Adoption challenges of blockchain technology for reverse logistics in the food processing industry

Anupama Panghal, Suyash Manoram, Rahul S Morand, Priyanka Vern

ABSTRACT

Streamlining the product movement through blockchain technology helps organisations manage logistics functions more efficiently and gain advantages such as speedy delivery, better traceability, decentralised data, transparency, etc. At the same time, blockchain has many implementation challenges too. This paper empirically examines the factors affecting blockchain technology adoption for reverse logistics in the food processing industry. This research has used the exploratory factor analysis method to derive factors perceived as challenges to adopting blockchain for reverse logistics. The study findings revealed six factors, i.e., lack of resources, cooperation issues between partners, fear of data breach, technology asynchronization, intensive capital requirement, and mishandling of bulk orders, which emerged as significant challenges. Managing identified challenges can help address issues related to adopting blockchain technology for reverse logistics functions and make operations more efficient.

Introduction

Globalisation has led the food processing industry to focus on value deliveries through supply chains to achieve competitive advantages. Managing wastage is one of the rising concerns for the food processing industries, as food waste occurs at several stages of the agri-food supply chain (Mor et al. 2022; Sathiyagothai and Saravanan 2017; Balaji and Arishinder 2016. The processed food packets that have reached their expiry, the customer returns or damaged or leaked food packets, etc., add to the wastage of food and resources. The companies are getting aware of this issue and taking it seriously. Reverse logistics is one such activity that focuses on managing the returns (Zhang et al., 2022). Reverse logistics aims to focus on process operations that impact environmental conditions at various stages of production, such as waste minimisation and resource utilisation (Dadi et al. 2021; Kazancoglu et al. 2020). With the changing environmental laws and increased e-commerce businesses, companies are obligated to implement reverse logistics for various reasons (Samadhiya et al. 2022). In recent years, reverse logistics gained much success in economic terms and environmental concerns (Bensalem and Kin 2019). The organisations are introducing reverse logistics in their supply chain to maintain a smooth product flow for product recall, service return, warrantee period return, and end-of-use return. Reverse logistics is essential for reusing products in the same market instead of getting discarded and thrown in landfills and is a reactive approach with less visibility (Mor, Bhardwaj, and Singh 2018; Sharma et al. 2011).

Some of the significant issues of reverse logistics are that it cannot be forecasted or anticipated, recall management, disposal management, transportation, information flow, product identification, and visibility across the supply chain (Hall et al. 2013); thus, tracking is required (Tibben-Lembke and Rogers 2002). In a trustless environment, blockchain has evolved as a novel solution to enhance trust, ensure data integrity and availability, reducing paperwork, traceability, and security in data management (Farouk and Darwish 2020). Subramanian et al. (2020) concluded that blockchain technology positively influences reverse logistics by reducing costs, improving efficiency, enhancing sustainability, and improved coordination of supply chain operations. Alawi, Al Mubarak, and Hamdan (2022) suggest traceability and security as critical criteria for implementing blockchain in the supply chain. The concept of blockchain technology is prevalent in the mainstream that many are making it the next disruptive digital technology (Bekrar et al. 2021; Cagliano, Mangano, and Rafele 2021). Blockchain consists of a group of blocks that store information and details in decentralised and distributed network chains. It ensures transparency, traceability, decentralisation, immutability, auditability, etc. It makes transactions safe and well structured (Monrat, Schelen, and Andersson 2019). However, there are various challenges when implementing blockchain for reverse logistics, such as fear of breach of sensitive information to competitors, high initial investments, lack of trust among stakeholders, lack of skilled human resources, etc. The extensive literature review revealed that few studies had explored the factors affecting blockchain adoption for reverse logistics. EFA approach has also been explored in different domains but is yet to be explored regarding blockchain adoption challenges in reverse logistics for food processing industries. Thus, the current study examines the adoption challenges of blockchain technology in reverse logistics for the Indian food processing industry.

The remainder of the paper is organised as follows. The following section provides an overview of reverse logistics and blockchain technology. Section three discusses the research methodology adopted for the study. Sections four and five highlight the results and discussions. The implications of the study are discussed in section six. Finally, section seven concludes the study.

