NC STATE
Wilson College of Textiles

JTATM
Journal of Textile and Apparel, Technology and Management

Special Issue, 2021

New Thinking about Blockchain in the Fashion Industry

Xingqiu Lou[1] and Trevor J. Little[2]
[1]Deparment of Apparel, Merchandising, Design and Textiles
Washington State University
[2]Department of Textile and Apparel, Technology and Management
North Carolina State University

ABSTRACT

Blockchain is a relatively new and emerging technology that can be considered as a digital, decentralized and distributed public ledger that records data, tracks transactions and updates information. The majority of blockchain research has been conducted on bitcoin or other cryptocurrencies. Recently, however, researchers have recognized blockchain's potential in other areas, including supply chain, smart contract, healthcare, the Internet of Things, education, privacy and security and data management. Blockchain technology offers a system of recording information in a way that makes it nearly impossible to alter or hack. The concept of blockchain technology is already starting to be applied in the fashion industry. While Blockchain finds many applications related to sustainability, the view expressed in this paper relates more to product attribute information. In this research, a Blockchain model is developed to map out the future fashion supply chain from a product attribute perspective.

Keywords: blockchain, cryptocurrencies, supply chain

Introduction

Blockchain is a relatively new and emerging technology that can be considered as a digital, decentralized and distributed public ledger that records data, tracks transactions and updates information (Greene & Longobucco, 2018). The origins of blockchain can be traced back to 1991, when Haber and Stornetta published the paper "How to time-stamp a digital document" (Haber & Stornetta, 1991). The authors detailed how hash values can be assigned to digital files to provide authenticity for the files. A "hash value" is a numeric value of a fixed length that uniquely identifies data that is commonly used today to validate digital content. However, this concept was not applied until 2008, when Satoshi Nakamoto published the paper "Bitcoin: A Peer-to-Peer Electronic Cash System" (Nakamoto, 2008). The name Satoshi Nakamoto is thought to be a pseudonym by some authors (Lemieux, 2013).

Blockchain was first successfully implemented in 2009 through "Bitcoin", a cryptocurrency and digital payment system. Since then, it has grown in popularity and opened a wide range of new possibilities in various industries, such as banking, financial services, healthcare and automotives (Chakrabarti & Chaudhuri, 2017). The concept of blockchain has been further developed and evolved into blockchain

technology that can be applied in more commercial and economic fields, especially sharewashing (Hawlitschek et al., 2018). Blockchain technology offers a system of recording information in a way that makes it nearly impossible to alter or hack. While blockchain finds many applications related to sustainability and transparency, the view expressed in this paper more relates to product attribute information. More and more customers demand sustainable practices in the choice of products they purchase or acquire. *Forbes* notes that around 60% of consumers are more likely to buy products from companies with clearly defined sustainability policies. This is most evident in the success of fashion brands such as Allbirds and Veja, both of which are known for their sustainable business practices (Welfare, 2020).

Mechanics of Blockchain Technology

The majority of blockchain research has been conducted on bitcoin or other cryptocurrencies. Recently, however, researchers have recognized blockchain's potential in other areas, including supply chain, smart contract, healthcare, the Internet of Things, education, privacy and security and data management (Chakrabarti & Chaudhuri, 2017). Azzi et al. (2019) have provided details about the use of blockchain in the supply chain and illustrated the blockchain data structure.

The blockchain consists of a chain of information blocks. The first block is known as the genesis block. Each block has two parts: header and body. The body of the block contains the list of transactions. As shown in Figure 1, the block header contains various fields, including the set of rules that should be followed for validation, a hash of the previous block header, a timestamp and the Merkle tree root hash that represents the hash value of all the transactions in the block (Zheng et al., 2018). Information such as the timestamp (the time of the transaction) and hash (the identity of the block) are calculated and stored in the header part, while all the transaction information is stored in the body. The hash is a function that converts input (transaction information) into an encrypted output. The nonce and target are block header fields, used for the proof of work protocol. It is a computational process, known as mining, in which miners are the nodes that calculate the block header hash. A block is accepted by all nodes if a miner finds a nonce (authentication protocol) such as: hash (block header) < difficulty target. The nonce is a 32-bit field that is incremented until the equation is solved (Zheng et al., 2018). The beauty of the blockchain is that all the transaction information (about previous ones and the current one) will be hashed altogether as a unique identity of the block. Each party on a blockchain has access to all the information, and no single person or entity controls a blockchain.

