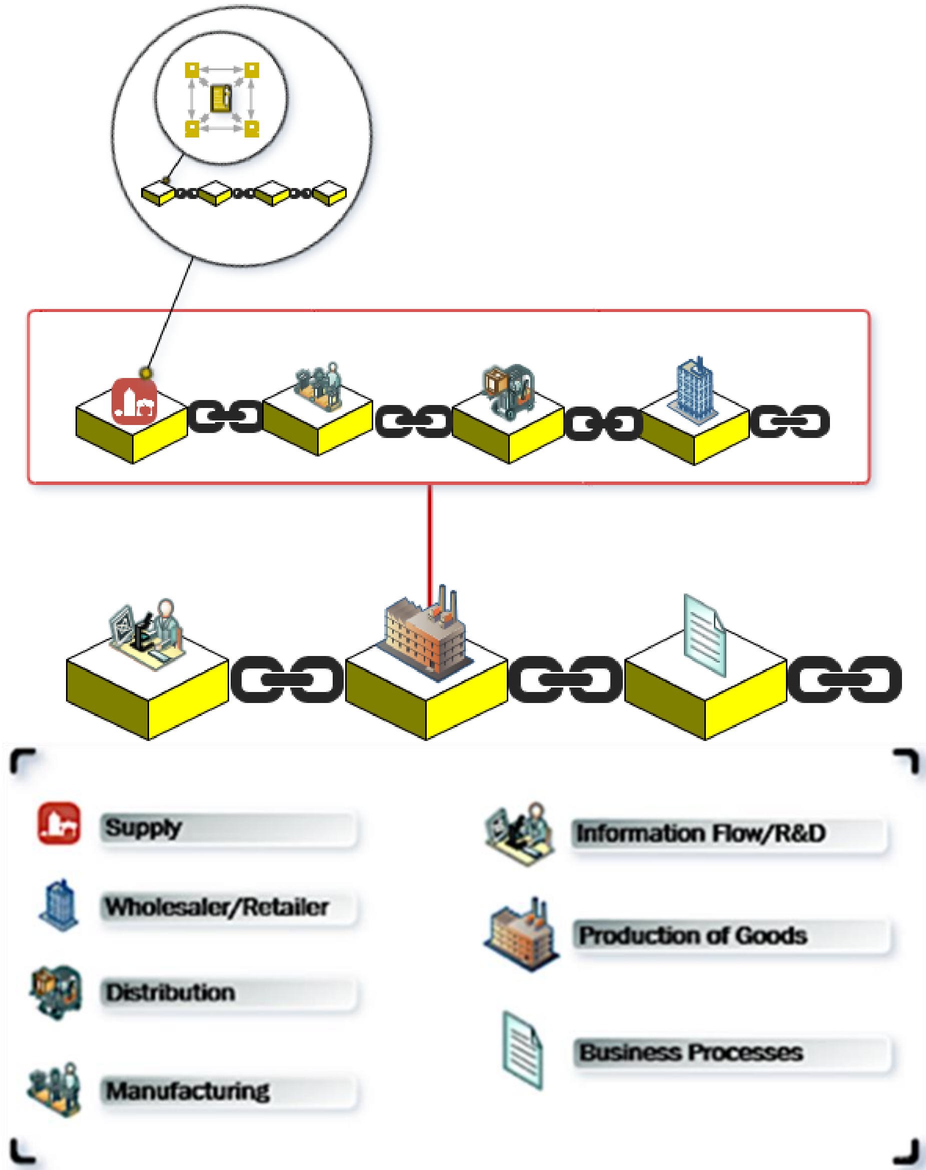

Figure 11

Throughout this paper, many opportunities for blockchain, blockchain for supply chain, and blockchain for omni-channels in the retail industry have been explored. Along with the exploration, many new capabilities were brainstormed, for blockchain holds many potential uses that have yet to be discovered. Blockchain is not only a back-bone for companies to strengthen and support their current business processes, but also a stepping-stone for companies that struggle to effectively incorporate technology in their business. Blockchain is an emerging technology with capabilities greater than technologies available today; it will change business environments for the better at a grandiose scale.