Literature review

This section reviews the literature on reverse logistics and blockchain technology in the food processing industry.

Reverse logistics

When an order is placed for a product by a customer residing at a remote location, manufacturing companies fulfil the order using their extensive supply chain. Sometimes upon order fulfilment, it so happens that the order needs to be returned by the customer due to several reasons (Nitsche, Straube, and Wirth 2021; Fleischmann et al. 1997). In a nutshell, moving the finished product from the customer to the manufacturer through the supply chain is reverse logistics (Samadhiya et al. 2022). Reverse logistics starts when the customer moves in reverse order to the supply chain and ends with the distributor, manufacturer, or supplier (Srivastava, Jayaraman and Luo 2007). There are various reasons to return the product by the customer: undesired product ordered, no requirement of the product, an expectation not fulfilled, wrong product received, cost of product diminished, fraud, defective product received (Sarkis, Helms, and Hervani 2010). For organisations, reverse logistics is considered a good source for maintaining an effective and efficient flow of products. Value creation occurs by reusing, recycling, and reselling the returned products by converting waste into sales, improving customer relationships, and reducing storage and distribution costs. Reverse logistics benefits organisations regarding cost reduction, consumer trust, efficient service, brand image, waste management, and sustainability (Pohlen and Theodore Farris 1992; Melo et al. 2022). For keeping the fresh inventory, return plays a significant role. This helps clean the channel and introduce new and desirable products in that channel (Meade, Sarkis, and Presley 2007).

Sometimes, the product delivered is damaged, and when it reaches the destination, the customer will dispose of the product, which ends up the product utility, but reverse logistics gives the customer an option to return the product (Zhang et al., 2022). For manufacturers, it allows them to properly utilise the product and its packaging material (Lambert et al., 2011). With the help of reverse logistics, consumers can return or exchange the product. The manufacturer can remanufacture the product and satisfy the customer, providing value and eventually gaining customer loyalty (Rubio and Jimènez 2014). There are minimal natural resources available in the current scenario, and the pollution status is also very critical. By reverse logistics, organisations can efficiently use their resources, thereby being climate positive (Sharma et al. 2011). This opportunity to transform into an environment-friendly organisation can deliver competitive advantages and even reach consumers concerned about being environmentally friendly. Thus, reverse logistics benefits the customer, manufacturer, and the environment. For a customer, these offer comfort to keep only the desired product; for the manufacturer, it opens the options for recycling, reusing, refurbishing, replacing, gaining customer interest, and improving brand value (Autry et al., 2001). When the product lies in the maturity phase during the product lifecycle, it slowly moves towards the decline phase due to reduced demand. Using reverse logistics, manufacturers identify a suitable cause for the decline in product sales (Jayaraman and Luo 2007). Following this, a proposed remedy to troubleshoot the problem and a boost is given to the product lifecycle. By employing reverse logistics in the supply chain, an organisation targets various customer groups by providing value, achieving customer loyalty, and improving customer relationships (Bensalem and Kin 2019).

Reverse logistics in the food processing industry

Reverse logistics is the process of planning, implementing, and controlling the effective and cost-efficient flow of inventory, raw material, inventory, finished products, and information related to the point of manufacture to capture value or proper disposal. The arena for facing the challenges of sustainability and globalisation is recycling, refabricating, and adequate disposal (Lambert, Riopel, and Abdul-Kader 2011). Reverse logistics means the physical flow of unused or discarded material that lost its value from the consumer place. Its main feature is to regain that value or get adequately disposed of (Shi et al. 2012). When the final product is no more in the use of the customer than either for disposal or recycling of the product, the onset of reverse logistics begins with the collection of recyclable material. Further, transportation, sorting, storage, and remanufacturing make the product recycled and transformed into a usable form, and the waste is transferred to be dumped at the proper place (Pohlen and Theodore Farris 1992). Reverse logistics significantly impact the company’s performance by reselling value and customer satisfaction. Profitable business emerges with reverse logistics’ involvement in repairing, refabricating, reconfiguring, recycling, etc. This company can gain the advantages of economies of scale. Effective reverse logistics directly benefit customer satisfaction, decrease inventory level, etc. (Autry, Daugherty, and Glenn Richey 2001).

