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RFID-integrated blockchain-driven circular supply chain management: A system architecture for B2B tea industry

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ABSTRACT

Circular supply chain management (CSCM) is required for the tea industry to transition from a linear economic model to a more productive circular economic model. However, tracking reusable and recyclable materials over the life cycle of the tea supply chain involves multiple stakeholders. Radio frequency identification (RFID) technology driven by blockchain technology (BCT) can help to manage the complexities of circular tea supply chain management (CTSCM), establishing transparency and traceability in the industry. This study takes the first step in developing a distributed and service-oriented system architecture that embraces an RFID-integrated BCT-enabled circular supply chain practice model for a business-to-business (B2B) tea industry network. The study provides a deeper understanding of inventory performance, resource use, and the industry's processes. Furthermore, the results will aid enterprises in the B2B tea industry to better understand the factors influencing supply chain performance. Managerial and social implications of implementing RFID-integrated blockchain-driven technologies in service of the circular economy agenda are discussed.

1. Introduction

The linear economic paradigm underpins the conventional economic output and distribution framework. However, the linear economic model is not viable because it produces much waste. Any production company faces a difficult situation to reduce waste production and destruction of the environment. Thus, organizations should shift from a linear economic model to a circular economy model, which is more sustainable (El Wali, Golroudbary, & Kraslawski, 2021). However, tracking supply through various life cycles across multiple stakeholders may be difficult in the circular economy model (Pólvora, Nascimento, Lourenço, & Scapolo, 2020).

A blockchain technology (BCT) is a decentralized ledger that is accessible to users. The technology has the appealing characteristic of making it extremely difficult to alter transactions once registered in a blockchain. Thus, an RFID-integrated BCT-based model can help to manage the complexities of circular supply chain management. RFID technology has been widely praised for its ability to streamline supply chain operations (Wang, Hu, & Zhou, 2017). However, its unique data-capturing characteristics, which help real-time decision-making, have received little publicity (Brunoe, Andersen, & Nielsen, 2019). Therefore, businesses can be revolutionized by introducing modern automated detection technologies like RFID (Kim & Glock, 2014).

Meanwhile, BCT refers to an organized collection of blocks containing data and information about transactions, documents, and events (de Villiers, Kuruppu, & Dissanayake, 2020). Thus, BCT can make supply chain transactions safer, more transparent, traceable, and efficient. Transparency in the supply chain describes the ability through which both trading partners and independent stakeholders can access information. At the same time, supply chain traceability enables the tracking and provision of information about products (for example, their origin, features, and locations) throughout their manufacturing and distribution processes (Treiblmaier, 2018).

Prior literature has focused on various applications of BCT, such as the value creation potential of blockchain in business (Schlecht, Schneider, & Buchwald, 2021), social collectives in cryptocurrency markets (Breidbach & Tana, 2021), bitcoin applications in portfolio management (Li, Naqvi, Rizvi, & Chang, 2021), the determinants of blockchain adoption in supply chain management (Wong, Tan, Lee, Ooi, & Sohal, 2020), the application of bitcoin in improving prospects of investment and profitability (Islam, Marinakis, Olson, White and Walsh, 2020; Su, Qin, Tao, & Umar, 2020; White, Marinakis, Islam, & Walsh,

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2020), blockchain-based platforms: decentralized infrastructures (Pereira, Tavalaei, & Ozalp, 2019), and blockchain adoption challenges in supply chain (Queiroz & FossoWamba, 2019). However, in the existing literature, the nature of the gathered and distributed data, and the need to reinvent potential BCT-enabled supply chain networks, are often overlooked. This paper is the first step toward creating a system architecture for RFID-integrated BCT-based circular supply chain management (CSCM) in the tea industry.

The tea industry was chosen for this study for many reasons: First, the tea plant (*Camellia sinensis*) is the basis of the most widely consumed processed beverage on the planet (Biggs, Gupta, Saikia, & Duncan, 2018; Munasinghe, Deraniyagala, Dassanayake, & Karunarathna, 2017). It has grown in over 35 countries, providing valuable employment and export revenue sources, particularly for developing countries (Chen, Jia, Li, & Zhang, 2021). The world's largest tea producers and exporters are China, India, Kenya, and Sri Lanka. Second, the tea industry has recently faced numerous challenges: rapid cost increases, a drop in world tea prices, extreme debilitation of tea bushes, and a lack of productivity improvement (Paul, Mondal, Islam, & Rakshit, 2021; Sen, Rai, Das, Chandra, & Acharya, 2020). Third, the tea supply chain networks are still in their early stages, with many issues, including a lack of modern equipment and funds, a poor degree of information use, disorganized regulatory regimes, and a paucity of monitorable traceability systems (Zhang, Chen, & Chang, 2020). Finally, India is the world's second-largest producer, producing 1.338 billion kg in 2018 and 1.3897 billion kg in January–December 2019. The Indian tea industry directly employs 1.2 million people and supports over 3 million tea labourers. In 2018–19, total tea exports reached US$830.9 million and climbed to US $535.13 million in 2019–20 (till November 2019) (Tea Board of India).

In light of these concerns, this research will aid managers and practitioners in achieving three goals: first, determining the importance of BCT and RFID-integrated CSCM deployment in the tea industry; second, creating an interpretive structural model to explain the complexities of system architecture for the B2B tea industry to successfully apply CSCM practices; and third, exploring the structural relationships between the established technologies and their hierarchical levels as applicable to CSCM implementation in the tea industry. Therefore, the present study seeks to examine two research questions: (1) How can BCT and RFID technology help achieve a circular economy? (2) How can an RFID-integrated BCT-driven circular supply chain improve the performance of the tea industry?

We followed three steps to address the research questions. First, we conducted an extensive literature review to clarify previous BCT, RFID, and circular supply chain studies. Second, we used an explorative mixed-method research methodology to contextualize the potential of applying BCT and RFID technologies in the tea supply chain to achieve a circular supply chain. Focus group discussions and interviews were used to collect qualitative data, and a questionnaire survey was used to collect quantitative data. Third, we proposed and empirically tested a hypothesis on the performance of the B2B tea industry through the implementation of BCT and RFID technologies to achieve a circular supply chain.

The study makes three key contributions. First, it is the first report to adopt BCT and RFID technologies in the B2B tea industry. Our study contributes to the literature on the circular economy in tea supply chains by revealing how blockchain technology supports the best possible transparency and traceability among tea growers, tea processors, and tea-branding companies. It thereby responds to a demand for more visible connections of the benefits of supplies between circular supply chain players in a buyer–supplier relationship. Second, the research work formulates a system architecture, the RFID-integrated BCT-driven Circular Tea Supply Chain Model (CTSCM), as the basis of future research on the circular economy that drives performance in the tea industry. The findings reveal how innovative technologies contribute to supply chain needs and to designing and implementing solutions. Third, our findings indicate that managers should realize the importance of blockchain technology in supply chain transparency and traceability, particularly in agribusiness. The findings demonstrate how RFID and BCT contribute to the whole solution, providing a process by establishing a circular tea supply chain that enables effective supply chain management and solution design and implementation.

The rest of the article is structured as follows. Section 2 presents the literature review on BCT and RFID, BCT for supply chain management, and BCT for circular supply chain management. In section 3, we address the development of the BCT-driven RFID-enabled B2B CTSCM. In section 4, we demonstrate the research model and hypothesis. In section 5, we discuss the detailed research methodology. In section 6, we present the results, and in section 7, the discussion. Finally, in section 8, we offer a brief conclusion, including implications, limitations, and future research directions.

2. Literature review

2.1. Supply chain transparency and traceability

Transparency and traceability in the supply chain could be described as tracking and tracing all information and transactions (Alvarado & Kotzab, 2001). A transparent system should trace the origins of all resources, including raw materials, ingredients, and equipment. Tracking raw materials and the transitions that a product goes through from source to destination is essential. That allows stakeholders in a supply chain to have information and identify the product's origin, transportation, and recipient (Centobelli et al., 2020). While, traceability is another important component of supply chain management and is increasingly enforced by authorities to ensure safety, reliability, and consumer rights. It offers access to product-related information throughout the product's lifespan with the use of digitalization (Guercini & Runfola, 2009). Therefore, transparency and traceability enable stakeholders to monitor the whole chain and product's movement (Ranta, Keränen, & Aarikka-Stenroos, 2020).

Supply chains have evolved into very complex systems in recent years, integrating new partners and the expansion of existing ones, regionally dispersed and with a rigorous focus on satisfying progressively more demanding clients. Simultaneously, transparency and traceability have become critical criteria in an entire supply chain (Despoudi, 2021). BCT can assist in the establishment of supply chains that are highly transparent and traceable (Treiblmaier, 2018).

2.2. BCT and RFID adoption in supply chain management

Satoshi Nakamoto first presented the concept of BCT in 2008. It is defined as a technology that develops data structures and encodes transactions using data mining and bitcoin techniques (Nakamoto, 2008). BCT is most famously used in cryptocurrencies, such as Bitcoin, Ethereum, and Zerocash (Zcash) (Chen, Xu, Lu, & Chen, 2018). The data in a blockchain should be permanently stored digitally, with high transparency and encryption. Decentralization, trust, transparency, traceable and immutable transactions, encryption, and credibility are the main advantages of BCT (Centobelli et al., 2020). Therefore, BCT is not just for cryptocurrencies and stock exchanges (Lansiti, Lakhani, Iansiti, & Lakhani, 2017). It can also underpin smart contracts, network security and privacy, and other applications and platforms. Beyond facilitating modern business, BCT has aided in transforming the supply chain to make it more transparent (Centobelli et al., 2020).

Radio frequency identification (RFID) tags are used to annotate and identify items (Venkatesh, Kang, Wang, Zhong, & Zhang, 2020). RFID tags are mainly used to track and trace the items to which they are connected. They mostly replace barcodes, but they are also used in other applications where barcodes have not previously been used (Sidorov et al., 2019). At any time, an RFID tag can be accessed to collect data about its immediate surroundings and the object to which it is connected. Thus, RFID is a prominent emerging data-ensuring technology, with devices capable of assembling, capturing, analysing, and storing data. RFID tags are widely used in the supply chains of many industries (Zelbst, Green, Sower, & Bond, 2019).

The ability to collect relevant supply chain data is important, and the incorporation of RFID technology can facilitate this in a BCT-driven supply chain infrastructure (Wang, Luo, Zhang, Tian, & Li, 2020). RFID technology can collect data on how a product was treated during the entire manufacturing process (Sundaram, Zhou, Piramuthu, & Pienaar, 2010). RFID tags also allow for a more automated Internet of Things (IoT) process of collecting information. At certain points in a supply chain, such as a processing facility or a cargo trailer, it is possible to identify RFID-tagged goods to produce spatial and temporal records of how a product reaches customers (Astill et al., 2019).

BCT can assist in the integration and sharing of data across the supply chain. Therefore, material and product exchange can be smooth (Musigmann, Von Der Gracht, & Hartmann, 2020). Furthermore, BCT provides greater protection when it comes to storing and handling information online. This feature can help protect organizational intellectual property by preventing the leakage of sensitive information. All members of the supply chain, particularly consumers, can quickly obtain more information from upstream, such as raw materials and manufacturing processes (Terrada, ElKhaïli, & Ouajji, 2020).

BCT can provide potential support to achieve five strategic objectives of supply chain management effectively. First, each transaction can be given a unique code by BCT (Wang et al., 2020). That provides a detailed exploration of the financial flow across the entire supply chain. Thus, BCT helps to handle costs transparently (Olatunji et al., 2019). Second, by reducing physical interactions and communications, BCT can speed up supply chain processes. Thus, information sharing could be transformed into an Internet of Value Exchange by BCT (Pan, Xin, Xu, This, & Publishing, 2016). Third, transactions in the BCT network will only occur if all relevant stakeholders verify and are confident no tampering has occurred. This feature facilitates the protection of data throughout all supply chain transactions. Fourth, BCT can assist in the development of observable and relevant environmental, economic, and social sustainability performance assessment metrics. Finally, BCT can help consumers understand the entire supply chain and, as a result, improve supply chain integration and collaboration (Lo, Zhang, Wang, & Zhao, 2018; Mikalef, Krogstie, Pappas, & Pavlou, 2020).

Thus, BCT would revolutionize the supply chain structure by managing supply, manufacturing, logistics, and the exponential development of the global knowledge-based economy. This ground-breaking technology has many potential applications due to its immutability, transparency, and traceability for all transactions performed in a network (Czachorowski, Solesvik, & Kondratenko, 2019; Gupta & Knight, 2017; Lansiti et al., 2017).

2.3. BCT for circular supply chain management (CSCM)

At present, the global economy acts to transfer raw materials into trash via intermediate steps. An alternative is a circular economy (Rejeb, Simske, Rejeb, Treiblmaier, & Zailani, 2020) and a circular supply chain (Raut, Yadav, Cheikhrouhou, Narwane, & Narkhede, 2021). The world's resources are, unfortunately, precious and limited. Therefore, modern supply chain operators need to plan to continue expanding and becoming viable for the future without an uncontrolled source of revenue in CSCM that involves all reversal logistics processes (Younis, Sundarakani, & O'Mahony, 2020). Thus, CSCM's definition incorporates the nature of circular thought into SCM. The objective of CSCM is to create a zero-waste supply chain by integrating all supply chain functions and working with each stakeholder. Table 1 shows the main areas of application of BCT in CSCM.

Therefore, the use of BCT would remove all inefficiency and negligence from the supply chain. Businesses are being transformed by blockchain-based supply chain solutions that provide end-to-end decentralized processes through distributed ledger technology and a digital public ledger. Thus, BCT is ideal for CSCM, as it allows for real-time monitoring of products and waste and is particularly attractive to investors in recycling and reuse divisions. Past literature has concentrated on BCT adoption in different purposes, such as the value creation potential of blockchain in business (Schlecht et al., 2021), social collectives in cryptocurrency markets (Breidbach & Tana, 2021),

Table 1
Application of BCT in CSCM.

