

2025-11

Application of Blockchain in Ready-Made Garments Supply Chain: A Conceptual Model

Kadery, Syed Muhammad Nadeem

School of Business and Entrepreneurship, Independent University, Bangladesh (IUB)

<https://icebtm.iub.edu.bd>

Downloaded from IUB Academic Repository

Application of Blockchain in Ready-Made Garments Supply Chain: A Conceptual Model

Syed Muhammad Nadeem Kadery¹, Rafat Arrahman Al Haque², Md. Mamun Habib³

^{1,2,3}School of Business and Entrepreneurship, Independent University, Bangladesh, Dhaka, Bangladesh

¹syednadeemkadery@gmail.com, ²rafathaque23@gmail.com, ³mamunhabib@iub.edu.bd

Paper ID: ICEBTM-25-1032

Abstract - The global apparel industry is highly competitive, demanding innovation and cost-effective production models. Bangladesh, a leading textile exporter, struggles with long lead times (90–100 days) compared to rivals like China and Pakistan. Relying only on cheap labor makes it difficult to sustain market leadership, especially as Cambodia and Vietnam rise. The COVID-19 crisis accelerated blockchain adoption worldwide, particularly in apparel, where it enhances transparency, authentication, and efficiency, strengthening brand image and profits. Blockchain, introduced by Satoshi Nakamoto, offers secure, decentralized data sharing, preventing breaches and fostering trust. For Bangladesh, integrating blockchain into the RMG supply chain could reduce costs, improve stakeholder collaboration, and ensure competitiveness. Research highlights that traditional supply chains depend heavily on labor and contractors, but blockchain's distributed ledger can streamline information flow among stakeholders. To maintain dominance in the digitized 21st century, Bangladesh must embrace blockchain, ensuring sustainability, customer satisfaction, and global relevance.

Keywords- Blockchain, Supply chain, Ready-Made Garments, RMG

I. INTRODUCTION

The apparel and textile industries fundamentally influence the global economy and society. Access to markets, capital, skilled labor, and natural resources is insufficient for any apparel company seeking a competitive edge in a global economy. Furthermore, to meet the ever-changing needs of its clientele, the global textile manufacturing industry must adopt cost-effective production techniques as part of a "Gandhian Engineering" based economy. In this sense, the future of the worldwide apparel manufacturing industry is presently being shaped by a significant globalization effect. Like any transformation effect, there are many growth opportunities, but there are also many challenges. Since apparel manufacturing companies are not individually self-sufficient, this globalization and competitive environment direct business activities through supply chain networks, or more recently, collaborative networks of business partners. To fulfill the business partners' overall goals and strategic objectives, clothing manufacturing companies that comprise these operational chains or networks must be integrated and coordinate their business processes to become more efficient. All things considered, research and operational process automation greatly enhance the design of the supply chain network for the apparel manufacturing industry and improve its performance [2].

The textile and apparel (T&A) supply chain is an intricate web of suppliers and partners at every stage of production, as well as a variety of materials and complicated procedures. T&A products have a short shelf life with multiple styles and collections every season because of trend-based consumerism and changing and varied consumer choices. The first link in a traditional T&A supply chain is a fiber producer, either a natural fiber or an industry that produces chemical fibers derived from petroleum. The yarn-manufacturing units then spin these fibers into yarn, which is turned into fabric through nonwoven, knitted, or weaving techniques. These fabrics are then sent to factories that make clothing, sewn into clothes, accessories, or furniture. Subcontractors and sub suppliers that offer trimmings and value-added items (such as buttons, threads, chemical treatment, embroidery, etc.) are also a part of the supply chain.

In the T&A supply chain, fashion brands—typically retailers—are the focal firms. Based on several variables, such as low-cost production location, suppliers' track record, and consumer market, they drive the supply chain configuration by buying finished textile products from upstream suppliers and selling them to end consumers. Due mainly to globalization, the manufacturing of T&A has been offshored and outsourced to regions with more lenient labor laws, lower labor costs, and greater supply availability. This has reduced risk by eliminating the need to own manufacturing facilities and increasing supply chain flexibility. As a result, the supply chain comprises a dispersed manufacturing network with numerous intricate processes within each. However, effective information sharing has become essential due to the institutional and geographic distances between various partners, and insufficient information sharing impedes the T&A supply chain's ability to operate flexibly and synchronously [10]. Bangladesh is one of the top exporting nations for apparel and RMG in the global market. Beginning in Bangladesh in the late 1970s, this sector grew notably in the 1980s and experienced a boom in the 1990s. Using simpler technology, inexpensive labor, and simple-to-use sewing machines allowed the industry's rapid expansion. Look at the charts below, which show the export of RMG relative to Bangladesh's overall exports. Supply chain management systems shorten order cycle times, lower operating costs, boost asset productivity, and improve a company's ability to respond to the market. Aside from these advantages, effective supply chain management techniques allow the

apparel industry to react quickly. "Quick response" refers to the cooperation and information exchange between distributors, suppliers, and manufacturers, enabling them to react to consumer needs more quickly [1].