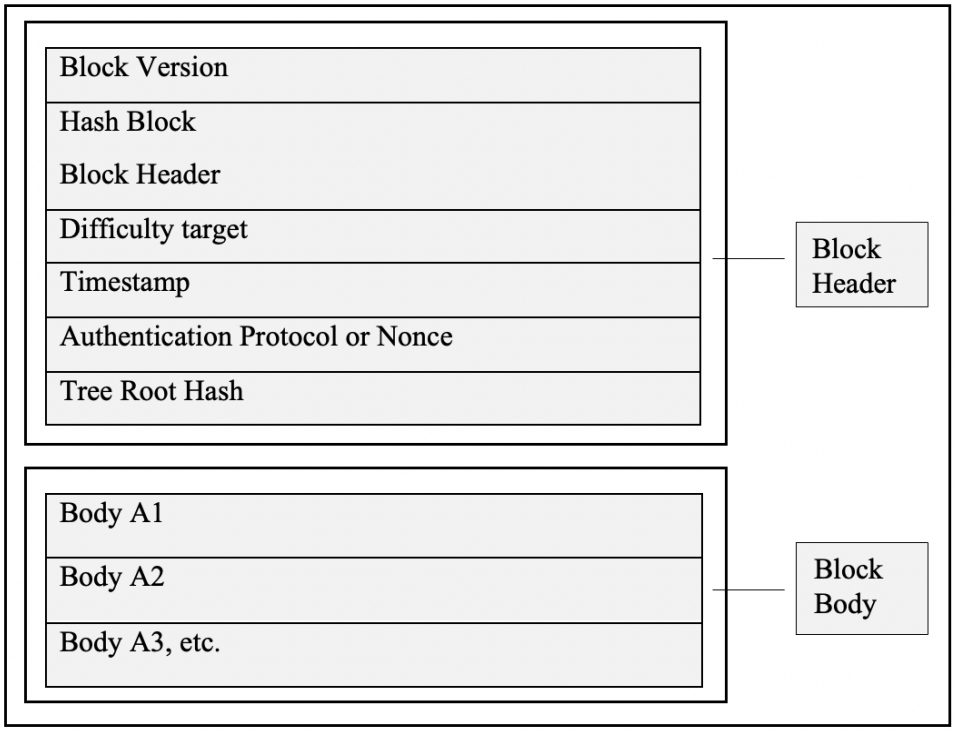


Figure 1. Basic components of a Block

Iansiti and Lakhani (2017) identified the underlying architecture and characteristics of the blockchain including: 1) distributed ledger or database, 2) direct node to node communication, 3) accessibility within the network and 4) immutability. According to Drescher (2017), each block of the chain structure has the following key characteristics: they are 1) immutable, 2) timestamped, 3) append only, 4) secure and 5) open and transparent. Blockchain technology could create secure, transparent, authentic and trustworthy supply chains due to its decentralized system and its features (Azzi et al., 2019).

The majority of the academic literature on blockchain has been conducted from 2015 onwards, since blockchain technology is still in the early stage of development. Most literature has focused on conceptual or theory-based research frameworks. Limited empirical data has been collected. In practice, companies such as IBM, Walmart and Apple are currently applying blockchain to logistics and supply chains. However, most of these companies are still in the early proof of concept stage. Therefore, overall blockchain research is still in an early and exploratory stage in terms of its applications.

Applications of Blockchain in the Fashion Industry

Bain & Company defined supply chain management as "the complex collaboration of suppliers, manufactures, distributor, dealers, customers, and so on to ensure a seamless production and delivery of finished goods" in its publication "Management Tools & Trends 2015". In the fashion industry, the supply chain traces all parts of the process, from concept to customer. This includes the source of raw materials, the factories where those materials are made into garments and the distribution network where the finished garments are presented and delivered to consumers. The chain also involves large numbers of people, including designers, manufacturers, merchandisers, retailers and consumers.