The strategy behind reverse logistics in an organisation is to improve the redemption of the products and increase their shelf life. Sustainability is essential for an organisation to gain a competitive advantage and customer loyalty. This sustainability comes with social and ethical responsibilities, including reuse, recycling, redemption to save facility space, fossil fuels, landfill costs, etc. (Sarkis, Helms, and Hervani 2010). By recovering the used product, reverse logistics grabs lots of attention. The social factor, consumer awareness, and the political system encourage reverse logistics in organisations. Reverse logistics focuses on recycling, recovery of parts of product or product, waste management, etc. It dramatically impacts the pricing policies, designing of the new product, process planning, etc. (Pokharel & Mutha, 2009). With the increase in the environmental crisis, many organisations are implementing the policy to go green to gain competitive advantages and attract customers. They are focusing on introducing reverse logistics in their business to reuse, recycle their product and dispose of the waste properly (Srivastava 2008). Recovery and reuse of products attract the organisations economically and consider environmental concerns. Reverse logistics provides the opportunity to make a new product flow from the existing one. This conversion reduces the manufacturer's cost and helps them gain customer loyalty (Fleischmann et al. 1997). For building the competitive advantages strategies company takes the holistic approach by manufacturing and distributing material to generate value among the customer through an information system, design of the product, resource allocation, process reengineering, recycle of product. In all these aspects, reverse logistics is most important to introduce in the organisation. Recovery is cheaper than preparing a product with new material; thus, the reverse logistics should be reorganised as a cost minimisation exercise (Jayaraman and Luo 2007). The latest technology is helpful for both forward and reverse logistics, but reverse logistics includes receipt management, handling, and deposition of products to the merchandise.

Reverse logistic functions are unique, time-sensitive, and complicated, so honest collaboration and information sharing are required. The information helps perform tasks optimally like inspection of returned commodity, credit in the customer account, and return product release (Jayaraman, Ross, and Agarwal 2008). Reverse logistics is an activity of maintenance, refabricating, product replacement, product return, the substitution of material, reuse of material, disposal of waste, and reprocessing. Reverse logistics means the physical flow of unused or discarded material that lost its value from the consumer place. Its main feature is to regain that value and get adequately disposed of (Hazen et al., 2012). The flow of information and materials highly enhances logistics performance. Blockchain leads to the correct information being shared among the partners that cannot be altered and helps the product to reach the desired location at the expected time, thus, adding a competitive advantage to the company (Jayaraman, Ross, and Agarwal 2008). When assessing the challenges of reverse logistics, two of the most prominent challenges organisations face are the costs of delivery and communication problems. For example, when a customer returns a product, the company takes care of charges related to pick-up and reshipping the product (Huscroft et al. 2013). In addition to this, the extra cost is incurred in an incorrect invoice, incorrect transactions, or refund. However, dealing with this problem traditionally can be done by demand forecasting. Yet the problem persists as it is time-consuming and complicated to be used in the present scenario (Shi et al. 2012). Another solution is applying emerging digital technology, i.e., blockchain technology, to deal with reverse logistics challenges in the supply chain..