One of the main problems facing the Bangladeshi ready-made clothing industry is order time management. Foreign buyers probably require a short lead time for clothing manufacturers. Because there is a seasonal demand for apparel. In response to requests from customers, buyers place orders. If the production is delayed, the buyer cannot catch up with the season. The lead time was 120–150 days at the start of the 1990s, but it was cut to 30–50 days in 2007, so it is currently 90–100 days. China only needs thirty days because of its facilities for textiles and other backward linkages and its export-friendly management and supportive policies. In Pakistan and India, it lasts 45–60 days (Nuruzzaman, 2008). Because of the unusually long lead time, it appears that the Bangladesh RMG industry will not be able to compete successfully in the global market under the current circumstances. This is the primary area of concern for current research [3].

Due to its potential to streamline business procedures, blockchain technology (BT) has recently gained more attention and generated excitement across various industries, including the textile and fashion sectors. A "blockchain," as the name implies, is essentially a decentralized database that stores data safely and encrypted in a distributed public ledger. It is made up of previously verified "blocks" of transactions. In an environment where security is not guaranteed, the practice of encoding data to prevent unauthorized access is known as cryptography. BT uses cryptography to safeguard the system's integrity by employing sophisticated cryptographic algorithms. All transactions are digitally signed and encrypted to ensure that no part of a transaction can be changed without the approval of other users in the blockchain. A chain of blocks is formed by adding blocks that, via a cryptographic signature, refer to the previous block.

This makes smart contracts or transactions unchangeable by guaranteeing their reliability. Blockchain technology is dependable because of its characteristics, which include the dispersion of data storage among several nodes and the application of consensus algorithms, which offer immutability and transparency and do away with the need for a central authority. Blockchain provides a safe and effective means of conducting international payments, improving capital markets, streamlining trade finance, enabling safe peer-to-peer transactions, and thwarting money laundering in the banking and finance industries. Researchers have noted the potential for blockchain applications in the supply chain of several industries, including fashion and textiles. Fashion brands that can adjust to growing complexity by updating their operational models and changing their digital marketing, supply chain, and sales channel strategies will be most equipped to survive in a market with this level of competition [4].

The benefits of blockchain technology for cryptocurrencies have increased its appeal, leading scholars to investigate and assess how it might be used in logistics and supply chain management. For instance, Walmart and IBM are well-known for their supply chain tracking projects utilizing blockchain technology. Every transaction and action in blockchain-based traceability systems is visible and can be tracked down and retrieved at any moment by numerous parties. One of the main applications of blockchain in T&A is tracking materials and products through different manufacturing stages, from initial raw material management to finished goods management. Blockchain promises that, in the case of a fashion product manufactured from eco-friendly materials, it will not require any additional certifications or inspections.

Once stored in the blockchain system, the data is permanent and accessible to the public. This becomes crucial because it becomes more challenging to hold fashion companies accountable for the conditions under which their clothing is made and their sustainability pledges when supply chains lack transparency. Concurrently, consumers and industry participants express a greater desire for more sustainably and ethically produced goods. A study by Morning Consult found that 64% of participants would purchase a garment if it could use new technology to support its claims about sustainability. Blockchain-SCM integration is an unexplored field with little research. It is essential to research blockchain operations while considering its applications and supply chain requirements because supply chains across various industries vary significantly in their features and functionalities (Umeh, 2016). To achieve this, we examine some case studies of blockchain applications in textile and apparel supply chains in the following section before moving on to the literature analysis [10].

II. LITERATURE REVIEW

Blockchain has become the new standard for technologically advanced business applications. Financial services, manufacturing, food, agriculture, pharmaceuticals, combating COVID-19, hotels, airlines, healthcare, government, and supply chain management are just a few industries using blockchain technology. Benefits of blockchain technology include traceability, visibility, authenticity, legitimacy, aggregation, automation, resiliency, accurate and prompt decisions, reduced costs, enhanced supply chain performance, and customer satisfaction [6].