One of the major applications of blockchain in the fashion industry is in supply chain management, including

transparency and traceability, product authentication and inventory management (Greene & Longobucco; 2018; Hanson, 2018; Jordan & Rasmussen, 2018). Combined with radio frequency identification technology, which has already been used in many companies, blockchain technology helps track the finished product from the beginning of product lifecycle all the way through the distribution chain until the product reaches the consumer (Hanson, 2018). This tracking information includes details such as location, date and time, shipment handling details, temperature and condition of the package or product (Chakrabarti & Chaudhuri, 2017). Blockchain technology not only tracks whether the shipment was properly handled or arrived on time, but can also help retailers find any products that were lost or damaged during shipping (Chakrabarti & Chaudhuri, 2017). Due to the structure of blockchain, this information cannot be altered, lost or destroyed (Greene & Longobucco; 2018; Hanson, 2018). The information saved in the blockchain is visible to all stakeholders, including consumers, retailers and suppliers. These stakeholders can see the product source and process, which reduces the possibility that products are counterfeits (Chakrabarti & Chaudhuri, 2017).

The concept of blockchain technology is already starting to be applied in the fashion industry. Designer Martine Jarlgaard collaborated with Provenance, a supply chain transparency company, and presented her blockchain-tracked garments at the Copenhagen Fashion Summit in 2017 as the first fashion company using blockchain technology (Beckwith, 2018). Her garments came with a tag with a QR code that could be scanned with a mobile phone to access a full history of the supply chain behind each garment, as shown in Figure 2 (Beckwith, 2018). In Shanghai's fashion week, Babyghost teamed up with technology providers to allow everyone in the supply chain, including customers, to confirm the authenticity of its clothing. In their 2017 spring and summer collections, the company embedded small chips that anyone could scan inside their clothing and accessories to verify if the garments were authentic. In 2019, LMVH launched the AURA platform with Microsoft and blockchain software company ConsenSys. Several brands of LMVH, including Louis Vuitton and Parfums Christian Dior, enable their consumers to access the product history and proof of authenticity of luxury goods using blockchain technology. Consumers are able to use an app to view the story of the luxury item, including the design and its raw materials, manufacturing and distribution, as well as information about product care and warranties.

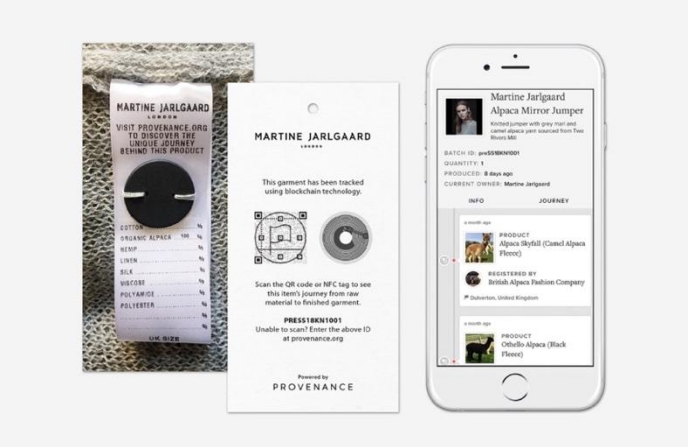


Figure 2. Martine Jarlgaard's garment using Blockchain technology (Beckwith, 2018)

Expected Benefits of the Adoption of Blockchain

Given the characterization of the global fashion supply chain and the features of blockchain technology, SWOT (Strength, Weakness, Opportunity, Threats) analysis is used to illustrate what the apparel and footwear supply chain can gain from the adoption of the technology.

Transparency and Traceability

1) The characteristic of immutability and chain structure make a supply chain more transparent and traceable (Strength and Opportunity; Kshetri, 2018).
2) A transparent and traceable supply chain with supported data could provide a positive image of a company (Strength and Threat).
3) A transparent and traceable supply chain increases the overall quality of products and efficiency in the manufacturing process (Strength and Opportunity).