Application areas	Context	Reference
Suppliers' choice and production	By recording all suppliers' historical performance data, BCT can develop platforms and databases. That allows clients to find the most appropriate suppliers easily.	(Ciardiello, Genovese, & Simpson, 2020)
Control of materials in logistics	Using BCT, goods and materials can be traced, reducing losses of products and materials through logistics. That will shorten the lead time to increase resource productivity in the storage and delivery process.	(Younis et al., 2020)
Deployment of information management resources	Every stakeholder can benefit from good information management by making rapid improvements.	(Hallikainen, Savimäki, & Laukkanen, 2020)
Supply chain management	Stakeholders in the supply chain can better manage inventory, resources, and process efficiency using the traceability and transparency of blockchain transactions.	(Castañer & Oliveira, 2020)
Operations and production	The data for internal processes, manufacturing, and external supply chain specifications can be completely integrated by BCT. Thus, the circle's definition can be precisely harmonized and audited by all CSCM stakeholders.	(Raut et al., 2021)
Procurement	BCT could monitor and evaluate the product life cycle so that the procurement process simultaneously enables all CSCM stakeholders to develop resource efficiency and material supply stability.	(Zhang et al., 2020)
Reverse logistics	The features of reverse logistics are associated with material, product, and waste recycling, recovery, and reuse. However, it is difficult for conventional reverse logistics to get accurate information about the time, place, quality, and condition of materials, products, and waste. All transactions in a supply chain are traceable by BCT. Therefore, the stakeholders in CSCM can easily track and monitor the entire logistics process for waste recycling, refurbishment, and reuse.	(Lo et al., 2018)
Waste reuse through various circular supply chains	When two companies from different circular supply chains require each other's waste or used components, they may conduct transactions and free transfers without involving a third party. Therefore, BCT may provide a forum to promote the incorporation of the circular economy across various supply chains.	(Akinade & Oyedele, 2019)

blockchain adoption in healthcare (Balasubramanian, Shukla, Sethi, Islam, & Saloum, 2021), bitcoin applications in portfolio management (Li et al., 2021), blockchain in the private and public sectors (Su et al., 2020; Toufaily, Zalan, & Dhaou, 2021), technological interventions in social business (Soni et al., 2021), the business-to-business relationships (Gligor, Pillai, & Golgeci, 2021), blockchain adoption in operations and supply chain management (Babich & Hilary, 2019; Kshetri, 2018; Francisco & Swanson, 2018; Wong et al., 2020; Kopyto, Lechler, von der Gracht, & Hartmann, 2020; Sunny, Undralla, Pillai, & Madhusudanan Pillai, 2020; Venkatesh et al., 2020; Queiroz & FossoWamba, 2019; Wang, Han, & Beynon-Davies, 2019; Cole, Stevenson, & Aitken, 2019; Saberi et al., 2019), supply network design (Tsolakis, Niedenzu, Simonetto, Dora, & Kumar, 2020), industrial transformations (Pereira et al., 2019; Pólvora et al., 2020), and bitcoin as a technology-based product (White et al., 2020).

Therefore the examination of the extant literature (Table 2) shows that studies on blockchain technology are mostly focused on the use of cryptocurrencies in financial organizations and the perspective of technology acceptance, ignoring other aspects of sustainable performance in the supply chain. In particular, studies on the impacts of BCTs on circular supply performance are underrepresented. Therefore, there is a significant opportunity for researchers to concentrate on this specific research gap.

3. Development of the RFID-integrated blockchain-driven CSCM framework for the B2B tea industry

Since the study's basic objectives are to identify existing issues in the B2B tea industry and develop a system architecture for the industry, we first identified the supply chain's sustainability challenges through field visits (as given in Table 3).

3.1. Sustainability challenges in the existing B2B tea industry

The tea plant is a leaf-harvested crop that grows in humid and sub-humid tropical and sub-tropical climates. Tea growers are the suppliers who supply the plucked green tea leaves to the tea processing factories (Paul & Mondal, 2019). Thus, the tea processing factories are the manufacturers that produce processed tea using the plucked green tea leaves as raw material (Paul & Mondal, 2021). The processed tea then needs further processing to become the final product as branded tea. Tea branding companies carry out this process, producing branded tea. Therefore, the tea branding companies are the processed tea buyers that purchase processed tea from tea auction centres, either directly or through brokers (Munasinghe et al., 2017). Tea auction centres work as a bridge between tea processors and buyers. The branded teas then reach tea consumers through the distribution channel. This research considers only the business-to-business (B2B) part, i.e., the supply of processed tea from tea processing factories to the tea branding companies through auction centres.

From the field study, we identified that every phase of the existing B2B linear tea supply chain faces several sustainability challenges as follows:

i) **Suppliers' challenges:** First, tea leaf production depends on the season. Most tea leaves are plucked during the monsoon, and the onset of winter brings an end to harvesting. Every tea processing factory has limited production capacity, so tea growers face difficulty selling all their plucked tea leaves in the plucking season, and a huge amount of tea leaves are wasted in peak season. Second, as bio-fertilizers and herbal pesticides carry many costs, tea growers usually use chemical fertilizers and pesticides. For example, they do not use vermicompost or heap compost; rather, they use artificially produced manures like urea, which decrease tea-garden productivity and health in the long term. Third, tea cultivation is not as economically profitable as possible due to

Table 2
Existing literature on blockchain technology.

The focus of the study	Main findings	Reference
Identify the future value creation potential of blockchain for organizations	This research uses the Delphi method to determine how much value blockchain may provide to enterprises by 2030. In addition, their findings forecast huge efficiency benefits through technology advancement. As a result, the study provides managers with clear indicators of blockchain trends and action suggestions.	(Schlecht et al., 2021)
Individual roles in cryptocurrency markets	This study attempts to address future research and provides managerial suggestions that enable practitioners to benefit from cryptocurrencies. These contributions include a typology outlining four unique roles that individuals play in shaping bitcoin markets.	(Breidbach & Tana, 2021)
Readiness assessment framework for different factors	The study suggested a paradigm for assessing preparedness that considers the intricate interplay of many underlying variables, social structures, and institutional procedures.	(Balasubramanian et al., 2021)
Use of Bitcoin for portfolio optimization	The research examines how the banking industry might leverage Bitcoin to boost the efficiency and prosperity of the economy. The findings indicate that Bitcoin has a strong proclivity to improve an investor's risk-reward profile.	(Li et al., 2021)
The socio-economic value of blockchain adoption at the ecosystem level from a multi-stakeholder perspective	The authors present a conceptual framework that focuses on the environmental, organizational, and technological issues associated with blockchain adoption. The article discusses the distinctions between permissioned and permission-less blockchains and identifies new concepts in adopting blockchain technology.	(Toufaily et al., 2021)
Blockchain technology is being used in sustainable social enterprises to ensure the long-term viability	The findings of this study indicate that digital technologies are rapidly being regarded as instruments for social companies' sustainability and scalability.	(Soni et al., 2021)
Examining blockchain technology's potential to transform B2B relationships and identify dark side effects	Despite improvements in studying the dark side of business-to-business connections, concerns have been voiced that this stream of research is under-theorized. Researchers address these issues by evaluating how emerging technologies have the potential to change business-to-consumer relationships.	(Gligor et al., 2021)
Adoption of Blockchain for supply chain management as a behavioral intention	This article examines the behavioral intention of adopting Blockchain technology for the supply chain management. The study	(Wong et al., 2020)

(continued on next page)

Table 2 (*continued*)

The focus of the study	Main findings	Reference
	paradigm considers how performance expectancy, effort expectancy, facilitating conditions, technology readiness, technology affinity, and trust may all contribute to technology adoption.	
Blockchain-centric food supply chains for the Thai fish industry	The study indicates a data imbalance in supplier networks tasked with achieving the Sustainable Development Goals.	(Tsolakis et al., 2020)
Blockchain technology and its disruptive impact on supply chain design and operations	The study identifies that, while blockchain technology enables transactions between untrusted parties, the system's trust-related benefits are not simply convertible to SCM without additional restrictions. This research demonstrates the continued necessity for active trust management among supply chain parties.	(Kopyto et al., 2020)
Adoption of blockchain technology in specific European industrial and business contexts	The study provides evidence for a transdisciplinary, forward-looking strategy to address such issues as to effect and value. It intends to push the boundaries of standard practice in policy guidance when it comes to early-stage technologies such as Blockchain.	(Pólvora et al., 2020)
Application of traceability to create transparency in supply chains	The study provides an overview of the many blockchain-based traceability systems that have been described in the literature. The Microsoft Azure Blockchain Workbench is used to demonstrate a Proof of Concept for a cold chain scenario.	(Sunny et al., 2020)
Blockchain offers a promising future to achieve instant traceability in supply chain social sustainability	The study finds that Blockchain technology can revolutionize supply chain social sustainability by enabling rapid traceability. The purpose of this project is to design a system architecture that incorporates the use of blockchain, the internet of things (IoT), and big data analytics to enable sellers to monitor the sustainability of their supply chains efficiently and effectively.	(Venkatesh et al., 2020)
Bitcoin's behavior more closely resembles a technology-based product than a currency or a security	The study shows that there are currently over 2000 Bitcoin-like cryptocurrencies in use. Cryptocurrencies are not regulated in the majority of nations. They discover that Bitcoin's behavior is more akin to a technology-based product, an emergent asset class, or a bubble event. They propose that existing currency and securities rules should not apply to cryptocurrencies.	(White et al., 2020)
Financial implications of the fourth industrial revolution	This article examines the causal relationship between the Bitcoin price (BP) and the oil price (OP). The negative impact of OP on BP can be attributed to the bust of the Bitcoin bubble, which undermined the company's capacity to hedge. There is also a negative impact or reverse causality extending from BP to OP, indicating that the growing BP may jeopardize investor demand for oil.	(Su et al., 2020)
Blockchain technology allows for decentralized versus centralized governance modes	The study finds that through decentralized governance and distributed data infrastructures, blockchain technology can eliminate intermediaries in transactions.	(Pereira et al., 2019)
Individual blockchain adoption patterns in the logistics and supply chain industries	The study finds that Blockchain is a cutting-edge technology that is transforming and remodeling the relationships between all logistics and supply chain systems.	(Queiroz & FossoWamba, 2019)
How a blockchain-enabled supply chain configured from a design perspective.	The study finds that the benefits of blockchain technologies for supply chain management come in the form of increased visibility and traceability, digitization and disintermediation, data security enhancements, and smart contracts.	(Wang et al., 2019)
An explanation and analysis of blockchain technology to identify implications for the field of OSCM	This article concludes that there are several potential ways for organizations to gain an advantage over their competitors by leveraging blockchain technology. Managers must assess their goods, services, and supply networks to decide whether they require or might benefit from blockchain implementation.	(Cole et al., 2019)
Investigate how blockchain can address and aid supply chain sustainability	The study revealed that blockchain technology and smart contracts had been subjected to a rigorous examination regarding their potential applicability to supply chain management.	(Saberi et al., 2019)
How does blockchain affect key supply chain management	This study investigates the potential impact of blockchain on critical supply chains management objectives such as cost, quality, speed, reliability, risk reduction, and flexibility.	(Kshetri, 2018)

increasing production costs, drops in world tea prices, and competition for land and productivity. Fourth, commercial tea bushes are pruned every 2–3 years to rejuvenate them and produce a high-quality succulent flush. This periodic pruning causes a slew of economic issues as crop production temporarily falls to zero, and it takes some months to start harvesting. Completely redeveloping the canopy cover takes more than 9 months. Thus, reducing crop yield after pruning reduces the income of the tea growers, who depend on the quantity of tea plucked.

ii) **Manufacturers' challenges:** First, the quality of processed tea depends on the quality of the tea leaves. Therefore, recognizing appropriate varieties of tea leaves is crucial to ensure premium processed tea production. Second, other challenges include recognizing the growing conditions of the tea plants, cultivation practices, and the tea leaves' harvesting time: all these factors significantly influence the quality of the processed tea. Third, at the end of March or the first week of April, when tea leaves are plucked after pruning and nursing of the tea plants, it is called the 'first flush'. Then, when tea leaves are plucked at the end of May, usually after a heavy rain, this is called the 'second flush'. The first and second flushes have the correct properties to produce the best quality of tea. Therefore, it is not easy to stress these premium-quality tea leaves.

iii) **Branded tea companies' challenges:** First, commercially processed teas are divided into various groups based on their processing methods, such as fermentation and oxidation. Green tea, black tea, oolong tea, white tea, yellow tea, and dark tea are the most popular categories. In the production of processed tea, many varieties are used within each group, sometimes with widely differing quality. Several thousand tea varieties are thought to be grown in various parts of the world. As a result, precise varietal identification is vital to ensure the traceability and authentication of premium tea brands. Second, the market for premium teas, such as organic tea, first-flush tea, and roasted tea, has been steadily expanding. Therefore, accurate visibility is critically important to ensure the authentication of special processed teas to produce premium-quality tea.

The industry requires proper monitoring of the tea's quality and consistency, which are the most important factors in ensuring consumer loyalty. Therefore, in the B2B tea network, a safe and efficient track-and-trace system is needed. RFID technology can act as a basis for introducing BCT and the two technologies can work together to create a solution that enhances the transparency and traceability of the B2B tea industry and consequently increases its performance.

3.2. *Proposed RFID-integrated BCT-driven B2B CTSCM framework*

The research identifies that the existing B2B tea industry is leaner compared to circular and faces several sustainability challenges, which require it to upgrade to a circular economy approach. The research also identifies that the tea industry struggles with the two most important criteria: transparency and traceability, which are the key factors to increase its performance. BCT and RFID-integrated mechanisms can provide the required transparency and traceability. Therefore, we propose a theoretical BCT-driven RFID-integrated CTSCM (shown in Fig. 1) to increase the performance of the B2B tea industry in the following way: (See Fig. 2.)