Applications of blockchain technology have the potential to revolutionize how we currently use the apparel industry, as well as the hardware and software infrastructure that goes along with it. In contrast to the conventional legacy systems currently in the apparel industry, we contend that the underlying technology and the corresponding cryptocurrency with its decentralized architecture suggest a range of applications that can bring cost savings to the e-

garments industry [5].

This technology can identify the various actors represented as network components in a company's production and distribution chain. The network tracks a product's journey from one actor to the next, making every transaction visible to the public. To comply with environmental and social sustainability regulations and showcase sustainable practices to their clientele, businesses must ensure that the manufacturing and distribution processes are traceable and transparent, and all parties involved are identified. Moreover, blockchain offers environmentally sustainable solutions for the fashion apparel manufacturing industry, including decentralization, transparency, automation, and immutability, lowering carbon emissions at every critical stage of clothing-making [6].

In 2009, Nakamoto first put forth the idea of BCT. He described this idea as a technology that develops data structures and encodes information transactions using Bitcoin and data mining techniques. A blockchain's data will be permanently saved online with extreme security and transparency. Some of the main features of BCT are decentralization, distrust, transparency, traceable and unforgeable transactions, anonymity, and credibility. Blockchain technology (BCT) can be utilized on various platforms: "Blockchain technology is not limited to capital markets and cryptocurrency."

In-depth training is also provided on smart contracts, privacy, and network security, among other platforms and applications. BCT can, first and foremost, facilitate information integration and sharing throughout the entire supply chain process. Consequently, there can be a seamless exchange of goods and materials. Furthermore, BCT provides better security for storing and handling data online. This quality can help to safeguard organizational intellectual property and stop the leakage of private information. Finally, more information about design, raw materials, and manufacturing processes can be swiftly accessed by all supply chain participants, but particularly by consumers. BCT can enhance integration and cooperation amongst supply chain participants by helping consumers comprehend the entire supply chain [7].

A distributed digital ledger is called a blockchain (Chen, 2018). Transactions are entered into the ledger in blocks. It is present in numerous copies dispersed throughout computers, called "nodes." Because every new block of transactions is connected to earlier blocks in a way that makes tampering nearly impossible, the ledger is secure. Because it is decentralized, it is not dependent on a single organization for storage, such as a bank. As new transactions are made, the ledger is updated and sent to the nodes connected to the blockchain network.

The "truth" about each transaction completed thus far in the blockchain can be found in the multiple copies of the ledger.

To attempt a ledger fraud, one would need to time the falsification of the copies precisely. There is very little chance that this can be accomplished in blockchain networks of any practical size. Supply chains typically consist of procurement, production, storage, and distribution. It maintains relationships with suppliers, partners, subcontractors, and customers. Additionally, it is organized internally by department or function.

When operating in a silo, every department tracks goods and services using its own systems. This implies a decrease in transparency and an increase in friction. Supply chains can escape their silo mode with the aid of blockchain. Blockchain is a distributed, digital ledger that improves efficiency and transparency. Everyone may have access to the same transactional data. Subsequently, as software applications, smart contracts can be integrated with the blockchain. The smart contracts can take automatic action as events are recorded. The blockchain can help supply chain managers and their businesses in several ways, such as increased accountability and transparency among suppliers; almost instantaneous transactions using smart contracts; a tamper-proof ledger of manifests, departure and arrival times, and a general decrease in human error because of increased automation. The capacity to track and permanently record the flow of information and goods between participants in a supply chain is enhanced by blockchain technology, which substitutes a flexible, decentralized infrastructure for inflexible, centralized supply chain systems [8].

In addition, many additional intermediaries, traders, and logistics companies are engaged in the procurement, distribution, and transportation of textile and clothing goods throughout the primary value-adding operations and/or in the execution of processing tasks like fabric dyeing and finishing. While most product design and development occur in developed nations, many production activities, such as spinning, fabric manufacturing, cutting, sewing, and finishing, occur in developing nations. Leading clothing designers and manufacturers often take the lead in product development.