Cost

1) Blockchain could build up a trusted relationship between suppliers and fashion companies, reducing the cost of middleman auditors in terms of the sustainability and quality issues of products (Weakness and Threat; Kshetri, 2018).
2) The mechanisms of blockchains such as automation, streamlined process and processing speed could lessen the labor requirements and optimize the production process, which thereby reduces the production-related costs (Weakness and Opportunity; Hughes et al., 2019).

Speed

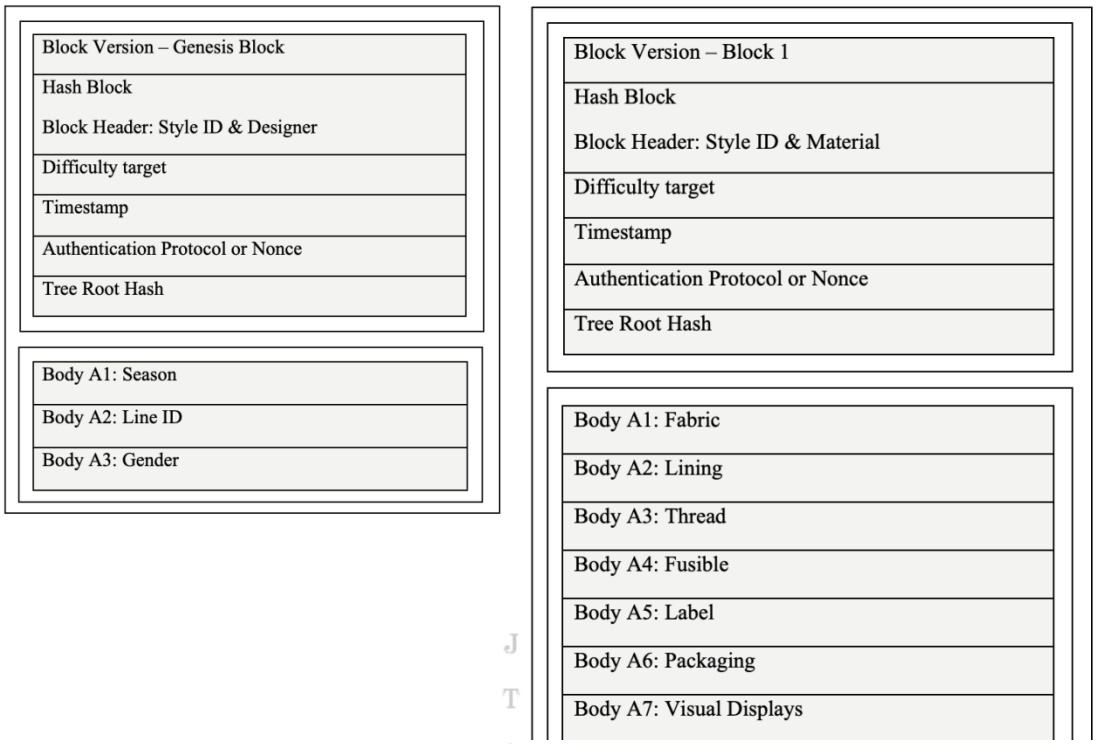
1) Blockchain could seamlessly capture end-to-end data through each digitalized production process. These data insights could be used to optimize the production process and therefore reduce the lead time. Furthermore, as the supply chain begins with the definition of the product, blockchain can have applications in the product design and development phases (Weakness and Threat).