First, in the proposed model, RFID provides a secure link between

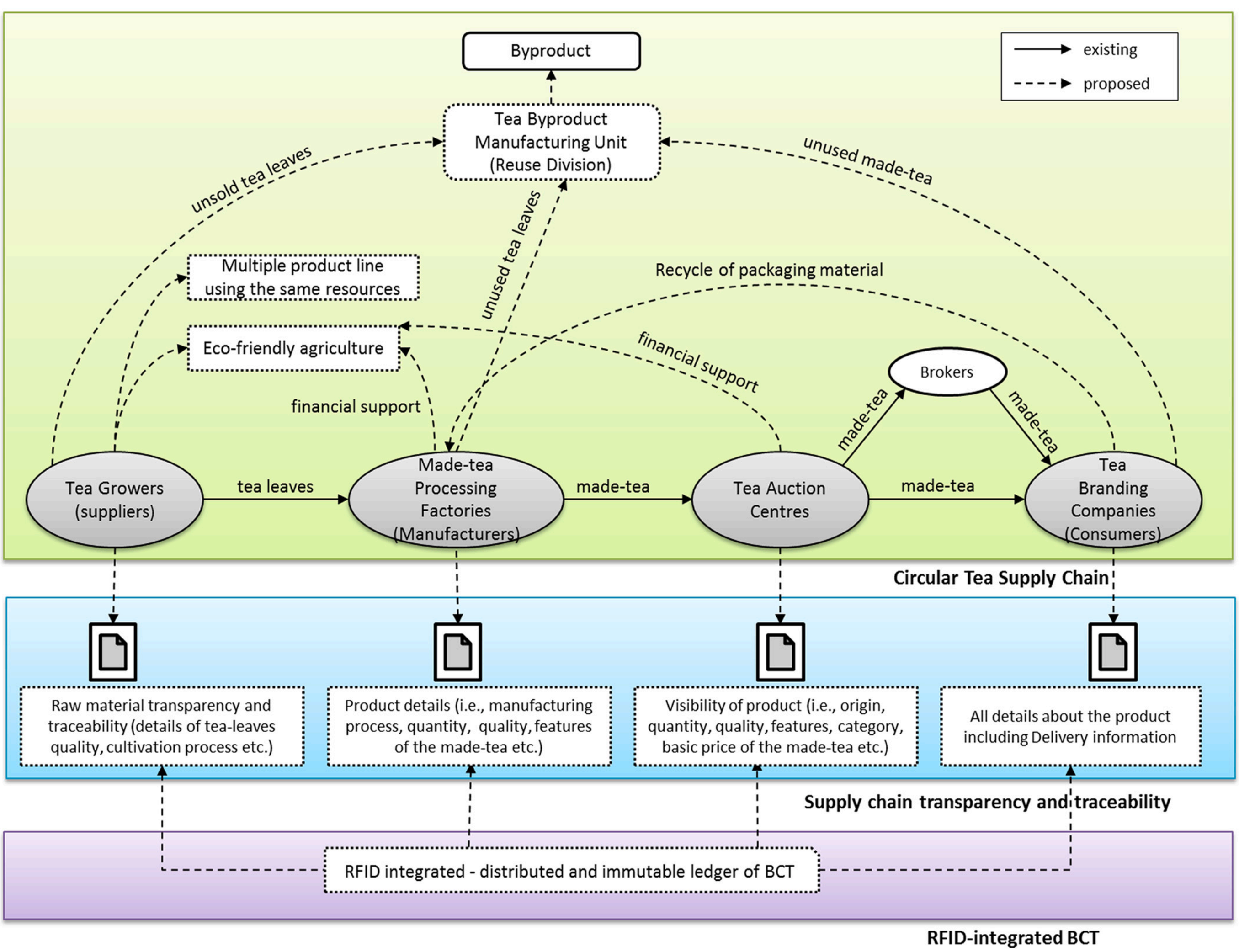

Fig. 1. Proposed RFID-integrated BCT-driven B2B CTSCM framework.

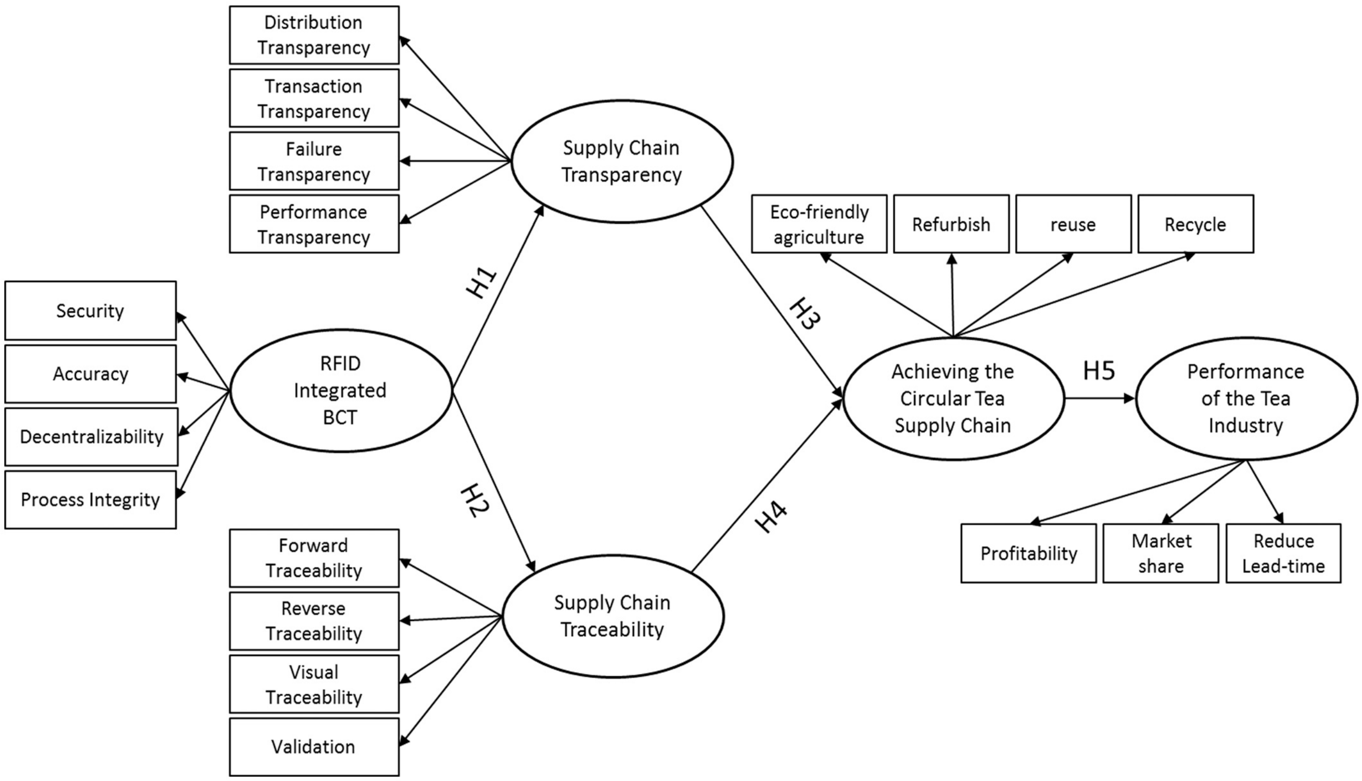

Fig. 2. Constructs and research hypothesis.

physical supplies and their digital identities. In this model, supplies (i.e., plucked tea leaves and processed tea) can have a distributed digital presence with a secure RFID code, the details of which are visible to every stakeholder. Comprehensive information – including the supplies' quality, quantity, unique features, and standards – can be easily identified at any stage. A protected information tag will be attached to all the supplies and will work as an identifier that links physical supplies to their digital identities.

Second, before supplies are shifted to the next stage in the proposed BCT-based supply chain, the associated payers can sign a digital contract to verify the transaction (Kumar, Ramachandran, & Kumar, 2020). Digital signatures control the sharing of network data between supply chain participants as well as process improvement. Transaction details update the BCT database if all stakeholders have met their formalities. Beyond just supply information, this transparent CSCM model (Govindan, Mina, Esmaeili, & Gholami-Zanjani, 2020) has enormous potential to improve the performance of the B2B tea industry.

Third, premium features of the supplies can be emphasized in the BCT database with secure RFID codes (Tsolakis et al., 2020). The resulting transparency and traceability facilitate the efficient transfer of supplies and information (Tsolakis et al., 2020). This allows all stakeholders to examine the continuous distribution chain and transactions at each point (Kopyto et al., 2020; Schlecht et al., 2021). Therefore, the premium quality of tea leaves can be tracked by the tea manufacturing company. Similarly, the premium quality of processed tea can be tracked by the tea branding companies, including the details of tea leaves. That will encourage the tea growers and tea processers to produce the best-quality tea leaves and processed tea, respectively.

Fourth, the tea-branding companies would monitor specific processed tea production to improve confidence associated with processed tea quality and features in the proposed model. The tea-branding companies and tea processers can also provide financial support to the tea growers to encourage eco-friendly agriculture, which is important to establish a circular economy (Saif, Rizwan, Almansoori, & Elkamel, 2017) and create a more sustainable environment.

Fifth, tea plants grow better when planted in the shade of trees. The trees of 'Sarish' (*Albizia lucidor*) are often used in India as shade trees. However, these shade trees do not add any additional revenue to most of the tea growers. The proposed model suggests that tea growers could use those shade trees to support black pepper (*Piper nigrum*) plants and cultivate black pepper along with tea in their tea gardens. Tea growers could also start fisheries in the garden ponds used to supply water to their gardens. Therefore, using available resources can create multiple product lines, which may help the present supply chain become circular.

Sixth, the proposed model suggests a reuse division, i.e., a tea by-product manufacturing unit, which can produce different products using unused plucked green tea leaves and processed tea, instead of treating them as waste. Thus, the reuse division can help to achieve a circular supply chain. That could help to increase the profitability of this supply chain and be an alternative source of income for the stakeholders. Especially in the plucking season, a huge amount of unused plucked tea leaves can produce most tea by-products, supporting the tea growers during the pruning season.

Seventh, the proposed model further suggests the recycling of packaging material. The tea processing factories use strong wooden boxes for processed tea packaging, which can be reused many times. Therefore, recycling the packaging material can again lead to achieving a circular supply chain.

The proposed RFID-integrated BCT-driven B2B CTSCM model may increase the performance of this industry. However, to realize the concept, privacy and confidentiality of information must be considered, because all the members of the BCT have access to all the data. Therefore, maintaining a balance between the transparency and confidentiality of transaction data and tamper-proof documents is an operational problem that must be addressed. Thus, the model may necessitate a secure, privately approved BCT with a specific set of participants (Balasubramanian et al., 2021; Breidbach & Tana, 2021; de Villiers et al., 2020; Kimani et al., 2020; Marsal-Llacuna, 2018; Park, Shin, & Choy, 2020; Shah & Murthi, 2020).

4. Constructs and research hypothesis

The proposed RFID-integrated BCT-driven B2B CTSCM model needs to be further validated for its acceptance among the stakeholders. Hence, the research is extended through an empirical study to identify the impact of the proposed model based on five identified constructs (Fig. 2) from the literature (as given in Table 2). Structural equation modelling (SEM) with a graphical approach to the analysis of moment structures (AMOS) is used to develop theoretical and computational power to illustrate an appropriate relationship among the identified constructs: RFID-integrated BCT, supply chain transparency, supply chain traceability, achieving circular tea supply chain management (ACTSCM) (Akinade & Oyedele, 2019), and performance of the tea industry. The description of the constructs is as follows:

i) ***RFID-integrated BCT***

The decentralized design of a BCT transforms transaction databases from secure, centralized ledgers maintained by a few accredited users to open, distributed ledgers maintained by tens of thousands of nodes. The failure of a single node does not affect the overall function of the network. That eliminates the possibility of a single point of failure and guarantees the high reliability of blockchain-based applications. By virtue of its decentralizability, BCT can track and establish accurate transaction records of raw material supply (Bartlett, Julien, & Baines, 2007) (plucked green tea leaves), production of processed tea, and logistics in the supply chain life cycle (Pólvora et al., 2020). Premium features can also be highlighted for better quality assurance.

Besides, RFID could be used for product identification and tracking. RFID technology is central to the model in enabling intelligence (Chen, Jiang, Jia, & Liu, 2021). The information from each RFID data tag (Shi & Yan, 2016) can be stored in a blockchain to trace the position of each item during its life cycle. RFID-integrated BCT can be used to provide a paradigm shift in industrial applications, especially in the supply chain, to achieve security and accuracy (Lacka, Chan, & Wang, 2020). Therefore, highly transparent and traceable process integrity can be developed inside the RFID-enabled BCT-driven tea supply chain model.

Thus, by reducing inventory losses, increasing process quality and speed, and improving information accuracy, RFID-enabled BCT can enhance the potential benefits of supply chain management (Francisco & Swanson, 2018). As a result, we hypothesized that RFID-enabled BCT would improve supply chain transparency and traceability (Kopyto et al., 2020). Thus, we suggest the following hypotheses:

H1. RFID-integrated BCT has a significant positive effect on enhancing tea supply chain transparency.

H2. RFID-integrated BCT has a significant positive effect on enhancing tea supply chain traceability.

ii) ***Supply chain transparency***

A CTSCM requires a strong association with each supply chain situation regarding transparency (Raimondo et al., 2021). All parties to a CTSCM should have common knowledge and product-related information as required, such as the quality, quantity, and location of the resources, without any inaccuracy or ambiguity, i.e., with transparency about distribution, transaction, failure, and performance (van Capelleveen et al., 2021). To succeed in the cutthroat competition of open global markets, every business requires a well-synchronized and scalable supply chain with minimal risk.

BCT helps create a "supplies record", a blockchain database in which individuals can manage and store their data and information. Instead of stakeholders in the supply chain having their own internal databases, BCT can monitor all underlying supplies by exposing a decentralized database with cryptographic verification that is automatically propagated across the network and increasing transparency in information

Table 3
Field visit – methods and schedules for qualitative data collection.

Field visit	Field visit schedule	Field visit methods and agendas
Small Tea Gardens (In India, a tea garden that is smaller than 25 acres or 10.12 ha in size and without a made-tea processing factory is classified as a "small tea garden".) • We visited 18 small tea gardens in Jorhat, Assam. • We visited 11 small tea gardens in Dibrugarh, Assam. • We visited 9 small tea gardens in Sivasagar, Assam. • We visited 5 small tea gardens in Lakhimpur, Assam, and • We visited 3 small tea gardens in Golaghat, Assam.	We visited 46 small tea gardens and observed the agriculture strategy and supply of plucked green tea leaves in detail. We arranged 21 focus group discussions with the plucking laborers. We arranged 39 interviews with the small tea growers.	**Observation:** i) We observed the process of tea cultivation. ii) We observed the plucking techniques. iii) We observed the next step after plucking green tea leaves from the gardens. **Focus group discussion:** • Plucking timing, plucking season, plucking strategy, and nursing of the tea plants. • Limitations or difficulties encountered during cultivation, harvesting, and selling. **Interview:** Q1. What are the factors responsible for producing the highest quality tea leaves? Q2. Who are the customers of the plucked green tea leaves? Q4. What are the limitations or challenges faced by tea cultivators? Q5. What are the limitations or challenges faced during the sale of the plucked green tea leaves?
Bought Leaf Factories (Bought leaf factories do not have their own tea gardens; rather, they depend on the small tea gardens for plucked green tea leaves.) • We visited the Deha Tea Factory in Jorhat, Assam. • We visited the Dhanshree Tea Factory in Jorhat, Assam. • We visited the Titabar Tea Factory in Jorhat, Assam. • We visited the Choice Tea Industry in Dibrugarh, Assam, and • We visited the Bishnu Tea Company in Golaghat, Assam.	We visited 5 bought-leaf factories and observed the made-tea process in detail. We arranged 9 focus group discussions with employees of the bought-leaf-factories. We arranged 8 interviews with the administrative manager (assistant manager) and 4 managers of the bought-leaf-factories.	**Observation:** i) We observed the process of producing the made-tea. ii) We observed the next step after the production of the made-tea. **Focus group discussion method:** • Different phases of the made-tea process. • Use of Logistics. • Distribution channel. **Interview:** Q1. From which source do the bought-leaf factories get plucked green tea leaves to produce the made-teas? Q2. What are the factors responsible for producing the best quality made-tea? Q3. Who are the customers of made-tea? Q4. What are the