There are several ways to implement blockchain technology in supply chain configurations. Some well-known blockchain applications in the clothing and textile sector:

1. AURA Consortium: To spearhead and encourage industry-wide cooperation to investigate and implement blockchain technology for product traceability and authenticity, LVMH partnered with ConsenSys and Microsoft Azure to establish the AURA consortium. New members of the consortium include Prada and Cartier. AURA seeks to track products from the source of raw materials to the point of sale and demonstrate authenticity to consumers.
2. Arianee Consortium • The Arianee consortium is an industry-wide partnership that seeks to create guidelines for the blockchain-based Arianee protocol, which will be used to certify valuable assets digitally.
3. HUGO BOSS • The high-end apparel and fashion goods company Hugo Boss has partnered with ASTRATUM to

create Tracey. This blockchain platform allows them to track products throughout their supply chain and guarantee their authenticity.

4. Chargeurs Luxury Materials is a top global provider of wool. To guarantee the quality of its fibers and facilitate traceability from the sheep to the retail customer, the company has created a label called Organica Precious Fibers using blockchain technology.
5. Martine Jarlgaard • A jumper Jarlgaard owned was the first clothing article to be tracked via blockchain technology. Through collaboration with Provenance and A Transparency, data regarding the product was tracked via a blockchain application as it moved through the supply chain.
6. C&A Foundation Bext360 is leading a blockchain pilot project to reach consumers eventually, which tracks organic cotton from the farm to the spinning stage. Blockchain was employed in the pilot as a safe data platform to integrate data along the supply chain.

The blockchain project's goal will determine how far product traceability in the supply chain can be extended. If the only goal is to guarantee the authenticity of the products, traceability can cover a range of upstream and downstream supply chain stages. For instance, the traceability system may begin at the garment manufacturing stage to authenticate an LVMH garment piece. However, suppose the goal is to guarantee that the garment is made of organic cotton. In that case, the scope of traceability may begin at the source of raw materials or the fiber producer. The upstream supply chain phases should be covered when the goal of traceability is to guarantee the sustainability of products. However, Supply chain traceability may be used in applications that seek to guarantee product authenticity and sustainability [9].

III. METHODOLOGY

The secondary data used in this study's analysis includes papers from conferences, journals, digital libraries, and other sources. Numerous academic and professional research papers on the textile industry have been compiled from various reputable international journals, including IJBER, IJSCM, JTSE, IJTS, JBMER, AJBMS, and others. The textile and apparel industries were chosen for this study based on several criteria. First off, the industry's blockchain technology experimentation is progressing quickly. Second, this industry differs significantly in supply chain configuration, product attributes, and business process characteristics, as well as in the regulatory frameworks and market conditions in which they function. Thirdly, because there are so many social and environmental problems, sustainable development is one of the most challenging sectors. Production, shipping, and logistics are important industries that manage material flows across intricate and international supply chains. They are also highly fragmented and globalized and must adhere to several rules, business procedures, and management requirements.

THEORETICAL MODEL

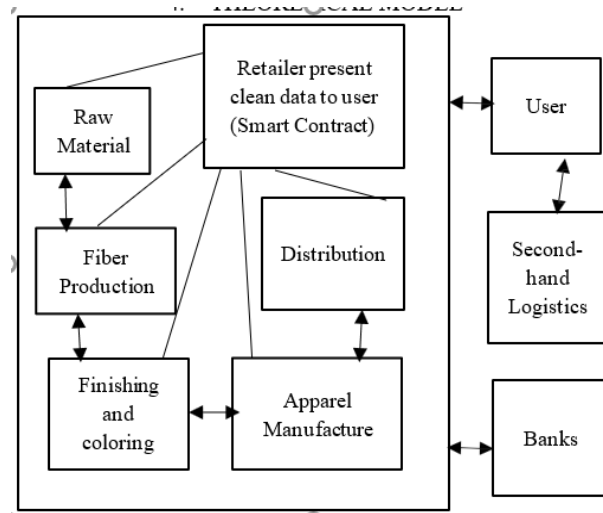


Figure 1: Textile retailer facilitating a blockchain ecosystem. Source: (Francisconi, 2017)