Mitigation of the Social Impact

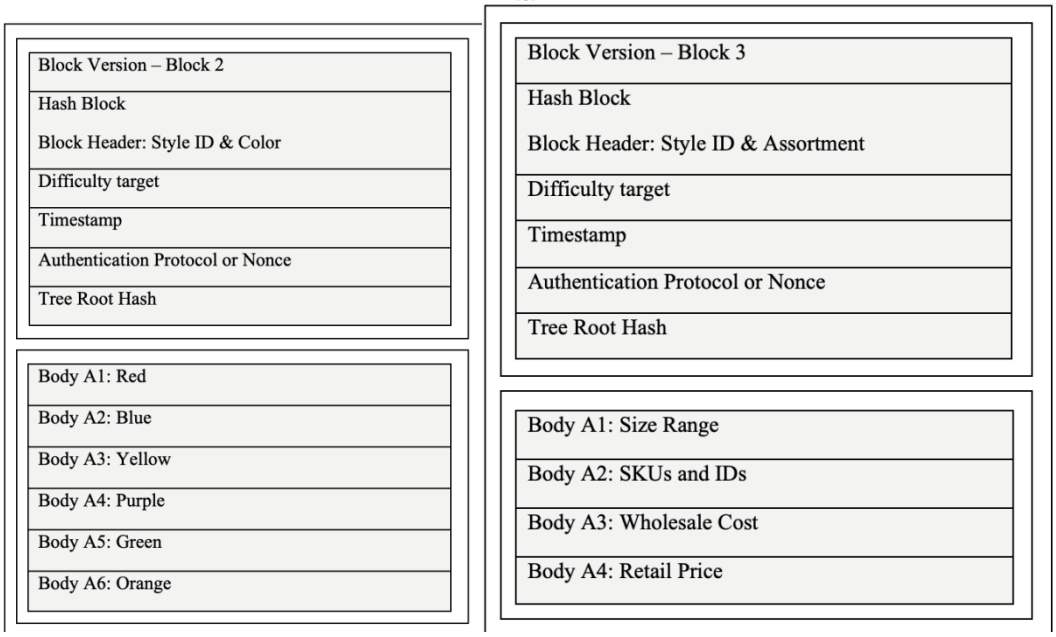
1) According to Kshetri (2018), the blockchain architecture could provide secured, trusted and transparent data. This data could support decisions being made by the buying team of a fashion company to make responsible sourcing decisions. As discussed previously, blockchain can inform consumers about the authenticity of products under purchase consideration (Weakness and Opportunity).
2) Blockchain technology could improve sustainability in the textile supply chain. Knowledge of material content for each product can greatly assist in decisions related to recycling and repurposing. Blockchain extends beyond the current labeling laws and practices to provide a traceable digital ledger of all the components in the product (Opportunity). Of course, a tag or label must accompany the product through its lifecycle and therefore requires modification of the laws governing labels.
3) Blockchain could help manufacturers and designers protect their brands against counterfeiting (Weakness and Opportunity).
4) Blockchain gives credit to all the people involved in the supply chain.

Opportunities for Blockchain in the Fashion Industry

Blockchain technology has the capacity to boost efficiency and bridge the gap between suppliers and brands. Using this technology to track and trace products from raw materials to their end consumption can not only enable full visibility of the fashion supply chain, but also maintain consistent data for all suppliers across the supply chain. This research developed a blockchain model to map out the future fashion supply chain from a product attribute perspective. As presented in Figure 3, the blockchain model consists of one genesis block and five blocks.


Block Version – Genesis Block
Hash Block
Block Header: Style ID & Designer
Difficulty target
Timestamp
Authentication Protocol or Nonce
Tree Root Hash
Body A1: Season
Body A2: Line ID
Body A3: Gender
Block Version – Block 1
Hash Block
Block Header: Style ID & Material
Difficulty target
Timestamp
Authentication Protocol or Nonce
Tree Root Hash
Body A1: Fabric
Body A2: Lining
Body A3: Thread
Body A4: Fusible
Body A5: Label
Body A6: Packaging
Body A7: Visual Displays

(a) (b)


Block Version – Block 2
Hash Block
Block Header: Style ID & Color
Difficulty target
Timestamp
Authentication Protocol or Nonce
Tree Root Hash
Body A1: Red
Body A2: Blue
Body A3: Yellow
Body A4: Purple
Body A5: Green
Body A6: Orange
Block Version – Block 3
Hash Block
Block Header: Style ID & Assortment
Difficulty target
Timestamp
Authentication Protocol or Nonce
Tree Root Hash
Body A1: Size Range
Body A2: SKUs and IDs
Body A3: Wholesale Cost
Body A4: Retail Price

(c) (d)