Blockchain technology

With the global increase in the food production option for the consumer also grown, to satisfy consumer needs while providing value, proper networking is most required for the tracking and tracing their order (Kayikci et al. 2020). Blockchain emerges as a new technology that can restore the trust of individuals through transparency and traceability (Nofer et al. 2017). It is a whole data set of transactions that are difficult to alter or crack. It provides transparency to the system by decentralising the data so that any participant can access data (Alawi et al., 2022 Monrat, Schelen, and Andersson 2019). The data is end-to-end encrypted in the technology, enhancing participants' trust and reducing the chances of data manipulation and fraud. It allows a participant to track their respective goods as this technology provides the feature of instant traceability (Yli-Huumo et al. 2016). With the help of this technology, malicious exertion, i.e., paperwork, is eliminated, and the chance for human error is also reduced. Thus, blockchain helps increase the effectiveness and efficiency of operations (Chen et al., 2021). This technology sets up a smart contract system. It helps to diminish fraudulent risk as the terms in the contract cannot be altered, so the claim settlement or other criteria can be accomplished smoothly (Aste, Tasca, and Di Matteo 2017). It removes the intermediates by transferring the digital information from sender to receiver fully encrypted. Lack of coordination between the supply chain partners hampers the organisational integrity and disturbs the supply chain surplus (Shuaib et al. 2022). Blockchain-based traceability can be integrated to handle information verification, identify the product counterfeits, and enhance communication among stakeholders and customers (Laforet and Bilek 2021; Attaran 2020; Al-Jaroodi and Mohamed 2019). It helps merge customer relationship management with supplier relationship management (Bodkhe et al. 2020). It also helps bring forth the required transparency and smooth flow of information among the participants of the reverse logistics, i.e., organisation, suppliers, retailers, and customers (Zhang et al., 2020).

Blockchain for reverse logistics in the food processing industry

There is a significant risk of fraud in the returned products with reverse logistics. Blockchain became the unique solution to reduce this fraud as it helps determine the ownership of a product (Shih et al. 2021). Blockchain technology guarantees authenticity and safety by reducing the consumption of resources. It also confirms that the movement of goods is eco-friendly and assures proper recycling (Centobelli et al. 2021). Maintaining the record in a single book is time-consuming; thus, the company can be efficient and reduce audit disputes (Aste, Tasca, and Di Matteo 2017). It brings a trusted, secured, and transparent system capable of solving the significant problems of the supply chain. Blockchain helps trace the location of products and authenticates all stakeholders involved in the recycling process (Dutta et al. 2020). It lets the parties know the price, date, location, state, quality of the ordered product, and other relevant information. It removes the third-party involvement in transactions to make them smooth and fair (Farouk and Darwish 2020). Blockchain technology has the great potential to make reverse logistics sustainable. It records the original data, secures them, and enables them to be traced and audited without altering and maintaining a peer–to–peer network (Saberi et al. 2019). In most organisations, there is the involvement of third-party for currency transactions. Even for the digital transaction, the third party is involved. Hence, the development of blockchain technology solves this issue by creating a decentralised network where there is no scope for the third party to interfere in the transaction process or breach the data (Kamble et al., 2020).

However, there are various challenges when implementing blockchain as a part of reverse logistics. The blockchain members can leak essential data to other parties, causing concern about maintaining data storage and transmission control. Employing a security mechanism for the data can be a tedious task regarding financial costing. Also, implementing the blockchain for reverse logistics can be a risk considering the huge investments required. While it is known that incentive mechanisms are the foundation for blockchain platforms, designing one suitable for reverse logistics is not easy. Blockchain technology might be related to human behaviour when it is introduced as a working mechanism for reverse logistics. There could be a lack of trust in the new technology. Also, there might be a lack of skilled workforce. But to resolve that, organisations may train their employees, which could be time and capital extensive. Sometimes, even after receiving proper training, employees might lack interest and resist working with the blockchain (Bekrar et al. 2021). When the adoption of blockchain technology is considered from the organisation's perspective, it might be seen that accessing optimum resources to work for reverse logistics may be a difficult task to achieve. Another challenge is that it requires many investments to prepare the platform and customise it according to reverse logistics requirements. Also, the fear of confidential information leaked to competitors might reduce the chances of blockchain introduction for reverse logistics (Darwish et al., 2020).

The previous literature reflects a lack of research on factors affecting the adoption of blockchain for reverse logistics in the food processing industry. There have been various studies that explore the adoption of blockchain in different other sectors. However, it has not gained much acceptance when its application is perceived for reverse logistics. Thus, this study attempts to identify significant blockchain adoption challenges for reverse logistics in the food processing industry.

Methods

The study identifies significant blockchain adoption challenges for reverse logistics in the food processing industry. The study adopted an empirical approach to identify and evaluate the factors.