The following is how the transactions would happen in the event of a retail initiative and the presence of the necessary infrastructure: every stakeholder would be a distinct system user. When raw materials are converted into fibers, transactions are started by the fiber producer and verified by the yarn producer once received; yarn producers initiate another transaction to be confirmed by finishing and coloring agents; apparel manufacturers then start the unit-level authentication once they receive final fabrics. This process starts with a genesis transaction, which creates a hash value for future blocks to be built upon. The company harvesting and processing the raw materials initiates the transaction, and the recipient validates it. The clothing manufacturer imports the historical supply chain data by integrating a smart device into the garment, either the actual fabric or the garment label. Distributors use the blockchain network to record their activities as well. Customers can view provenance and impact data, which is verified by blockchain and curated by the retailer, by scanning a smart device embedded in the garment. When a user decides they no longer want a garment, data on the blockchain can help with responsible disposal by connecting the item with a buyer interested in used clothing. Because the blockchain transaction system deviates from centralized networks, which are prone to fraud and errors, its implications are revolutionary. Blockchain also changes the game by changing the script of traditional linear transactions from data push to data pull. Stakeholders can now pull verified, trustworthy, real-time information from the network instead of receiving data that may or may not be real. In contrast to traditional IT systems, blockchain systems can grant access to significant stakeholders not part of the direct network, like customers and banks, who depend on data being pushed out to them. Banks would be incorporated into the smart contract in a blockchain system to speed up clearings and other significant financial transactions. Clearing times are postponed, giving banks more time to verify transactions due to their growing concerns about fraud. This is an unneeded restriction in a blockchain system where transactions are validated automatically. An important departure from the status quo is that blockchain systems can give all stakeholders

access to immutable, secure, authentic, verified, agile, and real-time data. Using digital components, second-hand logistics providers can automate clothing distribution to suitable second-hand markets, promoting a circular supply chain. Because of the financial benefits and the ability for all parties—from raw material producers to consumers—to fully understand the environmental and social implications of their decisions and utilize this knowledge as a springboard for investigating alternative procurement methods, such a system can support sustainable supply chain management [10].

IV. DISCUSSION

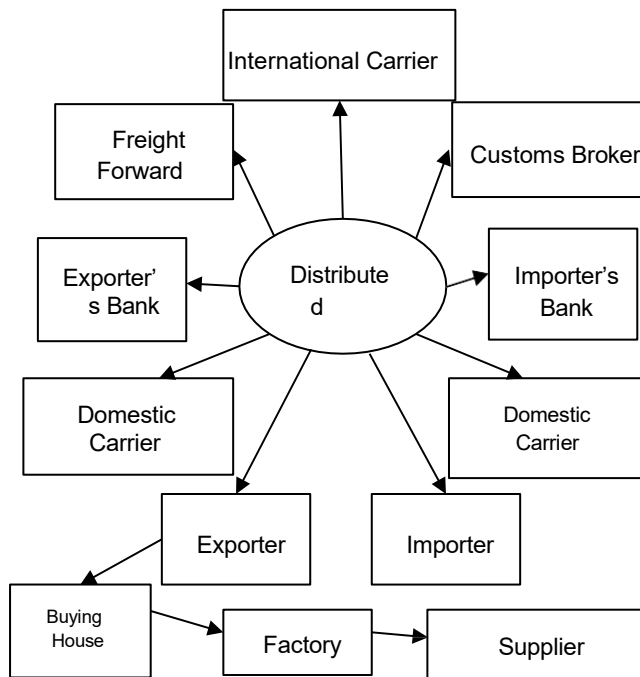


Figure 2: Proposed Model

Our proposed model is an application that will be controlled and updated centrally, known as the distributed ledger. The concerned parties, i.e., suppliers, manufacturers, retailers, consumers, logistic companies, banks, freight forwarders, etc., will have an ID and password to log in and check the shipment status. Moreover, they will also be able to update the information so that other members can check their dashboard, and all the concerned parties are updated via the distributed ledger. For example, a buying house brings an order from an American buyer and passes it on to the factory to manufacture the garment's product. Thus, the buying house will have a dashboard where the buyer will be able to see the update of the order; similarly, the factory will have a dashboard where the buying house will be able to see the update of the product. Each user will be separated by category so that the information does not overlap. The main aim of the model is to ensure transparency and accountability among the members. We believe such a ledger will help the industry stakeholders stay on the same page while sharing only the required information. This will lead to

an efficient supply chain and will eventually lead to profit maximization.