(continued on next page)

Table 3 (*continued*)

Field visit	Field visit schedule	Field visit methods and agendas
		limitations/challenges faced by the bought leaf factories?
Tea Estates (A large garden with its own made-tea processing factory is together called a tea-estate.) • We visited Hunwal Tea Estate, Lakhibari Tea Estate, Kolony Tea Estate, Praphat Tea Estate, Kharjan Tea Estates, Bagrodia Tea Estate, Towkok Tea Estate, Banwaripur Tea Estate, and Gatoonga Tea Estate in Jorhat, Assam. • We visited Desam Tea Estate, Langharjan Tea Estate, Naharkatia Tea Estate, Nadua Tea Estate, Thanai Tea Estate, and Dikom Tea Estate in Dibrugarh, Assam. • We visited Ajoy Chetia T.E., Duwari Tea Estate, Azim Tea Estate, Humali Tea Estate, and Surab Tea Estate in Sivasagar, Assam. • We visited Doolahat Tea Estate, Cinnatolliah Tea Estate, Madhupur Tea Estate, and Koilamari Tea Estate in Lakhimpur, Assam. • We visited Hathikuli Tea Estate and Aalmat Tea Estate in Golaghat, Assam.	We visited 26 tea estates and observed their agriculture strategy and made-tea process in detail. We arranged 9 focus group discussions with factory laborers and plucking laborers from the tea estates. We arranged 9 interviews with the administrative managers (assistant managers), 10 field laborer managers (assistant managers), 7 field managers (assistant managers), and 6 managers of the tea estates.	**Observation:** i) We observed the process of tea cultivation. ii) We observed the process of producing the made-tea. iii) We observed the next step after production of the made-tea. **Focus group discussion:** • The tea cultivation process. • Plucking and pruning strategies. • Different phases of the made-tea process. • Use of Logistic. • Distribution channel. **Interview:** Q1. What are the factors responsible for producing the best quality made-tea? Q2. Who are the customers of made-tea? Q3. What are the limitations/challenges faces by the Tea estates?
Tea Auction Centre (Tea auction centres provide trading facilities and serve as a bridge for both 'made-tea' buyers and sellers.) • We visited the Guwahati Tea Auction Committee (GTAC) in Guwahati, Assam; • We visited the Calcutta Tea Traders Association in Kolkata, West Bengal.	We visited 2 tea auction centres. We arranged 4 interviews with the employees of the tea auction centres. We arranged 6 informal discussions with employees of the tea auction centres.	**Interview:** Q1. Who is the seller of the made-tea? Q2. Who are the buyers of the made-tea? Q3. What is the role of the tea brokers? Q4. What are the limitations or challenges faced by the tea auction centres? **Informal discussion:** • Opportunities for selling and purchasing made-tea. • Roll and responsibilities of the Tea-Auction-Centre. • Purchase trends.
Tea Research Institute (The Tea Research Institute assists both new and established tea growers through its innovation processes.) • We visited the Tocklai Tea Research Institute in Jorhat, Assam.	We visited Tocklai Tea Research Institute. We arranged 3 interviews with the scientists of the Tocklai Tea Research Institute. We arranged 2 informal discussions with scientists from the Tocklai Tea Research Institute.	**Interview:** Q1. What is the role of the Tea Research Institute? Q2. What are the factors responsible for producing the best quality tea? Q3. What are the limitations or challenges faced by the Indian tea industry? **Informal discussion:** • Tea Research Centers' Role in Tea Cultivation and Processing. • Plucking, pruning, and nursing strategies. • The quality of the finished tea.
Tea branding companies (The tea branding companies produce branded-tea (finished-tea) after blending and packaging the made-teas. Afterward, the tea (branded-tea) reaches end-users through a distribution network of wholesalers and retailers.) • We visited Aza Tea Packaging Company, Durga Tea Industries Company, K. B. Tea Product Pvt. Ltd., and M/S Tea Emporium in West Bengal, India. • We visited Shahi Gazab Tea Company and Seol India Pvt. Ltd. in Assam, India.	We visited tea branding companies. We arranged 8 interviews with the employees of the tea branding companies. We arranged 7 informal discussions with the employees of the tea branding companies.	**Interview:** Q1. What are the processes involved in producing branded tea? Q2. What are the factors responsible for producing the highest quality branded tea? Q3. What are the limitations/challenges faced by the tea branding companies? **Informal discussion:** • Blending and packing strategy, • Factors influencing the production of high-quality tea (branded tea), • Distribution channel.

flow and secure transactions. That also helps the stakeholders and investors to recycle and reuse the supplies as required.

Thus, transparency allows for greater exposure of CTSCM by identifying good-quality resources (i.e., features of the tea leaves and processed tea), increasing business productivity levels, and saving time (Pan et al., 2016). Supply chain transparency allows everybody to see and know the actual source and authenticity of the supplies, which is one of the key factors in achieving CTSCM. Thus, the study develops the following hypothesis:

H3. Supply chain transparency has a significant positive effect on achieving circular tea supply chain management.

iii) ***Supply chain traceability***

Supply chain traceability is the other most important step to ensure the long-term viability and security of a CTSCM. In CTSCM, traceability is vital for quality control of tea leaves' production and tea processing, inventory recall, tracking of forward and reverse logistics, and spreading knowledge across the chain. One of the key characteristics of BCT is that single entities cannot manipulate data because transaction data are exchanged with all supply chain stakeholders. With such an attribute, it is possible to achieve traceability (Cagliano, Worley, & Caniato, 2016).

Since every transaction in BCT is time-stamped, the ledger will display all past transactions. Any point of error in BCT can also be traced in detail. The ability of BCT to display actual data to end-users boosts consumer and supply chain network organization trust. With decentralized ledgers and RFID-secure codes, RFID-integrated BCT can build new trust. These ledgers can be distributed through a network of tamper-proof nodes (Zelbst et al., 2019).

Therefore, forward traceability, reverse traceability, visual traceability, and validation encourage individual stakeholders to participate, one of the most important aspects of achieving a CTSCM (Jia, Yin, Chen, & Chen, 2020). The study therefore suggests the following hypothesis:

H4. Supply chain traceability has a significant positive effect on achieving circular tea supply chain management.

iv) ***Achieving circular tea supply chain management***

CSCM is a restorative distribution system in which materials are reused, remanufactured, and recycled in an infinite loop (Vegter, van Hillegersberg, & Olthaar, 2020). Therefore, CTSCM can be a part of the circular tea economy, which seeks to minimize energy use in the commodity life cycle by using eco-friendly agriculture, increasing tea quality by using organic processed tea, reusing unused plucked tea leaves and unsold processed tea to manufacture tea by-products (Aroyeun, Olubamiwa, & Ogunjobi, 2005), creating multiple product lines using the same resources, and recycling packaging material.

The circular economy provides an alternative to resource scarcity. Therefore, CTSCM is a good way to address deforestation, unattainable supply and use rates, and resource shortages. Thus, the B2B tea industry can reduce waste and harmful environmental effects of tea supply chain operations by following a circular commodity (Hallikainen et al., 2020), inventory, and disposal flow (Martha, Douglas, & Pagh, 1997). CTSCM could help to improve soil quality, reduce pesticide use, and ensure the quality of tea. Furthermore, CTSCM could operate on the concept that supply chain materials, including waste, can be recycled and reused. Therefore, by achieving CTSCM, the performance of the tea industry will increase significantly. The present study therefore proposes the following hypothesis:

H5. Achieving circular tea supply chain management has a significant positive effect on the performance of the tea industry.

v) ***Performance of the tea industry***

The performance of the business depends on profitability, market share, and reduced lead time (Gunasekaran, Patel, & McGaughey, 2004). Each business's success is contingent upon its consumers; if businesses provide high-quality services, their chances of profitability increase (Zhou & Li, 2020). Moreover, the level of performance depends on market share. A business's performance decreases when its lead time is extended (Munir, Jajja, Chatha, & Farooq, 2020).

Tea leaf producers have been forced to exchange quality for quantity in the linear tea supply chain due to rising production costs and decreasing yields (Sen et al., 2020). In the proposed CTSCM model, every process is transparent, and each tea grower's activity is easily traceable. Thus, tea growers can be financially supported to carry out eco-friendly agriculture by the tea processors and branded tea companies. Therefore, tea growers will begin discarding chemicals and shifting toward organic farming practices, which help increase the quality of tea leaves and, consequently, the quality of branded tea; that will increase the tea customers' satisfaction, which will lead to increased performance in the tea industry along with the environmental improvements.

The purchase trend of premium-quality branded teas is expanding rapidly day by day. In the proposed CTSCM model, RFID-integrated BCT-driven technology can also increase the transparency and traceability of premium-quality branded teas, which can gradually influence their market share (Astill et al., 2019). The increasing demand for premium tea will result in higher revenues and profits for tea growers, tea processers, and tea branding companies.

Furthermore, in the proposed CTSCM model, RFID-integrated BCT-driven technology can increase the supply chain's transparency and traceability; thus, the visibility of the demand and supply of each stage increases, which could help to decrease the lead time (Bhatnagar & Teo, 2009) of every stage and also to identify the unused supplies, which could be reused by the by-product manufacturing unit, again leading to increased profitability.

Therefore, RFID-integrated BCT-driven CTSCM could increase the B2B tea industry's performance, maximizing profitability, increasing market share, and reducing lead time by enhancing the supply chain's transparency and traceability.

5. Methodology

This study employed a mixed-methods approach, incorporating both qualitative and quantitative data, to ascertain the impact of RFID-enabled, blockchain-based circular supply chain management. This research focuses exclusively on the business-to-business tea market, i.e., tea producers selling to tea branding firms. The research team performed an in-depth field visit to gain a thorough understanding of the tea supply chain and the sustainability problems encountered at each level (collected qualitative data). Then, we conducted a literature review and held discussions with blockchain professionals to better understand how blockchain technology can be used to address the identified challenges; additionally, we held discussions with RFID professionals to better understand how RFID integration improves supply chain performance. A circular supply chain management model based on RFID integration and blockchain technology was presented based on the findings of the qualitative investigation.

The suggested model should be further verified to ensure its adoption by stakeholders in the B2B tea business. As a result, we expanded our research with an empirical investigation to determine the suggested model's impact using a questionnaire survey. As seen in Fig. 3, the approach is separated into five parts.

5.1. Field visit

This study is based on a 3-year comprehensive field study of Assam's B2B tea industry (Table 3). The state is located in northern India, between latitudes 24°8′ N and 28°2′ N and longitudes 89°42′ E and 96° E. We choose Assam as the data collection region for the following reasons: first, Orthodox Assam tea is well-known across the globe for its brilliant liquid and unique flavour. Second, the world's largest tea plantation is situated in the foothill areas of the Eastern Himalayas and the Brahmaputra Valley in Assam. Third, Assam produces 52% of all tea produced in India and approximately one-sixth of all tea produced worldwide (Dikshit & Dikshit, 2014). Fourth, Assam has 307,080 ha of land for tea growing, and tea production is 629.05 million kg. Assam has 56,191 small tea gardens, 761 tea estates, and 220 tea processing factories (Biggs et al., 2018).

5.2. Development of survey questionnaire

The creation and design of questions and projections are essential in ensuring the relevance, validity, and reliability of studies (Mitchell, 1996). To generate succinct and thought-provoking projections, a detailed and well-established multi-stage methodology was adopted. Related journal and conference papers (Kopyto et al., 2020; Musigmann et al., 2020; Tsolakis was adopted. Related journal and con, 2020) and online forum posts were screened to recognize essential factors concerning the future of BCT in CTSCM. To ensure that all relevant concerns were gathered for projection growth, a small-scale survey was conducted among BCT practitioners and academicians to identify additional factors and reconstruct the selection process. The final set included 19 RFID-integrated BCT-driven CSCM factors (Table 4).

The small-scale survey was open to BCT practitioners, tea growers,

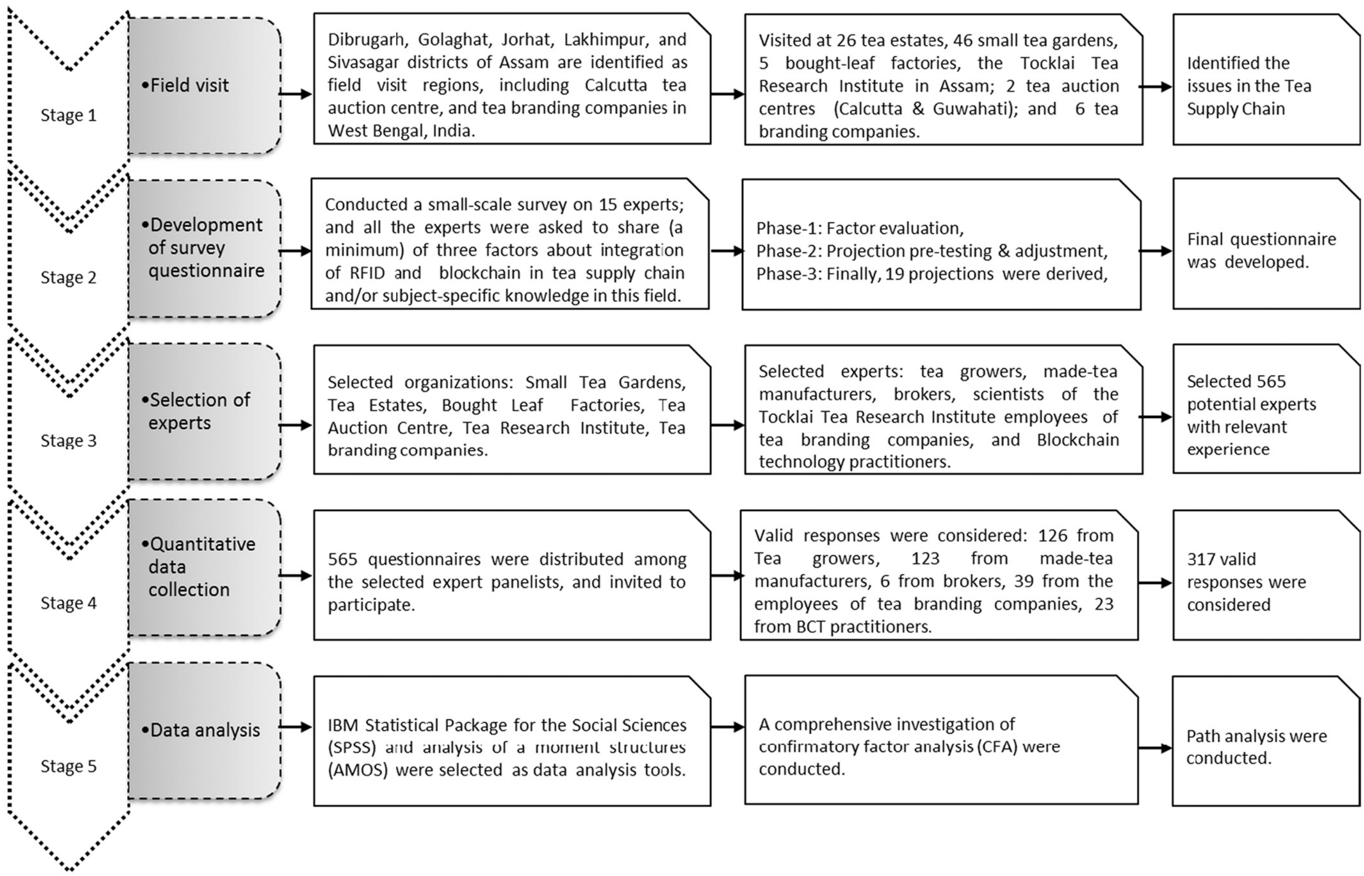

Fig. 3. Stages of research method.

and manufacturers. Academics who have written papers on blockchain technology were also invited to attend. Experts were contacted via email and asked to include at least three keywords relating to the effect of blockchain technology. The survey was carried out until there were large-scale redundancies and diminishing returns on new elements. Six academics, four tea growers, and five manufacturers with considerable experience in this field pre-tested the questionnaire, ensuring the precision, transparency, reasonableness, and logical adequacy of the predictions to ensure the validity of identity and material, as suggested by Warth, Von der Gracht, and Darkow (2013). Their comments resulted in small changes to the questionnaire's wording and structure, and the final questionnaire was developed (Appendix 1).