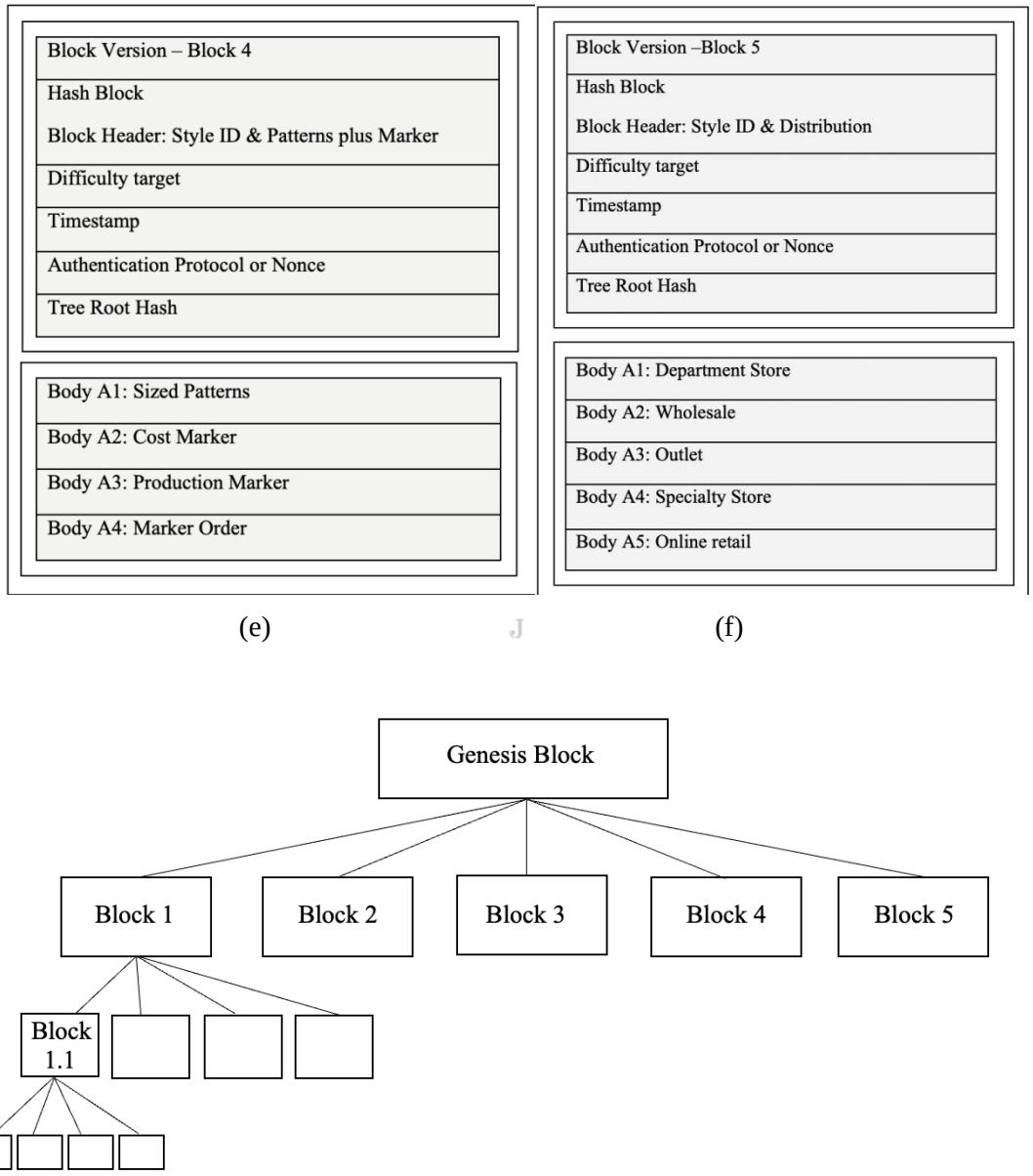


Figure 3. Proposed blockchain model for the future fashion supply chain.

Summary

The application of blockchain in the fashion industry will bring many changes. It is already under serious investigation by firms that have a strong information system. While the blocks used in this paper represent only a portion of the total blocks that can be created, the application of blockchain brings a new level of traceability and transparency to the fashion complex.