Bibliography

1 "How Does Bitcoin Work?" How Does Bitcoin Work? - Bitcoin, bitcoin.org/en/how-it-works.

2 Baliga, Arati. "Understanding Blockchain Consensus Models." Persistent Systems Ltd. April 2017, https://pdfs.semanticscholar.org/da8a/37b10bc1521a4d3de925d7ebc44bb606d740.pdf

3 "Blockchain Is Revolutionising the Trading Process." *Société Générale*, 1 Mar. 2018, www.societegenerale.com/en/digital-and-innovation/innovative-services/blockchain-innovation.

4 Suberg, William. "'Higher Than Expected': Louis Dreyfus Reports Results of First Blockchain Agricultural Trade." Cointelegraph, Cointelegraph, 22 Jan. 2018, cointelegraph.com/news/higher-than-expected-louis-dreyfus-reports-results-of-first-blockchain-agricultural-trade.

5 "Royal Bank of Canada Explores Blockchain to Automate Credit Scores." *CoinDesk*, 16 Mar. 2018, www.coindesk.com/royal-bank-of-canada-credit-scores-blockchain-patent-application/.

6 Damiani, Jesse. "SimplyVital Health Is Using Blockchain To Revolutionize Healthcare." *Forbes*, Forbes Magazine, 7 Nov. 2017, www.forbes.com/sites/jessedamiani/2017/11/06/simplyvital-health-blockchain-revolutionize-healthcare/.

7 Goh, Brenda. "Fake Paperwork, Poor Parts Challenge China's Aerospace Boom." Reuters, Thomson Reuters, 16 Oct. 2017, www.reuters.com/article/us-china-aviation-whistleblower-insight/fake-paperwork-poor-parts-challenge-chinas-aerospace-boom-idUSKBN1CL0R2.

8 "The Pros and Cons of Overseas Manufacturing." *Sourcing Overseas*, 4 Nov. 2015, sourcingoverseas.com/the-pros-and-cons-of-overseas-manufacturing.

9 "Hansae Vietnam: Case Study of Hazardous Working Conditions and the Failure of Corporate Social Responsibility Audits to Fix the Hazards." *The Pump Handle*, 16 Jan. 2018, www.thepumphandle.org/2016/12/13/hansae-vietnam-case-study-of-hazardous-working-conditions-and-the-failure-of-corporate-social-responsibility-audits-to-fix-the-hazards/#.WsJFzGbMxAY.

10 "Coca-Cola to Use Blockchain to Combat Forced Labor." Material Handling and Logistics (MHL News), 21 Mar. 2018, www.mhlnews.com/global-supply-chain/coca-cola-use-blockchain-combat-forced-labor.

11 "A Shortage of Skilled Workers Threatens Manufacturing's Rebound." *TradeVistas*, 10 Aug. 2017, tradevistas.csis.org/shortage-skilled-workers-threatens-rebound/.

12 “Blockchain for Trucking.” *Transport Topics*, 14 Feb. 2018, www.ttnews.com/articles/blockchain-trucking.

13 “Food Safety.” *World Health Organization*, World Health Organization, Oct. 2017, www.who.int/mediacentre/factsheets/fs399/en/.

14 “Outbreaks - FDA Investigates Multistate Outbreak of E. Coli O26 Infections Linked to Chipotle Mexican Grill Restaurants.” *U S Food and Drug Administration Home Page*, Center for Food Safety and Applied Nutrition, 1 Feb. 2016, www.fda.gov/Food/RecallsOutbreaksEmergencies/Outbreaks/ucm470410.htm.

15 “11 Greatest Supply Chain Disasters.” SupplyChainDigest, Jan. 2006, http://www.scdigest.com/assets/reps/SCDigest_Top-11-SupplyChainDisasters.pdf
“From Shore to Plate: Tracking Tuna on the Blockchain.” Provenance, Project Provenance Ltd, 15 July 2016, www.provenance.org/tracking-tuna-on-the-blockchain.