5.3. Selection of experts

The reliability of the survey's findings is highly reliant on the selection of panellists. The expert panel was systematically selected to achieve a high degree of variability and reduce the cognitive biases of various participants, such as framing and anchoring bias, desirability bias, and the bandwagon effect. Heterogeneity was achieved by including designated experts from academia, the Tea Research Institute, the Tea Auction Centre, the Tea Board of India, and various other domains, such as tea growers, manufacturers, brokers, and employees of tea branding companies.

Consequently, the panel of experts was expected to include 565 potential experts who were invited to participate in the research. Participants with truly extensive knowledge of the tea industry or BCT practitioners were chosen to ensure that only experts were included on the credible panel, and the participants were fully informed about the study's background before the survey and were told that their private data would be kept private.

To rule out non-response bias, the Mann–Whitney *U* test was used. Estimates of early and late respondents were compared in this process, as it is assumed that late respondents exhibit characteristics similar to non-respondents (Wagner & Kemmerling, 2010). Comparing the differences in responses to all 19 predictions revealed no major differences ($p < 0.05$) or non-response bias.

5.4. Execution of the quantitative study

This study used a questionnaire survey approach, with immediate quantitative interpretation of the panellists' responses. Prior appointments were made to boost response rates. The experts were given their questionnaires individually. In terms of quantitative analysis, each expert was asked to rate the predictions on a 0–100% metric scale based on their estimated probability of occurrence and a 5-point Likert scale based on their desirability of occurrence. Furthermore, respondents were given the option of providing qualitative justifications for their quantitative estimates. After discarding incomplete replies, 317 valid responses were considered (Table 5).

5.5. Data analysis

A two-step approach was used to evaluate the data in IBM SPSS and AMOS. A confirmatory factor analysis (CFA) was performed first to assess the measures' reliability and validity. Following that, structural paths were examined in order to test the hypotheses. The data collected followed multivariate requirements for ensuring that the data were normally distributed and free of multicollinearity issues (Kock & Lynn, 2012). Common method bias (CMB) may be a problem due to the self-reported nature of the data (Podsakoff, MacKenzie, & Podsakoff, 2012), which was analysed using a single-factor Harman test.

Table 4
Development of constructs.

Constructs	Variable	Item sources & year
RFID-BCT (RFID-integrated BCT)	Security	(Sidorov et al., 2019)
	Accuracy	(Tsolakis et al., 2020)
	De-centralizability	(Centobelli, Cerchione, Esposito, & Oropallo, 2021)
	Process integrity	(Shi & Yan, 2016)
SCTcy (Supply Chain Transparency)	Distribution transparency	(Zelbst et al., 2019)
	Transaction transparency	(Orji, Kusi-Sarpong, Huang, & Vazquez-Brust, 2020; Upadhyay, 2020)
	Failure transparency	(Sunny et al., 2020)
	Performance transparency	(Fosso Wamba, Queiroz, & Trinchera, 2020; Tsolakis et al., 2020; Yang et al., 2019)
SCTty (Supply Chain Traceability)	Forward Traceability	(Tian, 2016)
	Revenue Traceability	(He & Shi, 2021)
	Visual Traceability	(Thakur, Møen Tveit, Vevle, & Yurt, 2020)
	Validation	(Wang, Luo, et al., 2020)
ACTSCM (Achieving the Circular Tea Supply Chain management)	Eco-friendly Agriculture	(De Angelis et al., 2018; Lahane, Kant, & Shankar, 2020)
	Refurbish	(De Angelis et al., 2018)
	Reuse	(Kim & Glock, 2014)
	Recycle	(De Angelis et al., 2018)
PTI (Performance of the Tea Industry)	Profitability	(Seiler, Papanagnou, & Scarf, 2020)
	Market Share	(Zhou & Li, 2020; Chowdhury & Quaddus, 2021)
	Reduced Lead time	(Gunasekaran et al., 2004)

Table 5
Demographic details of the respondents.

Attribute	Alternatives	Frequency	Percent (%)
Belong in the Group / Employee of a:	Small Tea Garden	126	39.75
	Bought Leaf Factory	43	13.56
	Tea Estate	80	25.24
	Tea Branding Company	39	12.30
	Distributors	06	1.89
	Blockchain Professional/Others	23	7.26
Experience:	0–4	64	20.19
	5–9	88	27.76
	10–14	74	23.34
	15–19	45	14.20
	20–25	37	11.67
	25 or above	09	2.84

6. Results

The convenient statistical method of structural equation modelling (SEM) was used to simultaneously analyse the measurement and structural models, allowing for simultaneous factor analysis, multiple regression analysis, and hypothesis testing. A two-stage method was used to evaluate and interpret the data collected: a measurement model and a structural model.

6.1. Multicollinearity and common method bias

Before the CFA, data were analysed to see if there were any multicollinearity impacts. We assessed the inflation variance variables and tolerances to achieve this. The results revealed that variance factor values were less than 10 and tolerances were greater than 10, confirming the absence of multicollinearity (Hew & Kadir, 2016).

There is a possibility of common method bias, since all the data came from the same instrument. Harman's single-factor test (Harman, 1976) was used to see if this issue was present in our dataset, consistent with previous research (Talwar, Dhir, Kaur, & Mäntymäki, 2020). The results revealed that a single factor explained 36.496% of the total variance, which being less than 50% confirms the absence of common method bias.

6.2. The measurement model validity

The CFA was used to determine the measures' validity and reliability. The data obtained from various respondents were tested for normality. The skewness is within ± 3, and the kurtosis is within ± 10 for all variables examined (Kline, 2011). The Kaiser-Meyer-Olkin (KMO) sampling adequacy measure (0.895) revealed a high shared variance and low uniqueness invariance. Bartlett's test of sphericity (Chi-square $= 5916.454$, df $= 171$) has been thoroughly validated (Cooper & Schindler, 1998). The sample size's adequacy confirms the suitability of conducting factor analysis on this dataset.

The minimum number of items for each construct should be three, all measured standard factor loadings were greater than 0.70, and the average variance extracted (AVE) for all constructs exceeded the recommended level of 0.5, suggesting good convergent validity. In addition, the composite reliability (CR) of each construct was greater than 0.70 (Table 6) (Hair, Anderson, Black, & Barry, 2016).

The Cronbach alpha coefficient was considered acceptable for all constructs, with alpha >0.7 (Nunnally & Bernstein, 1994), and it was therefore reasonable to infer that the instruments used had adequate internal consistency. Confirmatory factor analysis (CFA) was used to establish specific patterns of relationships between observable variables and factors. The goodness-of-fit indices were found to be satisfactory ($\chi^2/\mathrm{df} = 2.219$, RMSEA $= 0.062$, CFI $= 0.971$, TLI $= 0.965$, IFI $= 0.917$, NFI $= 0.948$).

6.3. The structural model's validity

After examining the validity of the theoretical model's measurement scales, we tested the developed hypotheses. Based on the literature review and CFA results, a structural model was proposed for this study (Fig. 4). Analysis of Moment Structures (AMOS) was used to analyse the model. The standardized regression weight and the probability values representing the significant direction were calculated using the maximum probability estimator. The structural equation modelling method was used to evaluate the relationship between variables after the structural model was validated (SEM).

As depicted in Fig. 4, the proposed RFID-integrated blockchain-driven CTSCM model improves the sustainable performance of the B2B tea industry (PTI), with supply chain transparency (SCTcy) and supply chain traceability (SCTty) playing crucial roles. The framework places the roles of BCT and RFID in such a way that they link SCTcy and SCTty to achiev circular tea supply chain management (ACTSCM). The result is an integrated description of the core components of CTSCM from the recent literature and the analytical work on the various supply chains. The results demonstrate the positive impact of RFID-integrated BCT on CTSCM.

The model was examined to ensure that the relationships between the various parameters were correct. This study used covariance regression to model the structural equation. The structural model path analysis results are shown in Fig. 4. Table 8 summarizes the results of the structural model.

6.3.1. Evaluating the goodness-of-fit criteria

The comparative fit index (CFI) indicates a good fit value of 0.968, while the goodness-of-fit index (GFI) indicates a good fit value of 0.931 within the range of 0.90. The root mean square approximation error (RMSEA) is 0.064, indicating data accuracy and a good fit. CMIN/DF has

Table 6
Results of confirmatory factor analysis.

Items	Skewness	Kurtosis	Factor Loading	Constructs	α*	AVE	CR
RFID-BCT 1	−1.238	0.124	0.938	RFID-BCT	0.963	0.862	0.926
RFID-BCT 2	−1.242	0.213	0.931				
RFID-BCT 3	−1.275	0.318	0.916				
RFID-BCT 4	−1.231	0.087	0.941				
SCTcy 1	−1.066	−0.488	0.903	SCTcy	0.937	0.790	0.938
SCTcy 2	−1.081	−0.335	0.900				
SCTcy 3	−0.977	−0.502	0.886				
SCTcy 4	−0.879	−0.705	0.865				
SCTty 1	−0.594	−1.131	0.916	SCTty	0.955	0.843	0.956
SCTty 2	−0.708	−0.957	0.929				
SCTty 3	−0.583	−1.037	0.915				
SCTty 4	−0.597	−1.066	0.913				
ACTSCM 1	−1.749	2.481	0.802	ACTSCM	0.916	0.736	0.918
ACTSCM 2	−1.568	2.124	–				
ACTSCM 3	−1.445	1.397	0.867				
ACTSCM 4	−1.432	1.507	0.883				
PTI 1	−1.806	3.217	0.809	PTI	0.844	0.647	0.846
PTI 2	−2.312	5.214	0.779				
PTI 3	−2.326	5.188	0.824				

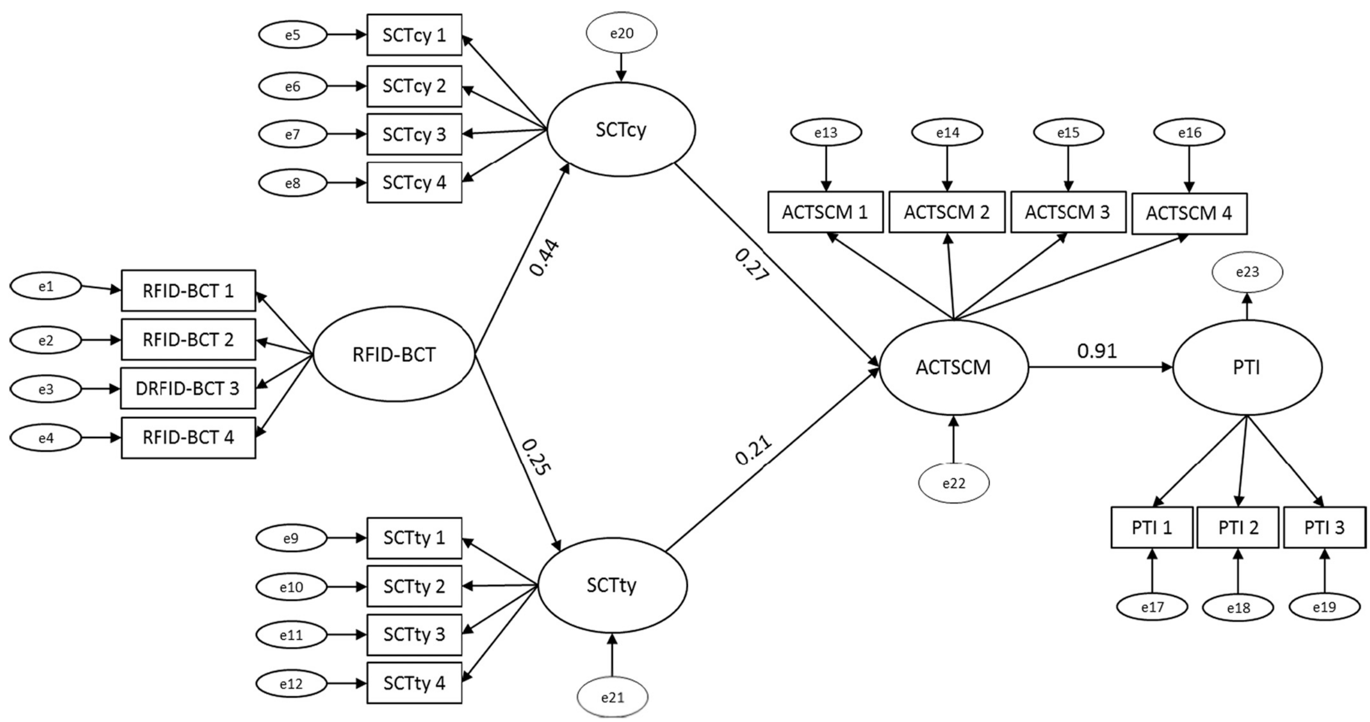

Fig. 4. Results of hypothesis testing.

a calculated value of 1.511, suggesting a good model fit. The AGFI (0.901), TLI (0.962), IFI (0.968), PNFI (0.812), and PGFI (0.693) values indicate that the proposed model is statistically suitable, indicating that the resulting parameters are higher than the recommended values for good fit (Table 7).