Sampling and data collection

The target population for the study was organisations in which reverse logistics plays an important role. The study used a quantitative research approach that involved data collection through personal interviews and an online survey. For this purpose, a survey instrument in the form of a structured questionnaire was developed based on an exhaustive literature review to identify the potential challenges of blockchain adoption for reverse logistics for the development of the questionnaire. The questionnaire was validated by subject and industry experts. The experts were from agri-food supply chain management, reverse logistics, and blockchain technology. The structured questionnaire used as a research instrument contained nineteen items related to the employee's opinion on the adoption challenges of blockchain for reverse logistics. These items were measured using a five-point scale ranging from 1 (Most important) to 5 (Least important). A total of 106 responses were received. Twenty-two responses were removed due to illegible responses or missing data. Hence, the final sample size for the study was 84. The respondent's demographic profile is explained in the following sub-section.

Respondent’s demographic profile

A sample of 84 agri-food professionals and technology adopters from India was considered for this study. The responses were collected from all ranks, i.e., managers, general managers, managing directors, etc. Among all the respondents, around 62.5% were from managerial posts, and 29.16% were from the assistant manager and executive-level posts. The remaining 8.34% were from managing directors’ positions in the logistics department, having experience of nearly 15 years.

Statistical tool and analysis

The study adopted a factor analysis method to identify factors perceived as adoption challenges of blockchain for reverse logistics. The order and structure of multivariate data can be studied using factor analysis. Exploratory factor analysis (EFA) is used when researchers have no defined hypotheses related to factors and want to uncover internal reliability. EFA has three fundamental decision points: determining the number of factors, choosing an extraction process, and choosing a rotation method (Mor et al. 2020). The study identified 20 factors through literature review for the analysis (Table 3). EFA was done using IBM SPSS statistic software with the principal component analysis approach and varimax rotation, and all values were found to be under the acceptance range.

Analysis and results

Factor analysis identified and grouped significant factors restricting the organisation from adopting blockchain for reverse logistics in the food processing industry. Factor analysis is a data reduction tool. For this study, the KMO value of >0.6 reflects as substantial and specifies the suitability of factor analysis, and it came out to be 0.632 for the adoption challenges of blockchain. Bartlett’s test of sphericity was highly significant ($P < .000$), thus confirming the correlation between the attributes of the population. The communality value for each attribute came out as 0.709 or higher.

Six factors have been extracted, as shown in Table 1, which explains 84.47% of the variance. All the extracted factors have eigenvalues of more than 1. The remaining factors are not found that much significant. Rotated Component Matrix to reduce the factors on which attributes under study have high loading are shown in Table 2.

Table 1. Total variance explained (eigen values).

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.395	36.973	36.973	7.395	36.973	36.973	5.083	25.414	25.414
2	3.421	17.103	54.076	3.421	17.103	54.076	4.264	21.318	46.732
3	2.137	10.685	64.760	2.137	10.685	64.760	2.771	13.855	60.588
4	1.494	7.471	72.231	1.494	7.471	72.231	1.813	9.063	69.650
5	1.433	7.163	79.394	1.433	7.163	79.394	1.509	7.544	77.195
6	1.016	5.080	84.474	1.016	5.080	84.474	1.456	7.279	84.474
7	.658	3.288	87.762						
8	.602	3.009	90.771						
9	.507	2.534	93.305						
10	.426	2.131	95.436						
11	.284	1.421	96.856						
12	.220	1.102	97.959						
13	.162	.808	98.767						
14	.084	.420	99.187						
15	.054	.271	99.458						
16	.048	.238	99.696						
17	.034	.169	99.864						
18	.015	.077	99.941						
19	.008	.042	99.984						
20	.003	.016	100.000						

Extraction Method: Principal Component Analysis.

Table 2. Rotated component matrix.