16 Partz, Helen. “S&P Global Platts Launches Blockchain Network To Track Oil Data In UAE.” *Cointelegraph*, Cointelegraph, 22 Feb. 2018, cointelegraph.com/news/sp-global-platts-launches-blockchain-network-to-track-oil-data-in-uae.

17 “From Shore to Plate: Tracking Tuna on the Blockchain.” *Provenance*, Project Provenance Ltd, 15 July 2016, www.provenance.org/tracking-tuna-on-the-blockchain.

18 “Report Shows a Third of Consumers Prefer Sustainable Brands.” Unilever Global Company Website, www.unilever.com/news/Press-releases/2017/report-shows-a-third-of-consumers-prefer-sustainable-brands.html.

19 “Total Retail Sales Worldwide 2015-2020 | Statistic.” *Statista*, www.statista.com/statistics/443522/global-reta.

20 “Global Retail e-Commerce Sales 2014-2021 | Statistic.” *Statista*, www.statista.com/statistics/379046/worldwide-retail-e-commerce-sales/il-sales/.

21 Mackenzie, Ian, et al. “How Retailers Can Keep up with Consumers.” *McKinsey & Company*, www.mckinsey.com/industries/retail/our-insights/how-retailers-can-keep-up-with-consumers.

22 Brewer, Edward, et al. “Customer Service Challenges in Omni-Channel Retailing.” *Kennesaw State University*, https://digitalcommons.kennesaw.edu/cgi/viewcontent.cgi?article=1151& context=ama_proceedings

23 “Starbucks: Revenue Worldwide 2017 | Statistic.” *Statista*, www.statista.com/statistics/266466/net-revenue-of-the-starbucks-corporation-worldwide/.

24 “Starbucks Card Terms & Conditions.” *Starbucks Coffee Company*, www.starbucks.com/gift-cards/manage/card-terms-and-conditions.

25 “Starbucks Still Has a Problem with Long Lines.” CNNMoney, Cable News Network, 27 Jan. 2017, money.cnn.com/2017/01/27/investing/starbucks-long-lines-mobile-ordering-earnings/index.html.

26 “10 Examples of Outstanding Omni-Channel Brands.” *Enterprise Ecommerce Blog - Enterprise Business Marketing, News, Tips & More*, www.shopify.com/enterprise/10-examples-of-outstanding-omnichannel-brands.

27 Fickenscher, Lisa. “Vendors Are Losing Confidence in Struggling Neiman Marcus.” *New York Post*, New York Post, 10 Jan. 2017, nypost.com/2017/01/09/vendors-are-losing-confidence-in-struggling-neiman-marcus/.

28 Taylor, Andrea Browne. “7 Stores With the Worst Return Policies.” *Www.kiplinger.com*, Kiplingers Personal Finance, 27 Dec. 2016, www.kiplinger.com/article/spending/T050-C011-S001-retailers-with-the-worst-return-policies.html.

29 “Returns & Refunds.” *Returns & Refunds - Shopping Help - Education - Apple*, www.apple.com/us-k12/shop/help/returns_refund.

30 McKevitt, Jennifer. “In-Store Returns Offer Most Economic Benefit for Retailers.” *Retail Dive*, 3 Jan. 2018, www.retaildive.com/news/retail-returns-Alix-Partners-omnichannel/513979/.

31 “The Six Hidden Costs of Reverse Logistics.” *Reverse Logistics Magazine - The Six Hidden Costs of Reverse Logistics | RL Magazine | Reverse Logistics Association*, www.reverselogisticstrends.com/rlmagazine/edition04p14.php.

32 Szego, Daniel. “Blockchain Scalability: When, Where, How?” *Blockgeeks*, Nov. 2017, blockgeeks.com/guides/blockchain-scalability/.

33 Stark, Josh. “Making Sense of Ethereum's Layer 2 Scaling Solutions: State Channels, Plasma, and Truebit.” *Medium*, L4 Media, 12 Feb. 2018, medium.com/l4-media/making-sense-of-ethereums-layer-2-scaling-solutions-state-channels-plasma-and-truebit-22cb40dcc2f4.