This paper makes a sound argument for the application of blockchain and inherently adds information about the product, including its size. Of course, size information is vital as more and more companies want to be assured that the size will fit their intended consumer. Many other product attributes will be available to the consumer, changing the information flow as an ethical approach to the acquisition of the product. As clothing acquisition moves into

the online space, blockchain can provide authenticated information about the product. This will take time to implement but pioneers will undoubtedly harvest the largest reward.

As stated in the paper, end of life options must be available. This will require a permanent labeling system that can be used to validate how to repurpose the product. Indeed, there are many options available yet they will require some standardization to be most effective at the end of life for the product(s).

Blockchain will find its way into design and development since many aspects of design and development are fixed early in the process – a significant attribute for blockchain. Furthermore, blockchain affords the opportunity to identify people along the way – a feature that is not part of today's systematic approach to design and development. Since 80% of design and development is responsible for the subsequent supply chains, there will be an increasing emphasis of blockchain on design and development since it determines many aspects of the supply chain.

References

Azzi, R., Chamoun, R. K., & Sokhn, M. (2019). The power of a blockchain-based supply chain. *Computers & industrial engineering*, *135*, 582–592.

Beckwith, C. (2018). *Fashion Blockchain startups-A survey of players in the field, Q1 2018*. https://medium.com/@fashiontechguru/fashion-Blockchain-startups-a-survey-of-players-in-the-field-q1-2018-36727660bb14

Chakrabarti, A., & Chaudhuri, A. K. (2017). Blockchain and its Scope in Retail. *International Research Journal of Engineering and Technology*, *4*(7), 3053–3056.

Greene, J. H., & Longobucco, A. M. (2018). *What is blockchain and what can it do for the fashion industry?* http://www.thefashionlaw.com/home/what-is-blockchain-and-what-can-it-do-for-the-fashion-industry

Haber, S., & Stornetta, W. (1991). How to Time-Stamp a Digital Document. In A. J. Menezes & S. A. Vanstone (Eds.), *Conference on the Theory and Application of Cryptography: CRYPTO 1990: Advances in Cryptology-CRYPTO' 90* (pp. 437–455). Springer.

Hanson, L. (2018). *Why Retailers Should Embrace The Blockchain*. https://www.whichplm.com/why-retailers-should-embrace-the-Blockchain/

Hawlitschek, F., Notheisen, B., & Teubner, T. (2018). The limits of trust-free systems: A literature review on blockchain technology and trust in the sharing economy. *Electronic commerce research and applications*, *29*, 50–63.

Hughes, A., Park, A., Kietzmann, J., & Archer-Brown, C. (2019). Beyond Bitcoin: What blockchain and distributed ledger technologies mean for firms. *Business Horizons*, *62*(3), 273–281.

Iansiti, M., & Lakhani, K. R. (2017). The Truth About Blockchain. https://hbr.org/2017/01/the-truth-about-blockchain

Jordan, A., & Rasmussen, L. B. (2018). *The role of Blockchain technology for transparency in the fashion supply chain* (Master's thesis). https://muep.mau.se/bitstream/handle/2043/25482/OL646E-1201-MASTERTHESIS-JORDANRASMUSSEN.pdf?sequence=1&isAllowed=y

Kshetri, N. (2018). Blockchain's roles in meeting key supply chain management objectives. *International Journal of Information Management*, *39*, 80–89.

Lemieux, P. (2013). Who Is Satoshi Nakamoto?. *Regulation*, *36*(3), 14.

Nakamoto, S., & Bitcoin, A. (2008). *Bitcoin: A Peer-to-Peer Electronic Cash System*. https://bitcoin.org/bitcoin.pdf

Welfare, A. (2020). *The Circular Economy and Sustainability Powered By Blockchain*. https://www.forbes.com/sites/forbestechcouncil/2020/01/13/the-circular-economy-and-sustainability-powered-by-blockchain/#6f5f9c76b8cf

Zheng, Z., Xie, S., Dai, H. N., Chen, X., & Wang, H. (2018). Blockchain challenges and opportunities: A survey. *International Journal of Web and Grid Services*, *14*(4), 352–375.