	Challenges	Component					
		F1	**F2**	**F3**	**F4**	**F5**	**F6**
C1	Need proper network system for information exchange						.911
C2	Fear of data security					.945	
C3	Chances of data misuse					.759	
C4	Lack of trust in the new technology		.821				
C5	Lack of technically skilled manpower						.620
C6	Hesitation from workers		.860				
C7	Employees are not showing interest		.882				
C8	Need extensive training for the employees				.607		
C9	Need for long term planning focus of the organisation				.871		
C10	Need for relating technology adoption with incentives				.840		
C11	Providing optimum resources to work for blockchain technology will be tough for the organisation						.849
C12	Consumer group is unaware of this technology		.698				
C13	Chances of confidential information going to competitors					.919	
C14	A large number of investments are required						.676
C15	Shareholders might not be interested			.677			
C16	The initial implementation period will be disturbing	.816					
C17	Coordination issues between the partners			.606			
C18	Profit distribution (even distribution vs. Incentive-based)			.877			
C19	Transparency in the system may not be welcomed by all partners			.806			
C20	Handling multiple orders will be tough	.750					
	Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalisation.[a]						
	a. Rotation converged in 7 iterations.						

Table 3. Factors identified.

Factors/Challenges	Variables included
(F1) Mishandling of bulk orders	
C16	Handling multiple orders will be tough
C20	Initial implementation period will be disturbing
(F2) Technology asynchronization	
C4	Lack of trust in the new technology
C6	Hesitation from workers
C7	Employees are not showing interest
C12	Consumer group is unaware of this technology
(F3) Cooperation issues between partners	
C15	Shareholders might not be interested
C17	Coordination issues between the partners
C18	Profit distribution (even distribution vs. Incentive-based)
C19	Transparency in the system may not be welcomed by all partners
(F4) Lack of focused strategic planning	
C8	Need extensive trainings for the employees
C9	Need for long term planning focus of the organisation
C10	Need for relating technology adoption with incentives
(F5) Fear of Data breach	
C2	Fear of data security
C3	Chances of data misuse
C13	Chances of confidential information going to competitors
(F6) Lack of resources	
C1	Need proper network system for information exchange
C5	Lack of technically skilled manpower
C11	Providing optimum resources to work for blockchain technology will be tough for the organisation
C14	A large number of investments are required

Discussion

The study has identified blockchain adoption challenges for reverse logistics in the food processing industry. The empirical findings grouped twenty factors into six major components: mishandling bulk orders, technology asynchronization, cooperation issues between partners, lack of focused strategic planning, fear of data breach, and lack of resources.

The study findings revealed that 'Mishandling of bulk orders' (F1) is a significant challenge for food industries. With the introduction of blockchain technology, a sudden increase in orders might occur. Thus, it will be an issue for organisations struggling with handling bulk orders. The initial implementation period of technology might be difficult due to poor handling of bulk orders which can cause the downfall of blockchain usage for reverse logistics.

Factor 'Technology asynchronization' (F2) is a significant adoption challenge of blockchain as employees are unfamiliar with the technology. Due to the lack of knowledge and expertise, employees might not be interested as they are well adjusted to the existing technology. There might be resistance from stakeholders, i.e., farmers, due to the lack of trust in the technology and the fear of fraud. It would be difficult for consumers as well as they are unaware of how blockchain functions. Thus, lack of trust in the new technology and hesitation from employees towards the blockchain introduction may also be a challenge for the organisation.

It was found that 'Cooperation issues among stakeholders' (F3) is a significant challenge. It is essential to have excellent cooperation between the partners to build a better team and positively influence the work environment in an organisation. The shareholders' disinterest and lack of coordination may dishearten the employees and hamper the blockchain introduction. Every shareholder may not welcome a difference of opinion upon the transparency brought by the blockchain; this again can pull back the introduction of blockchain for reverse logistics. Sometimes the benefits of introducing blockchain may be overlooked by the shareholder before their gains. The introduction of blockchain-enabled transparency within the system holds importance as all partners and shareholders might not welcome it.

The factor 'Lack of focused strategic planning' (F4) emerged as a potential challenge towards blockchain adoption. The introduction of blockchain within the system requires extensive training of the employees and long-term planning for efficient utilisation of resources and technology. This shows how critical long-term goals and visions are for organisations.

Results showed that the factor 'Fear of data breach' (F5) is another significant challenge as fear of data security and data misuse are a cause of concern for stakeholders. Blockchain makes sensitive information about the process and personal information about employees publicly available on the platform, which competitors can access. This creates fear of data security and misuse, due to which organisations are hesitant to adopt blockchain for reverse logistics. This reveals that stakeholders are uncomfortable sharing sensitive information on such platforms as they perceive them as risky and thus, show a high resistance level.