6.3.2. Path analysis

This method helps assess the relationship between the main factors influencing the tea industry performance. This investigation used SEM to test five hypotheses to evaluate the impacts of RFID-BCT, SCTcy, SCTty, ACTSCM, and PTI. Table 8 summarizes the significances of the structural relationships (*t*-values) and the coefficients of the paths. In the structural model, the correlations between the constructs were all significant. These findings support hypotheses H1–H5 of this research. Therefore, the study highlighted the positive influence of RFID-integrated BCT-driven CSCM on the B2B tea industry.

7. Discussion

In this study, we examine how BCT and RFID technology could help the tea industry to achieve a circular economy and how a RFID-integrated BCT-driven circular supply chain could improve the performance of the tea industry. Hypothesis 1 predicts that RFID-integrated BCT (RFID-BCT) has a significant positive effect on enhancing tea supply chain transparency (SCTcy). The standardized coefficients (β) of resource allocation and transparency are 0.442, and the t-value is 8.005, $p < 0.01$, indicating statistical significance. The findings support this hypothesis. Hypothesis 2 proposes that RFID-BCT has a significant positive effect on enhancing tea supply chain traceability (SCTty). The standardized coefficients (β) of competitive advantage and transparency are 0.249, and the t-value is 4.333, $p < 0.01$, indicating statistical significance. The results support this hypothesis. Hypothesis 3 suggests that SCTcy has a significant positive effect on achieving circular tea supply

Table 7
Goodness-of-fit indices of structural model testing using AMOS.

Good-of-fit Index Statistics	Abbreviation	Recommended range of values for a good fit	Resultant Value
Absolute Fit Measure			
Chi-square test	χ^2	$p > 0.05$ (Marsh & Hocevar, 1985)	336.783
Degree of Freedom	df	df > 0 (Bentler, 1990)	147
Chi-square/Degree of Freedom	χ^2/df	χ^2/df < 3 (Marsh & Hocevar, 1985)	2.291
Goodness of Fit Index	GFI	GFI ≥ 0.90 (Chau, 1997)	0.931
Adjusted Good-of-Fit Index	AGFI	AGFI ≥0.90 (Chau, 1997)	0.901
Root Mean Square Error of Approximation	RMSEA	RMSEA <0.08 (Byrne, 2013)	0.064
Increment Fit Measure			
Tucker Lewis Index	TLI	TLI ≥ 0.95 (Rex B Kline, 2016)	0.962
Normed Fit Index	NFI	NFI ≥ 0.95 (Hooper et al., 2008)	0.944
Comparative Fit Index	CFI	CFI ≥ 0.90 (Segars & Grover, 1993)	0.968
Relative Fit Index	RFI	RFI > 0.90 (Hooper et al., 2008)	0.935
incremental fit index	IFI	IFI > 0.90 (Hooper et al., 2008)	0.968
Parsimonious Fit Measure			
Parsimonious Normed Fit Index	PNFI	PNFI >0.50 (Hooper et al., 2008)	0.812
Parsimonious Good-of-fit Index	PGFI	PGFI >0.50 (Hooper et al., 2008)	0.693

Table 8
Path coefficients estimates.

Hypothesis	Structural Equations	Coefficients (β)	*t*-value	*p*-value	Result
Hypothesis 1	RFID-BCT → SCTcy	0.442	8.005	***	Accepted
Hypothesis 2	RFID-BCT → SCTty	0.249	4.333	***	Accepted
Hypothesis 3	SCTcy → ASTSCM	0.267	4.567	***	Accepted
Hypothesis 4	SCTty → ASTSCM	0.207	3.609	***	Accepted
Hypothesis 5	ASTSCM → PTI	0.912	14.931	***	Accepted

Notes: *** Significance level: $p < 0.01$.

chain management (ACTSCM). The standardized coefficients (β) of commodity trust and reliability are 0.267, and the t-value is 4.567, $p < 0.01$, indicating statistical significance. The results confirm this hypothesis.

Hypothesis 4 proposes that SCTty has a significant positive effect on ACTSCM. The standardized coefficients (β) of quality of business relationship and reliability are 0.207, and the t-value is 3.609, $p < 0.01$, indicating statistical significance. The findings support this hypothesis. Hypothesis 5 predicts that ACTSCM has a significant positive effect on the performance of the tea industry (PTI). The standardized coefficients (β) of transparency and sustainable performance of OTSC are 0.912, and the t-value is 14.931, $p < 0.01$, indicating statistical significance. Thus, this hypothesis is accepted. Therefore, the results of the study support H1, H2, H3, H4, and H5, revealing that RFID-integrated BCT has significant positive associations with supply chain transparency and traceability, which have significant positive associations with achieving circular tea supply chain management that has significant positive associations with the performance of the tea industry.

The study finds that there are data inaccuracy problems due to a lack of integrity in record keeping in the tea supply chain. These include an incorrect number of registered tea gardens, obstructed traceability, and production quality deficiency. The current study aims to bridge this gap by using RFID-integrated blockchain-driven circular supply chain management in the tea industry. The findings appear to be an important addition to the literature on blockchain-based supply chain management and indicate advancement in its functioning. The study summarizes important BCT-centric CSCM architecture guidelines, which take into account the complexities of the problems in the tea industry. Incorporating complete CTSCM operations in the BCT is possible due to sensors along with automation. The implementation of RFID and BCT in the tea supply chain can revolutionize the management of the circular economy to enhance tea industry standards.

The following are some of the fundamental emerging innovations underpinning BCT-driven RFID tags used to track supplies. When plucking tea leaves from tea gardens, a smart tracking system considers the movement of the tea leaves. Navigation survey cameras and automated surveillance devices can aid in the detection of encounters with tea-plucking labourers. Subsequently, when processing tea, a smart tracing system follows the movement of the processed tea. RFID tags should be attached to every processed tea package and save the records to the BCT's distributed databases, which could help the processed tea consumers (branded tea companies) track and trace each particular product. In addition, weight monitoring may be automated and incorporated into the BCT database to assist in predicting the arrival date at the chosen processed tea variety. Additionally, comprehensive information may aid in identifying unused supplies that may be sent to the tea by-product manufacturing unit via reverse logistics. Thus, the advantages of BCT in the tea supply networks can be operationalized by establishing a reliable traceability mechanism that allows all collaborating players to share sensitive data.

Supply chain stakeholders may obtain better knowledge of inventory performance, resource use, and processes by tracing and visualizing BCT transactions. Additionally, knowledge sharing may help stakeholders engage in less opportunistic behavior. Finally, data sharing through blockchain technology can aid in supply chain collaboration. As a result, the study offers a distributed, service-oriented architecture for a supply chain network that incorporates an RFID-integrated BCT-driven CSCM practices model. Furthermore, the findings of our study will assist businesses in gaining a better understanding of the elements that affect success when using RFID-integrated BCT-driven circular supply chains.

8. Conclusion and implications

The tea industry will benefit from an RFID-integrated BCT-driven technique that speeds up resource deployment, reduces waste, and improves the durability and sustainability of the circular tea supply chain. By documenting all suppliers' (i.e., tea growers' and tea processers') comprehensive information, BCT can build performance databases. As a result, consumers (i.e., tea branding companies) can easily identify the most appropriate suppliers. BCT also assists customers and suppliers in the creation of smart contracts that monitor and benchmark supplier results. Furthermore, BCT can monitor and evaluate product life cycles, allowing all CTSCM stakeholders to develop resource efficiency and material supply resilience in the procurement process at the same time. In addition, RFID-integrated BCT can make supplies (tea leaves and processed tea) highly traceable during the logistics process. As a result, lead times can be reduced and efficiency improved in the logistics process. Reverse logistics can also be used to send unused material to the tea by-product manufacturing unit. BCT can track all transactions in a CTSCM, which could make the supply chain more transparent. Therefore, the proposed circular tea supply chain model is the first report to adopt BCT and RFID technologies in the B2B tea industry. Findings reveal how innovative technologies contribute to supply chain needs and to designing and implementing solutions. Additionally, researchers have highlighted that managers need to understand the value of blockchain technology for supply chain transparency and traceability, particularly in agribusiness.

8.1. Theoretical implications

Our research is among the first to investigate the use of blockchain in CSCM, and it expands the research into the tea business. Both BCT and the circular economy are gaining traction as rising hot issues with far-reaching consequences for academics and industry (Kumar et al., 2020). This study attempts to combine these two subjects in order to acquire important insights. BCT offers unmatched and unique benefits, including decentralization, transparency with cryptographic protocols, security, and digitalization (Howson, 2020; Pereira et al., 2019). Thus, the main contribution of this study is the RFID-integrated blockchain-driven CTSCM model, which is applicable in various supply chain contexts. A review of the existing literature reveals that most research on blockchain technology is focused on the application of cryptocurrencies in financial institutions and on technology acceptance (Breidbach & Tana, 2021; Li et al., 2021; Su et al., 2020; White et al., 2020), leaving out other aspects of sustainable supply chain management. Notably, despite the effective use of blockchain technology in the context of the circular supply chain, no empirical study has identified significant aspects associated with the performance of the blockchain-driven circular supply chain. The present study paves the way for future researchers to extend transparency and traceability to various stakeholders in the supply chain domain. Thus, this study responds to a demand for further research on the performance of blockchain-driven circular supply chains.

8.2. Managerial implications

Our research provides useful insights for practitioners in the tea industry and recommends ways to apply BCT to CSCM in processed tea production. (i) All stakeholders should seriously consider the tea industry's sustainability issues, including massive resource waste, pollution produced by chemical fertilizers and pesticides, as also impacts on workers and communities. Because all sustainability issues are connected to the transparency and traceability of processed tea production, all stakeholders, including tea growers, tea processers, and tea branding companies, may fully leverage the proposed framework. (ii) This study provided empirical evidence that RFID-integrated blockchain technology improves an organization's ability to exchange real-time knowledge/analysis among CSCM partners in a synchronous manner and, consequently, enhances the supply chain's performance. Managers must understand the use of RFID & BCT and the value of developing a CSCM system of interconnected and related technologies to deliver CSCM and make decisions more quickly. Managers' ability to make confident decisions can also be enhanced by assurance that the information is reliable and safe. Managers may be able to track and inspect purchases made in the CSCM system by using RFID-integrated blockchain technology. Because of the opportunity to see where faulty supplies reach the supply chain, the cost of recalls could be minimized. (iii) Finally, inside the blockchain-enabled tea CSCM system, post-production blockchain subsystems may be developed to sell/resell, reuse, and recycle tea items based on their condition and quality. The objective is to lengthen the life of plucked tea leaves and manufactured processed tea by maximizing their utilization.

8.3. Social implications

The paper develops RFID-integrated BCT-driven CSCM architecture for the tea industry scenario so B2B stakeholders can consider the socioeconomic and socio-environmental stresses that can arise. Potential B2B customers can profit from BCT and RFID technology's openness. BCT is commonly viewed as a game-changing technology with the potential to transform the economy and culture. The need for a trustworthy broker is excluded because each node of the network engages in the analysis and validation of new knowledge before it is approved. Although most research has concentrated on the paradigm's technical ramifications, we contend that social dimensions such as loyalty, identity management, recognition, and the user interface should not be overlooked. However, since confidence is crucial in influencing decisions while transacting with one another, it is important to know what impact the decentralized existence of RFID-integrated BCT could have on people's trust. Humanitarian approaches to RFID-integrated BCT-driven CSCM architecture for B2B tea industry solutions, such as quality-oriented design, positive innovation, and knowledge design (Rush, Marshall, Bessant, & Ramalingam, 2021), can provide useful structures to resolve this problem.

8.4. Limitations and future directions of work

This study's proposed model necessarily ignored some problems present in reality. According to the literature survey, one-third of all products addressed consumers' and businesses' lack of technological awareness of BCT to leverage it for CSCM. Because of the high costs involved in installing and operating RFID and BCT systems for tea manufacturing, the performance of these systems must be carefully assessed before a decision is taken. When an RFID and BCT framework is installed in the tea-manufacturing sector, it must be closely monitored to ensure that maximum production capacity is reached. Several general automation measurement approaches in the literature could theoretically be extended to RFID and BCT systems. However, a supply chain like the one described in our study may be viewed as a fundamental building block of more complicated supply chains, allowing B2B tea companies to coordinate relationships with their most relevant suppliers or buyers. An expansion of this paper might look at more complicated supply chains. Finally, our paper only simulated the impacts that RFID and BCT could have on CSCM. Other results should be added to our framework to provide a complete view of how RFID and BCT affect the management of the tea production process. The results of implementing a method like the one outlined in this paper correctly and incorrectly may be a worthwhile extension of our model. That and other subjects will be investigated further in future.

Appendix A. Appendix 1

Full Questionnaire for the distinct experts of the Tea Supply Chain/ Blockchain.

Management Studies, Indian Institute of Technology (Indian School of Mines), Dhanbad.

Dear Respondents,

I am a doctoral student in Supply Chain Management, Department of Management Studies, IIT Dhanbad. My research is focused on Small Tea Garden Supply Chain in the context of Assam.

This research seeks to improve the performance of the Tea Supply Chain. From this, I hope to develop an Efficient Tea Supply Chain Network by identifying the importance of some issues affecting the performance of this Supply Chain.

My efforts cannot be made possible without your valuable input. Therefore, I would like to request your cooperation to complete the attached questionnaire. You are requested to spare 5–10 min of your valuable time to fill out the questionnaire based on your experience working in the Tea-Industry/Blockchain. Your participation is critical to the success of the study. All responses will be kept confidential and will not be traceable to individual respondents.

I look forward to your valuable input and thank you in advance for your assistance in this research.

With Regards,

Tripti Paul.

Ph.D. student, IIT Dhanbad.

Remark: If you would like further information about the study, please contact me, Ms. Tripti Paul (tripti_paul2004@yahoo.com), or my Ph.D. supervisor, Dr. Sandeep Mondal (sandeepmondal@hotmail.com).

	Demographic Profile of the Respondent					
Name:						
Occupation / Designation:						
Belong in the Group / Employee of a:	Small Tea Garden	Bought Leaf Factory	Tea Estate	Tea Branding Company	Players of Distribution channel	Blockchain Professional/ Others
Experience:	0–4	5–9	10–14	15–19	20–25	25 or above

Questionnaire.

Please rate (√) the following factors which may affect the performance of the B2B Tea Supply Chain in the proposed model: RFID-integrated BCT-driven B2B CTSCM model.

Introduction to the Proposed Model:

The researchers proposed an RFID-integrated blockchain-driven circular supply chain model for increasing the performance of the business-to-business (B2B) tea industry.

In the proposed model, the researchers suggest that if the B2B tea industry players implement RFID-integrated blockchain technology (BTC) with the existing supply chain, it increases the Supply Chain Transparency and Traceability (as RFID and BCT technology provide enough visibility and trust to the users). Therefore, the improved Transparency and Traceability of the Supply Chain can help achieve the Circular Tea Supply Chain management by providing the prominence of the material flow of the chain, including unused and unsold materials. The circular supply chain provides an alternative to resource scarcity (for example, a tea byproduct-manufacturing unit can produce different products using unused plucked green tea-leaves and made-tea, instead of treating them as waste).