IV. CONCLUSION

In conclusion, the global textile and apparel industries play a pivotal role in shaping the economic landscape, driven by the need for cost-effective production techniques and a responsive approach to changing consumer preferences. Globalization has led to complex supply chain networks, necessitating collaboration and integration among business partners to enhance efficiency. With its intricate web of suppliers and partners, the textile and apparel supply chain faces challenges such as short product shelf life and the demand for quick response to market trends. Bangladesh, a key player in the apparel and ready-made garment (RMG) export market, has experienced significant growth, propelled by factors like simple technology, inexpensive labor, and favorable policies. However, a significant concern for the Bangladesh RMG industry is order time management, with foreign buyers requiring shorter lead times. The industry's ability to compete globally is hindered by longer lead times than competitors in China, Pakistan, and India. Recognizing the need for innovation in supply chain management, the adoption of blockchain technology has gained attention. With its decentralized and transparent nature, blockchain offers a secure platform for tracking materials and products throughout the manufacturing stages. This technology addresses the challenges of accountability, sustainability, and transparency in the fashion industry. The potential applications of blockchain technology extend to enhancing traceability, visibility, authenticity, automation, and resiliency in supply chain management.

It highlights the diverse applications of blockchain technology across various industries, emphasizing its role in revolutionizing the apparel industry and associated hardware and software infrastructure. The benefits of blockchain include traceability, transparency, authenticity, reduced costs, enhanced supply chain performance, and improved customer satisfaction. Several case studies illustrate the implementation of blockchain in the textile and apparel supply chain, showcasing initiatives by major industry players like LVMH, HUGO BOSS, and Martine Jarlgaard. These initiatives aim to ensure traceability, authenticity, and sustainability throughout the supply chain, addressing the growing demand for ethically and sustainably produced goods. The integration of blockchain technology in the textile and apparel supply chain holds immense potential for addressing industry challenges, promoting sustainability, and meeting the evolving demands of consumers. As the industry embraces technological advancements, blockchain emerges as a transformative tool that can reshape global textile and apparel manufacturing dynamics.

REFERENCES

- [1]. Md. Farhan Shahriar, Bishwajit Banik Pathik, Md. Mamun Habib. (2014). A Research Framework of Supply Chain Management in Bangladesh's Ready-Made Garments Industry. *International Journal of Business and Economics Research*, 3(6- 1), 38-44.
- [2]. Pal, K. and Yasar, A.-U.-H. (2020) 'Internet of Things and Blockchain Technology in Apparel Manufacturing Supply Chain Data Management', *Procedia Computer Science*, 170, pp. 450–457. doi:10.1016/j.procs.2020.03.088.
- [3]. Islam, M.S. and Liang, Mr.G.Q. (no date) 'Supply Chain Management on Apparel Order Process: A Case Study In Bangladesh Garment Industry', *Asian Journal of Business and Management Sciences*, 2(8).
- [4]. Cuc, S. (2023) 'Unlocking the potential of blockchain technology in the textile and Fashion Industry', *FinTech*, 2(2), pp. 311–326. doi:10.3390/fintech2020018.
- [5]. Miraz, M.H., Hasan, M.G. and Sharif, K.I. (2018) 'Supply chain management for garment industries using blockchain in Bangladesh', *Journal of Business Management and Economic Research*, 2(8), pp. 13–20. doi:10.29226/tr1001.2018.54.
- [6]. Singh, H. et al. (2022) 'Blockchain technology in the Fashion Industry', *Journal of Electronic Commerce in Organizations*, 20(2), pp. 1–21. doi:10.4018/jeco.300303.
- [7]. Wang, B. et al. (2020) 'Blockchain-Enabled Circular Supply Chain Management: A system architecture for fast fashion', *Computers in Industry*, 123, p. 103324. doi:10.1016/j.compind.2020.103324.
- [8]. Szewczyk, P. (2019) 'Application of blockchain technology in Supply Chain Management', *Scientific Papers of Silesian University of Technology. Organization and Management Series*, 2019(136), pp. 591–600. doi:10.29119/1641-3466.2019.136.45.
- [9]. Ahmed, W.A. and MacCarthy, B.L. (2021) 'Blockchain-enabled supply chain traceability in the textile and Apparel Supply Chain: A case study of the fiber producer, Lenzing', *Sustainability*, 13(19), p. 10496. doi:10.3390/su131910496.
- [10]. Saxena, M., Saxena, T. and Seth, N. (2022) 'SUSTAINABILITY IN APPAREL AND TEXTILE SUPPLY CHAINS WITH BLOCKCHAIN TECHNOLOGY: A BIBLIOMETRIC ANALYSIS', *Academy of Marketing Studies Journal*, 26(2).
- [11]. Rusinek, M., & Zhang, H. (2018) "Blockchain for a Traceable, Circular Textile Supply Chain: A Requirements Approach", *American Society for Quality*, 21(1).