The outcome highlighted that factor ‘Lack of resources’ (F6) for introducing high-end technology is a challenge. The introduction of any new technology requires a considerable investment initially. It is crucial to assess the cost of adopting blockchain. Adopting blockchain requires high investment in the initial phase, which stops at hardware and software requirements and includes costs associated with recruiting skilled human resources, blockchain experts, education, and training. Due to high costs, it might be challenging for organisations to provide optimum resources for the smooth functioning of blockchain.

Implications

The study has implications for managers and professionals of the food processing industry who wish to adopt blockchain for reverse logistics. Introducing blockchain for reverse logistics would require convincing shareholders to invest in the new technology, which can be achieved by introducing blockchain experts to the team. With the help of expert opinion, developing realistic revenue plans and strategies for blockchain adoption can positively influence the shareholders and pave the way for better investments. Understanding the applicability of blockchain for various operations will increase the trust, thus, improving cooperation issues among stakeholders. An increase in technical staff in the organisation will help better function the blockchain. Individuals with technical expertise and knowledge of blockchain will help deliver better results, increase profits, and grow the business. Blockchain as the base for the functioning of reverse logistics can improve data security to a remarkable level. Data can be secured using encryption and validation, reducing fraud. Besides, blockchain is easy to coordinate and works with other smart technologies that can help ensure data validation. A strong blockchain network will make hacking or altering the data difficult. A proper system for allocating resources to different stages of reverse logistics will help the organisation efficiently finish the operations. Blockchain requires a lot of resources to work to its total efficiency. This challenge can be overcome by utilising resources responsibly and efficiently, eventually increasing returns on investment. Implementing blockchain technology with proper resource allocation will help in increasing customer satisfaction while achieving better results with available resources. Multiple bulk orders can be handled by synchronising the orders received. The synchronisation will help share details with every partner in real-time and enhance visibility, speeding up the processing time for the multiple bulk orders. Synchronisation of orders will help fine-tune the reverse logistics process, and with blockchain, there could be complete visibility and transparency. Thus, this will enable the organisation to have increased revenue with efficiency and flexibility.

Conclusion

Reverse logistics bring products at least one step back in the supply chain, and its association with recalls and returns helps in asset recovery and efficient waste disposal. Streamlining the movement of products with the blockchain can help gain various advantages for the organisation. These include speedy service delivery to the customers, decreased operation costs, decentralisation of the data, transparency, etc. However, during the initial phase of blockchain adoption, there are various challenges that an organisation encounters. The current research aims to fill the research gap by exploring the significant challenges of blockchain adoption for reverse logistics in the food processing industry. After exploratory factor analysis, the outcome factor analysis reduced the 20 statements into six factors. The results highlighted six major factors as significant challenges: lack of resources, cooperation issues between partners, fear of data breach, technology asynchronization, intensive capital requirement, and mishandling of bulk orders. The blockchain introduction might not be of an instant benefit to the organisation; however, it will surely help reverse logistics work better and have the upper hand in the competition in the long run. Blockchain can help organisations alleviate many pain points for reverse logistics by properly managing orders, inventory, product quality, etc. In this ever-evolving world, understanding and applying smart technologies like blockchain in any organisation will make it future-ready and aid in accomplishing business goals effectively.

Building on the results of this research, future studies should extend the context of this research by identifying and gathering more data on the topic. Future research should closely track blockchain advancements and bring more empirical studies by conducting longitudinal studies. It will help in identifying the potential challenges of blockchain in reverse logistics. Research can also focus on conducting comparative analysis between developed and developing countries to understand the role of BCT in reverse logistics. Studies can focus on conducting research using use-cases to address these challenges. Therefore, this research study motivates academics to contribute to this evolving area of interest.

Acknowledgments

The authors are thankful to the National Institute of Food Technology Entrepreneurship and Management (NIFTEM), Kundli, Sonepat (Haryana), India for providing essential supports to conduct this research work.

Disclosure statement

No potential conflict of interest was reported by the author(s).