In the proposed model, every process is transparent, and each tea grower's activity can be easily traceable. Thus, tea growers can be financially supported for eco-friendly agriculture by the made-tea manufacturers and branded tea companies. Therefore, tea growers began discarding chemicals and shifting toward organic farming practices, which help increase the quality of tea-leaves and, consequently, the quality of branded-tea that increase the tea customers' satisfaction which leads to increase the performance of the tea industry, and also provide an eco-friendly environment.

1. **To what extent, RFID-integrated blockchain-driven B2B Tea Supply Chain influence Supply Chain Transparency and Supply Chain Traceability?** (please mark your opinion on the scale 1 = Very Low, 2 = Low, 3 = Neutral, 4 = High, 5 = Very High)

SL	Issues	1	2	3	4	5
1	RFID-integrated blockchain-driven B2B Tea Supply Chain can provide Security to this supply chain					
2	RFID-integrated blockchain-driven B2B Tea Supply Chain can provide Accuracy to this supply chain					

(continued on next page)

(*continued*)

SL	Issues	1	2	3	4	5
3	RFID-integrated blockchain-driven B2B Tea Supply Chain can provide De-centralizability to this supply chain					
4	RFID-integrated blockchain-driven B2B Tea Supply Chain can provide Process integrity to this supply chain					

2. **To what extent, RFID-integrated blockchain-driven B2B Tea Supply Chain Transparency influence achieving Circular Tea Supply Chain management?** (please mark your opinion on the scale 1 = Very Low, 2 = Low, 3 = Neutral, 4 = High, 5 = Very High)

SL	Issues	1	2	3	4	5
1	RFID-integrated blockchain-driven B2B Tea Supply Chain can provide Distribution transparency that helps to achieve the Circular Tea Supply Chain management					
2	RFID-integrated blockchain-driven B2B Tea Supply Chain can provide Transaction transparency that helps to achieve the Circular Tea Supply Chain management					
3	RFID-integrated blockchain-driven B2B Tea Supply Chain can provide Failure transparency that helps to achieve the Circular Tea Supply Chain management					
4	RFID-integrated blockchain-driven B2B Tea Supply Chain can provide Performance transparency that helps to achieve the Circular Tea Supply Chain management					

3. **To what extent does RFID-integrated blockchain-driven B2B Tea Supply Chain Traceability influence achieving Circular Tea Supply Chain management?** (please mark your opinion on the scale 1 = Very Low, 2 = Low, 3 = Neutral, 4 = High, 5 = Very High)

SL	Issues	1	2	3	4	5
1	RFID-integrated blockchain-driven B2B Tea Supply Chain can provide Forward Traceability that helps to achieve the Circular Tea Supply Chain management					
2	RFID-integrated blockchain-driven B2B Tea Supply Chain can provide Revenue Traceability that helps to achieve the Circular Tea Supply Chain management					
3	RFID-integrated blockchain-driven B2B Tea Supply Chain can provide Visual Traceability that helps to achieve the Circular Tea Supply Chain management					
4	RFID-integrated blockchain-driven B2B Tea Supply Chain can provide Validation of each transection that help to achieve the Circular Tea Supply Chain management					

4. **To what extent is RFID-integrated blockchain-driven B2B Circular Tea Supply Chain management influence increasing the Tea Industry's Performance?** (please mark your opinion on the scale 1 = Very Low, 2 = Low, 3 = Neutral, 4 = High, 5 = Very High)

SL	Issues	1	2	3	4	5
1	RFID-integrated blockchain-driven B2B Circular Tea Supply Chain management can provide Industry Eco-friendly Agriculture that helps to increase the Performance of the Tea Industry					
2	RFID-integrated blockchain-driven B2B Circular Tea Supply Chain management can provide Refurbish environment that helps to increase the Performance of the Tea Industry					
3	RFID-integrated blockchain-driven B2B Circular Tea Supply Chain management can encourage to Reuse the unused materials that help to increase the Performance of the Tea Industry					
4	RFID-integrated blockchain-driven B2B Circular Tea Supply Chain management can improve Recycle process that helps to increase the Performance of the Tea Industry					

5. **To what extent, the following factors increase the performance of the B2B Tea Industry?** (please mark your opinion on the scale 1 = Very Low, 2 = Low, 3 = Neutral, 4 = High, 5 = Very High)

SL	Issues	1	2	3	4	5
1	Performance of the B2B Tea Industry depends on Profitability					
2	Performance of the B2B Tea Industry depends on Market Share					
3	Performance of the B2B Tea Industry can increase by Reducing Lead time					

Thank you very much for your valuable time and participation.

References

Akinade, O. O., & Oyedele, L. O. (2019). Integrating construction supply chains within a circular economy: An ANFIS-based waste analytics system (A-WAS). *Journal of Cleaner Production, 229*, 863–873.

Alvarado, U., & Kotzab, H. (2001). Supply chain management: The integration of logistics in marketing. *Industrial Marketing Management, 30*(2), 183–198.

Aroyeun, S. O., Olubamiwa, O., & Ogunjobi, M. A. K. (2005). Development of wine from infused tea leaves (Cammellia sinensis). *British Food Journal, 107*(1), 34–41.

Astill, J., Dara, R. A., Campbell, M., Farber, M., Fraser, E. D. G., Sharif, S., & Yada, R. Y. (2019). Trends in Food Science & Technology Transparency in food supply chains : A review of enabling technology solutions. *Trends in Food Science & Technology Journal, 91*(July), 240–247.

Babich, V., & Hilary, G. (2019). Distributed ledgers and operations: What operations management researchers should know about blockchain technology. *Manufacturing & Service Operations Management, 22*(2), 1–18.

Balasubramanian, S., Shukla, V., Sethi, J. S., Islam, N., & Saloum, R. (2021). A readiness assessment framework for Blockchain adoption: A healthcare case study. *Technological Forecasting and Social Change, 165*, Article 120536.

Bartlett, P. A., Julien, D. M., & Baines, T. S. (2007). Improving supply chain performance through improved visibility. *The International Journal of Logistics Management, 18*(2), 294–313.

Bentler, P. (1990). Comparative fit indices in structural models permalink. *Psychological Bulletin, 107*(2), 238–246.

Bhatnagar, R., & Teo, C.-C. (2009). Role of logistics in enhancing competitive advantage: A value chain framework for global supply chains. *International Journal of Physical Distribution and Logistics Management, 39*(3), 202–226.

Biggs, E. M., Gupta, N., Saikia, S., & Duncan, J. (2018). Tea production characteristics of tea growers (plantations and smallholdings) and livelihood dimensions of tea workers in Assam, India. *Environmental Science & Policy Data in Brief*, 1379–1387. Submitted.

Breidbach, C. F., & Tana, S. (2021). Betting on Bitcoin: How social collectives shape cryptocurrency markets. *Journal of Business Research, 122*, 311–320.

Brunoe, T. D., Andersen, A. L., & Nielsen, K. (2019). Changeable manufacturing systems supporting circular supply chains. In *, Vol. 81. Procedia CIRP* (pp. 1423–1428). Elsevier B.V.

Byrne, B. M. (2013). *Structural equation modeling with EQS*. Routledge.

Cagliano, R., Worley, C. G., & Caniato, F. F. A. (2016). *The challenge of sustainable innovation in agri-food supply chains, 1–30*.

van Capelleveen, G., van Wieren, J., Amrit, C., Yazan, D. M., & Zijm, H. (2021). Exploring recommendations for circular supply chain management through interactive visualisation. *Decision Support Systems, 140*, Article 113431.

Castañer, X., & Oliveira, N. (2020). Collaboration, coordination, and cooperation among organizations: Establishing the distinctive meanings of these terms through a systematic literature review. *Journal of Management, 46*(6), 965–1001.

Centobelli, P., Cerchione, R., Esposito, E., & Oropallo, E. (2021). Surfing blockchain wave, or drowning? Shaping the future of distributed ledgers and decentralized technologies. *Technological Forecasting and Social Change, 165*, Article 120463.

Centobelli, P., Cerchione, R., Esposito, E., Oropallo, E., Ghode, D. J., Jain, R., & Yadav, V. (2020). Architecture to enhance transparency in supply chain management using Blockchain technology. *Procedia Manufacturing, 51*, 1614–1620.

Chau, P. Y. K. (1997). Reexamining a model for evaluating information center success using a structural equation modeling approach. *Decision Sciences, 28*(2), 309–334.

Chen, G., Xu, B., Lu, M., & Chen, N.-S. (2018). Exploring blockchain technology and its potential applications for education. *Smart Learning Environments, 5*(1).

Chen, L., Jia, F., Li, T., & Zhang, T. (2021). Supply chain leadership and firm performance: A meta-analysis. *International Journal of Production Economics, 235*, Article 108082.

Chen, L., Jiang, M., Jia, F., & Liu, G. (2021). Artificial intelligence adoption in business-to-business marketing: Toward a conceptual framework. *The Journal of Business and Industrial Marketing*. ahead-of-print.

Chowdhury, M. M. Hossan, & Quaddus, M. A. (2021). Supply chain sustainability practices and governance for mitigating sustainability risk and improving market performance: A dynamic capability perspective. *Journal of Cleaner Production, 278*, Article 123521.

Ciardiello, F., Genovese, A., & Simpson, A. (2020). A unified cooperative model for environmental costs in supply chains: The Shapley value for the linear case. *Annals of Operations Research, 290*(1–2), 421–437.

Cole, R., Stevenson, M., & Aitken, J. (2019). Blockchain technology: Implications for operations and supply chain management. *Supply Chain Management: An International Journal, 24*(4), 469–483.

Cooper, D. R., & Schindler, P. S. (1998). *Business research methods*. Irwin/McGraw-Hill.

Czachorowski, K., Solesvik, M., & Kondratenko, Y. (2019). The application of blockchain technology in the maritime industry. In *, Vol. 171. Studies in systems, decision and control* (pp. 561–577). Springer International Publishing.

De Angelis, R., Howard, M., & Miemczyk, J. (2018). Supply chain management and the circular economy: Towards the circular supply chain. *Production Planning and Control, 29*(6), 425–437.

de Villiers, C., Kuruppu, S., & Dissanayake, D. (2020). A (new) role for business – Promoting the United Nations' sustainable development goals through the internet-of-things and blockchain technology. *Journal of Business Research, 131*, 598–609.

Despoudi, S. (2021). Challenges in reducing food losses at producers' level: The case of Greek agricultural supply chain producers. *Industrial Marketing Management, 93*, 520–532.

Dikshit, K. R., & Dikshit, J. K. (2014). Agriculture in North-East India: Past and present. In *North-East India: Land, people and economy* (pp. 587–637). Netherlands: Springer.

El Wali, M., Golroudbary, S. R., & Kraslawski, A. (2021). Circular economy for phosphorus supply chain and its impact on social sustainable development goals. *Science of the Total Environment, 777*, Article 146060.

Fosso Wamba, S., Queiroz, M. M., & Trinchera, L. (2020). Dynamics between blockchain adoption determinants and supply chain performance: An empirical investigation. *International Journal of Production Economics, 229*(April), Article 107791.

Francisco, K., & Swanson, D. (2018). The supply chain has no clothes: Technology adoption of blockchain for supply chain transparency. *Logistics, 2*(1), 2–13.

Gligor, D. M., Pillai, K. G., & Golgeci, I. (2021). Theorizing the dark side of business-to-business relationships in the era of AI, big data, and blockchain. *Journal of Business Research, 133*, 79–88.

Govindan, K., Mina, H., Esmaeili, A., & Gholami-Zanjani, S. M. (2020). An integrated hybrid approach for circular supplier selection and closed loop supply chain network design under uncertainty. *Journal of Cleaner Production, 242*, Article 118317.

Guercini, S., & Runfola, A. (2009). The integration between marketing and purchasing in the traceability process. *Industrial Marketing Management, 38*(8), 883–891.

Gunasekaran, A., Patel, C., & McGaughey, R. E. (2004). A framework for supply chain performance measurement. *International Journal of Production Economics, 87*(3), 333–347.

Gupta, V., & Knight, R. (2017). *How Blockchain could help emerging markets leap ahead* (pp. 1–6). MAY: Harvard Business Review.

Hair, J., Anderson, R., Black, B., & Barry, B. (2016). *Multivariate data analysis - Joseph Hair, Rolph Anderson, bill Black, Barry Babin - Google books* (8th ed.) Cengage India.

Hallikainen, H., Savimäki, E., & Laukkanen, T. (2020). Fostering B2B sales with customer big data analytics. *Industrial Marketing Management, 86*, 90–98.

Harman, H. H. (1976). Modern factor analysis. *Journal of the Royal Statistical Society, 131*(4), 615.

He, M., & Shi, J. (2021). Circulation traceability system of Chinese herbal medicine supply chain based on internet of things agricultural sensor. *Sustainable Computing: Informatics and Systems, 30*, Article 100518.

Hew, T. S., & Kadir, S. L. S. A. (2016). Predicting instructional effectiveness of cloudbased virtual learning environment. *Industrial Management and Data Systems, 116*(8), 1557–1584.

Hooper, D., Coughlan, J., Mullen, M. R., Mullen, J., Hooper, D., Coughlan, J., & Mullen, M. R. (2008). Structural equation modelling: Guidelines for determining model fit. *The Electronic Journal of Business Research Methods, 6*(1), 53–60.

Howson, P. (2020). Building trust and equity in marine conservation and fisheries supply chain management with blockchain. *Marine Policy, 115*(February), Article 103873.

Islam, N., Marinakis, Y., Olson, S., White, R., & Walsh, S. (2020). *Is BlockChain mining profitable in the long run?*. IEEE Transactions on Engineering Management, Early Access.

Jia, F., Yin, S., Chen, L., & Chen, X. (2020, June 20). The circular economy in the textile and apparel industry: A systematic literature review. *Journal of Cleaner Production, 259*, 120728. Elsevier Ltd.

Kim, T., & Glock, C. H. (2014). On the use of RFID in the management of reusable containers in closed-loop supply chains under stochastic container return quantities. *Transportation Research Part E: Logistics and Transportation Review, 64*, 12–27.

Kimani, D., Adams, K., Attah-Boakye, R., Ullah, S., Frecknall-Hughes, J., & Kim, J. (2020). Blockchain, business and the fourth industrial revolution: Whence, whither, wherefore and how? *Technological Forecasting and Social Change, 161*, Article 120254.

Kline, R. (2011). *Principles and practice of structural equation modeling* (3rd ed.). PsycNET.

Kline, R. B. (2016). *Principles and practice of structural equation modeling* (Fourth Edi) (Fourth Edi, Vol. 8). New York: The Guilford Press.

Kock, N., & Lynn, G. (2012). Lateral collinearity and misleading results in variance-based SEM: An illustration and recommendations. *Journal of the Association for Information Systems, 13*(7), 546–580.

Kopyto, M., Lechler, S., von der Gracht, H. A., & Hartmann, E. (2020). Potentials of blockchain technology in supply chain management: Long-term judgments of an international expert panel. *Technological Forecasting and Social Change, 161*, Article 120330.

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

Kumar, V., Ramachandran, D., & Kumar, B. (2020). Influence of new-age technologies on marketing: A research agenda. *Journal of Business Research, 125*, 864–877.

Lacka, E., Chan, H. K., & Wang, X. (2020, July 1). Technological advancements and B2B international trade: A bibliometric analysis and review of industrial marketing research. *Industrial Marketing Management, 88*, 1–11.

Lahane, S., Kant, R., & Shankar, R. (2020, June 10). Circular supply chain management: A state-of-art review and future opportunities. *Journal of Cleaner Production, 258*, 120859. Elsevier Ltd.

Lansiti, M., Lakhani, K. R., Iansiti, M., & Lakhani, R. K. (2017). The truth about blockchain. *Harvard Business Review*, 1–14 (January-February).

Li, J. P., Naqvi, B., Rizvi, S. K. A., & Chang, H. L. (2021). Bitcoin: The biggest financial innovation of fourth industrial revolution and a portfolio's efficiency booster. *Technological Forecasting and Social Change, 162*, Article 120383.

Lo, S. M., Zhang, S., Wang, Z., & Zhao, X. (2018). The impact of relationship quality and supplier development on green supply chain integration: A mediation and moderation analysis. *Journal of Cleaner Production, 202*, 524–535.

Marsal-Llacuna, M. L. (2018). Future living framework: Is blockchain the next enabling network? *Technological Forecasting and Social Change, 128*, 226–234.

Marsh, H. W., & Hocevar, D. (1985). Application of confirmatory factor analysis to the study of self-concept. First- and higher order factor models and their invariance across groups. *Psychological Bulletin, 97*(3), 562–582.

Martha, C., Douglas, L., & Pagh, D. (1997). Supply chain management: More than a new name for logistics. *The International Journal of Logistics Management, 8*(1), 1–14.

Mikalef, P., Krogstie, J., Pappas, I. O., & Pavlou, P. (2020). Exploring the relationship between big data analytics capability and competitive performance: The mediating roles of dynamic and operational capabilities. *Information and Management, 57*(2), Article 103169.

Mitchell, V. (1996). Assessing the reliability and validity of questionnaires: An empirical example. *Journal of Applied Management Studies, 5*(2), 199–207.

Munasinghe, M., Deraniyagala, Y., Dassanayake, N., & Karunarathna, H. (2017). Economic, social and environmental impacts and overall sustainability of the tea sector in Sri Lanka. *Sustainable Production and Consumption, 12*, 155–169.

Munir, M., Jajja, M. S. S., Chatha, K. A., & Farooq, S. (2020). Supply chain risk management and operational performance: The enabling role of supply chain integration. *International Journal of Production Economics, 227*, Article 107667.

Musigmann, B., Von Der Gracht, H., & Hartmann, E. (2020). Blockchain technology in logistics and supply chain management - A bibliometric literature review from 2016 to January 2020. *IEEE Transactions on Engineering Management, 67*(4), 988–1007.

Nakamoto, S. (2008). *Bitcoin: A peer-to-peer electronic cash system*.

Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric theory*. McGraw-Hill.

Olatunji, O. O., Ayo, O. O., Akinlabi, S., Ishola, F., Madushele, N., & Adedeji, P. A. (2019). Competitive advantage of carbon efficient supply chain in manufacturing industry. *Journal of Cleaner Production, 238*.

Orji, I. J., Kusi-Sarpong, S., Huang, S., & Vazquez-Brust, D. (2020). Evaluating the factors that influence blockchain adoption in the freight logistics industry. *Transportation Research Part E: Logistics and Transportation Review, 141*(June 2019), 102025.

Pan, M., Xin, P., Xu, X., This, B. F., & Publishing, I. (2016). *Block chain: A new solution for supply integrity* (pp. 1–8). IVEY Publishing.

Park, G., Shin, S. R., & Choy, M. (2020). Early mover (dis)advantages and knowledge spillover effects on blockchain startups' funding and innovation performance. *Journal of Business Research, 109*, 64–75.

Paul, T., & Mondal, S. (2019). A strategic analysis of tea leaves supply chain before manufacturing – A case in Assam. *Benchmarking: An International Journal, 26*(1), 246–270.

Paul, T., & Mondal, S. (2021). Classification of Indian tea supply chain - in context of Assam. *International Journal of Process Management and Benchmarking, 11*(2), 220–253.

Paul, T., Mondal, S., Islam, N., & Rakshit, S. (2021). The impact of blockchain technology on the tea supply chain and its sustainable performance. *Technological Forecasting and Social Change, 173*, Article 121163.

Pereira, J., Tavalaei, M. M., & Ozalp, H. (2019). Blockchain-based platforms: Decentralized infrastructures and its boundary conditions. *Technological Forecasting and Social Change, 146*, 94–102.

Podsakoff, P. M., MacKenzie, S. B., & Podsakoff, N. P. (2012). Sources of method bias in social science research and recommendations on how to control it. *Annual Review of Psychology, 63*, 539–569.

Pólvora, A., Nascimento, S., Lourenço, J. S., & Scapolo, F. (2020). Blockchain for industrial transformations: A forward-looking approach with multi-stakeholder engagement for policy advice. *Technological Forecasting and Social Change, 157*, Article 120091.

Queiroz, M. M., & FossoWamba, F. S. (2019). Blockchain adoption challenges in supply chain: An empirical investigation of the main drivers in India and the USA. *International Journal of Information Management, 46*, 70–82.

Raimondo, M., Caracciolo, F., Cembalo, L., Chinnici, G., Pappalardo, G., & D'Amico, M. (2021). Moving towards circular bioeconomy: Managing olive cake supply chain through contracts. *Sustainable Production and Consumption, 28*, 180–191.

Ranta, V., Keränen, J., & Aarikka-Stenroos, L. (2020). How B2B suppliers articulate customer value propositions in the circular economy: Four innovation-driven value creation logics. *Industrial Marketing Management, 87*, 291–305.

Raut, R. D., Yadav, V. S., Cheikhrouhou, N., Narwane, V. S., & Narkhede, B. E. (2021). Big data analytics: Implementation challenges in Indian manufacturing supply chains. *Computers in Industry, 125*.

Rejeb, A., Simske, S., Rejeb, K., Treiblmaier, H., & Zailani, S. (2020). Internet of things research in supply chain management and logistics: A bibliometric analysis. *Internet of Things, 12*, Article 100318.

Rush, H., Marshall, N., Bessant, J., & Ramalingam, B. (2021). Applying an ecosystems approach to humanitarian innovation. *Technological Forecasting and Social Change, 165*, Article 120529.

Saberi, S., Kouhizadeh, M., Sarkis, J., & Shen, L. (2019). Blockchain technology and its relationships to sustainable supply chain management. *International Journal of Production Research, 57*(7), 2117–2135.

Saif, Y., Rizwan, M., Almansoori, A., & Elkamel, A. (2017). A circular economy solid waste supply chain management based approach under uncertainty. In *, Vol. 142. Energy procedia* (pp. 2971–2976). Elsevier Ltd.

Schlecht, L., Schneider, S., & Buchwald, A. (2021). The prospective value creation potential of Blockchain in business models: A delphi study. *Technological Forecasting and Social Change, 166*, Article 120601.

Segars, A. H., & Grover, V. (1993). Re-examining perceived ease of use and usefulness: A confirmatory factor analysis. *MIS Quarterly: Management Information Systems, 17*(4), 517–525.

Seiler, A., Papanagnou, C., & Scarf, P. (2020). On the relationship between financial performance and position of businesses in supply chain networks. *International Journal of Production Economics, 227*, 107690.

Sen, S., Rai, M., Das, D., Chandra, S., & Acharya, K. (2020, December 1). Blister blight a threatened problem in tea industry: A review. *Journal of King Saud University - Science, 32*(8), 3265–3272. Elsevier B.V.

Shah, D., & Murthi, B. P. S. (2020). Marketing in a data-driven digital world: Implications for the role and scope of marketing. *Journal of Business Research, 125*, 772–779.

Shi, P., & Yan, B. (2016). Factors affecting RFID adoption in the agricultural product distribution industry: Empirical evidence from China. *SpringerPlus, 5*(1).

Sidorov, M., Ong, M. T., Sridharan, R. V., Nakamura, J., Ohmura, R., & Khor, J. H. (2019). Ultralightweight mutual authentication RFID protocol for blockchain enabled supply chains. *IEEE Access, 7*, 7273–7285.

Soni, G., Mangla, S. K., Singh, P., Dey, B. L., Dora, M., Mangala, S., … M.. (2021). Technological interventions in social business: Mapping current research and establishing future research agenda. *Technological Forecasting and Social Change, 169*, Article 120818.

Su, C. W., Qin, M., Tao, R., & Umar, M. (2020). Financial implications of fourth industrial revolution: Can bitcoin improve prospects of energy investment? *Technological Forecasting and Social Change, 158*, Article 120178.

Sundaram, D., Zhou, W., Piramuthu, S., & Pienaar, S. (2010). Expert systems with applications knowledge-based RFID enabled web service architecture for supply chain management. *Expert Systems with Applications, 37*(12), 7937–7946.

Sunny, J., Undralla, N., Pillai, V. M., & Madhusudanan Pillai, V. (2020). Supply chain transparency through blockchain-based traceability: An overview with demonstration. *Computers & Industrial Engineering, 150*, Article 106895.

Talwar, S., Dhir, A., Kaur, P., & Mäntymäki, M. (2020). Barriers toward purchasing from online travel agencies. *International Journal of Hospitality Management, 89*, Article 102593.

Terrada, L., ElKhaïli, M., & Ouajji, H. (2020). Multi-agents system implementation for supply chain management making-decision. In *, (Vol. 177. Procedia computer science* (pp. 624–630).

Thakur, M., Møen Tveit, G., Vevle, G., & Yurt, T. (2020). A framework for traceability of hides for improved supply chain coordination. *Computers and Electronics in Agriculture, 174*, Article 105478.

Tian, F. (2016). *An agri-food supply chain traceability system for China based on RFID & blockchain technology. 2016 13th international conference on service systems and service management, ICSSSM 2016*.

Toufaily, E., Zalan, T., & Dhaou, S. B. (2021). A framework of blockchain technology adoption: An investigation of challenges and expected value. *Information & Management, 58*(3), Article 103444.

Treiblmaier, H. (2018). The impact of the blockchain on the supply chain: A theory-based research framework and a call for action. *Supply Chain Management: An International Journal, 23*(6), 545–559.

Tsolakis, N., Niedenzu, D., Simonetto, M., Dora, M., & Kumar, M. (2020). Supply network design to address United Nations sustainable development goals: A case study of blockchain implementation in Thai fish industry. *Journal of Business Research, 131*, 495–519.

Upadhyay, N. (2020). Demystifying blockchain: A critical analysis of challenges, applications and opportunities. *International Journal of Information Management, 54* (March 2019), 102120.

Vegter, D., van Hillegersberg, J., & Olthaar, M. (2020). Supply chains in circular business models: Processes and performance objectives. *Resources, Conservation and Recycling, 162*, Article 105046.

Venkatesh, V. G., Kang, K., Wang, B., Zhong, R. Y., & Zhang, A. (2020). System architecture for blockchain based transparency of supply chain social sustainability. *Robotics and Computer-Integrated Manufacturing, 63*(March 2019), 101896.

Wagner, S. M., & Kemmerling, R. (2010). Handling nonresponse in logistics research. *Journal of Business Logistics, 31*(2), 357–381.

Wang, B., Luo, W., Zhang, A., Tian, Z., & Li, Z. (2020). Blockchain-enabled circular supply chain management: A system architecture for fast fashion. *Computers in Industry, 123*.

Wang, Y., Han, J. H., & Beynon-Davies, P. (2019). Understanding blockchain technology for future supply chains: A systematic literature review and research agenda. *Supply Chain Management, 24*(1), 62–84.

Wang, Z., Hu, H., & Zhou, W. (2017). RFID enabled knowledge-based precast construction supply chain. *Computer-Aided Civil and Infrastructure Engineering, 32*(6), 499–514.

Wang, Z., Wang, T., Hu, H., Gong, J., Ren, X., & Xiao, Q. (2020). Blockchain-based framework for improving supply chain traceability and information sharing in precast construction. *Automation in Construction, 111*, Article 103063.

Warth, J., Von der Gracht, H. A., & Darkow, I. L. (2013). A dissent-based approach for multi-stakeholder scenario development - the future of electric drive vehicles. *Technological Forecasting and Social Change, 80*(4), 566–583.

White, R., Marinakis, Y., Islam, N., & Walsh, S. (2020). Is Bitcoin a currency, a technology-based product, or something else? *Technological Forecasting and Social Change, 151*, Article 119877.

Wong, L. W., Tan, G. W. H., Lee, V. H., Ooi, K. B., & Sohal, A. (2020). Unearthing the determinants of Blockchain adoption in supply chain management. *International Journal of Production Research, 58*(7), 2100–2123.

Yang, A., Li, Y., Liu, C., Li, J., Zhang, Y., & Wang, J. (2019). Research on logistics supply chain of iron and steel enterprises based on block chain technology. *Future Generation Computer Systems, 101*, 635–645.

Younis, H., Sundarakani, B., & O'Mahony, B. (2020). Investigating the relationship between green supply chain management and corporate performance using a mixed method approach: Developing a roadmap for future research: Green supply chain management and corporate performance. *IIMB Management Review, 32*(3), 305–324.

Zelbst, P. J., Green, K. W., Sower, V. E., & Bond, P. L. (2019). The impact of RFID, IIoT, and Blockchain technologies on supply chain transparency. *Journal of Manufacturing Technology Management, 31*(3), 441–457.

Zhang, J., Yang, R., Li, Y. C., Peng, Y., Wen, X., & Ni, X. (2020). Distribution, accumulation, and potential risks of heavy metals in soil and tea leaves from geologically different plantations. *Ecotoxicology and Environmental Safety, 195*, Article 110475.

Zhang, M., Chen, J., & Chang, S. H. (2020). An adaptive simulation analysis of reliability model for the system of supply chain based on partial differential equations. *Alexandria Engineering Journal, 59*(4), 2401–2407.

Zhou, H., & Li, L. (2020). The impact of supply chain practices and quality management on firm performance: Evidence from China's small and medium manufacturing enterprises. *International Journal of Production Economics, 230*, Article 107816.

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